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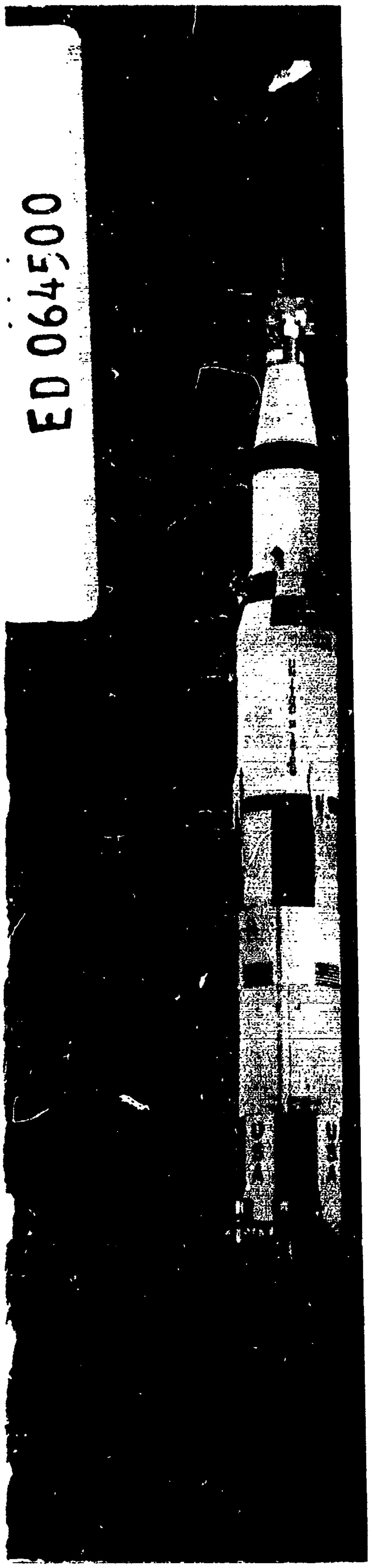
ABSTRACT

The 33rd annual American Industrial Arts Association (AIAA) convention was held in Miami in 1971. Topics for the AIAA general session addresses were: (1) "Technology--and a Time of Crisis-II," and (2) "Goals, Accountability, and Action for the Industrial Arts." Twenty-four addresses from sessions of the American Council of Industrial Arts Teacher Educators, American Council of Industrial Arts Supervisors, American Council of Industrial Arts State Association Officers, Industrial Arts College Clubs, and American Industrial Arts Student Association are presented in this publication. Also, 65 representative addresses from the major group and special interest sessions are included under the following major topics: (1) Aerospace Education, (2) Communications, (3) Construction, (4) Curriculum, (5) Ecology, (6) Educational Psychology, (7) Educational Technology, (8) Guidance, (9) International Relations, (10) Metals and Materials, (11) Man/Society/Technology Forum, (12) Relevance of Industrial Arts, (13) Teacher Aides, and (14) Technology. (GEB)



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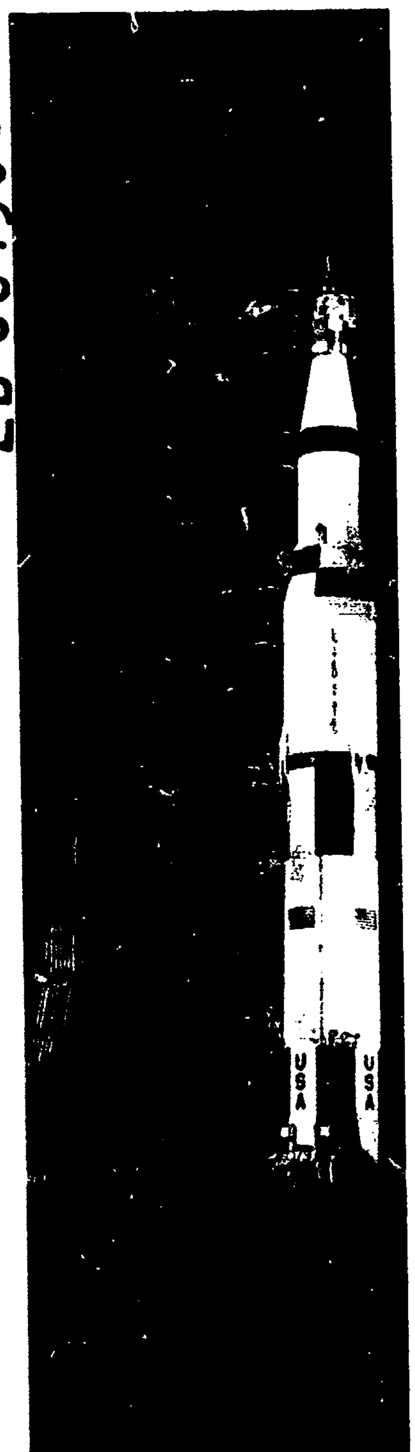

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Representative Addresses and Proceedings of the American Industrial Arts Association's 33rd Annual Convention at Miami, 1971.

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TABLE OF CONTENTS

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AIAA General Session Addresses

Technology—and a Time of Crisis—II

Edgar M. Cortright

If I were to ask each of you in advance just what you think the title to this talk implies, the answers would largely group into three different interpretations.

1. This nation is facing a crisis largely brought about by technology.
2. This nation is facing a crisis which requires technology for solution.
3. Technology is facing a crisis of its own.

Whether or not one hopes for the survival of our technology as the world's foremost depends on his position with regard to the first two interpretations—is it good or is it bad? The very fact that this question is being asked is a remarkable manifestation of the turmoil and confusion which pervade the national scene today.

For most of my lifetime, science and technology have worn a "white hat." They have represented man's continuing attempts to understand the physical laws which govern himself and his universe and his efforts to apply those laws to improve his own situation.

Because he has worked hard at it, man has generated a veritable explosion of ideas, discoveries, inventions, and new technologies during the past century. By tapping the energy of the sun stored in fossil fuels and more recently the energy of the atomic nucleus, he has energized the world. We are illuminated, heated, and cooled at the flick of a switch. Once onerous tasks are now handled by electric appliances. We speak to our friends and business associates half a world away—sometimes by satellite. We have seen the automobile, airplane, and spaceship open up undreamed of vistas of travel. Should we elect to stay at home, the activities of the entire earth—and sometimes the moon—are but an arm's reach to the switch of our television sets.

Similarly, we have made great strides in medicine and biology—without which perhaps as many as half of this audience would not be here today. With the remarkable advances in microbiology, such as the unravelling of the genetic code, the potential for understanding ourselves and treating our maladies seems almost limitless.

Thus far I have only touched on the positive aspects of science and technology. There is another side to the story. Part of this other side relates to unwanted side effects. During the past decade we have become acutely aware that we are polluting our own environment—fouling our own nest. The same fossil fuels which launched us into the technological twentieth century are choking people and plants to death in some parts of the world. The plaintive cry from the musical "Hair" of, "Hello carbon monoxide, hello sulphur dioxide—the air, the air is everywhere" (or words to that effect) has a disturbing jolt to it.

Many of the same agricultural chemicals that enable about 5% of our population to feed the rest of us are beginning to show up in strange places, with strange effects. Modern plumbing, which is credited by some with saving more lives than modern medicine, has merely delivered the waste of the city dwellers into the streams and onto the beaches of his less urban neighbors—or perhaps to his own weekend retreat. Out of sight, out of mind.

We have come only recently to realize that the vastness of the oceans and the skies above them are but limited repositories for man's waste pro[illegible], from which nothing escapes. Our earth is truly a spaceship, occupied by four or five [illegible]on passengers with little understanding or control of their delicate ecological balance and apparently intent on replicating themselves at a fantastic rate.

Another aspect of science and technology that concerns most people is its destructive potential in the form of weapons. Man seems powerless to restrain himself from killing his fellow man for one reason or another. "Man is a predator, and his prey is us," someone once said. So today we find ourselves in the ludicrous position of sitting with our trigger fingers on enough nuclear rockets to destroy the world, while the other guy does the same. If there is a being who looks on our world from afar, how he must laugh—or cry—to see our intellect so grotesquely applied.

What frightens many people is the mind-boggling rapidity with which these developments are taking place. If the four billion years of our earth were compressed into one year, Christ walked the streets of Jerusalem just 15 seconds ago, and the industrial revolution began only a second ago. Man and his works have evolved in the twinkling of an eye! If so, what might the next twinkling hold in store for us—bad as well as good? Should we slow it all down? Can we?

These are but a few examples of the philosophical arguments which are raging over technology in many circles today. Lawrence Lessing in the March issue of Fortune calls it "The Senseless War on Science." As Lessing puts it, "The immense prestige of U.S. science is being undermined by assaults from several different directions. If this wildly irrational campaign doesn't end soon, the U.S. can become a second-rate power and a third-rate place to live." Dr. Philip Handler, President of the National Academy of Science, says, "If we forswear more science and technology, there can be no cleaning up of our cities, no progress in mass transportation, no salvage of our once beautiful landscape, and no control of overpopulation. Those who scoff at technological solutions to those problems have no alternative solutions." The anti-technologists are just as vehement on the other side.

The immediate effect of all this debate is to slow down technology in the United States. Even in a favorable environment, it is often difficult to launch effective new programs in this country; witness the difficulty in attacking the social problems which are generally accepted as needing serious attention. In an unfavorable environment, it can be nearly impossible. The environment today is not favorable for science and technology. The manifestations of this include:

1. Technological timidity, if not downright aversion, on the part of an increasing number of national leaders.
2. Increasing attacks on areas of technical activity which are in good shape, a distinctly negative approach to our real problems.
3. Reduced R&D funding by the government.
4. Tens of thousands of unemployed scientists and engineers.
5. A vast weakening of our aerospace industry.
6. Loss of student interest in science and engineering.
7. Weakening of our technical colleges and universities.

In my view, it is a crisis situation bordering on a national calamity, one from which it could take years to recover. If, in the course of this presentation, there was ever any doubt as to where I stand, let that now be corrected. I stand for continued preeminence of the United States in science and technology. In the balance of this talk I'm going to tell you why I think we must choose this course—and how to achieve it.

The first thing we must do in this country is to decide what we want to be. Today we are a rich and powerful nation, with the highest standard of living, the most advanced technology, and the greatest capacity to do good works of any nation in the world. I believe that this is an excellent base on which to build and that most Americans agree with this point of view. True, we have plenty of problem areas which cry for attention. But, like Phil Handler, I feel that we will need our technology both to attack these problems directly and to stay economically strong enough to do so.

Whether all of us like it or not, we are a technological nation. Our entire business and commerce structure is built on technology. With our high pay scales, advanced technology is the only thing that lets us compete favorably with the lower-priced labor markets of the world. Even so, we have lost major portions of the manufacturing market to foreign competition in recent years. Advanced technology is really the only unique product we have to export. Prime items on this list have been aircraft and computers. Without these and similar items, our balance of trade would be hopelessly out of kilter. This is one reason why I feel that the recent cancellation of the SST prototypes may have serious repercussions in years to come.

We must remember that our global environment is competitive and belligerent. We must remain preeminent in technology in order to meet both the commercial and military competition. Without preeminence in both areas, we could become the victims of power blocks of one type or another. We might well lose the high standard of living we have attained to date, let alone improve it. The survival of the fittest is a natural law that still applies. Such statement are not scare tactics, but a simple recognition of the facts of life.

I think that those who would sell us on risking our lead in science and technology in the interest of a "better way of life" are guilty of wishful daydreaming. There are plenty of countries in the world today that have not made the transition into the twentieth century. While some aspects of their uncomplicated societies may seem like a welcome relief from our sometimes harried lives, a closer look usually reveals the strain of the fight for mere existence which our forbears passed through centuries ago. Reversion to that simple life is impractical for all but a few—although it may not be a bad idea to keep some of the simple verities in mind while coping with our complicated problems of today.

Even the assertion that federal funds spent on research and development programs, such as aeronautics and space, would be better spent on our current domestic problems does not ring true to me. We spend about 7% of our tax dollar on R&D. This is in contrast to the nearly 50% spent on domestic programs. Just like a successful business, the United States must plow back some of its gross national product into developing future opportunities for us all.

How then are we to maintain our preeminence in science and technology? The answer is relatively simple. We must continue to work on the most difficult scientific and technological problems of our day. There simply is no other way.

Good men thrive on tough problems. Tough problems demand new approaches and advanced techniques. It doesn't matter too much what the field is so long as the problems are advanced and difficult. In solving them, the frontiers of science and technology are pushed back on all fronts. From this process invariably come practical applications which benefit us all. Frequently they are unexpected offshoots of the prime objective. Such is the way of science.

Like it or not, military weapons requirements have sparked many of the technological developments in this country in the past. From them have come modern air transportation, nuclear power, solid state electronics, and a host of other technological advances. Today we have some good alternatives to set the pace for our science and technology. However, they are not generally in the area of the social problems which are getting so much attention these days. Here the immediate technological needs are modest compared with the legislative and financial problems. Rather, they are in such scientific fields as biophysics and the life sciences, ultra-high energy physics, plasma physics, and controlled fusion. And they are in such applied fields as transportation, power, oceanography, and space.

Of these fields, I'm going to choose to talk about space. Why? Because the future of this program hangs in the balance—and with it much of the future of science and technology in the United States.

It is ironic that after 10 years of "delivering the goods" in an unparalleled manner, culminating in manned exploration of the moon, the space program is fighting for its life with a host of other priority programs. Already the national team of government, industry, and university scientists and engineers has been slashed to about 1/3 its peak of over 400,000. If we are not to see the progress of a decade of dedicated national effort squandered away, we had better make our case for space loud and clear. I think we have a compelling case, even in these days of relevancy.

Some highly significant changes are taking place in the strategy of the space program. For the next decade or so, man will confine his space flights to the vicinity of the earth, leaving the deeper penetration of the solar system to automated spacecraft. The Apollo program will conclude next year after the completion of three more expeditions to the moon. These missions will have an increased capability to visit more difficult landing sites, carry a larger payload, stay longer, and travel farther on the surface. We must hope that the information which we gain will be sufficient to answer many of the remaining questions about the origin and nature of the moon. From these initial explorations, we can plan for a return to the moon in the 1980's, possibly with a combination of manned and automated systems. We have only seen the beginning of man's exploration of the moon, but for now we must turn back toward the earth.

In 1973 we will launch Skylab, our first space station. We may expect to see a Soviet station already in operation by that time. Skylab will help teach us how to extend man's capability to live and work in space. During occupancies of up to 56 days, our astronauts will conduct a host of experiments in solar astronomy, earth resources, and biomedicine.

Skylab is but the first step toward a permanent space station in the 1980's. You can think of it as much the same as a research laboratory on earth, but located in orbit. Here it will have unique opportunities for viewing both the heavens and the earth, as well as the unreproducible environment of vacuum and weightlessness. What wonders will be accomplished in such a laboratory? Who knows for certain? Was there ever a research laboratory built with a totally predictable output?

For a space station to be truly productive either as a research center or as a center for space operations, it will be necessary to transport men and equipment to and from it with relative ease and economy. To do this, we are proposing a revolutionary new machine called a space shuttle. The space shuttle is essentially a two-stage launch vehicle with one or more stages recoverable and reusable, for up to 100 missions. It is part rocket and part airplane. It takes off vertically and lands horizontally under piloted control. The upper stage carries into orbit as much as 50,000 pounds of payload for as little as $100 a pound—less than 1/10 the current figure. This type of transportation to and from orbit will enable us to do things in space that we could not even consider doing today. Scientific personnel other than astronauts could be rotated to and from a space station with relative ease. All manner of supplies and equipment could accompany them. Even automated satellites could be delivered to orbit, revisited for maintenance, and returned to earth for repair if necessary.

NASA is proposing to develop the space shuttle before the space station because it represents a longer and more difficult development. We are working closely with the armed services in order not to deny this country any military advantage that might accrue to a nation having the capability to operate in near space in such an unlimited fashion.

We expect the shuttle and space station to be an integral part of our program to accelerate the practical applications of our space technology. I wonder how many of us realize what has already been accomplished here? Meteorological satellites have been routinely operational for years. Their data are used daily by meteorologists, pilots, the military, and other weather-dependent operators. Furthermore, the U.S. and the Soviet Union are sharing their observations with each other and the rest of the world. Our program for the future will help ESSA extend the operational system to synchronous orbit, where uninterrupted observations will be possible. A third-generation low-altitude satellite will replace the current design and add quantitative measurements, which will aid in longer range weather forecasting.

Communications satellites are also routinely operational on a private pay-as-you-go basis. The commercial future here is extremely bright, with prospects for more economical voice, TV, and data transmission. In addition, opportunities for educational TV, medical service links, and other new applications are developing. For those nations that have not already invested in vast ground networks, the communications satellite holds great promise for early and economical systems. The Soviets have opened up Siberian communications with a satellite system.

Because communications satellites are flourishing so well commercially, NASA is concentrating on some special advanced applications. Two new Applications Technology Satellites are scheduled (ATS F and G). They feature a very large parabolic antenna and a variety of advanced communications experiments. This satellite will operate in a synchronous orbit 22,300 miles above the earth. It is sensitive and powerful enough for two men to communicate with each other via the ATS using only walkie-talkie devices. One interesting application of this satellite will be an experiment in which it will be moved so as to hover over India. This will permit the Indian government to broadcast educational TV, on such matters as health and population control, to its tens of thousands of outlying villages with no television service today. India is making and distributing its own small sets to receive the programs. We also plan a joint communications satellite with Canada, using very high frequencies to relieve the serious problem of frequency congestion.

Navigation satellites have also been routinely used for years, primarily by the Navy, where pinpoint accuracy can be achieved in all weather conditions at any spot on the earth. New developments will make such service economically available to civilian users in the future. In addition, NASA is working with the Department of Transportation to develop air navigation and traffic control satellites to insure safe operations in the crowded airways of the future.

In a more recent practical application of space flight, we are developing a capability to make ecological surveys from orbit. Such surveys include geography and cartography, agriculture and forestry, geology, hydrology, and oceanography. We believe that in time we can update maps and provide information for land use planning; we can inventory the world's wheat, corn, or cotton, and at the same time determine their health; we can help locate national resources; we can help predict floods and snowslides; and we can help locate good commercial fishing grounds. If the expanding population of this earth is ever to stave off natural disasters and live in relative plenty, man must one day come to cooperatively monitor and manage the earth's resources. With the advent of the satellite, he has a tool equal in scope to the size of his problem.

This is even more apparent when we consider the problems of pollution. As I discussed earlier, man's waste products merely stream about the globe from one spot to another in the air and in the water. How else can we ever come to observe, understand, monitor, and control this global distribution of waste except from the vantage point of space where we can see the earth at a glance?

In planning its program for the future, NASA has resisted turning its gaze exclusively back toward earth. To do so would be to deny the vision that has drawn man's mind toward space since he first gazed at the stars ages ago. Our scientific exploration of the planets with automated spacecraft is being extended to include not only the inner planets but the outer planets also. In a few months we will launch two Mariner spacecraft to orbit and survey Mars. In 1973, a single spacecraft will fly to both Venus and Mercury. In both 1972 and 1973, launches of small Pioneer spacecraft will be made to Jupiter. In 1975, two Viking spacecraft will be sent to land on Mars and search for possible life. And in the late 1970's, we hope to launch spacecraft on Grand Tour type missions to visit Jupiter, Saturn, and Pluto or Jupiter, Uranus, and Neptune on single flights of about 10 years' duration.

And by the end of this decade, from orbits high above the earth, a new High Energy Astronomy Observatory (HEAO) will look past even these distant places and peer tentatively into the starry, endless universe beyond.

Somehow, gentlemen, I think mankind has a birthright to such explorations as these—for the mind must be fed as well as the stomach—and how are we to know what to be, until we know what we are?

Mr. Cortright is the Director of NASA Langley Research Center, Hampton, Virginia.

Goals, Accountability, and Action for the Industrial Arts

Raymond Bernabei

There is a new spirit in American education today—a spirit of innovation; a spirit of dissention, experimentation, unrest; and a spirit of venture. It seems that the challenges always stay one jump ahead of even the most farsighted school system.

Many educators have broken the old molds and introduced changes into their schools. Fresh ideas in school organization, communications, technology, curriculum, and new approaches to teaching and learning beckon the challenged to even higher grounds. Those who have thrived on "the standard operating procedures" seem to be in a very uncomfortable position.

Time was when concepts like teacher, class, curriculum, class period, textbook, classroom, and school each had an accepted definition. Everybody knew—or thought he knew—what a teacher did, what the "ideal" class size was, what a curriculum consisted of, and what a schoolhouse was like. We built a program out of these basic blocks.

Now teacher takes on a new meaning; curriculum begins to sound too collective; period and class seem too rigid; a textbook, too structured; the project, too uniform. Widespread communications and technology seem to be developing for man new values, new standards, new quality of life. Educators find themselves perplexed and often in a quandary with respect to determining:

(1) What is it that our children should learn in the schools?
(2) Who should be shouldering responsibility for this instruction?
(3) Is there action to consider for change in institutions preparing our teachers?

The gap between wanting and knowing, promise and performance, dissatisfaction and positive action must be narrowed, if only for the sake of survival in our world of technology. This technology has created a new relationship between youth, society, and work, and education is placed squarely between them. This relationship exists for all youth and for all work.

Although technology today dictates the role education plays in preparing youth for the world of work, there seems to be no level of education which fully recognizes this fact of life. There seems to be an imbalance of educational programming tilted toward the approximately 20% of college bound. Most students, whatever their interests or abilities are steered to the high road of the baccalaureate degree.

Important as manpower and jobs may be, they represent only an opening for the force between the social and economic institutions new technology forces upon us. We must look at the symptoms of new technology and how the nature of its changes affects the relationship of youth, society, and education.

GOALS

New technology has shifted the stages of activity from the strictly manual skills to the affective and intellectual powers. We can no longer afford to let boys and girls leave the educational system with dichotomized experiences of mind, values, and muscles.

The educational system strives to give students opportunities to develop talents—but these talents are usually undefined. We pay lip service to providing meaningful learning experiences related to stated goals. There is a major effort, knowingly or unknowingly, to create a dual school system in America, one known as vocational education, the other known as academic education.

I believe it is past time to end this artificial cleavage between the two. Our educational system would be enhanced if industrial arts educators would begin to regard their field as more than manipulative powers related to the shops. Whereas the high degree of specialization found in many vocational and technical curricula appears to be misguided, so it appears that a majority of our industrial arts programs seem to be irrelevant to the needs of students as they relate to society.

What is suggested now is more and better industrial and occupational education. This means industrial arts education should turn on pupils who know as well as do. The intellect does not function in a vacuum. Increased application of technology should automatically dictate educational change. Yet, the emphasis of industrial arts content still remains manual skills and project-oriented; not that these are not important. However, if we accept the premise that subject matter is a means affecting behavioral change in the student so that he can assume his rightful position in society and the world of work, then we must go beyond the "hands-on" expression.

In a 1968 study, Dr. Edward Kabakjian, Executive Secretary, American Industrial Arts Association, noted that in the junior high schools in Pennsylvania, the basic core of approximately 90% of industrial arts programs revolve around wood, metal, and drawing. There was no noticeable pattern or evidence of consistency in which schools offered areas of industrial technology in their programs. This has been harmful to the image of industrial arts.

The low prestige of industrial arts programs has been harmful in many ways. Good students shy away. Teachers are difficult to recruit. Little interest is shown by other educators. Money is hard to come by. Industry remains aloof. More time seems to be spent on self-protection than self-improvement. The lag between what is taught in the school and what is actually practiced in industry constitutes a related problem. If we are to consider the industrial arts curriculum as a phase of general education, then we should take on a more forward look. We should reflect man's technological efforts to improve life, to control and to modify his environment. We should move forward on its contemporary meaning—industrial meaning the interrelationship of industry and technology; arts meaning man's ability to use his creative senses to modify materials to fit his needs. We should emphasize not just the "hands-on" technology, but how man meets and works with this technology. Should we thrust forward on this contemporary meaning, or are we to continue accepting the meaning of industrial arts in Webster's Dictionary?

> A subject taught in elementary and secondary schools that aims at developing manual skill and familiarity with tools and machines.

There are firm advocates of the concept, "Industrial arts should be exploratory in nature." There is no doubt that exploration has its place in education; however, no sound program has ever survived our time with such a shallow meaning. Perhaps we should ask, "What emphasis have we placed in our industrial arts programs which relate to air traffic control, aerospace technology, computer technology, labor and management relationships, socio-consumer economics, or the theo-ecological effects which technology has on man and his environment? Or are these concepts, real as they are, far beyond the capacity of industrial arts programs?

One would think that new advances in industrial processes would literally force us to look upon many traditional subject areas of industrial arts as obsolete. It would seem that the project-oriented program concept would give way to the basics of modern technology. We must open our eyes and minds to a resurgence of an industrial arts program as being "the" focal point for educational growth in terms of the stages of child growth and development.

To take action of this nature, one needs to consider several factors which I would like to propose today. The first begins with our ability to analyze contemporary industrial arts programs in terms of its goals or objectives. The second is acceptance of our responsibility in educating the pupils we have in our schools; and third, accepting changes in our expectations of higher education.

The question of legitimate goals and objectives for industrial arts is as unsettled as the war in the Far East. Many objectives of industrial arts seem to be vague, global, untenable, and controversial. Objectives for the industrial arts curriculum are usually expressed in terms of program function—for example, project activities, skills in handling tools, etc. As in other disciplines, the goals for the industrial arts will continue to vary and continue to be open to criticism.

In order to tighten these aims or goals, three basic recurring questions should be asked:

(1) What is it that we want children to be able to do after instruction in industrial arts?
(2) How do we propose to accomplish it?
(3) What evidence do we have that indicates the achievement of No. 1?

Industrial arts today should be concerned with contemporary issues and problems of man as he relates to industrial technology. In the past 20 years, we have witnessed a great change with reference to industrial technology. These changes have had effects on man internationally. Understanding these advances provides the underlying factors for industrial arts education. In recent years, there has been increased interest in obtaining information essential for establishing goals for industrial arts. The usual procedure has been calling a conference of leaders or experts to decide matters of educational policy. While information is available about procedures for deriving or defining goals and objectives, most of this information falls into categories of generalizations or descriptive statements. Little data is available concerning empirical methods for deriving or defining statements of goals for the industrial arts.

Frequently, goals have been stated in such general terms that they have little exact meaning for the practicing educator. If one is to measure the adequacy and efficiency of an educational program, then the list of statements relating to educational intents must be described in terms not of what schools do, but of what children do. Specifying goals or objectives in this manner poses some practical problems. Previous efforts indicate little reference to students, parents, teachers, and industrial personnel as important contributors to defining industrial arts goals.

In practice, most decisions of goal clarification are made locally. Educators seem to argue that one purpose of the schools is to teach the affective behaviors believed necessary for the pupil to use his rational powers of thinking in his decision-making process. In the recent past, we have been coming to grips with this intent, especially due to reactionary groups, student unrest, and questions of relevancy. A concern now faces the educator in terms of not only implementing positive affective behaviors, but also measuring the educational growth of pupils as it relates to these behaviors. The challenge today of maintaining or changing affective behaviors may run contradictory to changes based upon our present school practices of promoting cognitive and manipulative instructional inputs. While one can argue endlessly about educational goals, comprehensive sets of educational aims provide educators with directives in determining objectives for learning. Meaningful objectives define both the behavior sought in the learner and the area of human experience through which this behavior is to be developed. To carry out this task, we must move away from conventional armchair philosophy to a more precise method.

Employing the Critical Incident Technique is one method for systematically collecting empirical data. This method is suggested for defining explicitly the objectives and goals of a contemporary industrial arts program.

We have reached an era where industrial arts programs are to be recognized, judged, and promoted on the basis of sound logical principles and psychological methods of learning. Until this is accomplished, justifying industrial arts programs as a discipline is problematical.

ACCOUNTABILITY

For the second factor, acceptance of responsibility implies the acceptance of the concept of instructional accountability.

For years, teachers and administrators have run the schools as though they were private institutions. For the most part, parents continue to rely on their children for insight and understanding of the inner workings of the classroom. Teachers and administrators continue to explain their objectives in the vaguest terms—confusing not only to the parent but to the student as well.

Concrete answers are not available to terms such as "develop one's talents," "develop creative abilities," and "develop an understanding of industrial process." Perhaps part of the explanation for this confusion is the uncertainty of the proper function of the school. But, more importantly, this is also largely due to the bewildering and often contradictory points of view concerning the nature of the best industrial arts program. As an example of this uncertainty, once again in the curriculum study conducted in Pennsylvania by Dr. Kabakjian, a significant difference was found in the degree of emphasis graduates of four industrial arts teacher institutions placed on ten objectives of industrial arts. This kind of divergence in philosophy as to the purpose of industrial arts education merely adds to the present state of confusion. This might also be true in other areas of education.

From the original function of the school to teach reading, writing, and arithmetic and to cultivate in pupils our American heritage to the broadened areas of instruction today, the public has expected increasingly more service from schools. The public continues to demand accountability for the dollars spent, while teachers and administrators are unsure as to what it is for which they are to be held accountable.

Public criticism has been aroused partially due to the lack of objective data describing the relationship of instruction, school organization, and pupil performance to educational goals. The public has little or no basis for judging the quality of educational programs. Evidence crying for relevance in our schools is louder than ever before in our history, not only from parents, but from pupils. The schools are in the midst of a great crisis. If critically analyzed, I doubt that we will continue to weather the storm. Accountability begins to place emphasis on measuring what and how much pupils have learned in a given period of time. Although 90% of the nation's school administrators are satisfied with teacher performance, they express strong support for teacher accountability.

The value and optimism about education still remains. An important change is the attitude of the public in what they expect from schools. This attitude is reflected in questions being asked about pupil performance and accelerating costs for educating our youth. Public school criticism has reached such proportions as to elicit a partial abandonment of the public schools. The idea of accountability is an old concept in a free enterprise. Building contractors have always faced a performance clause in building. Business and industry have performed on contractual agreements. All of these have been based on quality assurance and knowledge of results.

Accountability in education appears to be the same. A group of people (known as educators) would establish a set of specifications indicating the service to be performed, specifying the amount of money needed, and devising an acceptable set of standards and measurement scales. For example, let us say that seven eighth grade teachers meet 200 pupils daily for one year. Their task would be to specify the services to be performed, the cost for such programs in their building, as well as submitting an acceptable set of standards and measurement scales.

Lest you think this concept is unreal, there are over 200 school districts now trying it. Over one million American children are being educated under this concept.

Clearly, there is a need for assessing the effect of changed inputs to organizational outputs. Does changing the present concept of industrial arts from metal, wood, and drawing to power, communication, and materials, for example, induce behavior changes related to the goals for industrial arts? There is some danger that the attractiveness of new concepts will promote a fad of superficiality and eventual disillusionment. How often have we heard, "It is important that evaluation practices be consistent with the goals and objectives of a program?" Yet, we seem to be no further along today than 20 years ago. How can we begin to measure the effects a program has on a group of pupils?

Writing specific, meaningful objectives for industrial arts programs seeks to deal with this problem. This presumes the instructional role of the teacher is indispensable to significant improvement in the learning process. Therefore, writing specific and measurable objectives is designed for and directed to teachers.

While writing performance objectives is intended to increase instructional competence, it does not relieve teachers from the responsibility to assess student needs and to prescribe objectives that are relevant, timely, and meaningful. Some may view the task of clarifying industrial arts objectives as theoretical, abstract, or philosophical. However, performance objective writing provides new and different perspectives about teacher accountability. It provides ways to relate the assessment of student learnings in industrial arts to explicitly stated objectives that are measurable.

By its very nature, performance objective writing makes evident that whatever it is that students are to learn in industrial arts is a function of objectives prescribed by the teacher. Objectives prescribed in this way are likely to establish goal clarity or goal visibility for student and teacher alike. Furthermore, it shifts student energies in the direction of learning and away from "psyching out" teachers. It also shifts instructional responsibility toward the teacher and away from the student.

Learning Responsibility

Performance objective writing affects at least two aspects of instruction which need attention. One is the problem of teacher-attitude as it relates to identifying who is or is not responsible for learning success in the school and classroom. The other is the problem of determining and measuring instructional performance. In practice, if not in theory, it is generally assumed that responsibility for learning rests with the learner rather than with the teacher. Educational folklore and some literature suggest differently. Careful observations and experiences indicate teachers generally claim credit for successful learning while abstaining from or shifting responsibility whenever learnings fail or are in doubt. This is not surprising and is not meant as criticism of teachers. It is, however, an accurate description of educational reality. More importantly, such practices can only exist in social systems like education. These systems lack formal mechanisms and procedures necessary to using feedback data for modification, change, and improvement.

Educational reality shows classroom practitioners also lack the measurable criteria and techniques needed to provide valid and reliable assessments about learning and teaching. This does not mean lack of student measurement and evaluation in classrooms. To the contrary, schools offer more than ample evidence of efforts to assess students in instructional settings. Numerous efforts to assess students occur in the absence of predetermined, identifiable, and measurable learning objectives.

Through the years, the assumption persists that because teachers teach, students learn. But unless the teaching-learning process makes specific provision, first to identify and prescribe what it is that is to be learned and then secondly undertakes to measure and determine these learnings, the explanations which justify successes or failures in school will continue to be ambiguous, contradictory, and indeterminant.

Teaching Accountability

Until recently, much of the potential and limitation in writing behavioral objectives was seen in terms of learner outcomes. Perhaps this was to be expected since the term objectives, measurable or unmeasurable, filled the tradition of looking upon educational progress in terms of student outcomes. Persistent work with objectives now indicates a different and perhaps more powerful use in objective writing. That potential is in promoting instructional accountability.

In many places, instructional accountability is already an emotion-laden issue. It promises to become more intense as controversies involving school decentralization, teacher-board confrontations, and skyrocketing education costs gain momentum. Instructional accountability is basic to all of the above issues. It is only a matter of time before these and similar questions are stripped of the facade which disguises the real controversy. Eventually, attempted and achieved student learnings will be related to instructional efforts. When that occurs, teacher accountability will be established. Teachers who identify and prescribe measurable learning objectives for students offer tangible evidence of accountability for themselves and their work.

Instructional accountability is not only a legitimate concern for public support; it is also indispensable to professional growth in education.

Unless we, as professionals, consider this course of action in our schools, there are those who are now predicting that industries will undertake the major task of educating our youth. Industry will also get accreditation, as well as granting degrees under the auspices of a cooperating college or university.

This suggests, then, a third course of action which might be considered a recurring beginning: another look at teacher-training.

ACTION

One of the challenges facing higher education institutions is to begin operationalizing the various contemporary concepts and theories about education. Logically, one would expect that in higher education, opportunities to learn procedures for implementing these concepts would abound, with instructors acting as facilitators or resource people. There is probably no other level in education wherein instructor-dependence is greater.

The shift away from subject-centered discipline to learner-action-centered programs becomes very new to many college and university faculties. Yet public school industrial arts teachers generally base their curriculum on a child-oriented approach. This divergence of philosophies causes great anxieties for public school people.

There is a feeling of uneasiness, a feeling of urgency, on the part of the public school practitioner. Never have so many seemed to have so little in common and so great a need to act in common. Everything cries out for some far-reaching changes in both our attitudes and our institutions. Yet, both are inter-dependent. We cannot change one without, in some way, changing the other. There are university scholars going about promoting the idea that the public schools should "humanize the curriculum." This urging by university professors for public school educators to be sensitive to values and conceive them humanistically is empty exhortation without some indication of how values become functional in the schools.

Many educators have advocated an "interdisciplinary" or a "unified arts" approach to teaching industrial arts. All well and good! We must, however, ask ourselves as public school educators, "In what ways are teacher education institutions promoting these ideas in their own curriculum?" There seems to prevail a common thread of educational growth strands in the areas of science, mathematics, English, social studies, and the industrial arts. Yet how often do we find mathematics, social studies, science, and English majors studying and working with the industrial arts majors in higher education? How often do we find the elementary majors in higher education learning activities about perceptual motor skills necessary for early reading and arithmetic achievement using the industrial arts program as the focal point? Other than the misused concept, the term paper, how often do we find the concept of independent investigation offered in teacher education institutions? Where are the concepts of team-teaching and team-planning being utilized in higher education? Or do we continue to follow the motto, "Do as I say, not as I do?" Are models not necessary in higher education as well as public school education?

It is uncanny the way the public schools have aped the promotional efforts of our institutions of higher learning. Yet the institutions that resist and impede change are the very same which encourage our public schools to change. Should we not hold accountable higher education institutions dedicated to the proposition that at least one-quarter of all freshmen must fail?

Successful curriculum implementation depends upon properly trained individuals. Successful staff assignments depend upon a delineation and definition of the various responsibilities along with the training skills necessary to carry out these tasks.

These role definitions lead to differentiating the staff in a school building using not only disciplines as a basis, but also using such specialities as technology, instructional processes, instructional skills, leadership development, curriculum development (research), administration, and clerical roles.

Teacher education programs should be adjusted to training these individual role expectancies. Acceptance of learning specialists in teacher education programs would have profound implications for the way teacher education personnel would be prepared and the kinds of programs required. Teacher education institutions should re-evaluate their programs and faculties in light of relevancy to actual school situations and curricula. Education courses should be taught by educators using the latest methods. Public school teachers and principals should be involved in designing courses both at the undergraduate and graduate levels. Unless this action is considered, the traditional prestigious image of higher institutions will further diminish not only in the eyes of its own clientele, but also in the eyes of the schools accepting its products.

Teacher Training

Training professionals to involve themselves in change might be a far-reaching goal for some colleges and universities. However, those teacher training institutions ready for change and action might wish to consider beginning with the student teaching program. Much of the literature and some limited research attempts to deal with the matter of improving student teaching by methods such as September experiences, lengthening the student teaching experience, using a team arrangement in terms of team teaching and video taping. All of these are modifications cast within the setting of the college of education. In other words, the basic assumption is that the student-teaching function in the school classroom can be manipulated by changing the programs and the activities located in the college of education. In this arrangement, the college supervisor, for example, makes final evaluations. It is assumed that the university supervisor possesses definable skills for systematic training of the student teacher. This approach is contrary to conditions and circumstances that truly influence human behavior in general social settings called schools and in particular settings called classrooms. If we are to change student teaching practices in the classroom, we must recognize the impact and influence of the school setting in which the student teaching will occur. The first step would be to identify the key person most likely to bring about change in that setting and train that person with skills essential to feedback by using a systematic scheme or conceptual arrangement. This change is most likely to occur by using the instructional manager as a catalyst in the school organizational setting.

There is a lack of evidence to support the present university student teacher structure, which is intended to promote improvement in the modification of pupil behavior. Because of this, we should attempt to shift the responsibility from the university supervisor in carrying out the direct supervisory act of student teachers to an instructional manager who is closer to the classroom. This, in effect, would place more responsibility for supervising student teachers within a classroom setting on the people on the firing line. The instructional manager could then become a catalyst for change within the environmental setting. This may modify the role presently played by the university supervisor in an educational system.

The organization and influences of the local school system tend to dominate how a student teacher performs. Therefore, the university should encourage the proper training of instructional managers who supervise the student teacher. There is a discrepancy of perceptions of effective instructional techniques between the teacher training institutions and the local school districts.

There is a lack of conceptual frameworks for student teacher training programs. Without the identification of some unifying theories or conceptual frameworks for structuring student teacher training programs, most of our efforts at improvement result in mere "tinkering."

An unplanned student teaching experience can turn out to be little more than a wasteful repetition of a narrow band of teaching behavior and student response sandwiched between large slices of coming and going. Improved opportunities to see student teaching ideas in action and thus understand them is highly important. They become more meaningful when carefully planned, structured, interpreted, and linked with conceptual frameworks.

To speed change and to facilitate experimentation, procedures must permit small groups of school system and college staffs to design and implement promising programs with adequate provision for evaluation and communication of experience. Mounting financial pressures on institutions for higher education and growing problems of schools could bring about a redirection of the student teacher training experience that would probably take the form of school systems undertaking the professional student teacher training program, while colleges and universities would focus entirely on the academic studies. Universities need to become more directly concerned with the problems of local communities, and schools need teachers capable of interpreting experiences within this framework.

It seems reasonable to project that if we are to produce a new generation of teachers, then the attitudes and practices of higher education must also change, even more rapidly than the public schools'.

I have attempted to identify some loopholes to close in our present scheme of educational programming. Concurrently, I have provided considerations for action.

I accepted your challenge today with great humility, hoping to leave you with some insights, questions, and directions for consideration: consideration for a more valid approach to goal derivation; consideration for the acceptance of accountability for what children learn; and consideration for change at the higher education level in striving for this accountability. For within these considerations, the quality of the decisions we make will then be made in respect for each other.

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ACIATE

American Council of Industrial Arts Teacher Educators

Technology: A Question of Values

Donald P. Lauda

According to the Dictionary of Mysticism, the sun entered the constellation of Aquarius in March of 1948 and should remain there for 2000 years. This harmonious epoch was celebrated in the Broadway musical, Hair, which claimed peace as our guidance system and love to steer the stars. Unfortunately, mythology is merely an allegorical narrative, and to rely on mythology is as ridiculous as relying on the immutability of human values.

There is no reason to deny the potential in the Age of Aquarius since we now have the technique for endless innovation and production. It is ironic that it was about 1948 that we began the "era of radical change." This was the beginning of the computer age, controlled nuclear power, plastics, jet engines, miniaturization, and the space age. It would be ridiculous, if not impossible, to list the inventions that have occurred since this era began. It would also be impossible to extrapolate such data into the future. What is important is that man has generated a technological society, and now he must alter his institutions if they are to survive. The result of this society and its technology is its randomness in volume with both negative and positive benefits.

This paper has been written with the conviction that, in the last analysis, an investigation into the ramifications of technology can be defined [illegible] in terms of values and man's quest for values. In most cultures, in the past, the assumption was made that some divine grace bestowed upon man all that is good and valuable. Nietzche, however, announced that "God is dead!" and that to live with meaning in the face of absurdity was the highest achievement to which humans could aspire. Such judgments are a fact of having human experience. We encounter them daily, since human valuations are an inevitable part of our daily life.

But what are values? Who is to judge a value system? What has caused our value system to change so rapidly in the Age of Aquarius? Werkmeister (Ref. 30, p. 94) gives us direction in answering these questions. He emphasizes that:

1. Value statements are not meaningless emotive expressions.
2. Value statements are basically of two types. One type is of the form "I value X", and the other is of the form "X is valuable." To say we value X, we ascribe a value to it, but to say it is valuable asserts that it is worthy of being valued.
3. Value experience includes judgments of preference. One value is higher or greater than another. This implies a realm of complex interrelated values and of many dimensions and dependencies.

Man is a unique creature who creates a culture, and that culture in turn is a formative force in his destiny. It is his response to his interaction with his values that develops his true humanity. We have a value system made up of value ascriptions that reinforce one another, or in some cases interfere with each other. Man is an heir to his cultural past and to its value patterns. He has the option to transcend these with higher value projections or he can acquiesce to the status quo. Either way, he finds fulfillment as a person. Gardner (Ref. 12, pp. 125-126) has stated:

> Instead of giving young people the impression that their task is to stand a dreary watch over the ancient values, we should be telling them the grim but bracing truth that it is their task to re-create those values continuously in their own behavior, facing the dilemmas and catastrophes of their own time.
>
> The moral order is not something static, it is not something enshrined in historic documents, or stowed away like the family silver, or lodged in the minds of pious and somewhat elderly moralists. It is an attribute of a functioning social system. As such it is a living, changing thing, liable to decay and disintegration as well as to revitalizing and reinforcement, and never any better than the generation that holds it in trust.

Technology presents mankind with such a vast array of alternatives that the idealistic "stable condition" has almost become a myth. The alternatives introduced into our culture daily threaten our institutions and their universals, causing the instability we know as "future shock," polarization, or other cliches so common in this age. This process brings previously unattainable goals within our grasp. Schon (Ref. 24, p. xii) states that the drive for stability forces us to ignore the change that is occurring. Therefore, we see our values and institutions as enduring. Change becomes a deviance with this Parmenides viewpoint. But, in fact, our institutions and concepts of man have changed; it merely seems that we are somehow insulated from the fact that changes are occurring.

It is very unlikely that we can anticipate returning to the stable state as we advance technologically. Toffler (Ref. 27, p. 269) refers to this as a lack of consensus. This is confirmed by the findings of Walter Gruen, a social science researcher, who has studied "the American core culture." He found, to his surprise, that diversity in beliefs was so striking that it may already be misleading to talk of an American culture complex. He suggests that, particularly among the affluent, educated consensus is giving way to what he calls pockets of values. As subcults continue to expand, we can expect that these pockets will proliferate as well. Thus, we perpetuate the unstable condition of our society.

With our technical knowledge doubling every 15 years, man is faced with an overwhelming amount of judgments that must be made in terms of his value perspective. These judgments will be based upon his view of technology as presented by his home environment, the mass media, and the educational system.

THREE VIEWS OF TECHNOLOGY

Every human must come to grips with his life in terms of space and time dimensions. We ask ourselves why our youth has a different perspective of our culture. Maybe it is time that we look at our technological environment in terms of these space and time dimensions. As they look forward into new vistas and parents look into McLuhan's "rearview mirror" back to Bonanza Land, it is no wonder that there is a value gap. The space and time dimension embraces our educational system and its orientation to the past...and this includes industrial arts education as well. But what are these views of technology?

Idealistic State

This view holds that technology is the creator of all progress, solves all of our problems, and promises us the panaceas necessary for the good life. The alternatives imposed upon our society are inherently good, and the second- third-, and fourth-order consequences are mere manifestations of progress. This viewpoint also holds that the negative side of technology is inherently good. Such a philosophy appears to be the mainspring of the profit systems being perpetuated in our society today.

Such a philosophy has been reinforced by history. The Luddites were stifled, production has been increased to phenomenal proportions, the GNP hovers near one trillion dollars, and the potential for further development is phenomenal.

Curse of Mankind

This view is by no means new, as testified by the plight of the Luddites several hundred years ago. According to this philosophy, mankind is shaped by tangibles with disregard for man and his environment. Power gravitates into the hands of the intellectual and scientific elite. Henry Thoreau, who subscribed to this philosophy, warned that we had become the tool of our tools. Such opposition is evidenced today by the "back to nature" clique which rejects man's achievements and sees future progress as an unmitigated curse.

Ambivalence

Surprisingly, a large number of persons have no particular feelings about technology and its consequences. It is this viewpoint that places our society in a most tenuous position, since it does not demand that the person(s) make a personal commitment. To acquiesce to any environment without questioning its validity implies that we will adapt to whatever is developed. Possibly, we have been so overwhelmed with technological innovation since the Age of Aquarius began that it is meaningless to us. Today we are not surprised if we go to the moon but we are shocked if we do not. The ambivalent accept research and development as a budget item; they do not question priorities, they make no commitments.

A technological environment demands that we gather information, synthesize it, and make rational decisions. We might ask ourselves: What are we doing as teachers to help our students be responsive citizens? Can we really expect a commitment from those who have little to look forward to, such as those in Appalachia, the inner city, and the American Indian, among others? You might also ask what your industrial arts program is doing to help understand man and his advanced technology. Or are you, too, a part of the ambivalent?

Professor Manfred Stanley of Syracuse University has been studying views of technology and rejects the conclusions of those who condemn it. He feels (Ref. 19, p. 24) that the potential in the process of radical change presents alternatives to the many consequences the pessimists seem to in..ate. He says:

> The problem—here, as well in the application of educational technology—is how to organize society so as to free the possibility of choice and how to control our technology wisely in order to minimize its negative consequences.

To subscribe to any one of the three views singularly is tragically inept. The pessimistic view stifles creativity at a time when we have progressed to the point where we can solve most problems through the use of more technology. The optimistic view allows us to remain drunk with our own productivity without regard for man and his environment. And the ambivalent attitude is not an unfamiliar syndrome. As Mesthene (Ref. 19, p. 60) says, "It is reminiscent of the long-time prisoner who may shrink from the responsibility of freedom in preference for the false security of his accustomed cell."

What is needed is an eclectic philosophy which is open-minded, responsive to human needs, and adaptive. Technology is an invitation to the good life, not an invitation to despair. But what of the condition of our society in 1971? It has been stated that we do not have a stable state. What has the present system done in terms of its priorities at a time when man's problems are no longer technological but rather social, psychological, economic, and political?

A MATTER OF PRIORITIES

To talk about priorities for mankind is to talk about precedence. It does not take any phenomenal amount of insight or intellect to filter out the priorities that man has set for his society. At the present time, military needs outweigh civilian needs, private needs rank above public interests, and countless fiascos requiring huge expenditures outweigh the need for improving our chances for immediate survival. Allow me to be more specific: The national budget, according to Wallia (Ref. 29, p. 11), was $195 billion in 1969-1970, which amounted to $974 per capita. Of that amount, $127 went to the Vietnam War effort, an additional $400 for other defense expenditures, while other areas suffered tragically. For example, cancer research accounted for $.93 of that $974.

It was President Eisenhower (Ref. 9) who first warned us of the consequences of the military-industrial complex. He said:

> In the councils of government, we must guard against the acquisition of unwarranted influence, whether sought or unsought, by the military-industrial complex. The potential for the disastrous rise of misplaced power exists and will persist.

Senator Fulbright (Ref. 3, p. 121) estimates that the United States since World War II has spent roughly ten times as much on warfare and related requirements as it has spent on human welfare. Marcus Raskin of the Institute for Policy Studies puts the actual figure for military spending since 1945 at $1300 billion. He also estimates that we have spent $100 billion to prop up foreign dictators who had no popular support in their own countries. This often was required to permit our own military presence overseas.

A second priority has been to explore the vast regions of outer space and more importantly to maintain worldwide superiority in the race for notoriety among our less fortunate allies. Between 1958 and 1968, our government spent $112 billion for research and development in science and technology (Ref. 29, p. 11). Of this vast amount, 55% went to the Department of Defense, 23% to NASA, 11% to the Atomic Energy Commission, 5% to Health, Education and Welfare, and 1.2% to the National Science Foundation. It is almost beyond our wildest dreams to imagine what the USOE could do with just 10% of the Department of Defense budget. Fuller (Ref. 4, p. 63) has shown the following alternative social costs that reflect the needs of education:

One $275,000,000 aircraft carrier would pay $251,000,000 for 12,000 high school dwellings.

One $104,616,800 naval weapons plant would pay for 35 school buildings at $4,000,000 each.

Fourteen standard jet bombers at a cost of $8,000,000 each would pay for a school lunch program of $110,000,000 and serving 14 million children.

It might be argued that the military-industrial complex is vitally necessary to the economy of the country due to its effect on employment statistics, GNP, and other financial indicators. President Kennedy, in his 1963 economic report, noted that the defense, space, and atomic energy activities absorb about two-thirds of the trained people available for exploring our scientific and technological frontiers. But is this rational? Wallia (Ref. 29, pp. 128-129) thinks not:

> To begin with, the very existence of these industries is hardly the result of scientific rationality. Many scientists have been highly critical of the whole defense-aerospace enterprise; even NASA activities are far from the product of a consensus of the scientific community. Though the pseudoscience of the war-gamers and other military-scientific seers has been used to expand, explicate, and justify our recent defense and space programs, the basic decisions have been made by generals, admirals, presidents, and congressmen, backed by a largely passive public opinion.

Space does not permit us to explore other expenditures of the federal government, although we are all well aware of those that exist. For example, the St. John River, right here in Florida, has cost the federal government $210 million since the Andrew Jackson Administration (Ref. 1, p. 12).

How do you establish value judgments on scientific objectives? This is the question that must be answered if we expect to survive on the spaceship earth. Peter Drucker (Ref. 7, p. 192) states that one reason such questions are difficult to answer is that they are concerned with the future, and we have no facts concerning the future. Therefore there is always a clash of programs and a conflict of political values. We not only must establish new values but also decide which ones we should abandon. All of these questions must be answered utilizing logical alternatives rather than opinion and emotion.

Our profession also has established priorities for content and methodology. These decisions are concerned with the future, a future for which we do not have finite information. We do know, however, that we live in a technological environment, that production jobs are decreasing, that we are entering the cybernetic age, and most important, that we should be preparing children to survive in the 21st century. My colleague Dr. Hahn will pursue this topic, but may I just ask one question: Are our current programs future-oriented or past-oriented, oriented to perpetuate a growing GNP or to produce man with a humanistic attitude towards himself, his fellow man, and his environment?

This attack on our current priorities implies that other priorities must be established. This is true, and allow me to set some priorities as I see them if we intend to survive the latter part of the 20th century. These will be broken into two main areas: three priorities necessary for immediate survival and those involved with moving mankind from survival to a humane environment.

IMMEDIATE SURVIVAL

Taming of Technology

In June 1937, the Science Committee of the National Resources Committee met in Washington, D.C., at which time William F. Ogburn, Professor of Sociology at the University of Chicago, made a phenomenal contribution. Ogburn (Ref. 25, pp. 12-14) warned the sub-committee of the volume of technological change and the inevitable consequences. Even then, 34 years ago, he was concerned with the ambivalence of man:

> In other words, even though changing technology may give information about future social conditions which may be used as the basis of planning, such knowledge may not be acted upon. For successful planning rests upon other factors than knowledge, particularly unanimity of purpose, the will to act. The place which a knowledge of technological trends occupies in planning is only to

furnish information without which plans are likely to be uncertain. Even though unanimity of purpose exists and the will to act is present, without knowledge as to what is likely to happen in the future, such plans as may be made will be to that extent defective.

Immediate survival in the 1970's will rely on our efforts to tame man and his technology. Please note that the phrase "man and his technology" was used. Technology, by itself, is inherently neutral; it is man who exploits his fellow man, his institutions, and his environment. It is not my intent to imply that our first priority is to call a moratorium on technology. Such an approach has been advocated by a number of people in this decade. This approach is ridiculous and the "back to nature" romanticists fail to realize that such an environment is one in which the life span is only a few decades, one in which malnutrition takes human life, and one in which human commitment is stifled by pure ignorance. To reject technology would be sheer suicide. We need more technology to solve the countless problems of our environment. Included in that environment, of course, are psychic as well as physical sorespots. Toffler (Ref. 27, p. 391) warns us of the potential for an international revolt against the irresponsible misuse of technology. When the Organization for Economic Cooperation and Development concluded its report, one of its authors, a former premier of Belgium stated, "We came to the conclusion that we were looking for something... which was not there: a science policy."

Jack P. Ruina (Ref. 23, pp. 36-37) warns us that the consequences and control of technology are treacherous territory, much too significant to be left to current managers of technology. Change will come when we are ready to create a system which can intelligently appraise new technology, be alert to its evolution, and then act to make mid-course corrections as the diagnosis demands. But the question remains, to whom can we entrust this responsibility?

In the United States, technical developments are filtered out by economic feasibility and profitability. This system has brought our society to near eco-cide, is no longer feasible, and is in fact cancerous. Many suggestions have been offered by the proponents of a controlled technology. Don Fabun has suggested a Secretary of Ecology at the Federal cabinet level. Toffler (Ref. 27, p. 390) suggests a Technology Ombudsman. Technology, by its very nature, is monistic, involving every segment of our society. No segment of mankind escapes the Odyssey and its social consequences. New technologies must be submitted to the scrutiny of behavioral scientists as well as engineers who can determine the potential strengths and weaknesses before the public is rapaciously exploited. Such a body of expertise may have to have legislative power for providing delaying action while further research continues. For the first time, such a process occurred with the SST controversy. Questions were raised and the element of doubt has delayed action. What might have happened if DDT, thalidomide, and the Vietnam War had undergone similar action?

Ironically, the social sciences are far behind in the needed research for assisting the technologist. Of the $112 billion allotted for research and development, 1.2% went to the National Science Foundation between 1958-1968. Of that amount, only 10% was used for social research. Jay Forrester (Ref. 11, p. 67) has stated:

> I suggest that the next frontier for human endeavor is to pioneer a better understanding of the nature of our social systems. The means are visible. The task will be no easier than the development of science and technology. For the next 30 years, we can expect rapid advance in understanding the complex dynamics of our social systems. To do so will require research, the development of teaching methods and materials, and the creation of appropriate educational programs. The research results of today will in one or two decades find their way into secondary schools just as concepts of basic physics moved from research to general education over the past three decades.

This emphasis on the taming of technology as a first priority implies the alteration, if not the demise, of the bureaucratic organization of industry, the military, and politics. The decision-making process is hampered by <u>en masse</u> procedures. In the cybernetic age, immediate feedback is essential for making decisions that eliminate those elements of the 1970's (e.g., pollution) that could destroy us. Decisions must be future-oriented, impregnated with social responsibility and aesthetic aspiration, and concerned with man rather than profit.

Conclusion of the Vietnam War Effort

To advocate technological solutions to the Vietnam War effort is to advocate the further use of military hardware. In a society which can produce whatever it desires and for the first time is within grasp of having a humane society, it is beyond comprehension to advocate escalation or even continuance. Again, this is a value decision, and it is based upon the ultimate value—human life. To control the industrial-military complex would involve ending the war.

One reason for curbing the war effort, in addition to elimination of taking human lives, is to save money for our other priorities. Cleaning up our environment, cities, etc., will take vast funds which can only come from a reduction in the military bureaucracy.

Elimination of the Ecological Crisis

Technological backlash manifests itself in many ways. An oil leak destroys thousands of birds and fish, raw sewage kills our lakes, and our throw-away society turns the landscape into a national dump. Stewart Udahl once stated, "Our resource problems are measured by a flyway of a bird, the length of a river, the half-life of an element, the path of a wind, the scope of the oceans, and the shape of our cities." Action must be taken immediately if we intend to survive the vast population growth and pollution of our air, land, and streams. Decisions can no longer be made utilizing the philosophy of "As long as it doesn't kill anybody." To do so denies us the right to survive physically, socially, morally, aesthetically, and emotionally.

FROM IMMEDIATE SURVIVAL TO A HUMANE ENVIRONMENT

The second set of priorities is aimed at solidifying the American spirit and utilizing technology to its fullest potential. The list could be endless, but allow me to list those that appear to be significant, demanding of time and monies, but yet not insurmountable.

1. Cleaning up of our cities.
2. Improvement and construction of educational institutions.
3. Improvement and construction of hospitals in all areas.
4. Improvement and construction of penal institutions utilizing the optimum socio-psychological research as a base.
5. Elimination of the tragic killer diseases (e.g., cancer).
6. Production of food for the millions of persons who either die or suffer the effects of severe malnutrition.

These priorities require value decisions, human commitment, and—whether we like it or not—money. Yet funds are available if we can channel them in the proper direction. Develop a scenario knowing that these priorities had been fulfilled and see what you have. Utopia? Not quite, but you would have equality, a clean environment, the best in education and medical care, and presumably a society of humaneness. It would mandate that means be subordinated to ends with greater attention devoted to spelling out national and international goals.

CONCLUSION

People today are born into a dominantly technological environment which requires that they be able to gather data, synthesize information, and make rational decisions. Many of these decisions will be value-laden since modern man is deluged with tangibles and their inevitable consequences. The past failure of society to keep pace with the backwash of technology has brought us to near annihilation. Our youth have the most at stake, and they are relying on us to provide the necessary environment for their future survival.

There are many ways to move toward a stable society. Alternate futures are not only possible but mandatory. We will need to try out any number of social reform models if we intend to cope with drastic change. We now have a totally new picture of what man can do. It is time to stand up to our commitment with awareness, confidence, and trust, as we strive for the potential that our technology provides us.

Our educational system must also remain flexible and be a leader in developing individuals who can make rational decisions based upon knowledge rather than emotion or ambivalence. This challenge tor the educational system is equal to that presented by our ecological problem. It is time to listen to our youth, look into our own philosophy, and accept the challenge that man has for the first time in the history of mankind—that is, to develop through advanced technology a humane society based on integrity, equality, rationality, and social justice.

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Education for Survival

Marshall S. Hahn

My topic for consideration this afternoon is "Education for Survival." "Education for Survival in the Age of Aquarius," if you will. The topic sounds morbid, as if we were on our last leg—and indeed, if we don't make haste with change, perhaps we are. After listening to Dr. Lauda, we know that there is much to be done. Let me spell out some of the points that I think can help us to begin to live in an era that can be more exciting, more civilized, and more directly related to the good life of Utopia than mankind has ever known. This greatness can be if we, as educators, as world and community citizens, will make a more definite commitment than ever before. We must make that "college try," that last or extra step that will reorder our priorities and help our students to at least become aware of and possibly face up to and commit their lives to solving the problems that surround us. This will give us hope, bringing us around the corner and away from crisis.

If you read the last School Shop magazine, a recent issue of Man/Society/Technology, or perhaps any recent issue of almost any magazine, you have read of the crises that surround us. I refer to the environment and its many forms of pollution, urban areas with over-population, apathy, and indecision, the never-ending threat from nuclear war, and the threat of student unrest on campus. There are many more.

What are we in education doing about these problems? Utopia is not just around the crisis corner, and it won't be after the second crisis corner if we go on as we have been in the past. But it will be closer if we in education will begin to pick up a few challenges that have been given us in the last few years. Let us begin to take up the challenge and honestly do something rather than just come to these meetings and talk about it. Talk is cheap and easy. The things that prove our dedication are action-oriented and begin to hurt in many ways. These may hurt in the pocketbook, in time, and in energy expended toward change. We must be willing to expend whatever is necessary in the way of personal fortune, reputation, or security to begin the reconstruction of a world and a society that the youth of today know we and past generations have polluted, razed, and befouled. We must begin the task of educating them in entirely new ways so they may take over the enormous building operation which is just now beginning to move. In my opinion, we as industrial arts teacher educators should consider:

1. Throwing out old single-entity courses like woodwork, metalwork, and drawing.
2. Revising the curriculum completely.
3. Abandoning grades, class schedules by bells and hours.
4. Instituting competencies and performance criteria.
5. Teaching for social values rather than materialistic values.
6. Educating for change.
7. Making decisions by conscious thought and reason from among alternatives.
8. Striving to bring parents back to school.
9. Freeing ourselves of the myth that another course is the answer.
10. Reviving the roving professor.

I would like to discuss each of these very briefly, give you some of my thoughts on this short list, and then leave you with several challenges.

Industrial arts has always been a leader in sound educational innovations, ahead of other educational content areas in making significant contributions to the education of youth. With this exciting and extremely difficult prospect in mind, let me elaborate on the preceding points:

1. We should throw out the old single-entity courses like woodworking, metalworking, and drawing. The courses originated at a time when our society was beginning to gear itself for the age of the machine, and these were very basic. However, today we are experiencing the beginnings of the post-industrial society. Can we limit our objectives to the past? It seems to me that the future is far more important. We may need to know some basics, but we live in an age where the basics have changed, society has changed. Let us unite the natural basic concepts that tie the educational structure together.

2. If we throw out single-entity courses, we will be well on the road to revising the curriculum completely. We need to entertain a whole-hearted systems approach and look at our basic purposes. We must continually ask basic questions. "Why are we doing what we are doing?" "What is public education supposed to do for the youth of today?" "Is

it filling the need?" "Are we serving all the youth or just a small portion of youth?" With proper organization, we should be able to take some of the emphasis away from the study of industry and develop the curriculum equally if not more predominantly on the true reason for our existance—man.

3. We should abandon grades, and class schedules by bells and hours. If our educational system is set upon a sound philosophy and organized accordingly, we will be able to switch from external spoon feeding of answers to internal learning through understanding. There is no such thing as a sudden switch from external learning to internal learning. If you have not been spoon feeding, the obstacle will not be unconquerable. On the other hand, we must also remember that most students have never really experienced anything but external learning.

We should consider instituting competencies and performance criteria. Competencies and performance would take the place of grades and classes. These would be the quality standards rather than marks indicating sit ability in required courses for certification. Real understanding of what education is all about is more important than certification. Certification requirements must also be changed, but that is another subject.

5. We should consider teaching social values rather than material values. In order to do this we need teachers with a sense of purpose, a reason for their existence, and a true philosophy of education. This means we need to develop teachers who are true scholars, who will think seriously, deeply, and continuously about the purposes of what they do and why they do it. In this type of educational system, the content and structure should be in the mind of the teacher for instant manipulation to benefit the student whenever it is most desirable and helpful for learning experiences to take place. Remember, the teacher is a coordinator of the learning environment and not a teller.

> There is the closely related fallacy that education is primarily intellectualistic in its processes and goals. Quite as important is that ideal factor in culture which gives meaning, direction, and significance to life. I refer to the element of faith or purpose which lifts man out of himself and above the level of his more narrow personal interests. Here, in my judgment, is one of the great lacks in our schools and in our intellectual class today. We are able to contemplate the universe and find that all is vanity. Nothing really stirs us, unless it be that the bath water is cold, the toast burnt, or the elevator not running; or that perchance we miss the first section of a revolving door. Possibly this is the fundamental reason why we are so fearful of molding the child. We are moved by no great faiths; we are touched by no great passions. We can view a world order rushing rapidly towards collapse with no more concern than the outcome of a horse race; we can see injustice, crime and misery in their most terrible forms all about us and, if we are not directly affected, register the emotions of a scientist studying white rats in a laboratory. And in the name of freedom, objectivity, and the open mind, we would transmit this general attitude of futility to our children. In my opinion this is a confession of complete moral and spiritual bankruptcy. We cannot, by talk about the interests of children and the sacredness of personality, evade the responsibility of bringing to the younger generation a vision which will call forth their active loyalties and challenge them to creative and arduous labors. A generation without such a vision is destined, like ours, to a life of absorption in self, inferiority complexes, and frustration. The genuinely free man is not the person who spends the day contemplating his own navel, but rather the one who loses himself in a great cause of glorious adventure.
>
> Counts, 1932

If we have a new type of individual for a teacher, educated in a different manner as just described, that will help to reassure faith in our youth and the ability of man to solve problems and to live in peace with less emphasis on materialism and more emphasis on humanism.

The youth of today are looking for relevance. This word has a different meaning for almost everyone. I use the term to mean not what is today in industry and society, but what should be, what can and ought to be.

It has been about eight or nine years since Rachel Carson wrote Silent Spring. I must ask the question, "What progress has been made?" In my estimation, very little. Industry has been without conscience since before the industrial revolution. Industry in general will never have a conscience until its managers as citizens have a conscience.

This will happen when something other than the profit motive and GNP receive top priority.

6. We must educate for change. Perhaps you have heard this many times recently. What does it really mean? What is the basis for change? The only basis for change, in my opinion, is new knowledge. You cannot move to laser beam communication if you don't know about the laser. Neither could you move to transistors in radio and TV if you knew nothing of the transistor.

These examples have shown change in a product. What does change mean for man? Alice Mary Hilton has said that man should prepare for job changes from seven to eleven times during his work life span. Other writers point to the economic slump in which we find ourselves today as the beginning of a series of slumps. (Heaves and shudders) To prepare our students for this change, we must have them grasp the fundamentals of the activity that engages the post-industrial society. The students must consciously assess the alternatives and crest the waves of shuddering depressions caused by technological leaps and imbalances.

The problem then is not to resist and suppress change, but to prepare for it and to manage it with knowledge of ourselves and circumstances. The mere fact that students have thought in detail about being out of work because of job changes or other reasons will put them on a better footing and make change easier to cope with. The way to get this to happen is to practice it. As Toffler has described it, to develop "cope-ability."

7. We must make decisions by conscious thought and reason and choose from among alternatives. The alternatives must be weighed with new objectives. For too long, education has been placing its objectives in the past, allowing the future to join the fragments and pieces. Now it is imperative that we educate for change, and the strongest references point to educating an individual in the process of learning how to learn, with much less emphasis on learning industrial techniques and processes.

8. We must strive to bring the parents back to school—both with their sons and daughters and without their sons and daughters—not necessarily for skills training, although this might be part of it, but for understanding the post-industrial society. Education has become a life-long process, and we should be working to bring parents into the classroom with fifth graders—not to the nonsense of rote memorization, but into a world of cooperation and understanding. They must understand the problems of technology. Man does not exist for technology; technology exists for all men, not just an elite few.

9. We must free ourselves of the myth that another course is the answer. We do not broaden the base of education in general and of industrial arts in specific by adding new courses to the curriculum. For example, now that plastic is about to overcome steel in the volume of production, we add a course about plastics; in the case of computers, we add a course in programming. Rather, what is important is that we solve the question of relationships of one course to another and to life. The basic concepts and principles that tie the cultural universals into living relationships must be found. No one has ever taken the challenge that DeVore gave us several years ago. Today we must accept the challenge—if only in small segments. It must be done to insure the integration of knowledge.

10. Industrial arts should revive the roving professor, much as this country used the itinerant teacher and minister in the colonial days of the 1700's. Several colleges or universities or both should band together for the benefit of their students. Roving specialists may come in for two or three days, a week or three, to stir up and ignite new fires for learning. It is a myth to think that we will be able to switch from external learning to internal learning overnight, but this is another part of the complete reversals that have to be accomplished in education.

CHALLENGES

In addition to the considerations just enumerated, I have three other matters to discuss. These three items take the form of challenges for survival in obvious ways. These challenges are made in good faith from one member of the Council to all other members fully assembled here today.

First, several years have gone by since Paul DeVore confronted us with a challenge that everyone seemed to dodge. That challenge had to do with a taxonomy of technology, a knowledge structure that would relate the various segments and facets of any part of technology to all other parts of technology and to man in his quest for understanding.

These patterns and cycles of the various segments of technology fit together and form the basis for action in the environmental crisis as in any other activity. These patterns can only be fully understood when they are joined by other designs and complete a loop in the system that I call integrated knowledge—education.

Therefore, I challenge each member of the ACIATE, assembled here today, to begin to study some small segment of technology to find all the basic concepts and underlying principles that tie that segment of technology with many other similar segments. When all these segments, including all the various concepts and principles, can be fit together to form the cultural universals of which DeVore spoke, then we can have true integration of knowledge.

These connections are more important than anyone ever thought. An example might be DDT. Inter-connections are critically important in education and must be constantly stressed for maximum effectiveness. When this inter-connectedness can one day be achieved, our form of education will indeed be general education for all. I sincerely hope that the members of the Council will lead the way for industrial arts to achieve this worthy goal.

Second, I challenge the executive officers of this organization to organize, charter or appoint a committee, a commission, or even a separate council on the future.

Such a commission could project today's trends into the future 10, 20, and even 30 years and then by active debate could define logical educational responses to these trends. We must forsake objectives that are grounded in the past, that appreciate only what was and is, and look to the future for what could and should be. Thus, we can yet produce a holding action and some guidelines for the youth of today to rebuild the world. These guidelines should be ideals that they suspect we have lost. Only when we have fashioned a finer and more authentic vision will they build a cathedral rather than a drug commune.

Third, I challenge each member of the council to choose an individual problem, similar to one that we would desire our graduate students to commit themselves to, that has techno/social significance. By this I mean a problem that has social significance and a technological base or is caused by technology and has implications for man. Hopefully, we would choose an adequately delineated problem where we can use our knowledge, techniques, ingenuity, and expertise to solve it. Thus, many small steps by the council members can lead to a leap for mankind.

As an example, we might choose some method of recycling waste—not for the benefit of industry, but for the benefit of mankind. I am no longer a believer that industrial arts exists for the benefit of industry or that industry should be the model for everything that we do. Let us begin to think of industrial arts as a curriculum for mankind where we use all of technology as a base and help man to live a better life. I no longer think that we can leave out of our teaching the inter-connections between such areas as agriculture, medicine, chemistry, business, and a whole host of other segments of technology which are, by their very nature, interrelated to many of the basic concepts and principles that we have been teaching in industrial arts. I believe that we have been doing a disservice to our students by confining our approach to selected narrow industries. Anything that is connected with technology is fair game. The problem is that we have not achieved the deciphering of the code of technology which is the taxonomy. Recycling by industry is just one of many alternatives that we should be able to choose from in averting a pollution demise. Just as René DuBos, Nobel prize-winning scientist from Rockefeller University, predicted a few weeks ago that the "Green Revolution" would fail, I predict that industrial recycling will fail. Dr. DuBos' prediction was made because there were no alternatives from which to choose a solution to the food problem. Just one solution was advanced. All the eggs were placed in one basket. I believe that we need many alternatives to pollution control. We need alternatives that will get more people involved. We must not rely on industry alone.

I therefore throw down the gauntlet and challenge the group of you to pick a project and report on it in 1972 at the Texas convention. In the meantime, you can become an expert and an example for your students. You can show them by example that you really care, that in your own way you are doing something, that you are involved, that you are committed. If everyone of us will do just this little bit, then as a whole we can begin to make a dent in the problem. Let us become part of the solution instead of part of the problem.

My challenge extends to the point that we work at our projects until it hurts our pride, our conscience, our attitude. I must ask this question, "How can you face your students on the subject of ecology, the environment, and the future unless you can show them what you are doing?" One of the best teaching methods is by example. In industrial arts we demonstrate. We are action-oriented. We live by doing.

What are you doing? Let us do something.

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Industry: Social Responsibility and Educational Involvement

John F. Silver

The topic of this paper may imply to some of you that I am going to talk about industry's immediate and much-discussed chore of repairing the ravages that have been made upon our physical environment. It is my belief that unless another war interferes, this is the sort of problem that our industry needs at this particular time. If we did not have this problem, we would probably have to create one of similar magnitude to absorb the reactive energy stored in our technological capacity as we cool off our defense hardware economy.

With your indulgence, I should like to explore with you what I believe to be a more basic relationship between industry and education. It is concerned with social unrest as evidenced by demonstrations and intense emotional criticism by our youth which, believe it or not, I generally applaud. There is, however, one apparently pathological symptom that seriously concerns me. This is the quite bitter, but sincere, disenchantment that our youth seem to have for the ideals and formulae for achieving those ideals held sacred by their forefathers.

Youth should be the time of enchantment. If the chances today's youth foresee for attaining happiness is less than my generation foresaw when we entered adulthood during the depth of the depression, there must be something seriously wrong with what they see or how they see.

This disenchantment probably results from the teaching of certain social scientists who imply that our social problems are caused by a technologically-oriented society pursuing technological accomplishments for their own sake and that the answer is to turn off the technology and become more humanistic. As a citizen, a parent, and, I hope, a human being, I, too, sense and feel the increase in societal stress as we measure our increase in affluence in terms of increased gross national product. As a scientist and engineer, I question the simplistic cause and effect relationships accepted by our youth. Particularly, I cannot accept the conclusions that disenchant them to the position of seeking escape from the establishment in all ways possible, including the use of drugs and irremediably injurious other habits.

Social problems belong to that family of problems for which there is no straightforward solution, and it isn't just because people are people.

Problem solving, in general, has to do with the consideration of a stimulus or stimuli, operating upon a network, machine, a complex, which elicits a response.

If we are given the stimulus and the characteristics of the intervening complex, we can solve for the response. This process is called analysis and is the most straightforward type of problem-solving, yielding the most specific answers.

Given the stimulus and the characteristics desired in the response, we design the complex to effect this response and only this response. This process is called synthesis. The answers obtained are generally not unique, and comparing one answer with another requires judgment, resulting in the possibility of intellectually sound difference of opinion. This type of problem is solved by engineers, as contrasted to problems of analysis generally pursued by the scientist.

Finally, we come to the type of problem for which the response and general characteristics of the complex are known, and the requirement is to determine the stimulus or stimuli leading to the response. There is no universally accepted name for this process, nor is there a straightforward means of solution. This is the type of problem faced by the doctor and the business manager. Effective solutions require a clinical or iterative approach, and this type of activity is more properly called a practice than a science. Most of us agree that the wise doctor places his patient in a hospital, where the results of his clinical probing can be professionally observed under optimally controlled conditions.

Professional observation of response under controlled stimuli and environment is much more difficult for the business manager, and even more so for the student or scholar of the social sciences. However, handicaps notwithstanding, objective observation by highly trained and dedicated psychologists, anthropologists, sociologists, and economists have been prolifically recorded. The conclusions reached are often contradictory and, at best, far short of the mathematician's definition of elegant.

We believe that man is most significantly different from all other animals because he can remember, associate, conceptualize, and communicate experiences. He has limited, if any, purely instinctive behavior and attempts to change his environment to suit his need, instead of genetically adjusting to his environment. He does this by his power of reasoning and a well-developed thumb.

However, like other animals, his complicated nervous system breaks down under frustration, causing responses in such varying and extreme degrees as escape, combat, homocide, and suicide. We diligently search for a wider, if not deeper, understanding of the individual effects and tolerances of frustration and that somehow related characteristic called motivation.

What can we say about the artistic or subjective view of societal conflict? The artist reacts and then synthesizes his message as a result of the stimuli acting upon his feelings, as well as his intellect, in the hope of obtaining a sympathetic response from his audience. Every generation has had its poets, bards, and graphic artists. As a young man, I sold my tenor banjo to buy a slide rule. Today, I would not be surprised to hear that some economically affluent student traded his computer for a twelve-string guitar; nor would I necessarily disapprove. If the statement I recently saw on the bulletin board in my daughter's college dorm was intended to get through to some of us overly objective individuals, I believe it succeeded. The message was: "The heart has eyes that the brain cannot see."

But we know that the artist is allowed artistic license. Poetic and rhythmically beautiful are those words written by Thomas Jefferson:

> "We hold these truths to be self-evident: that all men are created equal; that they are endowed by their creator with certain inalienable rights; that among these are life, liberty, and the pursuit of happiness."

Were they not more than merely the poetry of the times? Can it not be shown that they are profoundly basic and when understood provide continued navigational certitude for the progress of civilization approaching that which Newton's laws of motion insured for our space endeavors?

What is the system of organized thought underlying both the preamble to our constitution and Newton's laws of motion? I suggest that it is philosophy. In the broad simple sense, philosophy deals with learning through logic and reason, and includes both physical and human behavior.

But, says modern youth, human behavior, the mores of our society, are constantly changing. We are not constrained by natural, but manmade laws, laws made by someone else to constrain us. We should be allowed to establish our laws of navigation through life, not required to use your old maps.

I am glad for the sake of the astronauts and their families that our space scientists did not take that attitude. We must critically review the philosophical concept of our founding fathers to see if our later knowledge confirms and supports these original concepts. We need to know if they are still viable and challenging or whether youth should adopt a new philosophy, a new system, new means of implementation, or both.

The writers of our Declaration were in the main very well educated men, although they had to obtain their education from what, judged by today's standards, would be very limited resource material. Thomas Jefferson, in addition to being influenced by John Locke and other current English writers, studied the teachings of the golden age of Greece. There the foremost success had been attained in recognizing the desirability and even the short-term attainability of a working democratic form of government. He knew that the solution to the problems of immediate concern, those of life and liberty, would be important only if they could indeed provide for the pursuit of a life of happiness. Finally, he knew not only how to pursue happiness, but also that an improper interpretation of happiness would result in the same destruction of our democracy that overcame the Grecian experiment.

Dr. Mortimer J. Adler admits in "The Time of Our Lives" that his original intent was to show the current relevance of Aristotle's Nichomachaen Ethics by making those moral insights which he has gleaned over his years of teaching classical philosophy more easily understood by today's students. However, he soon realized that a "common sense" re-examination of this classical, but commonsense, philosophy was needed. The level of logical rigor must be acceptable not only by men of common sense but also those of "uncommon sense," i.e., the scholars dedicated to more recent and perhaps more currently relevant schools of philosophy.

Although I do not profess to qualify as a professional judge of this work, it does make sense to me as an engineer, a production manager, a business executive, a college instructor, an amateur student of the classics, and a continuing scholar of logical reasoning, critically concerned with mankind's physical environment and even more concerned, although more puzzled, with his human environment. Dr. Adler's book was more instrumental in helping me grasp the greatness of the "center of vision" of Jefferson and Franklin than any of the numerous biographies I have read.

A complete review of Dr. Adler's "The Time of Our Lives—The Ethics of Common Sense" is surely beyond the pale of this paper. However, the professional support this book gives my own personal philosophy suggests a thesis purposefully exaggerated here for the sake of emphasis.

Education and industry have common, but complementary, roles in re-enchanting our youth with the American dream of a happy life for all. If, for some reason, we were forced to reduce the free secondary school to one class and one teacher, a logical choice might be an industrial arts class taught by a skilled technologist who had majored in philosophy.

The task, I suggest, would be to help the student reach adulthood with a realistic understanding of the basic concepts of life, liberty, and the pursuit of happiness, an appreciation of the accomplishments as well as the failures of his forefathers in attaining those goals. Most importantly, as a result of the technological advancement demonstrable in this shop, for the first time in the history of mankind these goals are beginning to be realistically attainable.

The walls and corners of this shop would be filled with classical as well as modern pieces of art. Poetry and the strains of Beethoven and the other greats of our musical heritage would receive their fair share of time on the high-fidelity public address system.

On one side of this shop would be the cafeteria, gymnasium, and a medical examination room. (The best chances of reducing early heart failure are when you are a teenager.) The other sides of the room would open into reading rooms, lecture halls, and modern computerized libraries with quick access and rapid scan capability. The librarians would be selected for a broad knowledge of how to use the library, equally as important as their specialized field of knowledge. In fact, it would seem desirable that they be continuing scholars pursuing their chosen areas of specialization. They would hesitate to editorialize upon the teachings of others until they had produced essays and books judged by their peers to be a significant contribution to the knowledge previously accepted and available in their field.

All students who entered our hypothetical academy would have had a good elementary education in not only the basic skills, but also basic disciplines for continued learning. How much beyond reading, writing, and basic arithmetic is required is not a subject for consideration here. Not only the basic minimum skills for learning, but the minimum disciplinary habits required for continued study should be taught. These would be effectively conveyed by teacher, parent, and where necessary, the welfare worker, no matter how difficult, time-consuming, costly, or otherwise impossible the task may seem to be, before the youth reaches puberty and enters the secondary schools.

How do we expect our students in this system to work more effectively and most efficiently learn what it is in their best interests to learn at this time in their lives?

What to learn will be a set of goals or navigational standards for obtaining a good and happy life logically proven to be best for his own personal interests. Further, like the laws of gravitation, these goals are universal and common to the best interests of all of his fellow men.

That how to learn is inseparable from what is only common sense to most of us as we enter the later years of our life. As we all know, this is not so with youth. His goals, for the most part short range, constitute one area of selection. How he goes about obtaining them is another separate consideration of alternatives. Adults who "cop out" under the pretext that youth will have to learn by experience how to generate a good and happy life for themselves are not as wise as most other species of the animal kingdom. These teach their offspring how to make use of their instinctive knowledge. The offspring of mankind come into this world with a minimum of instinctive capability, yet are forced to make a maximum number of decisions, almost all of which have some irretractable cululative effect upon their chances of attaining ultimate happiness.

Goals as well as methods must, therefore, be taught. It will be the job of our academy to make certain that this is the primary subject, and all other subject material is in support of this over-all objective.

Now we come to the task of trying to sum up this concept of "Pursuit of Happiness" as a normative and commonsense ultimate objective. In itself, it is as logical and inspirational today as Mr. Jefferson recognized it to be when he insisted it be not only desirable but a necessary condition for a free and democratic society.

Paraphrasing Thomas Jefferson and relying directly on Dr. Adler's relatively concise summation of Aristotle's "Center of Vision" which we believe, at least in spirit, to have been Mr. Jefferson's center of vision, we can say we hold these truths to be undeniable but not necessarily self-evident for all of mankind:

1. That man as a species is uniquely aware of time, the moment of yesterday, the transcience of today, the apprehension of tomorrow, and the knowledge that his life on this earth is limited to some finite period of time.

2. That this life is divided time-wise into only five basic categories of activity. These are:

a. Health or hygienic time requirement, including sleep, eating, exercise, illness, etc.
b. Play, amusement, recreation engaged in only for the pleasures that are intrinsic to the activity itself.
c. Subsistence work, earning a livelihood.
d. Idling, doing nothing.
e. Leisure, work of personal growth or self-improvement, but definitely work as evidenced by accomplishment—not play or idling.

3. That generating a happy life results from the prudent and appropriate division of one's time between these five categories.

4. That the attainment of goods is basically a means of satisfying desire—at base all goods are desirable and, equally, all desire is good. That this is a natural truth and one of the basic laws of animal nature.

But for this truth to work for mankind, it must be understood that he does not have Nature's protective or guiding instincts. Therefore, he must be taught, or learn by experience, which are real goods, satisfying the needs of a good life, and which are only apparent goods. As Socrates repeatedly observed, no (well) man seeks that which he deems harmful or disadvantageous to himself. However, unfortunately, those goods which he deems good for himself may not so be, and are, therefore, only apparently real goods.

Once it is admitted that there are real goods common to the needs of all men, based solely upon the nature of man as a member of his species, the conclusion so derived now becomes an ethical or moral philosophy, both teleological and at the same time deontological, but not dogmatically so. It is a philosophy supporting a plan for a paramount end objective, and therefore teleological, since it is best for man for no other assumed reason than that he is a man. It does impose a moral responsibility upon each man not only to follow the plan himself, but to insist that he and the institutions of his community make it possible for others to support the same plan, and so assumes deontological proportions. However, it does not assume validity for moral "oughts" or "ought nots" beyond those that may be supported from the basic concept that man, both as an individual and a society, ought to seek a good and happy life for himself during his lifetime on this earth. It is, therefore, not a constraining dogma.

The whole good life so defined requires seven classes or categories of goods. These are:

1. Goods of the body—health, vigor, and the pleasures of the senses.

2. Goods of the mind—knowledge, understanding, prudence, together with such goods as skills of inquiry, critical judgment, and the arts of creative production.

3. Goods of character—such aspects of moral virtue as temperance and fortitude, together with justice in relation to the rights of others and the goods of the community.

4. Goods of personal association—family friends and personal loves.

5. Political goods—domestic tranquility; civil and external peace; political liberty under constitutional government, together with the protection of individual freedom by the prevention of violence, aggression, coercion, or intimidation.

6. Economic goods—a decent supply of the means of subsistence, living and working conditions conducive to health, medical care, opportunities for access to the pleasures of the senses, play, and aesthetics, opportunities for access to the goods of the mind through education facilities in youth and adult life, and enough time free from subsistence work to enjoy these opportunities.

7. Social goods—equality of status, opportunity, and of treatment of all matters affecting human dignity, the need and place for charity.

The first four classes of goods depend almost entirely upon the inner or private determination of the individual. However, the quality of these goods can be significantly altered by the student's environment and, in particular, the character and quality of the schools available to the youth during his formative years. During these years, the individual must realistically evaluate himself, not in terms of what his family profess to think of him, but in terms of how he measures up to his peers. It is my belief that the established secondary school structure provides not only too few, but too narrow and artificial modes of activity in which to make this evaluation. The youth who is unhappy with his ranking in the classroom, the athletic field, or such extracurricular activities as music, drama, debate, etc., attempts to compensate by being recognized in some spectacular fashion in social activities. In so doing, he or she may become involved in the use of alcohol or drugs and then seek escape through excessive use, because of a feeling of failure in all areas of competition.

It must be almost useless to realistically consider youth's acquisition of the goods of character, such aspects of moral virtue as temperance, fortitude, and justice in relation to the rights of others, until the individual can find a peer-respecting image of himself that does not conflict too greatly with that of his own desire.

An enlargement of shop or laboratory type of activity, covering as many as possible of later life modes, should provide a better opportunity for each individual to evaluate his personal worth at the highest possible level. He could proceed from there to build a character of high moral strength, properly tempered with a compassionate understanding of the human rights and weaknesses of his fellow beings.

A closer working relationship between secondary schools and the home is needed to insure as far as possible that the goods of personal association are not only not denied, but made most abundantly available. The products made in shop and recipes learned in domestic science generate paths of mutual interest between home and school more effectively than the semester grade card.

Perhaps the most important idea to convey to our students about these four categories of goods is that although they are consumable and must be continuously supplied throughout one's life, both quantity and quality have such a cumulative effect that the choices made each day affect the choices left open for selection later. Building a good life depends largely upon one's ability to make the proper moral choice of what is expedient in the short run, as against what will be best in the long run. Obviously, to make such decisions wisely requires that the individual understand and accept the requirements for a good and happy life as early as possible.

The goods of political life are those goods which we expect to be supplied by our state or national government. While the type and quantity of these goods must necessarily change as civilization evolves, both at home and abroad, the changes required can be brought into sharp enough focus to recommend action for change only if three basic considerations are clearly understood:

1. The center of vision or genius of our form of government as conceived by our founding fathers and zealously perpetuated by our forefathers.

2. A philosophical, but common sense, understanding of what is meant by "life, liberty, and the pursuit of happiness."

3. What the basic considerations are that are required for the good life and how each can best be obtained without jeopardizing the supply of the others.

Our youth will be voting at age 18. International and national issues are complex, and the political smog is thicker, by far, than all other forms of pollution. Our secondary school teachers may be in a position similar to the British fighter plane pilots about whom Churchill said, "Never have the lives of so many depended upon the lives of so few." We can only hope that all parents will recognize their individual responsibilities in helping their youth to reach the maturity and wisdom desired for this new responsibility.

Finally, we come to economic and social goods. These two goods are considered together because it is in the poor distribution of economic goods that we generate a genuine scarcity of social goods, particularly those dealing with the enhancement of human dignity. Further, technological advancement can, and in many cases apparently has, aggravated this situation. Quite probably this fact, more than any other, has generated today's state of disenchantment with the so-called establishment.

There are here, I believe, four major areas of consideration:

1. Human dignity is lost for those who cannot obtain the necessary minimums of quantity and quality of the other six classes of goods, those of body, mind, character, personal association, political, and economic. Regardless of who or what is to blame, this condition reflects lack of preparedness more than lack of opportunity to exchange one's services for a fair return.

2. The great majority of us increasingly suffer daily indignities on the job or in our transactions for other classes of goods in the community as a result of the "system." We are told even by the lowest-ranking clerk that it is beyond the reach of our voice, vote, or fist, leaving us frustrated and disenchanted with what we are led to believe is the result of technological advancement.

3. Thirdly, there is the area of what might be called physical entrapment. The pollution of our physical environment is but one, although I must admit a very important example of these. Others are the indignities, if not genuine hazards, that could result if two of Consolidated Edison's major power generators failed simultaneously, if all three

lanes of traffic, instead of only two, became blocked simultaneously during the "rush hour," the over-crowding of airports, etc.

4. Finally, there is the frustration and insult to human dignity resulting from short-sighted and expedient decisions made at the national level. These include not only the risk of life in an ill-advised war, but such major disruptions of normal activity as result from governments building up large complexes of specialized skills to supply specialized equipment and then abruptly cancelling all contracts, leaving those involved literally stranded in their pursuit of a happy and good life.

The one general fault common to all of the above situations, I believe, is bureaucracy of one form or another. Bureaucracy exists when the power of command stems from the hierarchical authority of an arbitrary organization structured to defend and perpetuate itself. Since it is a natural or expected fault in the behavior of organized groups, it is, of course, not new. The normal correction of this fault in a free society is brought about by an organization and system based upon real authority. This is one which stems from knowledge and the ability to use it, as recognized by peers who are also generally knowledgeable, taking over because bureaucracy cannot compete with the natural improved performance of real authority.

Major decisions in the political, educational, economic, and social fields cannot be made wisely in a society of high technological involvement unless the decision maker is knowledgeable in the truths of mankind's needs and in the truths of the technology expected to supply them. If such is the case, three major changes in attitude must occur:

1. The political constituency and the corporation stockholder must select leaders for organizations involved in the supply of educational, political, economical, and social goods who have the prerequisite technological knowledge and strength of moral character to recognize and support the difference between hierarchical and real authority in the organizations under their command.

2. Those individuals endowed with special skills and an understanding of our advanced technology should accept, as a moral obligation, the responsibility for understanding human needs sufficiently well to qualify for such positions of leadership.

3. All consumers of the essential seven goods required for the good life should be made technologically competent to make critical judgments, not only for the selection and integrity of the product, but of the organization responsible for the distribution and service of the product for maximum enhancement of human dignity.

This, I believe, provides the most logical approach to the new consciousness sought by Charles Reich in his "Greening of America."

Youth and its professorial advisors have been sharply critical of the bureaucratic attitudes that have evolved in large corporations. I must confess that Mr. Reich is mostly correct in his accusation that there is very little, if any, difference between the hierarchical bureaucracy of the large so-called free enterprise corporation and the tax-supported institution.

The United States has gained its position of leadership because our forefathers recognized the importance of placing the freedom of the individual above all institutional hierarchical constraints. This basic concept applied to both political and economic livelihood. Although there may be room for argument as to America's leadership in pure scientific research, there is evidence that our support of a competitive free enterprise climate has provided leadership in the application of scientific principles to the everyday use of mankind. This has generated a culture of accomplishment and generous (if not always the most gracious) living that is envied by all other nations.

Unfortunately, during the past 75 to 100 years, many of the enterprises conceived and initiated by such pioneers as George Westinghouse, Cyrus McCormick, George Eastman, Henry Ford, Louis Chevrolet, Alexander Graham Bell, Thomas Edison, and many, many others must now be managed by so-called professional managers. The operations are so large that too often centralized leadership is attempted by reducing all activity to the common denominator of dollars, merely exercising accounting control. Such an approach naturally tends to lead to a philosophy where optimization of profits or return on investment in the short run becomes the major objective, rather than one of the prerequisites to long-term growth. Back in the early days at General Motors, an accounting firm advised Mr. Alfred Sloan to phase out the Chevrolet Division because this division had made a poor showing against its giant competitor, the Ford Motor Company, in this particular year.

One of the successful entrepreneurs in the radio industry is credited with summing up the situation by saying, "All of the really important accomplishments of mankind were done just for the hell of it." Perhaps Charles Burnham, the creative architect largely responsible for Chicago's beautiful lake front planning, chose words more useful to the teacher when he said, "Make no small plans, for they fail to stir the souls of men."

However it is expressed, the message seems clear to me. Our large institutions, whether government-conceived or free enterprise, with their built-in potential for efficiency and capability of handling large-scale tasks, demand better prepared leadership. To be effective, this leadership requires not only the discriminating support or rejection of news media editorials but, most important of all, better informed consumers and constituents. In this way, our nation can reap the harvest of goods available for a good and happy life, which the combination of our founding philosophical concept and far-reaching technological enterprise has made possible.

The answer is not in choosing between an educational and operating philosophy of humanities on one hand and technology on the other. Rather, greater accomplishment in both fields is needed if America is to lead the world in the wise and sensible utilization of technology for the enhancement of human dignity and the general benefit of all humanity.

Of course, our shop-centered academy of learning is, at least for the present, a concept rather than a reality. But it must, I believe, be recognized as a very important concept. Lawyers seeking a political career must learn from Ralph Nader's experience. In addition to their knowledge of law, they cannot avoid the duty of becoming better informed as to the technical state of affairs if they are to become ombudsmen in the deployment of Federal funds for technical endeavor, educational support, and laws preserving safety and product integrity.

The division of funds and support between tax-supported vocational and liberal arts secondary schools can do great harm to future generations if there is not a firm conviction that the two activities must be complementary. One does not eliminate the need for the other, but rather emphasizes greater need for the other.

Our college campuses must find a way to bridge the gap between the technical and professional schools and the humanities. Schools should be forbidden to graduate students with so-called Business Management degrees and/or Education Administration degrees who do not have prerequisite higher level degrees in some recognized area of subject specialization plus a prerequisite number of years of real-world experience in their chosen field.

The development of that sixth sense required for true leadership can be abetted and aided by formal education but, unfortunately, it can also be squelched, leaving the graduate with a mistaken sense of capability which he zealously protests by support of hierarchy and inflexible systems. The impersonal considerations resulting from such bureaucracy and systemization, not technology, per se, is responsible for the scarcity of the enhancement of human dignity.

Industry's greatest challenge is to generate a means of providing more stable employment for all without losing the motivation and efficiency of the competitive free enterprise system. One of the greatest indignities to man is to be unable to find employment. Further violent swings in budgets for schools and other state commitments result from the uncertainty of economic cycles. This, as we all know, is an extremely complex problem and one for which there is, as yet, no tried and proven answer. Still, we have made progress and will continue to do so through a lasting and united effort.

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Space Age Technology: Relevance for Industrial Arts

William E. Brown

Will the human species survive? Perhaps this statement is a gesture of optimism. There are some authorities who foresee a dead planet, not laid to waste by thermonuclear war but by famine, thirst, fouled air, over-population, and ignorance of man's technological world.

Humanists who care about the state of the Homo Sapiens know that if something does ultimately destroy us, it will be because man chose to misuse technology instead of employing it wisely. If man's survival is endangered by technological advancement, then there is little doubt that his survival will be dependent upon technology. Much of the problem will be technological. The major job of solving that problem must be entrusted to men and women capable of dealing professionally with it—the scientists, the engineers, and the technical educators.

Historically, the men who have shaped this country—the men who have directed it, governed it, and handled its political, social, educational, and financial affairs—have been men who were trained as lawyers, businessmen, and entrepreneurs. These leaders had seldom been trained as scientists, engineers, or technical educators. In fact, their insight into the technological world has often been much less than what the technologist knew of the liberal arts, humanities, and social sciences.

The educational optimist who can see far enough into his "crystal ball" of the future—a disquieting, almost frightening future—knows t at the kind of leadership needed must include not only scientists, engineers, and technical educators but a population well informed about technology and technology's effects on man.

Man's technological developments in this century have advanced far beyond his wildest dreams. In this century man has seen the machine age, the atomic age, the computer age, and now the space age, including both outer space and inner space. This represents a greater compilation of technical knowledge in one man's life span than during the total history of man. From World War II to the sixties, technical knowledge doubled every decade; now experts tell us it doubles every seven years.

How has technology affected human resources? Medical scientists wanted to help the human being outlive his physical problems—biomedical engineers came up with such creations as the pacemaker to help human hearts; new ideas and products have improved man's diet; there is a reduction in the toll of viral diseases; hearts and kidneys are repaired; insect plagues are under control.

What are the results? A greater percentage of babies born now live, more people are surviving childhood diseases, and people are living to older ages. This partially accounts for the fact that our present world population includes over 1/4 of all human beings that have lived on this earth. Over-population or, as some ecologists refer to the problem, "people pollution" is a major problem threatening man's survival.

Man's total life style has been drastically affected by technology: where he lives, how he lives, what he eats, what he wears, how he entertains, and the size of his family—just to mention a few. His career pattern is no longer a sterile, "set-for-life," regimented job choice. There are few careers that presently fit into his pattern. Technological advancements are dramatically affecting career patterns. The projection a decade ago was that individuals would change careers from 3-5 times in a lifetime; the new projection is that he will change 4-7 times in a lifetime. With this change in career planning comes a greater mobility. Now the average duration an individual lives in one location is five years. Some young executives will move 3-4 t s within a five-year period. Occupational planning is changing from a company orientation to a job-satisfaction orientation; the career planner is placing more emphasis on individual needs than on company needs.

Employment trends are going through a majo ation. A study done by Wolfbein indicates some of the following major trends of fu icance in employment: the output man-hour has increased 3% yearly, every yea ce 1945 (almost 100% increase at present); the great majority of our people are emp in providing services—nearly 60% of our work force; one out of every eight workers a professional; more and more years of education are required, not necessarily degree ucation programs but post-high school, technical school, and in-service training schools; and the median years of education for professional people is now 17 years.

With the effectiveness of automation and computerized industries, fewer people will be needed in production. Instead, they will be needed in the services industries. Already we are beginning to see and feel the demand to meet these occupational needs.

Archeologists are constantly digging up new finds which remind man that his propellant through history was the technological advancement made by the builders and the innovators. But no historian nor philosopher can determine when early man made a crucial decision which has shaped our technology to this day—the decision that nature was a hostile fortress to be captured. Nature was an enemy to be reckoned with and controlled. Perhaps that decision is implicit in all of human history since the beginning of man's continual battle against the odds of nature.

In an effort to change these odds—Man vs. Nature—out technological insights are becoming limitless. We have developed the capability of manipulating our environment as well as destroying it. This knowledge can save us or destroy us. It has also produced monumental changes in our industrial world, creating new industries and new products. A good percentage of the products you see on the market today were either unavailable or unheard of 15 years ago.

Let us take a look at new industries of the space age technology "springing up" every day as a result of the breakthrough in ultrasonic sound—ultrasonic motors, nearly 100% efficient, and ultrasonic generators are performing many new tasks for us. Have you been to your family dentist lately to have your teeth cleaned? More than likely the operation was performed by an ultrasonic device. Other areas of industry such as cement mixing, excavating, cleaning, sewage treatment, and power supplies are using applications of ultrasonic sound.

The expanding industry of miniaturization in electronics is just beginning to make itself heard. In the health field, monitoring devices are used to aid in clinical tests; miniaturized electronics have revolutionized the computer field; the electronic age of Dick Tracy is now a reality. It has made space travel possible; a new design can be developed and tested on the electronic tube before a prototype is ever made. This is just a small sampling of the advancement made in this field of miniaturization of electronics.

The American Cyanamid Company, after 10 years of research into "chemical light," recently announced that chemical light wands harnessing the type of cold light produced by the "firefly" have been developed. Packaged as clear plastic cylinders weighing less than one ounce, the wands contain two liquids separated by a glass vial. When the cylinder is bent slightly by the fingers, the vial inside breaks, allowing the liquids to mix. What is the result? Instant light. The wands' instant light is unaffected by wind and rain, and is safe in flammable environments which preclude the use of flame. Applications are as varied as the need for safety illumination. The light wands can facilitate night-time changing of flat tires on highways and the illumination of boats and life rafts. Scuba divers may illuminate their underwater exploration with the wands. Marketing to consumers for a host of safety and decorative applications will begin this fall.

Exploration into space has produced many new materials and products that are already finding their way into practical uses in your home. These include new metal compounds, new fabrics, and even new foods.

What is on the horizon for space age technology? To identify a few: the use of lasers in many ways, ranging from brain surgery to message transmission to tunnel building; self-renewing fuel cells to power vehicles or to light and heat houses for years; three-dimensional, full-color picture-phone systems; energy generation by controlled photosynthesis; nuclear power harnessed to de-salt sea water; hydroponic farming—growing food in special solutions instead of soil to increase food production for an ever-increasing world population.

Some of these new processes and products have the gaudy glee of new gadgetry. Others, however, are as much in tune with nature as the wheel or the sailing ship. Which will catch the imagination of man? Which will command our resources? How will we as technical educators respond to this space age technology?

In our being a part of "making tomorrows happen," what are we going to do as educators that will have some positive effect on the tremendous problems of conserving our human and natural resources? What of the problems of our population, transportation, our dying cities, and the ecological problems of keeping the balance of nature and technology? Will this space age generation become so dependent on machine technology that it will abandon natural beauty entirely in favor of a totally controlled environment?

How will man, a social being, adjust to this new space age technology? Will the psychological problems of adjustment to the demands of this new technical society cause him to withdraw even more into a cocoon of social dependence? Can he meet the requirements of the new employment demands of changing career patterns four to seven times in a work lifetime? Will he be psychologically prepared for retraining cycles? These are just a few of the questions that will require answers in the rising decades.

Industrial arts programs and technical education programs have a tremendous challenge in "making tomorrows happen." The "industrial archeology" programs that presently exist in many of our schools throughout the country certainly will not meet the requirements. They have not been providing for the human educational needs of the past several decades. If man is to survive as a species, then our industrial and technical education programs must be prepared to face the challenge of the world of space age technology. We cannot afford the luxury of providing hobby—avocationally-oriented—curricula.

Man has little choice about his birthright. He is going to be thrust into a highly technological world. It is the mandate of education to provide him with the best possible tools for him to exist in this complex technical society.

During the past few years we have read, seen, and heard many discussions about innovative programs in industrial education. There is no question that these programs are needed and that they are providing new curricular directions, but the sad commentary is that they were needed 30 to 50 years ago. Many of the so-called innovations are not new. They could have been integral parts of the program decades ago. For example, these popular educational cliches—production methods, experimentation and research, team teaching, elementary industrial arts, and integrated programs, to name a few—are not entirely new and innovative. Many of these concepts have been an integral part of industry and some educational programs for years.

To help prepare young men and women to understand and to live in a complex technical society is certainly going to require an industrial education curriculum with a greater scope than one that is just related to the 7th and 8th grade levels. Industrial education must be an integral part of the total educational continuum.

Let us take a look at some new points of departure in curriculum planning for industrial education that must be dealt with if we as educators expect to meet the challenge of space age technology. First, industrial education or technical education must be a total part of the educational package; it must be a part of the continuum from kindergarten through advanced education.

Second, career planning must be integrated into this total plan. According to authorities in the field of vocational guidance, career planning is a developmental process that continues from birth to death. With the projection of the number of career changes an individual will make in a lifetime, senior high school or college is too late to be introduced into the world of work. Third, there is a need for the humanization of curricula in technical education. The divorce between the humanities, social sciences, and technologies must end. One discipline cannot exist without the other; they are interdependent. Fourth, a greater emphasis must be placed on conceptualism of curriculum content—the transfer of learning concepts, not totally skill-oriented programs. Fifth, the accountability of curriculum areas should be considered. Does the curriculum meet the needs of the individual and of society? Are there voids in the program? Is the curriculum expanding to meet new technological developments? Sixth, is the total curriculum relevant to the needs of the individual, to the community, to society, and to man's technological world? Seventh, the curricula must be related to man's environment and to man's technical world—if you will, the ecological world of man. This balance is the key to man's survival.

In making tomorrows happen, will man survive his technological wonders? Industrial and technical educators have a dynamic role to play in the destiny of man.

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Technologically-Oriented Experiences in Industrial Arts

Terence Trudeau

There exist a multitude of views regarding the term technology. For example, some people perceive it as involving skills and techniques, while others view it as human activity. For this theme, technology shall be defined as a technique that is logical and the application of scientific principles to the solution of practical problems. As further explanation, the term science shall mean the search for the truth.

In some instances, the application of these scientific principles will result in direct use. In others, it may lead to the manufacture of a product. This brings us to the definition of industrial technology. Note that a small i and t are used to differentiate this term from the discipline of Industrial Technology. For this theme, industrial technology is defined as the know-how or ability of industry to develop and produce usable material goods.

SCIENTIFIC METHOD OF PROBLEM SOLVING

Throughout the various technological activities to be discussed, the scientific method of problem solving should be evident, if not always defined as such. These activities would involve several, if not all, of the following steps: the individual has identified a felt need; the problem to be attacked is stated in understandable terms; a hypothesis is formulated; the necessary and pertinent data are gathered; and the activity is concluded. It may result in a written conclusion or in the development of an object.

TECHNOLOGICAL ACTIVITIES

It is not intended that the activities being presented follow any particular existing organizational pattern. Rather, they were selected at random, are representative of a number of topic possibilities, and therefore are not intended to be inclusive.

MATERIALS PROCESSING

The first technological activity involved manufacturing. The initial task was to select a product to be manufactured utilizing specific materials and involving specific processes. In this situation, the product selected was a "tic-tac-toe" game, and the materials to be utilized were varying types of plastics.

Several decisions were involved regarding the techniques and machinery required to produce the various components. The case, composed of a top and bottom, was produced by utilizing vacuum forming techniques. The playing parts were yielded through injection molding. Final finishing included shearing, sanding, etc., with packaging in a plastic bag. The total manufacturing sequence was accomplished by university students.

All of the above involved decision-making relative to the technological aspects of materials and processing techniques. To design and execute such an activity required an on-going utilization of technological knowledge. Several sources of technological information were used. That is, the problem was stated, data were collected, and conclusions were drawn.

The second materials processing task was in the category of construction. This portion had the unique aspect of involving elementary students, and the activity was adjusted to their ability level. It might appropriately be called technology for children.

The task was to carry on several construction activities evolving around a model construction site. The initial layout was centered around an accumulation of dirt, emulating natural terrain and a natural lake. The students accomplished the necessary earth moving and re-arrangement through the use of model construction equipment. They then constructed a road, a building, and final landscaping. Much construction technology was involved on the elementary level in terms of size, nature of equipment, and operations. The elementary students' activities were directed by industrial arts majors.

POWER AND TRANSPORTATION

In an attempt to show a technological activity that is unique, we chose two transportation activities not always associated with contemporary programs.

The first technological task was the development of a small garden tractor. This was not a challenge to produce a tractor to function as a garden tool but rather to enter a tractor-pulling contest. This is a competitive event where weight pulling is the objective rather than the ability to function as a gardening device.

Consequently, the vehicle looks like a garden tractor but does not behave like one. First, the rotary combustion power plant utilized was selected after an analysis of its performance capability. Due to its excellent power-to-weight ratio, it reduced the overall weight of the tractor, yet at the same time delivered more power to the rear wheels. The selection was based upon the task to be performed and followed a detailed and comparative analysis. Other aspects of the tractor such as rear axle assembly, transmission system, etc., were also selected with this in mind. The final result was a small tractor with a large pulling capability. Throughout the design activity, objectives were met by use of the scientific method of problem solving.

Another vehicle was designed for sports car activities, such as autocross, by sports car enthusiasts. This activity included a combination design problem between industrial arts and design students on a university level.

Basically, the design included a front wheel drive vehicle utilizing existing automotive components attached to a ladder frame designed to yield maximum strength and minimum weight. Several scientific calculations produced a technologically sound chassis assembly for the purpose intended. Two proposals were produced for the body by the design students. Each design was essentially a fastback sports car style. The project, as yet unfinished, is a technological challenge indeed.

The second power and transportation activity involved the analysis of a gas turbine for the purpose of understanding and comparing its function with other shaft engines. The project was centered around a Rover industrial turbine, a water-brake dynamometer, and an array of instruments for monitoring the engine's operation. Parameters such as pressures, temperatures, component speeds, fuel/air flow rates, etc., were recorded. Calculations involving brake horsepower, torque, efficiency, and other aspects of turbine function were executed. Student understanding of this power device as a product of man's technological ability was accomplished. Its limitation and assets were logically understood. However, no product resulted as in the previous activities.

ECOLOGY

Ecology is a timely topic. The challenge in this category was to develop an internal combustion engine that would meet, or exceed, 1975 federal exhaust emission standards in both the gaseous and particulate area. This included hydrocarbons (HC), oxides of nitrogen (NO_x), carbon monoxide (CO), and particulates.

To accomplish this, such considerations as compression ratio, fuel variations, etc., were considered. Following careful analysis, liquid propane was selected as the most appropriate fuel. This fuel was then related to several engine factors such as low compression, catalytic muffler, etc. A final design resulted.

The engine was installed in a specifically prepared vehicle and entered in the 1970 "Clean Air Car Race." The vehicle included a multitude of safety features such as a special frame which would slowly collapse under, rather than into, the occupants, in the event of an accident. The total project involved several technologically oriented activities based on sound reasoning and research. The activity was conducted by college students.

AUTOMATION AND CYBERNETICS

Automation is defined as the operation of machines through the use of mechanical, electrical, and fluid control devices. Cybernetics is defined as the operation of machines through the use of control devices that closely approximate the human brain.

The combination of automation and cybernetics was geared to emulate space activities conducted by NASA. First, a rocket engine with mechanical, electrical, and pneumatic controls was selected to represent the automation aspect. A computer was selected to represent the cybernetics segment and was programmed to control several burn modes of a typical rocket space trip. These modes includes lift-off, staging, course correction, etc.

The rocket and the computer were then linked together. The computer controlled the engine as it passed through a series of burns and shutdowns that ranged from one to fifteen seconds each. Each mode represented a specific burn, as stated above. Of course, the engine did not go anywhere, but rather, simulated a moon trip totally controlled by the computer within a laboratory setting.

RESEARCH AND DEVELOPMENT

All of the previously discussed experiences involved varying degrees of research and development. However, an example of a more basic R & D task was selected for this category. Gasoline was produced from crude petroleum through the use of a simple laboratory distillation process. This process involved several steps and was slow and tedious.

When the fuel was formulated, it was then analyzed in a variable compression engine to determine its octane rating. Standard commercial fuels were used as reference fuels. Following this procedure, the laboratory-manufactured fuel was compared with commercial fuels, utilizing a small engine and dynamometer test cell. All possible variables were kept constant except fuel differences. Results were recorded and compared. Again, no useable product resulted—only useable knowledge.

CONCLUSION

All of the foregoing activities required technological comprehension and resulted in developing further technological knowledge. No activities were conducted using canned outlines. Each represented a challenge to the student or students.

The student had to identify his needs, describe the problem, project the outcome, gather the necessary materials and information, and finally, draw conclusions and/or produce a product to meet the projected objectives. All were technologically oriented. Some resulted in a product plus technological knowledge, while others resulted only in knowledge.

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Industrial Arts Teacher Education in the Age of Institutional Obsolescence

Walter S. Mietus

You and I have witnessed hostile and revolutionary behavior toward the major institutions of modern societies. Too often, over-reaction and misbehavior permeated the scene.

However, the effects caused many public institutions that perceived themselves as being unchallengeable and sacrosanct to admit reluctantly to stagnation and to digress from following obsolescent policies and practices. Many agencies worked only for their own survival instead of meeting the developing needs of the society they were to serve. The inability to change, to absorb new knowledge, to work with other agencies, to maximize personal incentive, and in general, the inability to avoid becoming obsolete has generated a maze of aggressive, ineffective contesting institutions. This precarious position can be observed within universities, colleges, and the various departments. When innovations which would better meet the goals of the institutions and the needs of the group it serves were attempted to be implemented, organized and dedicated resistance was encountered.

Reconstruction cannot be achieved by insiders of single organizations, because no single organization has the capability or the social right to involve the total into coalitions, mergers, or other collective endeavors. The task of restructuring a cluster of organizations so that all may be upgraded can be achieved, not by a frantic application of innovations, but by the application of the Normative Sponsorship Theory of Updating Organizations (Christopher Sower, 1968).

This theory includes a process of maintaining an organization in a relevant state of renewal for preventing and reversing organizational obsolescence. It deals with the diagnosing of incumbent perceptions, roles, expectations, and methods of implementing appropriate innovations with existing leadership or new leadership whenever updating requires such actions.

From this theory I extracted five major questions, and from these inferred minor sub-questions for your discussion and analysis. These should be considered in relation to industrial arts teacher education programs and departments. The object intended here is for you, as participants, to gain insight as to whether or not you are a part of a live, growing, viable organization which will survive institutional obsolescence.

1. Does your department or program produce useful input into other disciplines or outside organizations?

   a. Is there evidence of receiving requests from these agencies to use written materials, facilities, and academic talents of the department personnel?
   b. Does your staff present papers at conventions other than those of your field of specialization?
   c. Does your department function on the myth that knowledge is stable?

2. Does society at large have an image of your department as being alive and growing?

   a. Does the average taxpayer perceive the need for and value of your activities?

3. Does the press describe your organization as being updated and useful to society—one which justifies its input of finance, members, commitment, and public support?

   a. Does your program or department find itself in a position where public opinion can obliterate it, as in the case of the recent SST program?
   b. Do administrators find industrial arts too expensive and complex and tend to reduce operational budgets, as witnessed in the space cutbacks?

4. Does your organization use a maximum amount of available human energy directed toward goal achievement and a minimum amount to maintenance functions and to contesting behaviors within and between departments?

   a. Is your department consumed with competition between informal power groups?
   b. Does the department work toward goals agreed upon, or is there a dualism between theory and practice?
   c. Are staff members involved in resolving infractions of policies, rules, grading, requirements, and other artificial barriers within and between departments?
   d. Are countless hours spent in making decisions that contradict and reverse previous decisions?

5. Does your organization have the ability to attract and hold the loyalty of young and competent members?

   a. Does your department strive to develop competent functionaries by processing the student through a rigid skills-oriented curriculum?
   b. Do students have the opportunity for self-expression, and are they being guided toward personalistic and humanitarian goals?
   c. Are there signs of schizophrenic behavior such as peppering a student with the stimuli of psychological and sociological basis for industrial arts and then salting him into project producing?
   d. Do you display a zealotry and enthusiasm for your theories at the cost of repressing the self-actualization of your students, or do you allow them to study within your program without succumbing to it?
   e. The more objectively verifiable questions are: What is the retention rate of your students? How many stay in the profession? Do we lose those who were beginning to make an impact in industrial arts to leadership roles in other fields? If this is true, as I have reason to believe, we are losing our leaders and much-needed

models who could make contributions to prevent obsolescence and, perhaps, extinction.

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Teacher Education: Update

Kenneth Stough

Since this session has been planned as a discussion meeting, I am not here to present my solutions to in-service teacher education problems. Rather, I hope to help us more clearly understand the status quo and raise some questions which might direct the thinking of the discussion groups toward fruitful conclusions.

In the September issue of Man/Society/Technology, Kabakjian discussed our quickness to suggest change but our slowness to adopt change. In in-service teacher education, this idea might be carried one step further. We are quick to suggest change, but so slow or remiss in assisting the in-service teachers in bringing to fruition desirable changes in classroom procedures and content.

I suggest the following analogy is appropriate in depicting our record. Let us assume that we are not airplane pilots and know very little, if anything, about flying an airplane. As any one of us drive down a crowded street waiting for three changes of the light to make it through each intersection, a stranger stepped up to the car and said, "Park this outdated vehicle and fly a plane. It is quicker, safer, less expensive, and causes less pollution." To say the least, we would consider this person very obnoxious even though we agree that flying is quicker, safer, etc. The stranger doesn't realize that we don't know how to operate in that mode of transportation. In some ways, we in industrial arts teacher education are as naive as the stranger. There are many teachers (let's say five or more years removed from teacher education) who are teaching as they were taught because this is what they understand. We condemn them for this, but they are not about to leave their automobiles and take off in airplanes without flying instructions. The results would be disastrous.

If you agree with the analogy, a difficult challenge must follow. What have we done and what might we do to equip the in-service teacher to better operate in the mode of instruction that we have been advocating?

Let's take a hard look at ourselves in at least four areas.

1. Publications—Magazines and Journals

Do our writings emphasize theoretical bases for industrial arts, justification for industrial arts in education, and communications between professors; or do our writings emphasize how an in-service teacher can successfully teach industrial arts using our newer approaches and content?

If our articles explained how to solve the major logistics problems when planning a newer approach such as line production or student enterprises, would industrial arts become stereotyped; or might such articles enthusiastically written entice in-service teachers to try such methods?

2. Accessibility or Availability

Who is responsible for translating educational philosophies into practical curriculum content?

Do we have built into our teacher education assignments the availability of help ... teacher groups, county group meetings, in-service workshops, and individual teachers so that , might assist or demonstrate the "how" and "why" of a new approach; or do we expect our ideas to be transferred into action with no assistance from us?

Can we afford such help, or can we afford not to provide such help? We all realize, I am sure, that the only things which work automatically are those which were designed to work automatically, and simple solutions usually apply only to simple problems.

3. Further Formal Education

What incentives are there for graduate study unless one wishes to leave the public school classroom?

How much of our graduate programs are applicable to the "nuts and bolts" problems of the public school teacher?

Is higher education for a select few or for those who can most benefit from further education? Can it accommodate both groups?

Do our programs allow for individual differences and competencies; or do we expect all teachers to adopt a rigid approach and all look alike? Do we educate for change?

Would you be inspired or embarrassed with a master's equivalent?

4. Lack of Contact or Communication

What percent of all industrial arts teachers attend the AIAA convention and/or its affiliated meetings?

What percent of those within a state attend the state industrial arts convention?

What percent of our industrial arts teachers receive the related journals and magazines?

What percent of the teachers are reached by our present communication methods?

What is our obligation to industrial arts teachers who do not belong to the AIAA or ACIATE?

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ACIAS

American Council of Industrial Arts Supervisors

Communications

Robert R. Neely

History begins with man communicating in a primitive way. For this reason, Communications is provided for the 7th grader. It introduces the student to the means by which man has employed and developed technology to aid him in better communicating ideas and information. It places the traditional technical subjects such as drafting, printing, photography, and electronic communication in a new context. Instead of attempting to develop skills in the technical areas, this course will develop an understanding of the changes man has introduced into his capacity for communicating.

Man has taken four routes to develop the technology used in various means of communications; they are man to man, man to machine, machine to machine, and machine to man. Each of these describes in general terms a manner in which information is presently handled. These forms of communications are interrelated. Creating, encoding, storing, transmitting, receiving, decoding, interpreting, and using are a few means of communication by which the four basic routes are applied.

Industrial communications itself involves two lines of thought, communications for industry and communications as industry. Communications for industry began when man became civilized, needed to communicate, and did so in very primitive forms. These forms developed into the abilities to talk, draw, record, write, and read. Man's next step was into the era of planning and designing.

Written language and the ability to design enabled man to create and develop forms which reduced the task of recording or transmitting his thoughts. Creative, technical, and aesthetic design have led to inventions and the drawings required for the exchange of ideas necessary for planned production.

Various forms of industry require specific types of drawings, such as perspective, orthographic, pattern, machine, or schematics to supply a needed type of information. The role of communication in industry is analogous to that of research and development in a scientific laboratory. An idea is analyzed, researched, sketched, modeled, tested, approved, then drawn in detail to be passed on for manufacturing.

The second point, communications as industry, uses previously acquired information in illustrating and words to develop a graphic product. Composition and photography are two methods by which the model or graphically shown "paste-up" would be developed. Laboratory experiences would be undertaken in these areas so that with further use of materials and machines the graphic model or proof could be produced.

Photography and photogenics played a parallel role. Photography itself is an end product, and it is also a step in the technical development of communication by all contemporary methods, such as letterpress, lithography, gravure, and screen process.

Activity in photogenics was best accomplished by the screen process, as it was the simplest, cheapest, safest, and fastest that could be accomplished on a 7th-grade level with a high degree of competency.

The basic goal is to acquaint the boys and girls with the world of work. Through this form of curriculum, hundreds of occupations could be introduced. The students learn through drafting to place their ideas on paper in such a way that they can be interpreted by someone else. Principles of design, press operations, mechanical processes, and printing forms are all activities which interpret communications as an industry. A follow-through as to finishing and distribution rounds out the idea of man communicating to gain the answers to how, what, why, when, where.

Throughout, basic operational skills and processes form, creating interest and motivation. A child putting forth his individual creativity and capabilities successfully is rewarded by a sense of accomplishment. This will be a program providing opportunities for children to observe, study, and experiment with materials, tools, machines, and processes through which man has adapted his physical environment to serve his needs. We live in an industrial society dominated by technology. There is room for all, and each has a place. It is our responsibility to help the individual find his or her place.

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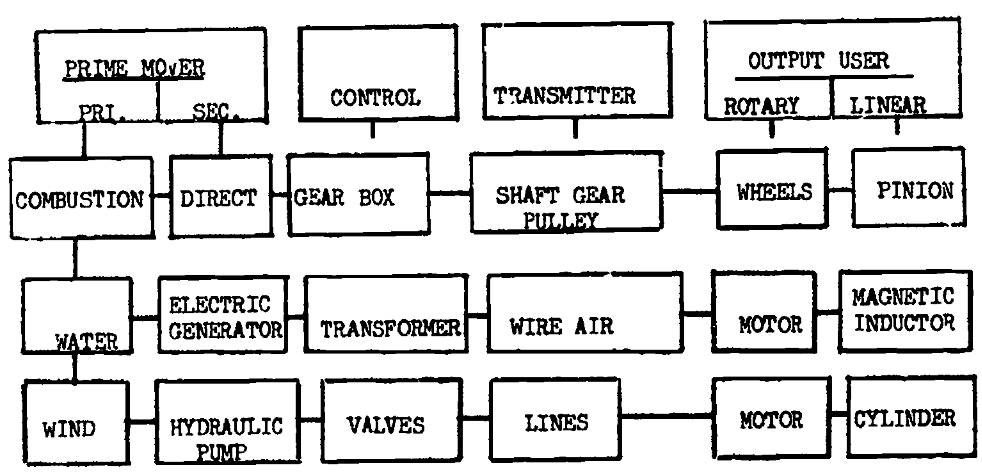
Power Technology

Robert R. Neely

In the time, now past, that the program of power technology was being piloted and refined to exactness of curriculum coverage, three questions were consistently asked. What do you teach? What do the students do? What do they learn? Simply, what the students learn is a result of what is taught combined with what they do. Generalities combined with specifics.

Close evaluation of the goals of almost any program will disclose practically the same curriculum, with the differences confined to various activities that are explored. For a class covering power technology, categorizing the curriculum in the areas of prime movers, controls, transmitters, and output users is generally considered the most logical and systematic method. The content of the prime movers is kept general in construction and operation, so as to encompass all the forms which are being utilized today. How the prime movers are used is summarized in what can be called the power train. Rather than teaching about controllers, then transmitters, then output users, the methods which man has of using power are taught in one complete unit which includes controling, transmitting, and utilization. The methods shown in the power training display are mechanical, electrical, and hydraulic.

POWER TRAIN LINE



The means by which each method is controlled, transmitted, and used is kept in a related progression, rather than trying to accomplish the same goal by covering all controls, then trying to relate them to various transmission methods, and then relating them to various types of output users. Only general concepts and understandings are taught; the specifics are left to be explored and experimented on.

This brings us to what the students do. Basically, they explore, measure, construct, evaluate, follow exact procedures, use various tools, solve problems, test, observe safe practices, identify, and demonstrate techniques in a series of experiments or explorations in each of the methods of utilizing mechanical, electrical, and hydraulic power. Money dictates the extent of the exploration. Even though there are numerous ways a lab can improvise, only so much actually can be done without requiring tools and the components that are to be used in the specific experimentation and exploration. Since the power form which is probably best utilized in mechanical transmission is internal combustion, exploring this form of energy producer can accomplish many of the goals of the course. Generalities such as the powerhead, fuel, ignition, cooling, and control can help in associating similarities in all energy producers. In electricity and hydraulics components, circuits and workable applications show basically how the methods by which power is transmitted and utilized is attained without developing specific skills or capabilities.

This, then, explains what the students learn. From the generalities they are taught through the specifics they experience, they should be aided in choosing a career or occupation closely related to their capabilities, interests, and desires by a closer association of their experiences and activities.

Throughout the program, such subjects as occupational need, requirements, training, sale practices, management, cooperation, self-discipline, conduct, and many other prevocational facts are injected in order to be as complete and practical as possible and to attempt to meet the needs of each individual.

The final success lies in the students. Their motivation and future endeavors in the world of work will assist them in their ability to find their appropriate place in society.

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Manufacturing—8th Grade

Robert C. Bills

It is my purpose here today to describe to you how an industrial arts course about manufacturing could be taught at the eighth grade level.

Many of the ideas presented here today were developed at Georgia Southern College through the efforts of 34 graduate students over the period 1960-1970. During the summers of 1969 and 1970, an EPDA Institute in Industrial Arts and Career Development directed by Dr. Donald Hackett also made significant contributions to the development of the course of study in manufacturing I will discuss here today.

This course was developed to fit into the Georgia Plan for industrial arts (see Figure 1). One can obtain a general idea of the nature and scope of this plan from this chart. Due to the shortage of time I cannot go into this plan in detail. My purpose in mentioning it is to give you a perspective, or a setting if you will, of the type of program we envision in Georgia into which this course in manufacturing will fit. A brief explanation of this plan can be found in a booklet titled Innovative Programs in Industrial Arts published by the American Vocational Association.

In describing what a course in manufacturing might be like, I will present a general outline of the course, including major lesson topics and a discussion of some of the methods and objectives of each of these lessons. Through this outline, I hope you will gain some ideas on how you might implement a course of this nature in your present curriculum or alter some of your present courses to better teach about industry through the study of manufacturing.

The purpose of this course in manufacturing is to provide students with an opportunity to acquire some basic understanding of (1) industry, its organization, tools, materials, processes, occupations, products, problems, benefits, and technology; (2) themselves in the areas of ability, aptitude, interests, and career maturity; (3) the relationship between knowledge gained about industry and knowledge of themselves; and (4) the usefulness of their relationship to industry in making educational and career plans for the future.

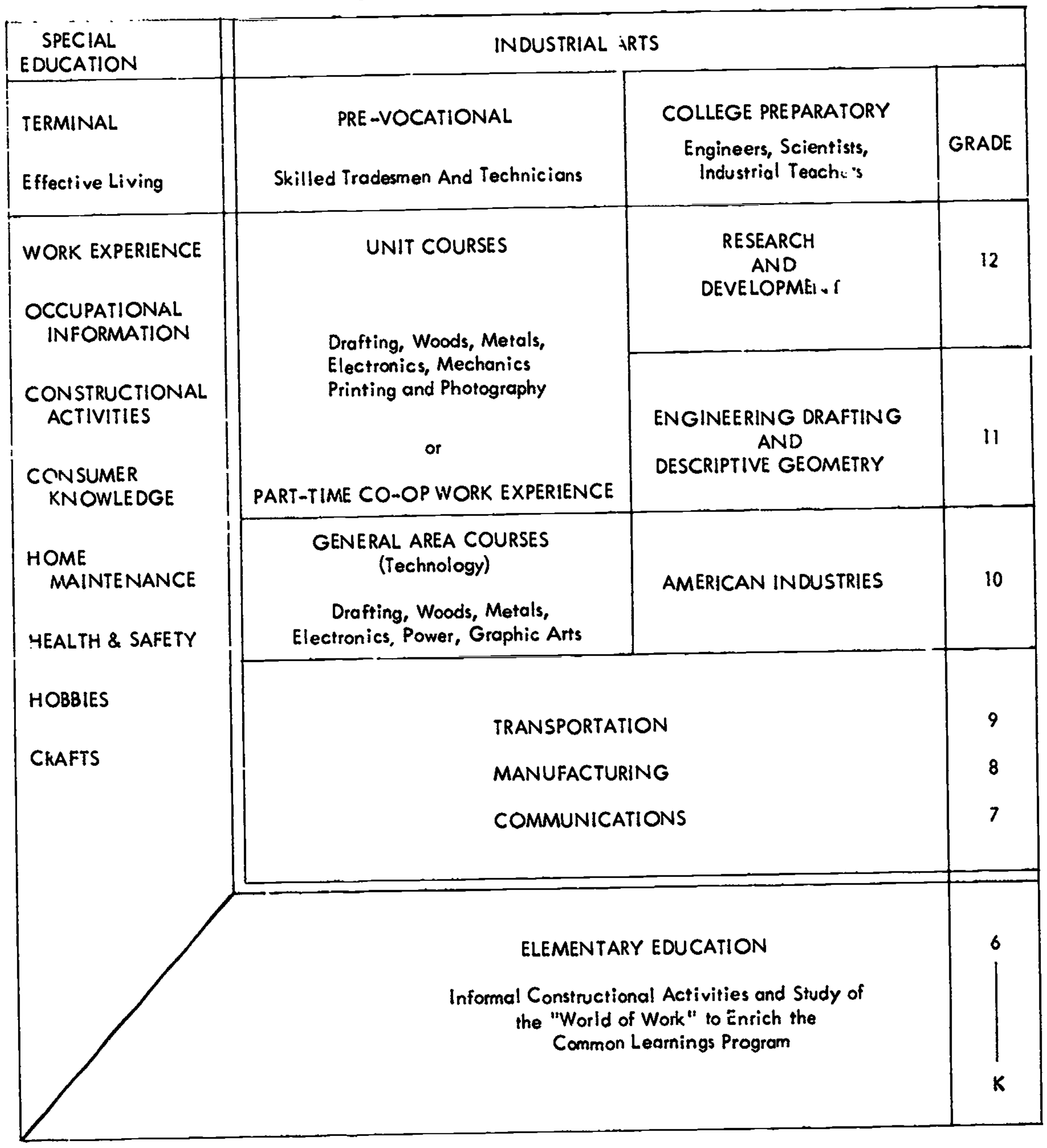
The first lesson in this course would be introductory. As in most orientation lessons, one would cover classroom formalities, a tour of the lab, etc. It would also include, however, a very real preview of manufacturing through a brief and limited mass production project to be completed in one or two days, perhaps a week at the most.

To carry off this operation in such a short period of time, the teacher must have prepared all the necessary tools, jigs, fixtures, etc., before class. All machines must be guarded to make student injury almost impossible. Of course, the product should be very limited as to the number of operations required and the skills needed to carry out these operations, all of which may be done with hand tools. This activity should help to generate interest and also satisfy the students' need to make and possess something.

To organize the students for the first project, it is suggested that you "hire" three or four students to be foremen and the remainder of the class as operators. You would then train the foremen so that they in turn can train the operators. If possible, the foremen should be trained outside of class time.

I strongly suggest that you make a trial run before letting the students start production. Also make sure that there are materials available so that students who are assigned

Figure 1. Industrial Arts in Perspective



to operations near the end of the production process, such as finishing or packaging, have a job to do till the products start reaching their stations. You might even have some partially completed projects so that they may start work along with the rest of the class.

It has been my experience that many times foremen are hard to find because they are afraid they will not get to operate the equipment as much as the people hired as operators. You may solve this problem by allowing the foremen to relieve operators or assist them where necessary. Also, letting the foremen operate the equipment while demonstrating its use helps fill their need to create something and feel that they had a real part in producing the product.

Upon completion of the product, you might conduct a class discussion about the product, its usefulness, demand, economy, construction, and possible improvement of it or the production procedures used to manufacture it.

The second major unit topic to be covered is manufacturing organization. Topics to be covered in this unit include various forms of ownership, a history of manufacturing, company organization charts, starting a company, and occupational information.

As the students will be forming a company of their own, the importance of this unit cannot be overlooked. By bringing this fact out to the class and letting their particular interest give direction as to the breadth and depth of coverage to be given the various topics, you should be able to make this a meaningful and interesting unit. By the end of this unit, the students should have a better understanding of the principles of organization used in our free enterprise system.

Once you have covered the basics of company organization, you might start guiding the students toward selecting how their own company will be organized. Decisions as to the type of ownership, departments, and major positions should be made. Students should start filling various positions in the company. Once this company is formed, you have given your class an organized base around which to function. You should be able to relate your future lessons directly to the students' company. In fact, you will find the students' need will almost demand certain lessions at various times. This is not saying that the students alone are capable of determining what in the way of lessons, etc., are needed; your strong leadership will still be absolutely necessary to make the students' company function as a valuable learning experience.

The next unit title is Research and Development. This unit will show how research and development apply to manufacturing. It will also deal with various categories of research and how it is used by industry to develop a product.

In the course of this unit, the students will be doing activities which involve designing, sketching, planning, selecting materials, measuring and laying out, cutting to rough size and exact size, assembling and fastening, finishing, etc. For this reason, during the course of this unit you will need to give lessons in these areas.

Many of you are saying this sounds like any traditional industrial arts course. This is true, but in this case the lessons will be directly related to industry when given, and the students will be applying the knowledge gained toward designing and mass producing a product, not an individual project.

This means that the information gained from these lessons will be used by different students at different times as the need arises. For this reason, as time goes by you will most likely need to review or go into more depth with various students or groups of students on some if not all of these lessons. The original major presentation of these lessons should require about three weeks.

Unit four's topic is product engineering. We will define product engineering as specifying, interpreting, and modifying for manufacture and marketing purposes the nature, performance, and quality characteristics of a product.

In this unit, students will apply what they have learned about design and drawing in an engineering problem. They will run tests for quality and performance, and eventually a factory follow-up to help overcome any manufacturing difficulties encountered by their company.

Some of the activities which the product engineering division of the students' company will be carrying out will be building a pilot model for testing to verify that the product complies with the company standards for quality, performance, reliability, manufacturability, and serviceability.

The students may also make charts and graphs to indicate the product and the system used to manufacture the product.

This application and constant use of information previously covered is, I feel, a major advantage of this type of course structure. The student not only gains new information and skills but he also learns their value and practical applications. One of the obvious advantages of practical applications is the better chance it gives the student to discover his likes and dislikes and thus it is of immeasurable value in making occupational choices later. The next unit, the patent system, dovetails with the previous one, which dealt with the development of the product. This unit will help the student to learn about the details required to get a patent and the importance of patents to the inventor, industry, and the nation.

Student activities in this lesson include preparing brief reports explaining the importance of having a new product patented and also oral reports on the operation of the patent office.

As a part of this unit, students may also investigate copyrights as they might apply to the advertising slogans and trademarks used by their company. You can once again relate back and forth between lessons and also show the students the interrelationship of various departments in a company. In this case, the relationship is between a legal department which would handle patents and copyrights and the product engineering, sales, and advertising departments.

The next unit, production, will draw together almost all of the areas covered up to

Figure 2. Production Organization

PLANT ENGINEERING	INDUSTRIAL ENGINEERING	PURCHASING	PRODUCTION PLANNING AND CONTROL	MANUFACTURING	QUALITY CONTROL
Utilities Design and Operation	Methods	Buying	Traffic	Part Manufacture	Control Methods Development
Facilities Design and Specification	Plant Layout	Purchase Expediting	Factory Receiving	Subassembly	Gage Control
Plant Equipment Control	Work Measurement	Purchase Records and Files	Factory Shipping	Final Assembly	Inspection and Testing
Maintenance	Materials Handling Study	Purchase Research	Materials Procurement	Service and Repair	Customer Complaints
	Tools, Jigs, Fixtures, and Patterns Manufacture and Repair	Salvage Sales	Operation Scheduling		Salvage
			Tool, Jig, Fixture and Gage Procurement		
			Production Instruction Distribution Dispatching		
			Production Expediting		
			Performance Report Stores Keeping Stores Control		

this date. If my personal experience is any indication, it will be one of the most popular areas or units covered. During the course of this unit, the students' company will manufacture its product. Besides holding great student interest, it is one of the most important units, as all other units either lead up to it or away from it.

Specific areas which will be covered as part of this production unit will be plant engineering, industrial engineering, purchasing, production planning and control, manufacturing, and quality control. As you can see from Figure 2, each of these areas has several topics under them which relate directly to the mechanics of actual production. If these areas are well covered before production starts, it should help to eliminate many production problems. At least, the students should be able to solve many of the ones which will come up.

It is very important that by this time the students involved in the various areas such as product engineering have their jobs up to date so that working drawings will be ready, jigs and fixtures designed and built, operators and other personnel directly involved in production will have been hired and trained, raw materials purchased, flow charts prepared, and all preparatory work for production brought up to date.

At this point you may be saying to yourself, "I simply don't have enough students to fill all the positions we are creating." As I mentioned in my discussion of the introductory manufacturing experience, it will be necessary for at least some students in management, engineering, and other areas to hold positions on the production line, not only because of a lack of students but also to help keep their interest.

At the start of production, you may see a need to review some of your earlier lessons on assembling, fastening, and other lessons directly involved in the mechanics of production.

You should make sure each student has a job during the actual production. This job may be anything from operating a machine to transporting parts from one operation to another. In any event, confusion and poor production turn out as the results when students don't have a job or do not fully understand the job they have.

The opportunity for student activities during these lessons is almost endless. The greatest advantage of assigning these activities at this time is that they can be made an actual part of the functioning process of the company.

Examples of activities which could both help teach the specific lessons mentioned and also be a part of the students' company's function include preparing a flow chart of the order of operations to be performed on the product, studying raw materials which might be used, inspecting for and identifying safety hazards in operations, deciding on how materials, etc., will move from place to place in the plant, and setting up a file of possible suppliers of raw materials and their prices. This brief list indicates the wide range of activities available to you as a part of this unit.

All companies operate for one reason: to make a profit. To do this, they must sell their product after it is made. Our next unit deals with the marketing aspect of a company. There is more to marketing than just selling a product. Marketing includes market research to determine who and where the customers are, what they will buy, when and how much they are willing to pay. Marketing in general may be divided into six areas or phases within an industry; they are market research, advertising, sales promotion, sales planning, sales operations, and physical distribution. Each of these six areas may serve as a lesson within this unit on marketing. If you are able to actually market your product, this unit on marketing can become a very real part of your company.

The students may operate an extensive sales promotion using school newspaper, bulletin boards, and display cases. One group could be assigned a market research project to determine what the market for their product would be like. This could be done even if the product was never marketed.

When company organization was discussed, some type of financial department to handle expenses and control any capital the company might have was most likely formed. Now that there is a chance of income from sale of the product, a unit on finance can be useful to the students in order to keep their company operating smoothly.

This unit is by no means an all-inclusive course in finance. Its purpose is to help the student become more familiar with the different financial aspects of industry. In this unit, the fact that financing in industry consists of planning, directing, and measuring use of company money is explained.

The student should come in contact with a simple bookkeeping system and all the details of keeping it such as writing receipts, checks, interpreting bank statements, preparing price lists, etc. I have found from personal experience that most industrial arts teachers are weak in the areas covered in this unit. For this reason, it is an excellent place to make use of some resource people or guest speakers. Suggestions in this area include a business teacher, bank representative, and accountant.

Now that the company is in full operation with production taking place, it is time to look at how personnel administration is being handled. There are five major areas which can be covered, employment, wage and salary administration, industrial relations, organization planning and development, and employee services.

This unit can be an area of real value to the student in his immediate future. It should provide him with information helpful to him in choosing and obtaining a job. As many students work summers or part time, they should be interested in such items as how to dress and act at an interview, what most companies look for when considering hiring someone, such as experience, ability, education, etc. They may also be interested in the wide variety of benefits available from various companies.

Activities in this area include establishing rules for your students' company on accident prevention and policies on working hours and absences. A merit rating system may be developed which you could use in obtaining some grades on students' work. As with all the units we have discussed, there are a great number of possible student activities. The few I have presented are only to give you an idea of what is intended to be included in the unit.

The next unit, external relations, is concerned with the public image of a company. There are two major groups into which external relations may be divided. One group would be responsible for collecting and releasing information that will favorably influence the public. The second group coordinates the company's participation in any outside activities such as civic, social, industrial, technical, and professional organizations.

The students' company could, as a group activity, participate in some school affairs, perhaps a school clean-up day or other event. In this way, students would be both learning to operate their company and also helping the school.

The last unit in our course is titled secretarial and legal affairs. The secretarial department keeps the stockholders well informed on the wide range of activities that contribute to corporate growth and health. The legal department advises the company on all phases of its operations and relations from a legal viewpoint.

In this unit, lessons on stocks and bonds and what part a stockholder plays in a company will be studied. Also, this unit can be related back to the unit on company organization and the patent unit.

Student activities might include following some company's stock's progress in the paper. In one of my classes, we had a contest to see which student would pick a company which progressed the most on the stock market for one week.

I hope that from this brief outline I have given you a better idea of how manufacturing could be taught in the eighth grade.

Mr. Bills teaches at Lakeside High School, Atlanta, Georgia.

A Senior High School Program of Relevance in Industrial Arts for a Dynamic Age

Donald Maley

I was pleased to accept the offer to come to your meeting to discuss with you some ideas that have been of interest and considerable challenge to me. As a teacher educator, a supervisor, and an administrator in my daily work at the University, I am certain that I have many of the concerns, frustrations, and anxieties that you share. There are the daily and operational problems related to financial support and personnel effectiveness that press upon each of us from every side, and it is quite easy to become totally preoccupied with what appears to be a series of immediate necessities.

However, this might well be the source of our demise and gradual elimination as a profession. The existential preoccupation that appears to demand 100% of our daily time and effort may in fact be gradually consuming our very existence.

I would like to propose that both you and I should set aside a portion of time each week for the sole purpose of examining where we want to go and how we might want to get there. We will in all probability want to involve others, our staff, our colleagues, as well as a range of people from outside our area of content. One might question who is going to mind the store while we are engaged in such an activity. My concern, and I have ample evidence to support it, is that we might not have a store to mind if we don't take time to constantly probe, plot, and generate momentum towards the role of industrial arts in the future. The future begins with the present, and it seems to me that any school administration worth its salt would in deed and fact demand that of each of us.

Haas, Wiles, and Bondi, in their text Readings in Curriculum, make the following statement:

> It is time that we learned to think about the present as a dynamically changing situation. If we wish to ameliorate the conditions of our life, we have to think far ahead in order to understand where we are going and to define whether we like our destination or not. If we do like it, we must decide how we can take a different road at some time in the future, which, when we act, will be the present (Ref. 5, p. 119).

As I view the present difficulties faced by an educational institution, I can clearly see the results of this lack of forward perspective and dedication—yes, dedication to the task that education must at least be running a "neck-to-neck" race with the society outside of the school if not running ahead of it.

As a prelude to a specific proposal for a program at the high school level, I would like to devote the next few minutes to developing the societal background which serves as a backdrop to this educational enterprise.

What do we observe outside the school as well as within its walls that gives concern for the generation of new, bold, different, and exciting programs that will satisfy the loud and persistent cries for "relevancy," for "meaning," for "significance," and for a world that the students live in or will enter within a matter of days?

I hear a society that is crying out for a concern for the "quality of living" instead of the past and present posture of "quantity of living."

Education is no longer simply concerned with earning a living or being a "good citizen"; it is now much more concerned with quality of life—one's own land and that of other people. The story of curriculum development has been largely the account of a struggle to keep the curriculum up to date and relevant. In the 19th and 20th centuries, the struggle was to convince those concerned that science was an important element to the curriculum. In the mid 20th century, the struggle was to introduce the social sciences as a worthwhile and relevant body of knowledge.

It looks as though in the late 20th century the struggle will be to introduce the study of ecology into the curriculum—to encourage young people to look at the problem of man and his interaction with the environment in a way which combines scientific evidence with social and aesthetic principles (Ref. 6, p. 46).

I hear a society that has placed increasing emphasis on the role of knowledge as opposed to apprenticeship (See Figure 1).

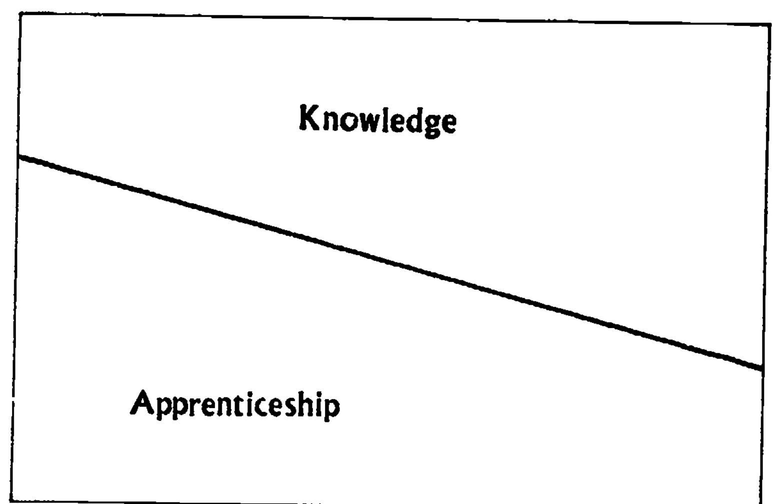


Figure 1. Productivity requirements in the contemporary society.

This point is elaborated by Peter Drucker in an article appearing in the Fall 1968 DAEDALUS.

> ...knowledge is taking over the function, which through the ages, apprenticeship has fulfilled. Indeed, there is no craft, from bricklayer to physician, where the application of knowledge could not telescope the learning period from the many years of apprenticeship to a few months or so—as the experience in World War II amply proved... (Ref. 3, p. 1249).

I observe a society that has moved beyond the industrial age to that identified with a post-industrial, a super-industrial, or a knowledge society.

In The Age of Discontinuity, Peter Drucker stated:

> ...The productivity of knowledge has already become the key to productivity, competitive strength, and achievement.
>
> ...knowledge has actually become the primary industry, the industry that supplies to the economy the essential and central resource of production. The economic history of the last hundred years in the advanced and developed countries could be called "from agriculture to knowledge"... (Ref. 2, p. 266).

I observe a society that is gradually becoming an urban society, with great cities stretching endlessly from Boston to Washington, from Chicago to Pittsburgh, and from San Diego to Santa Barbara.

> ...Moreover, by 1970, three-fourths of the population will be concentrated in urban areas, and by the year 2000, over four-fifths.

And by the 1980's, there will be 140 million people living in about 40 urban complexes which will spread over less than 2% of the land (Ref. 8, p. 205).

I hear a society that cries out for human dignity and greater humanization in the face of conflicting material and philosophical ideologies.

I hear a society that chooses to double its population in the next 30 years crying out for improved housing, new systems of transportation, greater amounts of power, increasing quantities of water, improved and expanded recreational facilities, more effective communications systems, in addition to the factors associated with food production, medical care, and a whole new series of governmental processes.

I hear a society that year by year consumes greater and greater amounts of the beauty and the natural elements (minerals, timber, oil, and land) to use and discard as if there were an ever-expanding supply of the same when we know we are traveling down the road that ends with exhaustion.

I hear a society that has to a limited extent become aware of the vital importance of recycling processes as opposed to the ancient procedures of burning, burying, and stockpiling our discards, abandoned vehicles, trash, and excesses.

I observe a society that has repeatedly neglected the lessons of technological history that came out of the coal, oil, meat packing, and forest products industries. Each of these industries in their early stages of development were guilty of discarding untold riches in order that the initial product or component could be extracted. I refer to the early processes of securing coke from coal so that our hungry blast furnaces could be fed. Yes, from the richness of the coal as mother nature had so generously endowed it, man chose to drive off and discard untold wealth to secure a fractional worth in the product coke. Our forefathers did the same thing with oil when they wanted to get kerosene for their lamps. The great wealth of oil was only in part used; that is, the kerosene, while the remainder was largely discarded and unused.

As we developed our nuclear plants with their fissionable materials, we again forgot our lessons from oil and coal, and we again discarded materials so hot and potent with energy that we had to find special containers and means of disposing of it.

We are now engaged in great debates over the thermocline that results in our bays and rivers from the exhaust waters of our nuclear electricity generating plants. The question is not what to do about the thermocline or its effects on the ecology of these rivers and bays. The question is, "What do we do with hot water that will make full and complete use of this valuable commodity in the face of diminishing earth supply of the sources that made the water hot?"

In each case and in such cases in the future, the decision may hinge on the factor of economics. However, much of the thinking in economics that has encouraged the waste of the by-product has been based on the economics of abundance or a concept of inexhaustible supplies at the source.

The economic posture of the future must add the additional dimension of more complete utilization of nature's diminishing resources. Society will insist on the same kinds of behavior exhibited by our economics-conscious housewives who do not discard the left-overs from our Thanksgiving or Christmas turkeys. Instead, we have in the ensuing days turkey soup, turkey stew, hot and cold turkey sandwiches, and many more ways of full utilization of the holiday bird. This lesson has not been learned or practiced in many industries where the economic concept of plenty and of material abandonment has had certain short-range benefits. We who have inherited the planet Earth today cannot and must not be insensitive to the needs of those who will inherit this planet in the centuries to come.

And, perhaps as significant as any, I have become aware of a society characterized by an accelerating technology that challenges our imagination, our emotional stability, and our sense of values.

This acceleration of change has come about as the result of the technological impact on contemporary man and the world about him. This technological impact is greatly aided by vastly improved and highly effective systems of communications, which in turn are products of a regenerative system that has developed out of the process of technological development. Let us see how this regenerative system works, and perhaps we can visualize the circumstances that have led to this phenomenon of acceleration of change.

Alvin Toffler in his text Future Shock discusses how technology makes for more technology in a three-step process: discovery, application, and impact or diffusion. That is to say, the acceleration of technology is due to the feeding and nurturing functions that technological impact and diffusion have on the process of innovation. New technology is discovered as a result of the need for new environments, implements, tools, knowledge, and procedures which grow out of the diffusion of technology into a society.

As a further explanation of this very important concept, Figure 2 depicts the process in its multiplying characteristic.

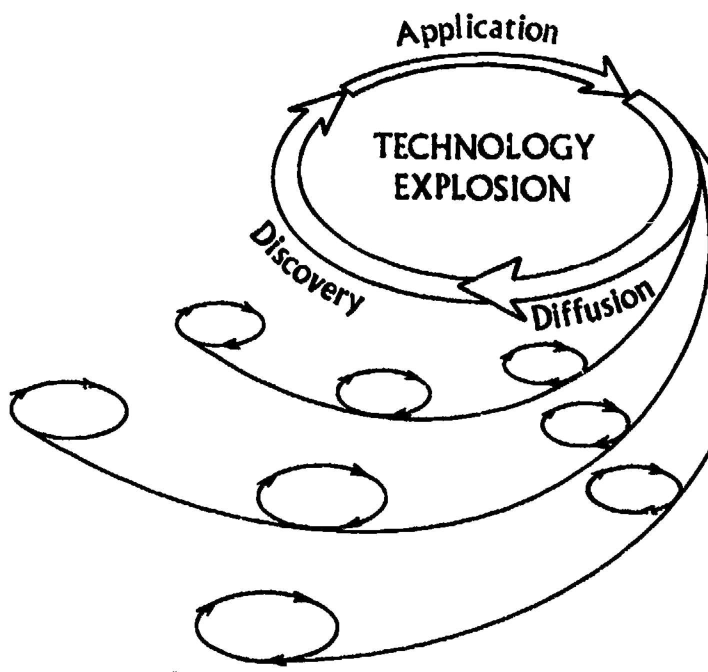


Figure 2. Development of technology

The generation is not a single linear one plus one addition, but it has a seemingly unlimited growth potential with each new generation of the potential manifold outcomes of diffusion.

Knowledge resulting from the impact of diffusion on society generates the capability for more change in a literal explosion of accelerated change.

> ...In our social setting, 'knowledge is change'—and accelerating knowledge-acquisition, fueling the great engine of technology, means accelerating change (Ref. 7, p. 31).

Let us now move closer home and make some observations or soundings in the area of industrial arts at the senior high school.

Many of the present industrial arts programs at the senior high school level have focused on the crafts of cabinet making, ornamental ironwork, sheetmetal craft, drafting, electronics, or carpentry.

In most instances, industrial arts has become an adjunct or an "extra" included in the student's program to fill the schedule. Students are scheduled into them as a convenience to either the student, the school administration, or the planners of the school schedule.

Another form of industrial arts has a "pre"-emphasis. That is, it is one or more programs designed for pre-engineering, as the commonly found pre-engineering drawing, the pre-electronics engineering, or the pre-mechanical engineering. I might add that many of these courses have very little direct tie with the requirements of an engineering curriculum. It also has served in a pre-vocational capacity.

The third common form of industrial arts at the senior high school level has been largely a hobby emphasis. Here again, it takes on the form of an elective, an extra, or a filler course.

A fourth and commonly-found form of industrial arts at this level has been what I will call a "quasi-vocational" emphasis. It is called industrial arts; its teacher is an industrial arts person. The report card says it is industrial arts, but the truth of the matter is that many of the graduates of this program do enter into gainful employment as a result of the skills and understandings gained in the program.

This was the case in numerous high schools throughout the nation prior to the advent of the Vocational Act of 1963. These high school industrial arts programs emphasized skills and technical understandings, and did in fact contribute great service to the many young people who did not go on to college, but who went to earn a living in areas of work related to their industrial arts experiences.

However, this form of vocational emphasis has lost its effectiveness as well as need in many localities as a result of the establishment of numerous vocational-technical high schools and vocational centers. These vocational-technical facilities have provided an opportunity for industrial arts to carve out a new role all its own.

It is this new role that I want to talk to you about here today. I do not propose another form of industrial arts that will be a schedule filler, a pre-engineering or pre-vocational option, or a craft experience.

I propose that industrial arts will never come into its own until it assumes the role of a requirement for every individual in the school. This opportunity may well be within our grasp at this time if we have the courage and the wisdom to move out into the arena of life for our cues and the directions to travel.

Let us look out beyond the laboratory and listen to the cries for quality living and the demands for new systems of communications, power generation, and transportation. Let us take heed to the world of tomorrow with its problems of housing, improved resource utilization, and the demands for workable solutions to the problems of waste, trash, and junk disposal.

Essentially, I am asking you to look ahead in the design of a program that is based upon educating for the future. Our present efforts for the most part merely reproduce the past, without much trace of the notion that the accelerating technology and the accompanying accelerated changes in society are indeed the challenges that we and all of education must face.

We must direct our attention to the principal endeavors of our society as well as to the major concerns of the world in which we live. This emphasis departs rather significantly from past postures in education. It is an attempt to establish education and what goes on in industrial arts specifically as a major force through which the school will play an important role in the processes of societal change. Furthermore, I would request that our national, state, or regional meetings devote their full energies to the task of demonstrating to all educators and the citizenry of this nation that industrial arts can have a significant role in helping people adjust to and assist in the solutions of specific problem areas facing mankind.

I would speculate that if we do our best, if we look to the future, and if we broaden the base of our efforts to encompass the needs of all of mankind in the next 30 years, we will be on our way to recognition, acceptance, and respect.

I am prepared to suggest to you here today what I think is a viable program—a program that examines the role of technology in the solution of major problems facing mankind in the years ahead.

My colleagues and I at the University of Maryland have spent considerable time over the past four years in an extensive study of this new concept and direction for industrial arts. Incidentally, we did it at the request of many individuals in the profession, and without one cent of outside help.

The development of the program grew out of a four-pronged study that involved the following elements deemed important to the task at hand.

1. The nature of the society ahead.
2. The nature of the student.
3. The trends in curriculum development.
4. Socio-psychological theories governing behavior.

We were challenged by the endless quantities of new and exciting literature. It was exciting because it caused us to think, to wonder, and to be challenged. How different this was than the usual literature that recounted the past and described the existing without providing any spark of wonder, excitement, or challenge.

Jerome Bruner had an appropriate comment along these lines in an article appearing in the Saturday Review.

> This brings us directly to the problem of relevance, the thumb-worn symbol in the modern debate about the relation of education to man and society. The word

> has two senses. The first is that what is taught should have some bearing on the grievous problems facing the world, the solution of which may effect our survival as a species. This is social relevance. Then there is personal relevance. What is taught should be self-rewarding, or "real," or "exciting," or "meaningful." The two kinds of relevance are not necessarily the same (Ref. 1, p.68).

I ask you to read Alvin Toffler's Future Shock, Brown, Bonner and Weir's The Next Hundred Years, "The Conscience of the City" in the Fall 1968 DAEDALUS, Stuart Chase's The Most Probable World, Mankind 2000 edited by Robert Jungk and Johan Galtung, Robert Prehoda's Designing the Future, Arthur Clarke's Profiles of the Future, the Report of the Commission on the Year 2000, John McHale's The Future of the Future, and many more.

The world of tomorrow belongs to the youth that we teach today. The educational program that insists upon a preoccupation typified by the experiences of a middle-aged teacher or his society is sure to miss the mark.

The events of the past three years have given ample evidence of the insights, concerns, and anxieties of the teenager and the young adult. It is here where the factor of relevancy lies, and it is here where the universality of such problems as pollution, housing, transportation, communication, power generation, water supply, resource utilization, and trash or junk disposal become apparent.

The program that we have designed focuses upon two important components from an educational point of view. The first item is the substance of the proposal—Major Problems Facing Man in the Future. This is the central trunk in the content area. The second component deals with the human element and the kind of "personal" education aimed at the fulfillment of self as well as a contributing self.

Each of these will be discussed in turn. Figures 3 and 4 give a breakdown of the different considerations and components of the programs.

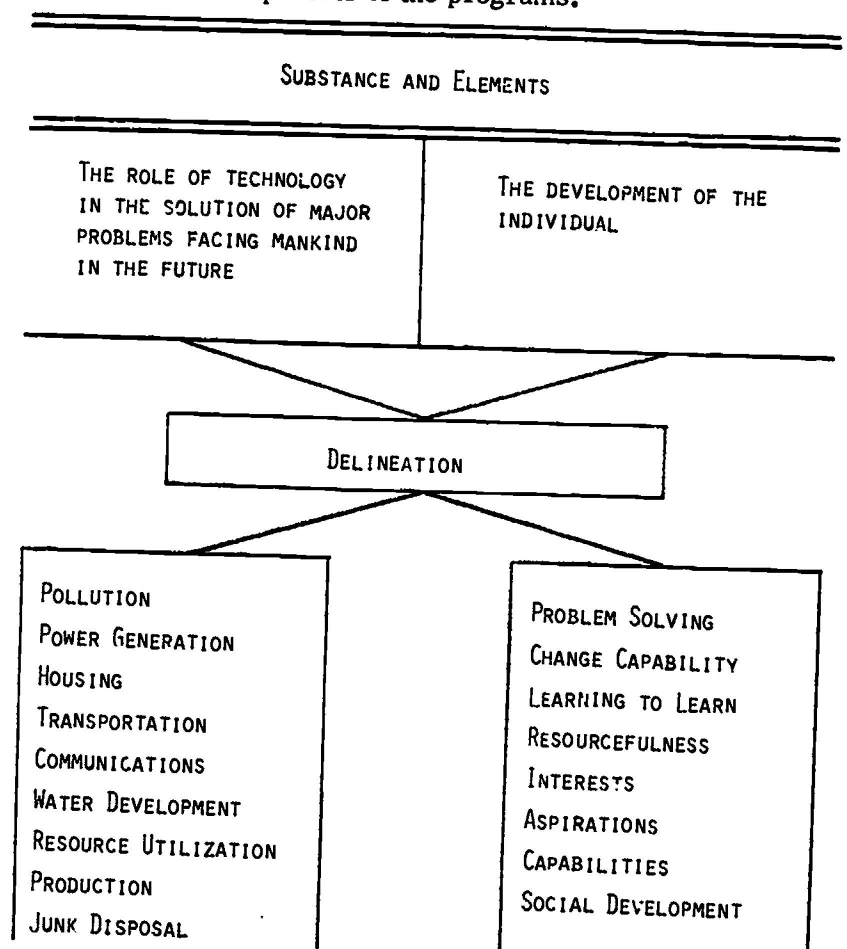
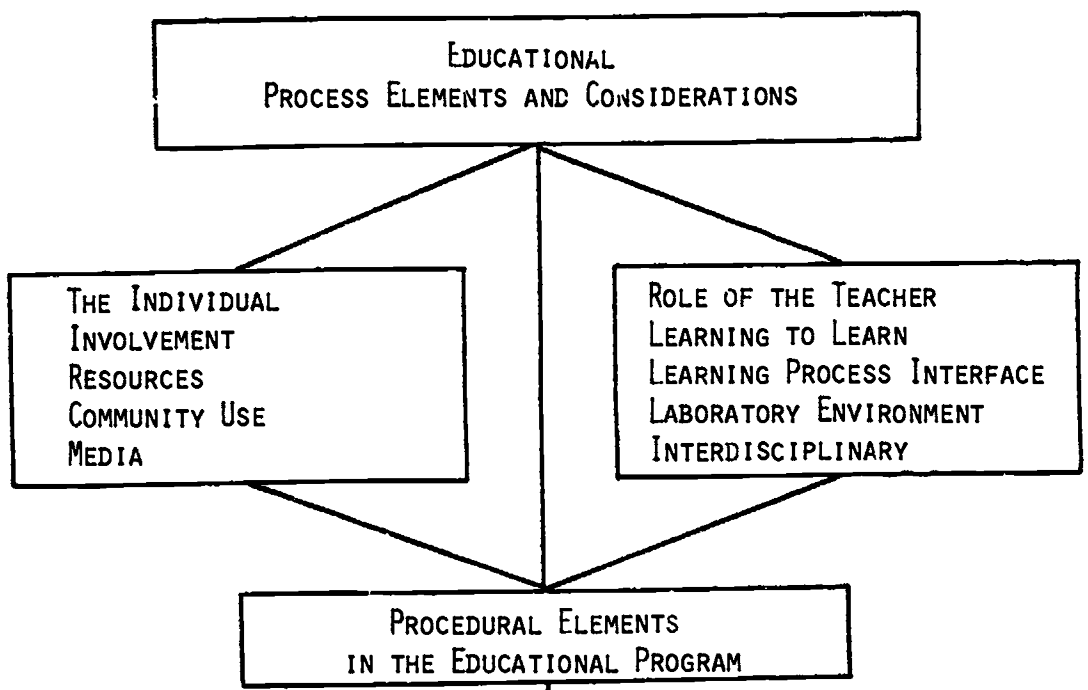


Figure 3. Components of the senior high school program for industrial arts that focuses on the future



1. THE UNIT APPROACH -- INVOLVING THE UNIT ORGANIZATION, CONTRACT METHOD, INDEPENDENT STUDY, PROJECT METHOD, PROBLEM METHOD, AND SEMINAR PROCEDURE.

2. THE GROUP PROCESS (GROUP PROJECT) -- INVOLVING THE GROUP ORGANIZATION, ROLE PLAYING, CONTRACT METHOD, INDEPENDENT STUDY, PROBLEM METHOD, AND PROJECT METHOD.

3. THE RESEARCH, EXPERIMENTATION, AND DEVELOPMENT APPROACH -- INVOLVING INDEPENDENT STUDY, PROBLEM METHOD, PROJECT METHOD, SEMINAR PROCEDURE, AND INQUIRY TECHNIQUES.

4. SCHOOL - COMMUNITY INTERFACE -- INVOLVING ON-SITE VISITATION, STUDY, DIRECT INVOLVEMENT, FIRST-HAND OBSERVATION AND CONSULTATION (APPLICABLE TO EACH OF THE PREVIOUS THREE METHODS).

Figure 4. Educational process elements

The substantive is intended to be the role of technology in the solution of major problems facing mankind in the future.

The importance of the study of technology as a viable component of contemporary education is quite obvious as one understands more and more about the progress of mankind. However, there are several directions that such a study of technology might take (see Figure 5).

...It could take the form of an in-depth study of separate areas of technology (transportation, communications, etc.)

...Another approach might involve a historical or evolutionary study.

...Still others might opt for a study of technology in a taxonomical framework.

Our decision was to go with the applications of technology in the solution of major problems facing mankind in the future. The projected payoff from such a direction would center upon the needs of man as a consumer, as a participant in the democratic processes,

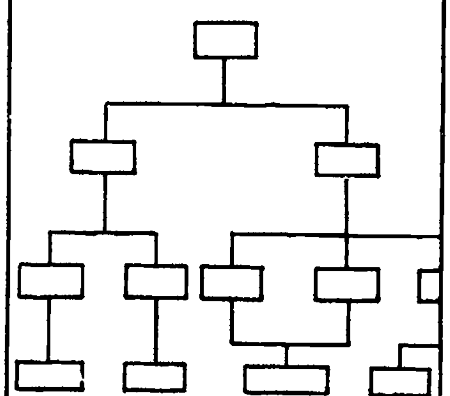
In Depth Study of	Historical or Evolutionary	Taxonomical Study
Transportation	Fire	
Communications	Wheel	
Production	Tools	
Power	Machines	
Medical	Power	
Etc.	Etc.	Etc.

Figure 5. Options in the study of technology

as a decision maker, as a planner of his environment, and as one who in all probability will engage in productive work with the technologies (see Figure 6).

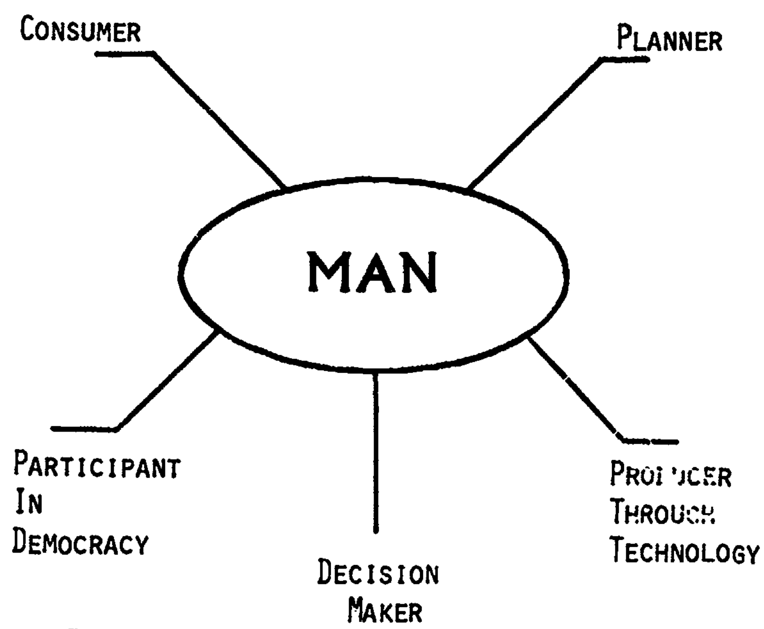


Figure 6. Implications of the study of the applications of technology

The second and certainly more important element in the considerations for the program was the individual or human component.

This new senior high school program is consistent with the philosophy of the junior high school program as projected by my colleagues and me. The "content" of a society—i.e., its accumulated knowledge, its artifacts, its manner of living, and its institutions—are the products of the human component and the developed processes within him. This strong emphasis on the individual and his development has led some of our critics to assume and proclaim that there is no content in such programs. It is true that there is no attempt to establish a fixed and worshipped set of facts, concepts, or processes. To do this would ignore the history of man's evolution as well as the history of his environment. Our position becomes more viable and defensible as we examine the requirements of all mankind in the accelerating changes he will face in the future. A strong emphasis on fixed content may be defensible in a static society—if that society wishes to remain a static society. The world in which we live and our children will live cannot and will not be so bound to relax and lay dormant for the centuries to come.

Man has had a taste of intellectual, scientific, and technological exploration that has whetted his appetite in dimensions that will never permit him to return to complacency, to a static state, or to a satisfaction with things as they are.

The restlessness of man has been awakened and agitated by the realization that his potential is literally endless and his penetration without bottom.

But how does this all come about, and what is the role of the school in this process? I am certain that the key to effective living and contribution in an accelerating technological society lies more strongly in the processes of education that relate to man's intellectual, social, and moral functioning than in the memorization of facts, concepts, or recipes.

Thus, any program in education that is worth its inclusion must first be dedicated to the human component and the processes through which the organism grows, develops, and aspires to new growth and development. Fundamental to this proposition is the process of learning to learn, the constant stimulation of curiosity, the strengthening of a positive self-concept, the broadening of experiences, and the development within each individual in those ways in which he may relate as well as contribute to the world in which he lives.

A further delineation of the substantive and the individual or human component is discussed in the following paragraphs.

The substantive components in this program relate specifically to the application of technology in such areas as:

- pollution
- power generation
- housing
- transportation
- communications
- water development
- resource utilization
- industrial production
- trash and junk disposal

As a general education component in the high school, there can be no doubt about the efficacy of such areas of exploration in the years ahead. Each of these can and must be a part of an environmental and ecological concentration that will be required of all students.

Pauline Gratz has stressed this same idea in a discussion appearing in the NEA publication Educating the Young People of the World.

> I am firmly convinced that one goal of education today is to discover why man has done so badly in his efforts to manage his affairs in the 20th century. The study of the relationship between man and his environment, both natural and technological, will help man to understand the consequences of his actions: how sulfur-laden fuel oil burned in England produces an acid rain that damages the forests of Scandinavia; how DDT used by a tobacco farmer in North Carolina turns up in the fat of an Eskimo living in Alaska; why a farm subsidy which helps one group of individuals can force another group of individuals to riot. A student who comprehends man's relationship to the environment will be equipped to do something about the environmental problems that beset the world. If we can reach enough students, it is quite possible that man and his environment may survive against all the odds a while longer (Ref. 4, p. 37).

It is our opportunity to move out into the mainstream of education—away from the elective, pre-engineering, prevocational, program filler, and hobby-lobby syndromes to which we have been attached. It is our opportunity for significant contribution to the functional citizen of the future.

The program emphasis will remain with the projection, exploration, and examination of technological solutions to the previously mentioned problems. However, this does not diminish the significance of the social engineer in his important and unique roles. Each—i.e., the technological engineer and the sociological engineer—must function in a planned and satisfying state of growth and development if we are to avert disaster, an "extra-legal state," or rule by a technocratic elite.

The appeal to the students—that they will be working with and studying alternatives, evaluating systems or processes that will be important elements in their world—will provide a dimension of relevancy that has been difficult to establish in programs that have concentrated on the past and a world they will never experience.

The delineation of the human or individual component is an attempt to look at areas or processes relating to the functioning as well as the capabilities of the student as a member of present and future societies.

Emphasis has been placed on such processes as problem solving, learning to learn, use of unlimited resources, and the process of resourcefulness itself.

Understanding the phenomenon of change and the capability of dealing with change has become a necessity for contemporary man—and in dimensions that have not confronted him in previous generations.

The program is conceived for and dedicated to a greater degree of involvement of the student in the areas under study. The motivation for such involvement is initially "locked-in" to the relevancy of the areas of study with respect to the almost immediate future of the student. This point is strengthened by the fact that each individual upon reaching the age of 18 (voting age) will automatically become a part of the establishment involved in seeking solutions to the problem areas identified. A substantial number of this age group may still be in high school.

This point was emphasized by Fred Wilhelms in an article titled: "Which Way to a Curriculum for Adolescents."

> Yet, even more fundamentally, all the youth of our day are growing into an age of uncertainty about themselves and about their significance.... They are threshing about, often in crudely rebellious or even bizarre ways; but the important thing is that they are searching, impelled by a fine idealism and relentless honesty. They deserve our help. And to give it to them we shall have to shuck off a lot of scholastic impedimenta and go to where a young person meets the realities of adulthood (Ref. 9, p. 15).

Aside from the motivations for involvement, there are the numerous program designs that encourage and enable greater amounts of participation.

The flexibility and structural consistency of the new high school program permits wide opportunity for exploration and development of the interests, aspirations, and capabilities of large numbers of students.

Of particular concern has been the matter of social development and how the person relates to the endless variety and patterns of individuals associated with daily living. Here again, the social context of each individual in a world that doubles its population within 30 years and is characterized by endless sprawling urban communities merits such concern.

It is fair to say that the human in his frail and precarious existence today and his technology are inseparably tied into a struggle for existence. Each is a dependent of the other in the struggle. Each is a potential contributor to the other. Thus, it appears that ways must be sought in our educational scheme to get the best out of both technological engineering and social engineering in the interest of all mankind. This is a prime objective of the program being discussed.

The next phase of our program development involved taking the delineated areas of problems of mankind as well as the components of individual development and focusing on them as integrated factors in a broad educational experience.

The following brief statements give a few of the highlights and concerns in this process.

1. The role of the teacher was identified with that of a "manager of education"—i.e., a facilitator, a stimulator, an evaluator, and one who gets results from others (students).

2. The laboratory in its initial setting would be broad and comprehensively equipped with the facility for diversity in mental and manual activities.

3. The community would become a strong partner with direct responsibilities and activities in the pursuit of solutions to man's pressing problems. The students might well be involved directly with the personnel and processes by which a community seeks to solve its problems in the areas previously identified.

4. The activities of the industrial arts area would find great need to integrate the other areas of the school (social studies, science, literature, geography, geology, etc.) into the exploration of solutions to the problems under study.

5. The range of activities and the diversity of experiences would provide a wide latitude for meaningful participation on the part of nearly every individual in the program.

6. Emphasis would be placed on a form and quality of individual involvement that would move away from mimicking teacher demonstrations, memorizing minutia of a temporary nature, and carrying out a series of educational exercises. The emphasis would be on learning to learn—a self-actualizing process growing out of concerns, needs, problems to be solved, as well as a new role of resourcefulness and inquiry related to the subject or development under study.

7. The educational program would be characterized by a wide range of educational media, team teaching, guest speakers, community consultants, and the full spectrum of learning processes aimed at a broad, rich educational experience.

Each of the aforementioned characteristics would focus on the two important components of the substantive and the human development.

PROCEDURAL ELEMENTS

If educational programs and educational theories are to be of any value, there must be a concerted effort at the translation of such programs and theories into the practices and operations carried out in the laboratory and at the numerous other locations associated with the student, faculty, and community involvement.

I would like to take a page out of the philosophy of John Dewey and emphasize that it should be a living-learning involvement with the content of the area/s of study. I believe we have moved very strongly and effectively in this area. This has been accomplished through the three broad aspects of instructional organizations that we have selected for the study of the applications of technology in the solution of major problems facing mankind.

The three process elements are as follows:

1. The Unit Approach—involving the unit organization, contract method, independent study, project method, problem method, and seminar method.
2. The Group Process (group project)—involving the group organization, role playing, contract method, independent study, problem method, and project method.
3. Research, Experimentation, and Development—involving independent study, problem method, project method, seminar method, and inquiry.

The program has been carried out in several high schools and one junior high school. Additional programs are planned for the 1971-72 school year.

My colleagues Kendall Starkweather and Ralph Tanner will discuss their respective programs that grew out of the senior high school projection as I have just presented it.

Finally, I ask you: Are we running a close race with societal challenges and issues? Are we providing the leadership that puts us out ahead of society as a force that brings about needed changes?

(or) Are we running clearly in the rear, trying to defend that which we have and feel comfortable doing?

My plea and my proposal is one that can proceed in its accomplishment through a gradual evolutionary movement, with our physical plants initially where they are. I do not see the great impediment being the physical plants we have, if we have not locked in the present plans and all future plans to just more of the same.

The great obstacle is and will be the personnel we hire to teach the classes associated with the proposal. It is here where teacher education at all levels must get into action and resolve to move neck to neck with society or optimally ahead of it.

The implication of this proposal is to change the nature of the mental manual effort and the great potential of the laboratory setting in the direction of societal problems that are pivotal in the growth and productivity of the world in which the students today, tomorrow, and the years ahead will live.

Haas, Wiles, and Bondi in their text Readings in Curriculum put it this way:

> Today's curriculum planners should study conditions and trends in contemporary society and probable conditions and requirements for democratic living in the last half of this century. It may be we are planning to educate children for a society that does not now exist. Education for the immediate future in our rapidly changing society is almost useless unless it prepares learners to meet problems that are new and that neither they nor anyone else has ever encountered before (Ref. 5, p. 419).

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Implementation of a Senior High Program

Ralph Tanner

Gentleman, I need to preface my remarks by making an apology. Dr. Maley, I offer you my sincere apology for, on one occasion this past year, being a real Judas to industrial arts. Early in the school year, my supervisor made my classroom a tourstop for some visiting industrial arts teachers. After showing them the facility, letting them talk with students, and presenting the results of the students' research, we gathered in a conference room to give them time for questions. One very outspoken gentleman came forward, faced me, looked me square in the eye, and said, "Wait a minute. I bet I know how this program is working. You're one of Maley's boys, aren't you? Did you graduate from the University of Maryland?"

Then, sheepishly, I halfway lowered my head and quietly admitted that I had. I was being apologetic for having received training which better enables me to implement this type of program. Well, gentlemen, I stayed awake a long time that night trying to analyze the incident. It became increasingly apparent that I had given in to some kind of nebulous stigma which opponents of the Maryland Plan like to place around it in order that they might have an invisible shield so as not to scuff their status quo. While I cannot deny that having graduated from the University of Maryland well prepared me to tackle this program, I emphatically deny that this can be considered "the reason" for the program's success.

Permit me then to acquaint you with my program, to examine some of the problems I have encountered related to this Maryland Plan "stigma," and to offer my solutions.

One of the most provocative things about the program which Dr. Maley has described is its flexibility. It can be modified to fit every teaching situation in general education. I have taken the Maryland concepts and methodology and have pieced together a custom-tailored program for my school and its scope of industrial arts. In a comprehensive general laboratory, I offer three independent courses.

First, because none of our feeder schools offers the anthropological look at technology (an orientation which I deem to be of utmost importance if the student is to gain some understanding of where society is heading), I offer a course in Industrial Evolution. Here, we trace the history of technology through 900,000 years of development. The emphasis rests on the process of change and how it may project into the future.

Secondly, because the environment is of prime concern to our students, I offer a course entitled Industrial Environment. Here we study environmental problems and possible solutions attributable to contemporary industry.

A third course, Industrial Technology, invites the student to step up time and study the pleasant and not so pleasant aspects of our immediate future. The subject: those areas which Dr. Maley has already presented.

The methodology used incorporates most of the Maryland Plan concepts of the Unit Approach, the Group Project, and Research and Experimentation.

I could give you laborious detail of how I manage each course. I could give you each successive instructional step in the methodology. However, I would hasten to guess that most of you are, to a degree, familiar with the methodology, and a description of my specific situation would not be of any great value to your program. Therefore, let me begin to chip away some of that stigma to which I previously alluded.

"So! You're one of Maley's boys, eh? Well, that explains how you can run this program and get these results. Now, tell me, how do you select these choice students?"

That is probably the most frequently asked question. This is stigma resulting from a Research and Experimentation program initiated several years ago in a junior high school. This was a situation in which the teacher was provided the opportunity to select students into his highly academic course. Well, may I make the revelation that this was an exception to the rule and that not all Maryland Plan teachers are given that privilege. In fact, inasmuch as my lab was without a teacher for two years prior to my arrival, I found it loaded with cast-offs placed there by guidance counselors who saw an empty shop as a convenient study hall for their problem students. Therefore, the average academic and attitude characteristics of my students were probably inferior to the average industrial arts student in most general high schools. Still, the program worked!

Just a month ago, our curriculum committee was shown evidence that, in our county at least, industrial arts would soon become a dumping ground due to the increased demands placed upon academic and business students in their major subjects. I offer this information only to emphasize the fact that this program will work with all levels of students, not just the talented.

"Well, all well and good. But I've got students who can't read. Now tell me these students can succeed in your course with so much research and book work."

Let me give you an extreme example of a non-reader who was placed in my class just this year. After I had introduced the course objectives and after the class had selected a major unit of study (in this case, future transportation), this boy made it clear to me that he could not and would not do the research required to become expert in any one aspect of this topic. A little investigation on my part showed the student to be only able to read on a 4th grade level.

Now this, ordinarily, would seem to bring negotiations to a halt but for the fact that this boy has what every student has, no matter what his background: imagination. It is not always apparent, but every student has some preconceived notion of how things will be in the future. They watch Star-Trek, Lost in Space, see movies, and read volumes of comic books full of fantastic creatures who wield a technology of a complex if not believable nature. I asked this boy how he thought people would get around in the future. He scratched his head, thought a minute, and blurted out something about anti-gravity. "Go on," I said. "Do you think we will be able to use anti-gravity in space ships?" "Oh sure," he exclaimed, "I saw it in a comic book." Then I proposed that he just use his imagination and build a model of an anti-gravity space ship as he thought it would look.

One thing led to another, and pretty soon peer pressure had that boy asking me where he might find some information regarding his topic. I directed him to some books and the library. To shorten the story, and again this example is extreme, the boy ended up working his way through a watered-down version of Einstein's theory of relativity regarding gravity as an electromagnetic wave. Al Myers can document that: he sat in on the final seminar report the boy presented prior to entering the project in the school science fair and placing third in the Space Sciences Division. This year, by the way, projects done in my class accounted for 60% of the projects entered in the school science fair; while only eight of these placed in the competition, concepts and awareness of technological problems did place in the minds of students who would never have considered even viewing the science fair.

I cannot emphasize enough the important advantage we have by making our subject future-oriented and letting the imagination of the student run free.

The next most frequent remark, or is it excuse, that I hear has to do with the location of my school in Beltsville.

"No wonder. Look at all the resources around you: NASA, the University of Maryland, the Smithsonian, and all the Government agencies. How could we possibly run a program like that when all we have is the school library?"

This year, 84% of the information used as resource material came from writing letters and the school library. Now I admit that this shows me to be delinquent in helping these students reach the wealth of resource material available in our area, but it also shows that location is no excuse for passing over this program for lack of resources.

Now, back to my friend who asks, "Okay, but how do you manage to teach and know about all these new and scientific principles?"

I have tried in three of my four classes to be not a teacher, but what Dr. Maley calls a manager of education—I prefer "Senior Learner." That is, each student becomes an expert in his or her own topic while I remain a colleague helping them to put their ideas into tangible form. I never lecture; rather, I give periodic seminar reports, as do the students, on subject matter I feel they should encounter. I take an active though lesser role in the Group Project and, quite often, I will carry on my own Research and Experimentation project along with the class. I am not afraid to admit that I don't know the answer to some question but I work along with the student to find the answer. It's intriguing, fun, and the students respect it.

A final problem which I have discovered relates to industrial arts becoming an elective in senior high as opposed to being required in junior high. Students come into the course expecting to build traditional projects; i.e., gun racks, lamps, etc. One of my classes, in particular, balked very hard at the new concepts which I presented. Their main argument revolves around the fact that this program is not what they want. My students initially would rather have been placed in a unit shop where they could have worked on practical home-use items. On top of that argument, Rufus Jacoby, an artist in silver who presently teaches at High Point, presented the further case that students are turned off by technology because a higher regard is being placed upon the simple life where agrarian values and hand skills are more highly thought of than knowledge in the technical fields.

I had no quick answer for Jacoby and for that I was fortunate. I believe that argument can be approached from both sides. Take time to consider it; you will find it a much more complex point than it first appears. As industrial arts turns away from skills and crafts and delves into technology, has anyone thought to ask the students where they would like to see industrial arts head?

To me, it boils down to a question of want <u>vs.</u> need. The Maryland Plan senior high program utilizes concepts and methodology based upon two distinct and important kinds of need. First, it is based on the behavioral development needs of adolescent people, so it is valid. Secondly, its content is based upon the needs of a society and its future citizens. We, as teachers, have the responsibility of seeing that the technological investment that our society has made is placed in hands better able to use it and too wise to abuse it.

How did I implement this Senior High program? By believing that the program was soundly based, in the welfare of people, and by being optimistic in my approach.

Dr. Maley has placed you, today, in a room full of shiny, exciting new toys. How will you handle them? Pessimistically? These are too hard to comprehend, they have no place in the shop, we can't find a solution, so why bother? Or optimistically? You can't fool me. At the bottom of these problems is a better world tomorrow.

One of Maley's boys, eh? Yes sir; and proud of it!

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Implementation of a Future-Oriented High School Program

Kendall N. Starkweather

High school level industrial education is a strategic vantage point from which to prepare to face the future, not only because today's students will have to live with the future and its technological needs and problems, but also because they will have to solve these problems. Therefore, the quality of a student's training today will go a long way toward determining the success of the solutions he will apply tomorrow.

The subject of many discussions in government, industry, and education during the coming decades will be the problems of expanding population, pollution, poverty, the housing backlog, the advent of leisure time, sophisticated communications, and highly developed transportation systems. To deal with these problems, a new role for industrial education was implemented through a sequence of "industrial processes" courses at Huron High School, Ann Arbor, Michigan, 1969-70. The aim of these three courses has been to allow the student to study industry and technology of the future, exploring solutions to the problems they will present. What will our needs be in the future in these areas of distress? What implications will they present? Our young people want to know about these problems and possible solutions today more than ever before.

To describe briefly the activities in the first course, the students selected a subtopic taken from a list of major problems facing man today. They researched this subtopic through the use of the school's library, resource teacher contacts, telephone calls, and letter writing to various industries and specialists in science. Next, using their research as a guide, they developed plans for construction of a project and began their project work of simulating their futuristic technology. Seminars were held to communicate the problems, advances, and knowledge gained by each class member. By the close of the semester, much was completed towards learning about the future. Also, much was learned about guiding students in a program of this nature.

Many observers have asked what we do with the non-motivated student who does not care to choose a topic. Experience has shown that most of the students will become interested in a topic during class discussions or while they are in the library. The few that have not made this selection will do so as a result of discussions with their peers in the class. It is very rare for a student not to choose a topic when he can focus on automobiles, space programs, or architecture.

The problem of motivating the learner to complete research was done by first letting the student choose the topic so that he would be interested. Secondly, the librarians and instructor gave much assistance when the class went to the Resource Center. The students soon found that the center had something which was of interest to them. Traditionally, they had been unsuccessful in library work because they were lost at finding the materials and could not see the value of their topic. Having the student choose the topic for research and giving assistance with library work allows for successful results. This also develops a new student attitude toward the resource center, which many educators would consider a major achievement in itself.

Another form of research, writing letters, was anticipated as being a difficult problem but did not turn out in this manner. Using the blackboard, a form letter was produced for each student to use in writing and acquiring information. A very high percentage of the students wrote letters because they were given assistance with grammatical and spelling problems. This help gave them a sense of confidence to follow through with their endeavors. A check on the outcome of the letter writing was made by routing all mail through the instructor.

Other forms of research were used for acquiring information, as has been mentioned. Some students were even fortunate enough to gain advice from their parents who shared a common interest. This parental identification seems to be something that we need more of in today's fast-moving society. Please note that the students were not expected to use all of these forms of research, although this did happen.

When project construction began, the students were allowed to use any hand tools, machines, or materials available. Most of the students quickly identified with a certain type of material but soon found themselves using a variety of woods, metals, plastics, and ceramics in their construction. Instruction on the use of tools and machinery was given to the individual or small groups as the need arose. In this way, the instructions were given when the student was ready to learn. At times, filmstrips were used along with class-time demonstrations and discussions in teaching the safe use of equipment.

This brings us to one major criticism of a contemporary program of any type. Many educators believe that newly structured programs lack manipulative skills. In this program, just as much time can be spent in the lab as the instructor wishes. Not all of the students learn the same skills, but they do learn a large variety of procedures which are needed to complete their projects. Many of these same skills are used in the construction of furniture or common sheetmetal projects which have dominated the laboratory activities in industrial arts for many years. For example, the use of wood doweling would be just as important in futuristic project construction as in furniture construction. It is important to note here that a program of this nature can be implemented in any type of facility, regardless of the available machinery. A facility such as the industrial processes laboratory at Huron High School would be ideal for such a program. However, a facility set up strictly for woods or metals can easily be adapted to this teaching situation. When we first moved into our new school, only two machines were hooked up electrically in the entire lab, which incidentally had no tables. The program was carried out with the use of hand tools until proper installations could be made. At present, we are fortunate enough to have all of the equipment running for student use. Therefore, the type of projects produced now are somewhat different from those produced one year ago. I do not believe that this laboratory situation limited the amount of learning that took place, although it did alter the direction of the skills learned. The Maryland approach utilizes the same manipulative skills that are common in any other program, but on a different type of project—one that will have some significance either technically, scientifically, sociologically, or economically in the future life of the student.

We as educators no longer have the sole purpose of dispensing information to our students. The complex communication systems in our society do this for us through television, newspapers, and other media. It is now necessary for the educational system to instruct its students on how to locate and use media to solve questions which seemingly have no answer. This characteristic is evident at all levels of the industrial processes courses.

The second level of this program utilizes the group project to further knowledge and skills with materials while gaining an insight into corporate structures of industry. To summarize the activities of this course, the students decide upon a project that they would be interested in constructing, a company structure is developed with each class member holding a position in the organization, and then each student performs his company function until the project is completed. At Huron, group projects have been constructed dealing with urban development, pollution, and transportation. The students are presently working with transportation by constructing a hover-craft vehicle.

A valuable characteristic of all levels of the program is that it spans the spectrum of student abilities. So often, educators are guilty of presenting subject matter at only one level. By individualizing instruction, all levels of these courses cater to the individual, whether he may be mentally retarded or gifted.

To cite an example, a retarded boy in the first level course constructed a model of a futuristic jet transport. The boy was particularly enthusiastic because the project enabled him to identify with his father—a pilot. With the assistance of his parents, he was able to write to airplane manufacturers for brochures on his topic. These brochures were exhibited to the class during one of the seminars so that everyone could visualize the various models of future air transportation. In the second level course, the same student worked very effectively on a group project. As the group completed their research on pollution, this student (who could not read) surprised everyone by finding pictures of the research topic. On finding such pictures, he would have them discussed with him. This special education student found stimulation as a result of his work and was accepted by the other students.

The program has had mentally retarded, emotionally disturbed, physically handicapped, and hard-of-hearing students enrolled in its courses. These students are deployed among several course sections so that the instructor has a chance to maximize the attention he is able to give each one. This approach has been successful in terms of improving the self image, gaining confidence, developing analytical thinking, and acquiring an awareness of their individual capabilities. Therefore, the program permits each student to be rewarded for his individual ability while at the same time becoming an important part of his peer group.

Reading skills are developed because the students are stimulated to read critically and think constructively about their chosen research topic. They are allowed to question, learn, practice, and review the skills of communication at their own pace. For some students, such as the retarded class member, it presents a different type of challenge than for others. However, no matter what the challenge, a positive approach to just practicing the common skills of reading can be most beneficial at any level.

During the present school year, the third and final level of the program was implemented with the use of a research and experimentation methodology. The students select an area of interest, write a research proposal, construct a testing apparatus, and complete the proposed research. The course was offered to allow advanced students an opportunity to work in depth on concepts of interest. Even though it has not been in existence for a complete year, its success has been recognized by the science department to the extent of giving science credit to any student desiring this type of recognition.

Naturally, the knowledge gained by the individual doing research cannot be limited to what the teacher knows. After all, how many teachers have the knowledge of how to build a lazer, or how to isolate ions in a potassium solution! This brings to mind two important concepts which are a part of research: that it is within man's power to "make" his own future, and that man can solve almost any problem, given the time and the means. Therefore, the teacher's role is to assist students in recognizing ways of refining their techniques of researching, constructing, communicating, analyzing, and problem-solving.

Allan Fromme, in the introduction of Holt's book on How Children Fail, describes everyday teaching as "a process of mutual discovery, interaction, and exploration of the self as well as of another person and a subject matter" (Ref. 1, p. xi). Our industrial processes program in Ann Arbor is essentially allowing the individual to become a part of all of these characteristics of learning in a way that meets his individual needs. The content of each course is presented in a conceptual manner which may be incorporated by the student to make his project work meaningful, no matter what type of materials or processes are used.

To date, the success of this program can be measured in many ways—by the hard-of-hearing student who had never before completed a laboratory course until he became a part of this program, by the gifted student, who was having problems with his chemistry course because he could not see the practical applications but was challenged by industrial arts research to the extent of building a lazer, and by many other students too numerous to cite.

However, real success cannot be measured today but must be projected into the future, as is suggested by Robert W. Prehoda in his book, Designing the Future.

> We must review the past, study the present, and project ourselves into the future in order to fully understand the changes that are taking place during these crucial years. However, our references must be primarily future oriented because comparisons of the current scene with "times gone by" often can be misleading. The nations that are able to most fully recognize emerging patterns, and take appropriate measures to properly direct their evolution, will bypass competitors that fail to do likewise (Ref. 2, p. 53).

Industrial education can and should be a leader in the total educational program by advancing responsible and serious investigation of the future. This can be done through class activities promoting methods of study of present and future technology in industry and education.

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ACESIA

American Council of Elementary School Industrial Arts

Developing an Elementary School Occupational Education Program—The Role of Project LOOM

James R. Heggen and John J. Geil

For many years, one of the basic roles of industrial arts has been occupational education. We learned about that role in undergraduate school, we tried to do something about it when we started to teach, and we found that the occupational role had to be largely ignored due to other pressures and the lack of any organized way to conduct occupational education. Those teachers who have attempted occupational education have squeezed it in as circumstances permitted.

We have also talked a great deal about—and have done a little bit with—industrial arts in the elementary school. But we have lacked in numbers of teachers and financial support, and have not, in the main, carried the message about elementary school industrial arts to the people who are the decision makers in matters relating to what should happen in the elementary school and what children should know about and be able to do.

Then winds of change began blowing in this direction. Some, sensing this, saw the movement as just another pendulum swing. Others, seeing at last a chance for "relevant" education (i.e., education relating to how to live in the real world), set about helping the change to occur. In addition to improving the relevancy of education, an increasing awareness of the need to reduce the alarming dropout rate developed, and the realization that if students leaving school do not immediately go into college or other training, they must be prepared to secure jobs which would be suitable to their interests and capabilities.

The first break came in 1963 with the passage of the new vocational act, which dramatically broadened the purposes of vocational education and introduced the idea of career development. But movement toward broad programs aimed at helping students make realistic vocational choices moved too slowly, and in 1968, Congress passed amendments to the vocational education act. The message began to get through.

Florida's legislature began in 1969 an extensive study of all aspects of vocational education. A special subcommittee reported to the legislature a strong academic bias and prevailing intellectual snobbery. They reported a lack of broad occupational programs, found that "... to its surprise ... industrial arts education is not included in the program and funding of vocational education in spite of the obvious functional tie thereto," and recommended that occupational education begin in the elementary schools with state support.

Bills to implement the subcommittee's recommendations passed quickly. The legal definition of vocational education was broadened to include instruction in industrial arts, and legislation provided for the establishment of a K-12 comprehensive vocational education program.

The effect of this legislation, which became law July 1, 1970, was immediate. The new laws had to be studied and interpreted; budgets must be prepared to finance the new programs. Within 30 days, the Division of Vocational, Technical, and Adult Education, Florida Department of Education, awarded to the Industrial Arts Department of Florida State University a summer grant for planning a project to accomplish development of a K-6 world of work program. This award was made because of the activity of FSU in the elementary industrial arts field and in recognition of other proposals the Industrial Arts Department of FSU had made regarding occupational education.

A two-day input workshop was held in August, in which teacher educators, elementary teachers, elementary supervisors, vocational educators, and lay public participated. From their expressions, the form and direction for a project was formulated. The proposal was written and submitted to the Vocational Division, and shortly afterward, Project LOOM came into being.

"LOOM" expresses a basic idea, that occupational materials should be pre-eminently learner-oriented—Learner-Oriented Occupational Materials. We would hope that everything in our schools would be learner-oriented, but we know this is not the case. In practice, we find much that is teacher-oriented, administrator-oriented, or school board-oriented; the child's needs are often the last to be considered.

A second basic idea in LOOM is that occupationally-related learning must include copious quantities of hands-on psychomotor activities. While there is much that the learner must come to know about the external, man-made world and about the scores of thousands of types of jobs and the certainty of rapid change, the learner has the task of learning about himself in relation to the external world. This self-knowledge must be realistic and positive. It must be developed in an activity context—doing, making, fixing, experimenting. It cannot be learned solely from books or role playing or by being counseled. People work actively in jobs and occupations. Children must learn about jobs and occupations in an active, participating context.

Our third cornerstone is the elementary teacher. No one better understands the contemporary elementary-age child than practicing teachers. We feel that LOOM Occupational Packages, if developed by elementary teachers, would be immediately valid. In addition, materials developed by practicing elementary teachers will, we feel, be more readily accepted by other elementary teachers.

Our fourth major tenet is that we must deal with a wide range of occupations, jobs, and professions. We cannot presume to attempt to "track" young children. We must open doors to further exploration in the world of man's work and help each child find his best role in it.

As Project LOOM got underway in September, we employed three graduate assistants, all doctoral students. One is a specialist in vocational guidance, one in elementary education, and one in media. Participating centers were identified, mainly by choosing from volunteer counties. We sought to include large schools and small schools—inner city and rural—across the length and breadth of Florida.

We researched what has been written about elementary occupational programs and sought information from other projects. We soon found that we were plowing virgin land, that while there has been in the past year or so a great deal of activity and writing, there is little in the way of research (or even educated opinion) regarding what is proper and effective world of work education in K-6.

Nevertheless, we knew that some program activity had to occur in Florida's elementary schools by September 1971. We developed a format for our LOOM packages, assembled supporting materials, and set out to hold day-long workshops with volunteer teachers in the participating counties.

We were impressed by the way elementary teachers accepted our mission and ideas. They said, in effect, "We've been looking for an opportunity like this for years."

The project provides money for substitutes for the participating teachers, money for supplies and hardware needed to develop their LOOM packages, a fee for a technical consultant within each county, and a modest sum for the teacher for developing a LOOM package. Thus, each participating teacher is a paid writer. While there are still many dedicated people in teaching who will work free for the benefit of children, the availability of funds to support the mentioned aspects of the project is essential to success.

Participating teachers selected an occupation and proceeded with the development of their LOOM packages. They agreed to try out the package with their students, make modifications, and submit it for review to the project staff. The package consists of a short reading unit, A-V materials, an activity guide, and suggestions for the teacher. In organization, the student is led from an assessment of present knowledge, through inquiry and activity, to a summary and reinforcement, with the way left open to further inquiry. He is led to inject himself into the occupation being studied—"Should I be...?"

This year, some 85 LOOM packages will be developed. Next year, we hope to experiment further with the first group of packages and involve additional teachers in the writing of more. Week-long workshops will bring participating teachers together this summer to see and evaluate the packages other teachers have prepared, develop strategy for integrating world of work education into existing elementary programs, develop tool skills as necessary, and plan for further in-service training.

Several packages have already been received from teachers. Teacher comments, plus what we hear from the field, lead us to summarize as follows:

There is a high degree of widespread interest in "hands-on" occupational education.

Other states (and some publishers) are interested in the project.

Administrators, once involved with and knowledgeable about the project, are enthusiastic.

The several elementary level world of work programs being developed across the country should attempt to exchange information, findings, and materials to avoid duplication of effort. A national conference might be considered to achieve this.

Local business and industry people are interested in the project and indicate a willingness to support programs with resource persons, materials, and, in time, perhaps money.

Undergraduate teacher education will have to be modified soon, to include occupational education and skills in using a variety of tools and materials. The occupational education job in elementary schools will have to be done, for the most part, by elementary teachers due to the number of children involved. Advisory teachers, with broad preparation in industrial arts, office occupations, home economics, agriculture, etc., in addition to an occupational education expertise, will be needed. Certification and accreditation will need modification.

One of the largest problems involves finding space within the present curriculum. This, plus the inadvisability of having occupational education separate from the main stream, points to the need for a closely integrated curriculum.

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World of Work—K-6, Elementary Industrial Arts

Eugene Woolery

Most pupils enrolled in present elementary education programs have very little opportunity to become acquainted with the world of work or to see any relationship between classroom learning experiences and a future job or career. The study of careers and jobs in the kindergarten through sixth grade curriculum has not been stressed in the past, yet the school traditionally has been assigned the task of preparing pupils for everyday living and for life itself. The typical elementary school boy of today can look forward to spending about 40 years of his life in a useful occupation, and the girl in the grade school will possibly work for 25 years. Willa Norris, in her book, Occupational Information in the Elementary School, states:

> "The choice of an occupation is usually one of the most important decisions a person makes in his lifetime. To choose a vocation is to choose a way of life. A person spends a large portion of his waking hours on the job. In fact, many workers spend more time on the job than they do with their families."

For many years, we as educators have somewhat assumed that the working world of reality is out there and the classroom is tucked securely and safely in a large building known as school. It is a stark fact that many of the happenings in the classroom have had little relevance to the working world, and to postpone exposure to realistic work until the sunset of their school experience is neither valid, natural, nor honest.

Occasionally, a resourceful grade school teacher will embark on a classroom unit about community helpers in an attempt to provide interested pupils with an insight into the duties of a policeman or a fireman. This unit might just be topped off with a trip to the firehouse or police station. However, organized programs on occupations integrated into the curriculum of the elementary school are not common today. It was this realization that prompted occupational programs in the elementary school to be developed.

A state-wide committee representing educational leaders from many areas was organized to develop guidelines for use by local school districts in Ohio desiring to implement an elementary World of Work program. The local district could submit a proposal or course of action to the State Department of Vocational Education for funding and approval.

A brief examination of the guidelines would show:

1. Students will gain an awareness of the wide range of occupational opportunities available to them, a realization of how education helps to prepare for jobs and careers, and a feeling of respect for opportunities to earn a living.

2. Any local public board of education may prepare and submit a proposal which will be reviewed by a panel of persons who are knowledgeable concerning elementary education and the world of work.

3. Proposals must provide for all students, boys and girls, in grades K-6, and include a general program description showing a logical progression of activities and experiences.

4. Active student participation is essential, using tools, equipment, and materials to provide an activity-oriented approach to learning about jobs.

5. Provision must be made for in-service education and evaluation, and a budget breakdown must be included as part of the project proposal.

James Reynolds, Supervisor of Industrial Arts in Dayton, Ohio, realizing the need for such a program in the Dayton Schools, wrote a detailed proposal and submitted it to the Division of Vocational Education for funding. This proposal, in addition to meeting the state guidelines, stipulated that a separate elementary industrial arts facility be established and that a program coordinator be appointed. This facility, designed to meet the physical requirements of small children, would be a separate room containing equipment such as a jig saw, drill press, 24-inch-high benches, and a portable tool storage cabinet. Also, there would be several pieces of equipment for coordinator use, including a circular saw for preparing stock and a grinder for tool sharpening. The room would be of sufficient size to accommodate a classroom of approximately 25 pupils working on group as well as individual projects.

The coordinator, a person with an industrial arts background and a proven record for working successfully with elementary teachers, would be appointed to assume leadership of the program. This type of leadership would be essential in conducting the in-service workshop sessions for the teachers since the major emphasis would be upon industrial arts centered activities. The in-service sessions proved to be an important factor to the success of the program.

Initially, the teachers were somewhat bewildered by the thought of using tools, equipment, and foreign materials in everyday teaching. They were not completely sold on the program and expressed reluctant thoughts and concerns, such as: we don't have the background or training to do this; we fear for the safety of the children; we don't believe we could take our classes into the shop and do construction activities.

The coordinator had a seemingly monumental task in selling the program to the teachers, as well as orienting them to the proper utilization of materials, tools, and processes.

An intensive two-week workshop was held prior to the opening of school. Seventh and eighth grade career orientation teachers joined the new World of Work teachers for the morning sessions, which consisted of exemplary field trips, talks by local business and industrial leaders, and demonstrations and seminars on successful approaches to different aspects of the program. In the afternoons, the teachers went into the industrial arts laboratory to work with the tools, equipment, and materials. In this relaxed atmosphere, teachers became at ease working in a laboratory with a higher noise level than they were normally accustomed to in the usual classroom. They were also actually using tools and equipment they might only have heard or read about. Ideas were converted into the "real thing," as teachers constructed projects which their pupils might be making six weeks later. Drawing or assembling a model of a space capsule might just be a future correlating agent with a social studies unit on aerospace technology. Subsequent workshops were held during the year to improve teacher competence in advanced tool usage and production line organization. Here again, the leadership of the coordinator in the workshop sessions was a vital and necessary key to the success of the program.

The administration of the program might best be described as a team effort involving the coordinator, the school principal, the two teacher chairmen, and the teachers. The coordinator, who spends one full day a week at the school working with teachers and on special occasions with pupils, assesses the success of the program, provides the expertise, and insures that activities are continuous and on-going.

The role of the principal cannot be too highly emphasized since he sets the climate and provides the administrative expediency whereby the program can successfully operate. His interest, involvement, and genuine concern is evidenced by the fact that regular committee meetings take place and flexibility exists in administrative policies determining pupil activities. The principal must show enthusiasm for the program and give the needed time and effort to see that the program is not all talk, but action.

The two teacher chairmen are the team leaders of their respective grade levels and are responsible for teachers getting together on a regularly scheduled basis, so that communication is ever present and each teacher knows what the other is doing. In this meeting the agenda might call for suggestions for possible field trips to illustrate and heighten pupil interest in an upcoming unit on communications. Another meeting might be a brainstorming session of industrial arts activities to reinforce a science unit on space vehicles and the workers involved.

Through the combined efforts of the principal, coordinator, and teachers, the student-centered curriculum is developed, implemented, and evaluated. The curriculum areas of mathematics, social studies, science, and language arts have been categorically allotted broad career areas to insure coverage of occupations in the world of work. Science teams with the professions, while mathematics covers technological and business careers. Industrial arts activities complement and supplement all curriculum areas. For example, textiles might be a unit theme, with pupils participating in weaving on a loom made by them as a mass production project in industrial arts. The unit concept might be further enhanced by hearing a talk by a fabric salesman or by visiting a department store to see carpet, yard goods, and clothing being displayed and sold. Social studies would include, as a part of this same unit, distribution and marketing careers, such as tailoring, delivery service, and retail sales. Additional industrial arts activities could include the building of a delivery truck, an airplane, or a ship.

The future units developed and the resultant activities designed would succeed in providing a general education of successful, well-rounded, behaviorally acceptable experiences.

However, to accomplish any type of acceptable educational program, money is required. The World of Work budget is based upon a state appropriation of $20.00 per student distributed among four categories. The first category provides for a yearly teacher coordinator fee and stipend allocations for teacher in-service. Instructional supplies is second and accounts for the largest single amount in the budget. A third category is necessary to equip a laboratory with a minimum of equipment. Finally, miscellaneous services which include monies for field trips and equipment rental provide the required flexibility that fits the budget to the program.

In closing, I would like to quote a paragraph from the original proposal:

> "Everyone must work. That alone is sufficient validity for encompassing career information into the curriculum from kindergarten on. The child should know where and what kind of work his father or mother does. Later he needs to know that which his neighbor contributes, then the business and industrial life of the community and the extension nationally. It is not at all unrealistic to expect that eventually today's youngster should be equipped with a concept of the global economic structure."

Is it not time to begin?

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Why Elementary School Industrial Arts

William R. Hoots, Jr. (Moderator), William A. Downs, Norma Measley, and Mary-Margaret Scobey

Moderator: The major purpose of this session is to discuss the general theme, "The nature of industrial arts in the elementary school." This discussion should serve as a background for programs to follow that will be primarily concerned with the implementation of elementary industrial arts programs or with reporting on programs that are in operation.

Many of you are familiar with the report of the National Conference on Elementary School Industrial Arts. The conference was composed of 20 outstanding educators in the field of elementary school industrial arts. I was privileged to serve as the director, making the total number of conference members 21.

One of the most significant outcomes of the conference was the following definition of elementary school industrial arts: "Industrial arts at the elementary school level is an essential part of the education of every child. It deals with ways in which man thinks about and applies scientific theory and principles to change his physical environment to meet his aesthetic and utilitarian needs. It provides opportunities for developing concepts through concrete experiences which include manipulation of materials, tools, and processes, and other methods of discovery. It includes knowledge about technology and its processes, personal development of psychomotor skills, and attitudes and understandings of how technology influences society."

This definition says that industrial arts should be a part of the elementary school curriculum for every child and that it should help them understand about how man deals with the technological influences on his life. It says that industrial arts will help the child develop an understanding of how technological change improves his environment and contributes to the fulfillment of his needs, that a learner may develop concepts of work and understand the processes of work through actual practice, and that through these he develops a positive self-concept and a positive attitude toward technological change.

Today the panel members will attempt to answer the question, "Why Elementary School Industrial Arts?" as they discuss the following four questions; (1) What is the nature of industrial arts at the elementary school level? (2) What is the relationship of industrial arts to the total elementary school curriculum? (3) What are the benefits of industrial arts to elementary school pupils? and (4) What are some of the trends in elementary school industrial arts?

Question 1. What is the nature of industrial arts at the elementary school level?

Dr. Scobey: I believe that industrial arts is a discrete discipline. That is, it encompasses a body of knowledge, skills, attitudes, and activities related to man's way of changing raw materials for the increasingly sophisticated needs of daily life. Industrial arts seeks interpretation of industry and technology on the cognitive, affective, and psychomotor skill learnings related to technological products, the work-world related to them, and their influences on society.

Moderator: Would you explain your last statement?

Dr. Scobey: Industrial arts experiences are not project activities alone. The concrete activities in industrial arts that help children discover the complexities of technology must be a part of a network of experiences that will help learners draw thoughtful conclusions and modify attitudes, as well as develop skills in using tools and materials. Just to make a tie rack or to mold plastic is not enough, nor should building an electric motor be an end in itself. The learner needs to know why that motor works and what influence that working motor has on our way of life. And perhaps he also needs to know the difference between a motor and an engine!

I also believe that industrial arts includes both training and education. The replicative and applicative aspects of training (learnings to be used in predictable situations) are reflected in skills such as using tools and materials. The associative and interpretative learnings, or education (used in unpredictable situations), are found in knowledge about the world of work, ways and means by which materials and products are obtained and prepared, and the changes produced by them in the pattern of life.

Mrs. Heasley: I see industrial arts at the elementary level as a subject that involves activities designed to help children understand people and the world in which they live. It involves the study of man and his technology in industries, businesses, services, and recreations.

As the child is involved in thinking, investigating, planning, and evaluating for project construction, he is also developing basic academic skills in reading, English, math, social studies, and science. Yet, as he constructs the project, he is developing personal skills that help him to deal with and adjust to his environment and life situations.

Dr. Downs: I would like to take a brief look at the nature of the learning process. Dr. Scobey and Mrs. Heasley have already implied that learning is a very complicated process. Learning theorists tell us that for effective learning to take place, the learner (a child in this case) must respond physically, intellectually, and emotionally as a total person to a whole situation. In other words, the learner must experience; he must interact with the world in which he lives; he cannot remain inactive. Effective learning takes place when the program is flexible and provides a variety of experiences which are, in part, physical in order that the child's basic needs are met and that he will approach the learning task with interest and enthusiasm. This is the point at which industrial arts comes into play at the elementary level.

I like to think of industrial arts at the elementary school level as a vehicle by which or through which the classroom teacher can provide a wider variety of learning experiences for children than are normally provided for children in the traditional elementary school program. In order to satisfy the aesthetic and utilitarian needs of children, their experiences should involve opportunities for interaction, exploration, planning, construction, experimentation, and problem solving, to mention but a few. Properly selected industrial arts activities provide such opportunities for the learner as well as providing the learner an opportunity to assume responsibility, to make decisions, to think and express himself freely and creatively, and to receive immediate feedback. I see this not as a crafts approach designed for only aesthetic and leisure time pursuits, but as an approach by which children are given an opportunity to develop a deeper understanding of our industrial/technological society. Mrs. Heasley said it very well when she said, "As a child is involved in thinking, investigating, planning and evaluating, he is also developing basic academic skills in reading English and the other subject matter areas of the elementary school curriculum."

Moderator: This is a question that will probably be debated for years and never be fully resolved to the satisfaction of everyone. Maybe we should move on to the second question.

Question 2: What is the relationship of industrial arts to the total elementary school curriculum?

Dr. Downs: Years ago, when the work of the world was in the home, on the farm, or in the village, children were afforded many opportunities to learn how the basic needs of life were met. This is no longer the case in our complex industrial/technological society of the 70's. There is little opportunity for the direct observation of the world of work by children. Yet, there is a definite need for children to understand the complex life of which they are a part and how it came to be if they are to develop the knowledge, attitudes, and appreciations essential to the steady progress of civilization.

Based on the changes in our societal structure, there are educators who would advocate that industrial/technological experiences should form the foundation of the elementary school curriculum. I cannot accept that position, even though I realize that well over 50% of the nation's labor force is engaged in occupations directly related to industrial and service-type occupations.

Another group of educators advocate industrial arts as a vehicle for imparting occupational information. I feel that industrial arts can make its greatest contribution when used in a supportive function for implementing more effectively the existing content of the elementary school curriculum. The enriching experiences that are inherent in this latter approach will more than provide a sound context wherein children may experience, directly or indirectly, a wide spectrum of the world of work.

I feel that the complexity of our world makes it imperative that children experience a large segment of our technology.

The unit approach to curricular organization is used by most of today's elementary school teachers and serves as an excellent vehicle to convey this kind of information. Industrial arts experiences are well adapted to this scheme of curricular organization, and through this integration of industrial/technological content with the existing curricular unit (through information and activity), the child is afforded a much better opportunity to learn how an idea eventually becomes a product.

Dr. Scobey: I must agree that industrial arts should be an interdisciplinary part of the elementary school curriculum. That is, the concept of industrial arts is developed through integration with other disciplines. This is necessary to make the most economical use of teaching-learning time and to help the learner discover the relationships between industry/technology and other areas of life. The tendency to break down disciplinary lines in the elementary school is already established.

There are three interdisciplinary aspects of industrial arts. First, the academic content of industry/technology is related to many subjects. For example, physics, design, advertising, and geology are some of the areas from which knowledge is needed to develop industrial/technical processes and products. Therefore, few industrial arts activities can be separated from content in other disciplines. Second, the method of teaching industrial arts, its activities, extend and support skills, attitudes, and ideas learned in other curriculum areas. For example, we well know the need for measurement and other mathematical computations in construction. To solve problems and organize information in industrial arts, students must use language skills such as research and reporting. Thirdly, the skills learned in industrial arts can be used to produce instructional aids that will make learning more interesting and productive for other disciplines. Examples of these are the abacus, pocket chart, and the electric circuit board.

I agree with Dr. Downs that the interdisciplinary character of industrial arts can best be utilized within the context of a unit of study. The focus for such a unit may come from any one of several disciplines, with content and activities from industrial arts integrated within it.

Mrs. Heasley: I feel that industrial arts should be an integral part of the total elementary school curriculum. Any analysis of a science book shows many experiences which gain value when involvement with tools and materials develop the experiment. Acting, discussing, and analyzing how this experience is useful to man gives meaning to an otherwise isolated activity.

Moderator: How does this lead the learner to know about the body of knowledge that Dr. Scobey mentioned a few minutes ago?

Mrs. Heasley: The body of knowledge becomes important when it is analyzed from the point of its effect on man's life. Therefore, children should be guided in critical thinking and planning, using the design that seems to be man's involvement with technological developments. That is: 1) recognize a problem, 2) collect, organize, and analyze data, 3) develop an hypothesis for solution, 4) execute this idea by planning and researching and test the idea by experimenting, constructing, demonstrating and evaluating, 5) put the idea to work, 6) re-evaluate the result, and 7) use the product for man's benefit until another problem arises. Through this involvement, children can gain understanding of changing raw materials to finished products and interpret technology in all phases of man's work and life.

I would like to add that every culture is and has been affected by technology and its implications. How man develops and uses his tools, machines, and materials and how this affects him is social studies.

When a child develops an idea, searches references, designs a plan, gets involved in research, experiments, constructs, demonstrates, and evaluates his work, he is making decisions that give dimension to abstraction. This is true at all levels of learning. This may include industrial arts experiences. This involves the development of reading, writing, researching, analyzing, and problem-solving skills.

Cost analysis and material analysis involves the use of math skills. Measurement experiences using a variety of tools and materials strengthen math skills.

Moderator: Maybe we have come to the point where we should take a look at our third question.

Question 3. What are the benefits of industrial arts to elementary school children?

Mrs. Heasley: I see elementary school industrial arts providing six basic benefits for children. They are:

1. An orientation to the world in which they live.
2. Opportunities to use and develop a variety of skills.
3. Opportunity for mind and body to work as a team and therefore develop levels of coordination.
4. Opportunity for analysis of parts to a whole.
5. Opportunity for interactions; students' interactions, teacher-student interaction, student-material-tool interaction.
6. Opportunity to organize, plan, create, and evaluate using a variety of media.

These benefits should be available to all children, including exceptional children, the mentally retarded, the handicapped, and the deprived. Industrial arts experiences can benefit gifted children by providing a unique opportunity for them to utilize their academic knowledge and put their creative thinking into concrete form. The value for these children lies in the fact that they can work more independently and can individualize their own instruction. With limited guidance, they will often go beyond teacher expectations. To this end, they should not be handicapped by being required to proceed at "whole-group pace."

Benefits to children in special education are much the same as with all children. However, when considering children of low intelligence, the need for greater direction from the teacher, a pace set much slower, and simpler projects often suggested by the teacher would necessarily be a consideration. Creativity in most of these children will be limited.

When considering neurologically handicapped children, the teacher must plan for the unexpected and help these children accept something different. The values of elementary industrial arts, as I see them for this group, are:

1. The opportunity to begin and follow to completion something of concrete value to the student.

2. The opportunity to be a part of a group. These children are often isolated for their basic schoolwork because they are so easily distracted. Being part of a group is important for becoming a successful and happy adult, no matter what the limitations.

Industrial arts for culturally deprived elementary children provides:

1. A variety of experiences not gained through normal childhood opportunities.
2. The opportunity to make and own something.
3. The opportunity to feel successful. This is especially important where children are having difficulty with schoolwork because of a deprived background.
4. Experiences that develop an awareness of things in the world that they may never have been exposed to.

Dr. Scobey: In my opinion, good teaching is much the same whether one is working with a normal child, a physically or mentally handicapped one, or a child from a cultural group that is different. The teacher must be concerned with individual differences, levels of learning and interest, and ways in which children can be motivated to discover ideas for themselves. The content of industrial arts, with its activities rooted in concrete experience, can contribute to such good teaching in several ways.

First, learning results best from concrete experience, and should develop from the concrete to the abstract. The exploration of industrial processes naturally involves much manipulation, experimentation, observation, and problem solving at the concrete level.

Second, study of the industry/technology of any group of people in any historical era or any geographical location provides a wide variety of activities suitable to varying interests, manipulative skills, and verbal capacities.

Third, there are a number of concomitant learnings resulting from well-taught industrial arts activities. There is training in the use and safety of tools and machines. As Mrs. Heasley has already pointed out, there is the opportunity to plan, research, solve problems of, and complete an individual or group task. There is the opportunity to evaluate one's own work and cooperate in the evaluation of the work of others. And finally, when children choose from so many kinds of pursuits in industrial arts, there is high motivation in active, manipulative learning.

Dr. Downs: I would first like to relate the findings of experimental research in the area of elementary school industrial arts. All of the experimental research to date indicates that children who have experienced an elementary school industrial arts approach to learning have either made significantly higher gains in pupil achievement and retention or are statistically equal to children who have studied by more traditional approaches. Similar findings are also reported in these studies which measured student and teacher attitudes toward elementary school industrial arts. Dr. Scobey mentioned concomitant outcomes. Researches have reported such concomitant outcomes as: more outside reading, increased interest and motivation, improvement in silent reading comprehension, and improvement in work-study skills for children who experienced elementary school industrial arts activities. Such outcomes speak highly for this approach to education.

I am concerned not only with the merits that elementary school industrial arts provides for the child in the regular school program, but also with the educational opportunities that it provides for the less fortunate child. Children in special education, for instance, need first-hand experiences with the real world just as do all children, but the need for these children is multiplied because of their added learning difficulties. I, too, feel that industrial arts experiences must be kept on a very practical doing level through the use of the tools, materials, and processes of our industrial/technological society.

Industrial arts activities deal with things that have practical meaning, things that can provide a common ground from which teacher and pupil start together. Children from culturally deprived backgrounds especially need these first-hand experiences. Statistics reveal that a very high percentage of these children will become involved in occupations directly related to industry; therefore, we need to start early to give them rewarding and satisfying industrially-oriented experiences which will foster a positive attitude toward the world of work. Industrial arts activities provide an opportunity to develop a higher degree of self-confidence through practical and first-hand experiences, a benefit not often found in other disciplines.

Moderator: We have taken a brief look at the nature of elementary school industrial arts, its relationship to the total elementary school curriculum, and its benefits to children. Now let us turn our thoughts toward the future.

Question 4: What are some of the trends in elementary school industrial arts?

Dr. Scobey: Trends in industrial arts at the elementary school level seem to follow many of the recent improvements in teaching and learning.

First, the concept of industrial arts includes a broader base of materials than wood and paper. No longer is wood construction the only type of activity emphasized. There is better balance of the many kinds of materials man uses, and the related processes needed.

Second, there is an ever-expanding variety of activities included in industrial arts, the heart of which is still concrete experience. We are advancing beyond construction to research, observation, experimentation, and many kinds of manipulation.

Third, industrial arts is being recognized as a discrete discipline embracing the academic content of industry/technology.

Mrs. Heasley: Some additional trends in elementary industrial arts that I see will take these directions:

1. There will be an increasing emphasis on the study of technology. That is somewhat in support of what Dr. Scobey ha said, but I believe that technology is becoming an important word with multiple meanings used in almost all of the new textbooks. Publishers are beginning to accept the fact of technology's tremendous impact on man and are realizing that in order to understand such a great phenomenon, study must begin with a solid foundation at a very early age. Elementary science textbooks are now beginning to include a study of the application of science in a technological process. Elementary social studies textbooks consider man in his environment and how his work, leisure, and life are affected by the type and degree of his technology. The words tools and materials are becoming more encompassing.

2. Administrators will move to packaged curriculum materials. Educators are beginning to buy package deals. When they buy a textbook or adopt a program they want to have all the materials and references that are supplementary to the basic adoptions. These packaged supplementary items include large charts, pictures, filmstrips, records, and tests. In science, additional equipment for experimentation is also included as part of a packaged learning unit. This is done for expediency in buying as well as the realization that multi-media approaches are considered enriching.

Companies will begin to place on one cart tools for a greater variety of material experiences. Filmstrips, slides, and simple books also included will help the classroom teacher help the students and help the students help themselves in industrial arts experiences. Booklets with projects designed, including orthographic drawings with specifications, will also help the teacher.

3. Elementary industrial arts experiences will result from team teaching and team planning between the classroom teacher and the elementary industrial arts specialist. As elementary industrial arts moves to the study of technology and considers its tremendous scope, determination of the best use of personnel must be made. Because industrial arts content and method is so important and because most elementary school teachers have a limited background in the subject, a move to team teaching will be made. Elementary industrial arts specialists and elementary school teachers will plan and work together, supporting strengths and working to improve weaknesses so that industrial arts may become an integrated part of the curriculum. This work may be in a laboratory situation or in the classroom by using a portable tool and material cart. At all times, both teachers should be part of the project experience.

4. There will be a move toward recognizing and building for successes. Although the importance of the feeling of success for future learning has been known for years, a great deal of the past evaluation has been based on failure. Educators are now beginning to look at the pluses for all children. Elementary industrial arts provides opportunities for different types of experiences and therefore a variety of evaluations.

Speaking of trends in life and education in general and relating this to industrial arts, we must consider that most trends seem to go in cycles. For example:

Women's clothing styles are returning to those of the 1920's. Men's hair styles are like the 1770's and earlier. Some new editions of elementary reading texts are taking ideas from McGuffey Readers.

Because of critical reports like those of Charles Silberman, I believe the trend in education will return to more active involvement, possibly like that advocated by John Dewey and Bonser.

Also, increasing knowledge expansion will necessitate a search for new avenues for learning. Here industrial arts educators will play an important role in proving the enriching and unique possibilities involved in their discipline.

New tax reforms in many states will help with educational expenses but will also place an increasing emphasis on accountability. This will encourage teachers to search for the most efficient and enriching way to enhance learning. Surely industrial arts will play a major role.

Dr. Downs: There has been a de-emphasis on the crafts as a significant part of the elementary school industrial arts program in recent years, and I hope this trend will continue. The crafts era is over, and I look forward to an industrial/technological emphasis to become the predominant pattern in elementary school industrial arts.

Even though we continue to gather research which is supportive of elementary school industrial arts, I look for a relatively slow growth in elementary school industrial arts programs in the early years of the 70's. There may even be a de-emphasis on all types of elementary school industrial arts programs across the nation. I hope that history proves me wrong, but the state of the economy leads me to think that I will probably be correct.

I think the philosophy that will be the most prevalent throughout the 70's will be one that utilizes industrial arts experiences to support the existing elementary school program. I look for this to be especially true in communities which have little or no industry. Larger cities will very likely place more emphasis on occupations related to our industrial/technological society because of the large percentage of the population that will work either directly or indirectly with industry. I agree with the other panel members that elementary school industrial arts will play a key role in such occupationally oriented programs. We are already experiencing this trend brought on by the presence of federal funds for such an orientation.

I look for industrial arts activities to receive much greater attention in all of the areas of special education. The emphasis that the federal government is already placing in this area will cause us (and rightly so) to focus attention on the problems of special education and cause us in the profession to investigate the contributions that industrial arts experiences can make to this field.

Moderator: These discussion indicate that industrial arts is that part of the school curriculum aimed at relating education to life in a technological society. If boys and girls are to learn about the effects of technology on their lives, industrial arts must become a part of the total curriculum beginning with kindergarten and grade one. It must serve as a catalyst to bring all segments of the curriculum together to give each real meaning in the lives of children. Concrete experiences in industrial arts will help the child develop a better understanding of himself and of his environment.

The need for industrial arts at the elementary school level is growing at the same phenomenal rate as technological change. Educators are slowly beginning to see its benefits, and there is evidence that some form of technologically-oriented education will find its place in all but the most traditional elementary school classrooms. It must if our children are to develop into adults who are capable of handling the problems of change in our industrial/technological society.

Dr. Haats is on the faculty of East Carolina University, Greenville, North Carolina. Dr. Downs is from Central Missouri State College, Warrensburg, Missouri. Mrs. Heasley is with Summit County Schools, Akron, Ohio. Dr. Scobey is on the faculty of San Francisco State College, San Francisco, California.

Fifth Grade Children Demonstrate Plastic Technology

INDUSTRIAL ARTS IN THE ELEMENTARY SCHOOL: EDUCATION FOR A CHANGING SOCIETY[1]

All who are concerned with the changes that are taking place in our society—the news media, economists, businessmen, and industrialists—insist that the phenomenal change that has taken place during the past decade is nothing compared with that to come. The age in which we live is one of such rapid change that even those who control and cause the change are frightened by its implications. The average citizen cannot completely comprehend the transformation; yet it is he who is creating the ensuing problem and his children who must cope with it.

Educators must awaken to the fact that they must keep pace with the changing technology. Many new and innovative devices, composing what is termed teaching technology, have been developed to help the teacher do a more effective job of teaching. But little has been done to change what is taught. Children need the exhilaration of manipulating materials, the joy of accomplishment and personal discovery as a part of growth and development and mental health. Children must learn about the world in which they live if they are to be expected to be productive and useful citizens in the world of tomorrow.

Industrial arts education is that part of the school curriculum that is dedicated to teaching boys and girls about the technological aspects of their environment. It, like all subjects, must start with the basic concepts and principles and build toward a full and complete comprehension. It, like all subjects, must originate at the beginning of the child's education. Since there are aspects of technology that are appropriate for the kindergarten child, it is here that we must begin to build the child's understanding of his world.

The discussions that follow deal with the nature of industrial arts in the elementary school, different approaches and requirements for its implementation, and some ways of meeting and solving some of its problems.

A DEFINITION OF ELEMENTARY SCHOOL INDUSTRIAL ARTS[1]

Industrial arts at the elementary school level is an essential part of every child's education. It deals with ways in which man thinks about and applies scientific theory and principles to change his physical environment to meet his aesthetic and utilitarian needs. It provides opportunities for developing concepts through concrete experiences which include manipulation of materials, tools and processes, and other methods of discovery. It includes knowledge about technology and its processes, personal development of psychomotor skills, and attitudes and understandings of how technology influences society.

IMPORTANCE OF PLASTICS TODAY

Today, plastics comprise one of the nation's few billion dollar industries in the United States. It is also one of the nation's fastest-growing industries, growing at a rate five times that of all industry. At all levels of everyday living—in housing, food, clothing, transportation, communications—plastics are at work in the end products, in the machinery of manufacture, in packaging for sale.

Children encounter plastics at home, at school, at work, and at play. Since plastics are so important in everyday life, children should have the opportunity to learn about plastics in their classroom and to participate in activities using various kinds of plastics.

Activities using plastics lend themselves to correlation with classroom work in math, science, social studies, language arts, and art as explained below. Industrial arts classes provide children with the direct experience of learning about plastics by using them: acetate plastic in vacuum forming; polystyrene plastic in injection molding; polyester resin in fiberglass laminating; acrylic plastic in heating and shaping objects. The direct

[1]National Conference on Elementary School Industrial Arts, East Carolina University, Greenville, North Carolina, 1971, pp. 1-3.

experience with materials and processes helps students learn about science and math principles, often too abstract to understand when presented just through books. Industrial arts presents abstract concepts in a concrete manner. The students discover and understand concepts and apply them to other topics or problems.

"PLASTIC"

Plastic is a synthetic or man-made material that is compounded from various chemicals. While the compounds are basically hydrocarbons, thousands of variations have been developed which have resulted in plastics with about any characteristic imaginable... plastics are commonly divided into two major categories: (1) thermoplastics, which can be reheated and reformed an infinite number of times, and (2) thermosetting, plastics which are "set" into their final form when produced and cannot be reformed through the application of heat.

Plastics are replacing materials such as metal because they have high strength for their weight, are good insulators, are durable, and are adapted to mass production.

The following describes the materials used so the children may learn about them as they work with them. The industrial arts consultant provides this information or inspires the children to use references to find it.

Polyester Resin - thermosetting (fiberglas laminating)
made from air, coal, and water
adding catalyst (hardener) completes hardening process
strong and tough
superior surface hardness
made in range of colors
highly resistant to most solvents, acids, bases, sets
good weathering qualities
low water absorption rate
doesn't conduct electricity

Polystyrene - thermoplastic (injection molding)
meets demand for economical, mass-market products
quickly and easily formed, lightweight, high output/pound
makes economical, colorful, hard-surfaced products
can be produced with smooth, satin texture or a special texture
available as a clear transparent, translucent, or opaque material in a variety of colors
low water absorption rate
shouldn't be exposed to continued outdoor uses
not harmed by freezing temperatures or short period of heat approaching boiling point of water
hard and rigid
good electric insulator
resists most foods, drinks, and usual household acids, oils, alcohol, vinegar, BUT NOT citrus fruit rind oil, cleaning fluids, gasoline, turpentine, nail polish and remover
not recommended for articles subject to severe impact or flexing

Acrylic - thermoplastic (heating and shaping)
derived from synthetic resins made from coal, air, water, and petroleum
exceptional clarity—good light transmission
comes also in brilliant opaques, transparent, or translucent colors
also made with corrugated and patterned surfaces
strong and rigid
resistant to weather and temperature (except boiling water)
scratches easily
an excellent insulator
unaffected by most household chemicals (as weak and strong alkalis, bleaching compounds, window cleaning solutions, salt, vinegar, animal and mineral oils, foods usually found in homes)
attacked by perfume, gasoline, cleaning fluids, acetone, chloroform, strong solutions of oxidizing acids

Acetate - thermoplastic (vacuum forming)
extremely rigid without being brittle
withstands adverse conditions of temperature and humidity
resistant to most solvents
has extreme toughness, outstanding tensile strength, stiffness, and fatigue life

PLASTICS TECHNOLOGY FOR CHILDREN

Miss Janet Rabe taught the plastics technology unit in the children's classroom before the convention, April 12 to April 21. The children demonstrated their work at the meeting so visitors could observe them at work. The activities included thermoforming, vacuum forming, injection molding, and layup of reinforced plastics. There was a videotape of the children at work in their own classroom.

I. Objectives
   1. Students learn about plastics by using them to make useful articles.
   2. Students become acquainted with the many uses of plastics in everyday life by working with the materials and studying them.
   3. To have children apply classroom math, language arts, and science to making things with plastics.
   4. To help children develop positive social skills by working on individual and group projects with plastics.
   5. To give children practice in reading and following directions when learning to make plastic objects.

II. Values
   1. To appreciate the many uses of plastics today.
   2. To understand the past, present, and future growth of the plastics industry.
   3. To learn how the plastics industry affects society (people).
   4. To appreciate the role of research in plastics technology.
   5. To appreciate the value of following directions accurately.

CORRELATION WITH OTHER SUBJECTS

Social Studies

Children may use the processes discussed to make small objects to be used in dioramas or displays. A map could be displayed that would show where leading plastics industries are located. Students may find out whether or not (or for what) plastics are used in other parts of the world. The class could compare cost, efficiency, etc., of producing a specific product from plastic rather than another material. Children can discuss how various products affect our lives—what it would be like without them.

Science

Concepts in science include learning the properties of the different plastics as well as the processes for their use. The effects of heat, air (vacuum), pressure, and added chemicals become clear through concrete work experiences. Students may make posters and/or diagrams showing how the vacuum forming and injection molding machines work, how plastic is changed from one form to another.... Students may wish to report on where plastic comes from and the basic kinds of plastic.

Math

Students strengthen their math skills as they check operating temperatures and time cycles for the various forming processes. Measuring (linear, solid, liquid) is involved as the children get materials ready to use for plastic projects, draw patterns, or construct forms. Geometric shapes and changing shapes are apparent in both the planning stages and the actual creation of the object. Size relationships become increasingly important as students must make sure that parts will fit, that they have enough material left.

Language Arts

Reading directions accurately becomes important for operating equipment successfully. Reports related to projects made or research on plastics may be prepared. Charts, posters, or displays may be prepared in order to convey desired information about plastic technology.

Art

Art concepts are applied during the creation of patterns for projects or in design for their duplication. Art is also involved in decorating or in mounting various plastic projects.

EVALUATION

As with other classroom work in the elementary grades, the evaluation is primarily subjective and informal. The classroom teacher and the consultant frequently question the children, not only to stimulate their thinking but also to evaluate their understanding of the activities in the unit. The teachers may adjust the work schedule or review some parts of work as a result of the evaluation.

The main purpose of making a video-tape is to show the convention audience the children at work in the classroom. However, this may be reviewed by the teachers and/or the children to evaluate their work.

BEGINNING THE UNIT

The classroom teacher may ask students to bring in objects made from plastic before the unit begins. Then as the class works with each plastic process, they may pick out examples of each particular process from the objects they collected.

The first day, the industrial arts consultant will lead a class discussion of plastics technology to identify the plastic objects that the children use at home, at school, and at play. By identifying the use of these objects, a list of general characteristics will be drawn (color, weight, resistance to moisture, strength, flexibility, cost, and others). Then the consultant will describe different ways of fabricating plastics like thermoforming, vacuum forming, injecting, and reinforcing. This leads to a brief description of the plastics experimentation the children may do to become acquainted with the processes. The teachers will then organize the class into work groups and plan a schedule for the remainder of the week. The following four sections contain plans and resource material for the units.

VACUUM FORMING

I. Objectives
   1. Students try the vacuum forming process to find out how some household goods are made.
   2. Students operate the vacuum forming machine and be able to explain (orally or in writing) how it works.
   3. Students make an original pattern and then form the plastic sheet over it.
   4. Students will be able to list common household objects formed by the vacuum forming process.

II. Tools, Materials, Supplies:
   1. Plasticene for patterns, 50¢/lb.
   2. Acetate sheets, 0.0075, 7" x 7" $4 per 100 sheets
   3. Vacuum forming machine (with vacuum) for 7" x 7" sheets, [2]$165
   4. Scrap wood for patterns
   5. General hand tools for wood working: hammer, coping saw, file, hand drill, etc.
   6. Fastening materials (nails, glue)
   7. Scissors
   8. Wood, cardboard, or construction paper for mounting
   9. Latex paint, tempora paint, felt tip markers for decorating

III. Introduction

Bring in samples of vacuum-formed products—discuss how they were made. Present vacuum forming machine and demonstrate process—discuss how forms are made. Have children discuss possible activities. Experiment with reheating the acetate plastic, heating but not using vacuum, using blower end of vacuum....

[2]Provided for demonstration by Industrial Arts Supply Company, 1408 West Lake Street, Minneapolis, Minnesota 55408.

IV. Steps
1. Create the pattern
   a. with modeling clay, like plasticene
   b. from plastic, wood, or paper
   c. from metal
2. Form the objects, using sheets of acetate plastic (follow manufacturer's directions for using machine)
3. The acetate sheets may be cut with scissors, and Duco Household Cement will fasten sheets together. Students may wish to mount the plastic object on wood, cardboard, or paper. The plastic objects may be painted or decorated with felt tip markers.

V. Summary and Evaluation
Discuss with students what they found out about acetate plastic, heat, "vacuum".... Have them discuss procedure they followed, problems (if any), "discoveries." Children may suggest ideas for future projects.

VI. Applications
1. Have children try a Mattel toy vacuum former (may be used at home). Compare and contrast with machine used at school.
2. Look for packaging materials made by vacuum forming process.
3. Make a display of commercially-made and student-made vacuum formed objects. Label those with specific uses.

VII. Things children can make as part of their experimentation

Wall plaque	Coaster	Figurine
Monogram	Labels	Pin tray
House number	Mold for plaster casting	Labels for booklets
Door label	Mold for liquid plastic	Decorations for wood project

INJECTION MOLDING

I. Objectives:
1. Students use the injection molding machine so they can describe the process of injection molding.
2. Students operate the injection molding machine and complete a project.
3. Students will be able to name common objects of plastic made by the injection molding process.

II. Tools, Materials, Supplies:
1. Emco Model #250 plastic injection molding machine, [3]$325
2. Molds for above machine (see catalog), $40 each
3. Polystyrene plastic and powdered tempera colors, $1.20/pound
4. Woodworking tools, supplies, and machines

III. Introduction
Have process chart available. Discuss previous knowledge of effects of heat and pressure on plastic. Demonstrate use of injection molding machine. Have students suggest possible projects. Experiment with changing colors of plastic, reheating and reusing plastic.

IV. Steps: see manufacturer's directions for using machine

V. Summary and Evaluation
Discuss process of injection molding, the changes in form of the polystyrene, effects of heat and pressure. Review problems, new concepts, further project ideas.

VI. Applications
Class might set up assembly line project centered around injection molding process. Collect and display objects formed by this process. Use process flow charts.

VII. Things children can make as part of their experimentation:

Chess men	Desk sets	Golf tee
Peace symbol	Pen holder	Key chain
Fishing lures	Key tag	Checkers
	Tree ornament	

[3]Provided for classroom work and convention program by Brodhead-Garrett Company, 4560 East 71st Street, Cleveland, Ohio 44105.

THERMO-FORMING ACRYLICS

I. Objectives:
   1. Students design a paper pattern for their project.
   2. Students cut out and prepare the plastic for shaping.
   3. Students heat and shape their planned plastic project.
   4. Students will be able to explain the thermo-forming process and the changes of form the plastic goes through.

II. Tools, Materials, Supplies:
   1. Acrylic sheets (plexiglas) 1/8" or thinner trim pieces, about 75¢/pound
   2. Infrared heat lamp in lamp base or oven (most effective) with thermostatic control (limit temperature to 350°)
   3. Asbestos gloves
   4. Paper, scissors
   5. Rubber cement, Duco cement
   6. Jig saw
   7. Woodworking or metalworking files, file card
   8. Flint paper—coarse, fine
   9. No. 320 silicon carbide abrasive

III. Introduction

Discuss the effects of heating and cooling on plastic. Show how a piece of acrylic plastic can be shaped after heating. Have students suggest ways of shaping plastic, discuss the different forms it could take and the relationship of cutting to the original shape, then bend the plastic into the final form.

IV. Steps
   1. Plan the project
      a. A full-size paper pattern is advisable.
      b. When edges are concentric, the paper can be folded and cut so the parts will match perfectly.
      c. When bends or twists are considered, the paper will shape somewhat like the plastic, except that the latter will stretch in shaping.
   2. Cut to size
      a. The upper grade children can effectively use the jigsaw for cutting acrylic plastic. The paper masking on the surface will not only protect the surface but also prevent the chips from melting and fusing the plastic pieces together after the plastic is cut.
      b. The woodworking or metalworking files can be used to shape the edges, using the file card frequently to clean the teeth of the file.
   3. Polish the edges
      a. While the masking paper protects the surfaces and the object is flat, the edges can be polished.
      b. A sequence of coarse flint, fine flint No. 320 silicon carbide is used for polishing.
   4. Heat and Shape
      a. The masking paper must be removed from the surface before heating, as it will keep the plastic from stretching.
      b. When the plastic is warmed to about 300 degrees, it will become soft and rubbery. Asbestos gloves are needed to handle the plastic and hold it in position while it cools. It is advisable to have some jig or object to help shape the plastic.
   5. Duco Cement is an effective adhesive for children to use on acrylic plastic because it has enough substance to fill imperfect joints and cracks.

V. Summary and Evaluation

Discuss thermo-forming process—any problems that come up, "discoveries." Children may suggest ideas for other projects. Review the changes in form that the plastic goes through as a result of heating and cooling.

VI. Application:

Make a display of objects produced by the thermo-forming process (commercial and student-made). Display charts that show the thermo-forming process.

VII. Things children can make as part of their experimentation:

Bracelet	Scatter pin	Coaster
Ring	Letter opener	Pencil holder

Tie clip	Photo holder	Napkin holder
Plant stand	Small bookends	Letter holder
Name plate	Salad fork and spoon	Nut dish
Earrings	Small candy dish	Earring rack
	Towel bar	Zipper pull

FIBERGLAS LAMINATING

I. Objectives:
  1. Students will be able to list (orally or in writing) the steps in laminating after trying the process.
  2. Students will be able to describe the change in form of the polyester resin and the relationship between the catalyst and the resin after using this process.
  3. Students will be able to explain the reason for using the glass cloth for laminating after experimenting with materials to find the purpose.

II. Tools, Materials, and Equipment
  1. Polyester resin with hardener, $1.75/quart
  2. Solvent for polyester resin
  3. Newspaper, rags
  4. Fiberglas cloth, 6 ounces, 38" wide, $1.25/square yard
  5. Mylar laminating film (lightweight), 40¢/square yard
  6. Rubber gloves
  7. Paper cups, 5 ounces, marked by ounces
  8. Eyedropper
  9. Stirring (coffee) sticks
  10. Tin snips
  11. Scissors
  12. Sandpaper

III. Introduction

A dramatic demonstration of the catalyst acting upon the polyester resin (1/2 ounce resin, 25 drops hardener) could be the starting point. Discuss what a catalyst is and what might happen if too much or too little is added. Discuss possibilities of what can be laminated—pictures, flowers, coins. Talk about the glass cloth, how it is made and what it is used for.

IV. Steps:
  1. Plan and prepare materials
     a. The materials to be laminated should be prepared; leaves should be dried and pressed flat, fabrics washed and pressed, pictures or name printed or crayoned, and pictures trimmed to size.
     b. Magazine pictures are not good to use because the printing from the back of the page will show through when the resin soaks the paper.
  2. Prepare the work area by padding the table with about four thicknesses of newspaper.
  3. A piece of glass cloth should be cut, about 2" longer and 2" wider than the finished picture. Two pieces of clear laminating film should be cut, each about 6" wider than the glass cloth.
  4. Measure the resin into paper cups with no more than 2 ounces per cup.
  5. Arrange a piece of mylar on the smooth work surface and place a piece of glass cloth in the middle.
  6. Follow manufacturer's recommendations for the number of drops of catalyst or hardener per tablespoon. Once the catalyst is added, there is a limit of about 30 minutes of working time before the resin stiffens. More hardener will cut this time. Use a stick to stir the mixture.
  7. Pour the resin on the glass cloth and use the stick to spread it around. The glass should seem to dissolve with the resin and disappears.
  8. Place the picture or leaves on the saturated cloth and then cover it with the second piece of glass cloth if more strength is desired. Be careful to locate materials in their exact position, as they are difficult to move later. Add the catalyst to more resin and saturate the top layer of glass cloth.
  9. The second piece of mylar film is placed over the parts to cover the sticky surface. Take a clear tongue depressor and lay it on edge to work out air bubbles. It is used like a squeegee to chase the bubbles, starting from the middle and

working over each edge. If too much pressure is used, all of the resin will be squeezed out. If insufficient pressure is used, the air bubbles will not flow out. This is the most critical step in the process and probably needs to be checked by the teacher.

10. After the two-hour hardening cycle, the edges can be trimmed to size with a tin snips or a jigsaw. The roughness can be smoothed with abrasives and buffed to a high gloss.

V. Summary and Evaluation

Review the laminating process, emphasizing the change in form of the resin and what causes this change. Discuss any problems, new ideas, possible further applications of the process.

VI. Applications

Make charts, posters with pictures of objects made from fiberglas laminates. Students may draw process chart describing steps in laminating or illustrating the resin-catalyst interaction.

VII. Things children can make as part of their experimentation:

Nature tiles	Window panels	Wall plaques
Name plates	Decoration for book covers	Hot pads
Place mats	Photograph frames	Boat repairs

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3. Brodhead Garrett, 4560 East 71st Street, Cleveland, Ohio 44105.
4. Local Industrial Arts Shop.
5. Cadillac Plastic & Company, 727 Lake Street, Chicago, Illinois 60606.
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Interdisciplinary Industrial Arts Teacher Education Program Development

John D. Dierke and Richard J. Dahl

The industrial arts major at San Francisco State College is one of two majors a student may elect from within the Department of Design and Industry, one of six departments that together compose the School of Creative Arts. The other member departments are: Art, Broadcast Communication Arts, Drama, Film, and Music. Each of the six individual departments offers course work leading to both the bachelor's and master's degrees. Students who wish to pursue an unusually rich and intensive liberal arts curriculum within the School of Creative Arts may elect to major in a seventh area of study titled "Interdisciplinary Creative Arts Programs." The Interdisciplinary Creative Arts Program offers both academic bachelor's and master's degree programs titled "Fine Arts" for students planning a career in elementary education.

Presently the California State Board of Education does not classify industrial arts as a commonly taught subject matter area in the elementary school. Students wishing to pursue a major in industrial arts education for use at the elementary school level may elect (with the approval of the industrial arts elementary teacher education advisor) an intensive course of study (39 units of course work in the industrial arts) closely paralleling that which a secondary teacher education candidate might elect; or the student may elect to pursue a course of study in the interdepartmental creative arts, fine arts major (40 units) where an emphasis will be placed on course work derived from selected industrial arts course offerings.

The innovative program development in the areas of preschool and elementary school industrial arts that individual students and members of the college staff have realized at San Francisco State College is directly related to the diversity of philosophy and course preparation which a student may elect to choose from when majoring in an interdisciplinary program. This program offers the student an opportunity to develop an individual program, with the appropriate college advisor, that will extend his skill, knowledge, awareness, and appreciation in regard to the industrial arts.

"The Teacher Education Committee of the National Conference on Elementary School Industrial Arts, believing that a study of technology is essential in the total development of children, strongly advocates that industrial arts be an integral part of the elementary school curriculum. The committee recognizes that special preparation is needed by the teachers who will be conducting these elementary school industrial arts activities" (Ref. 1). Elementary school industrial arts programs at San Francisco State College tend to strongly parallel this philosophy. Interdisciplinary thinking and planning is cultivated amongst students so that their laboratory experiences, curriculum development, and tool and material usage tend to reflect a high degree of individuality that is a composite of the total experience the student brings to the learning setting. Creating an atmosphere where a student may learn to think in a truly interdisciplinary manner produces positive results in relation to integrating industrial arts subject matter into the standardized elementary or preschool curriculum.

All students planning a career in elementary education with an industrial arts emphasis are required to enroll in a supervised field work class prior to completion of the major and entrance into the professional education sequence. It is in this field work class that students working at the neighboring State Laboratory Demonstration School, Frederic Burk, and other elementary schools within a ten-mile proximity to the college have the opportunity to develop innovative interdisciplinary activity-oriented programs under the supervision of both an experienced elementary school teacher and a member of the industrial arts faculty. An emphasis is placed on developing new classroom activities which reflect current technology. Students must work out practical solutions for correlating their activity-oriented classroom programs to established segments of the language arts, mathematics, science, social studies, and reading curriculums. The field work experience allows a student to gain first-hand knowledge concerning organization, administration, and curriculum at the elementary school level. This experience also allows students the opportunity to realistically assess their capabilities and aspirations for pursuing a career in elementary education.

In less than a year's time, over 25 separate elementary schools in San Francisco have requested field work students to develop industrial arts programs within classrooms at their schools. The field work program was just expanded this year to include elementary schools other than Frederic Burk. Unfortunately, the demand for supervised field work students exceeds the number of students currently ready for this experience. The numerous requests for field work interns stemmed from teachers in San Francisco who either saw the program in action at Frederic Burk or heard about the past developed interdisciplinary-based industrial arts activity-oriented classroom programs. The demand by local teachers in the San Francisco Bay Area for the college to offer in-service course work related to the industrial arts in the late afternoon became so intense during the Fall semester that two additional classes had to be added to the Spring schedule to insure adequate enrollment space. Interns in the Elementary Education Cycle 5 Teacher Corps Program, after requesting a formal presentation concerning the role of industrial arts in the elementary school early in the Fall semester, overwhelmingly voted after the presentation to ask the local director of Teacher Corps to have their contracts changed to include one course in the Spring semester that dealt with elementary school industrial arts subject matter. The students' request was met by adding yet another course to the Spring schedule. The Center for Technological Education at San Francisco State College was directly responsible for attaining the funding and faculty positions for the extra classes offered.

One of the most successful classroom program outgrowths of the supervised interdisciplinary creative arts field work course was conducted by two students in the area of early childhood education. The development of this program, utilizing industrial arts on the preschool level, has been outlined below.

PRESCHOOL TECHNOLOGY PROGRAM

In 1969, a Preschool Technology Curriculum Project was established to explore the design of an interdisciplinary industrial arts program for three-, four-, and five-year-old children. This year-long study was conducted by two undergraduate industrial arts majors from the Department of Design and Industry at San Francisco State College. Mr. James P. Cowan and Richard J. Dahl worked under the supervision of Mr. John D. Dierke, supervisor for one section of the creative arts field work projects class at the college, together with Mrs. Lois Shaw Copriviza, director of the Education Progress Center Compensatory Preschool Programs in San Francisco. Four preschool centers, situated in the Inner Mission and Haight-Ashbury Districts of San Francisco, were involved in the original experimental stages of this program.

The four preschool centers have since adopted the developed Preschool Technology Program and are currently offering concrete industrial arts learning activities to 120 preschool children on a weekly basis.

The developmental stages of the Preschool Technology Curriculum Project began in September 1969 and continued through June 1970. The first five months of the program were devoted to researching the principles, aims, objectives, teaching techniques, and learning activity content common to preschool programs, as well as identifying appropriate tools and materials for use in a pilot program. Upon the completion of this first phase, the emphasis was then placed on the development of industrial arts learning activity packages which would serve to strengthen and reinforce the preschool goals and objectives.

In-service teacher and para-professional training sessions were also conducted to familiarize the preschool staff with the content and rationale of the new program. A comprehensive curriculum guide (150 pages) was printed by the two college field work students during the summer of 1970 to provide a standardized curriculum for the preschool teachers and to simultaneously disseminate information regarding the program. Preschool teachers in various locations of San Francisco are now using this guide, offering interdisciplinary learning experiences with an industrial arts base to children in eight preschool classrooms.

Preliminary research conducted in regard to previous industrial arts program developments in early childhood education produced little usable information relating to the abilities and limitations of preschool children that could serve as guidelines in this pilot study. Earlier research and field work experiences done at the kindergarten level by Mr. Dahl provided the program designers with first-hand knowledge and insight regarding the abilities which five- and six-year-old children have for using basic hand tools in industrial arts related classroom activities. By scaling down the basic concepts applied at the kindergarten level, it was then possible to assemble a working list from which preliminary guidelines could be established for developing learning packages. Repeated reworking of the earlier developed guidelines and learning packages has since produced a workable set of guidelines for use in developing industrial arts preschool learning activities packages.

In order to compensate for social, economic, environmental, cultural, and/or family circumstances which deprive children of the motivation and readiness required for successful performance in the public schools, industrial arts serves to help strengthen the general aims of preschool education by providing children with real-life experiences that allow them to develop an awareness of the world in which they live through the development of auditory, oral, perceptual, conceptual, and psychomotor skills involved in the exploration of physical tools and materials.

A preschool program aids the child by allowing him to experience success in school. Successful classroom experiences are provided for through diversified, closely supervised learning opportunities. The Preschool Technology Program, as a functional segment of the curriculum, acts to fulfill that need by offering a greater variety of successful, concrete learning experiences (on an individual basis) than any other single discipline.

Preliminary indications concerning the educational significance of industrial arts in the preschool are very much in support of the Preschool Technology Program. The total results derived from the Inventory of Developmental Tasks has given the total preschool program, which incorporated industrial arts activities, an abnormally high percentile rating. By using information from this test, the behavioral objectives checklist developed specifically for the Preschool Technology Program, and a control school in which industrial arts activities were not offered, a final evaluation of the program's effectiveness will be determined.

A number of other innovative industrial arts classroom programs, both limited and comprehensive in scope, have been designed and developed by undergraduate and graduate students while doing field work at the elementary school level. The number of self-designed successful activities developed well supports the rationale for the Interdisciplinary Industrial Arts Teacher Education emphasis in both the Industrial Arts and Interdisciplinary Creative Arts Programs at San Francisco State College.

REFERENCE

(1) Representative addresses and proceedings of the American Industrial Arts Association's 32nd annual convention at Louisville, Man-Society-Technology, 1970, p. 52.

Messrs. Dierke and Dahl are members of the faculty at San Francisco State College, San Francisco, Calif.

ACIASAO

American Council of Industrial Arts State Association Officers

Taking Our Subject to the Public Through a State Fair Exhibit

Arthur J. Figurski

A public relations venture is taking representative industrial arts in New York State and, in a live, vivid drama of educational excitement, placing it in the grasp of the general public. I am speaking of our annual industrial arts exhibit at the New York State Fair. Before we examine a brief historical sketch of this promotional activity, explain the organization and mechanics, and then with the help of a slide series illustrate the most recent "Exhibit 70," I should like to establish a rather comprehensive rationale for considering this type of association function.

Public education at all levels is experiencing a period of challenge and change, a time of accountability and a call for action. About half of the nation's state legislatures are engaged in what appears to be a wholesale shearing of aid to education budgets, despite the warnings of educators that such cuts will drastically reduce the quality of education. Accompanying our educational traumas has been the charge by educational critics that teaching and learning should be made more relevant to the lives of the students. Teachers and teacher educators alike are experiencing this strenuous, but timely, period of evaluation and subsequent accountability, and, of course, industrial arts is far from being excluded.

Parents, administrators, and school boards are demanding justification for our programs as the schools are now being forced to face the issue of developing a total educational package that will meet the real needs of today's youth. "How can your course make my boy a better citizen?" "Why do you teach what you teach and the way you teach?" "Can you justify the costs of running your program?" These are but a few of the typical but pertinent questions posed by parents, colleagues, and administrators.

The emergence of this educational inquisition has been paralleled by the emergence of new curricula, new educational technology, and new consideration given to the student's role in the educational process. So, too, instructional innovations and new teaching-learning designs are being implemented by industrial arts practitioners as they attempt to make their subject culturally relevant.

Change, then, becomes the constant on the educational scene. Assuming that most of this change and redirection is basically sound, is it sufficient to expose our students to the excitement and relevance of well-planned and carefully executed programs through the classroom and then rely on them to indirectly communicate the new educational image to those same critics in the educational community who are conducting on-going, here-and-now campaigns?

Let me answer the foregoing question with a qualified, no! Perhaps one of our biggest failures in public education has been a lack of emphasis on public relations. Yes, you may say that we have been concerned about public relations, but how many PR programs that really deliver a message can you cite?

With the exception of the daily teacher-student contacts and the isolated and far too infrequent parent-teacher sponsored programs, open houses, or exhibits which are prevalent among the practical arts, we as an educational body, that is, public education, have failed to project the school's program into the mainstream of community life. Combine our lack of good, well-directed public relations with the negatively skewed efforts of the media to present the picture of education and you have a generally misinformed and often bitter citizenry.

If you care to put this hypothesis to the test, take time to approach parent, neighbor, or "Mr. Average Taxpayer" and ask a few questions to determine how much they are aware of school programs or policies. Then get down to business and ask a member of your state legislature, the superintendent of schools, a school board member, or even a colleague in another subject area how they view industrial arts. I am sure that many, if not all here today, have been in this arena and know the range of shallow, misguided responses.

Are we at fault for the uninformed or misinformed public that has little knowledge of why industrial arts is a part of the educational program in the public schools? If your answer is "No, we are not at fault," then I trust that you will be able to advance another hypothesis. If your answer is "Yes, we as educators are guilty," then we surely have a challenge ahead.

If we agree that education with its many dimensions is a total human process involving all segments of society, there is a need for more and better lines of communication between the school and the populace, the curriculum and the critics. Our charge is to develop and maintain new understandings. The results of this charge will be public relations efforts, but the techniques must be as contemporary and dynamic as our subject. Those from whom we derive the rudiments of our subject, our nation's industries, are alert to the economic and social consequences if they fail to maintain a positive image in the public eye. Industrial arts must also present its image if public support and understanding are to be solicited.

Now that a rationale is presented, a contemporary and dynamic public relations technique such as a "state fair exhibit" will be more thoroughly understood. Industrial arts teachers in New York State have recognized the challenge of good public relations and have, over the past two decades, initiated, nurtured, and ultimately developed the largest and most exciting public relations venture in the educational profession. The New York State Industrial Arts Association brings the citizens of the Empire State face-to-face with its curriculum through a unique public relations activity at the New York State Fair held annually in Syracuse. Through a student-centered, action-packed exhibit at the Fair, the teachers are focusing direct attention on the role of industrial arts in the public schools.

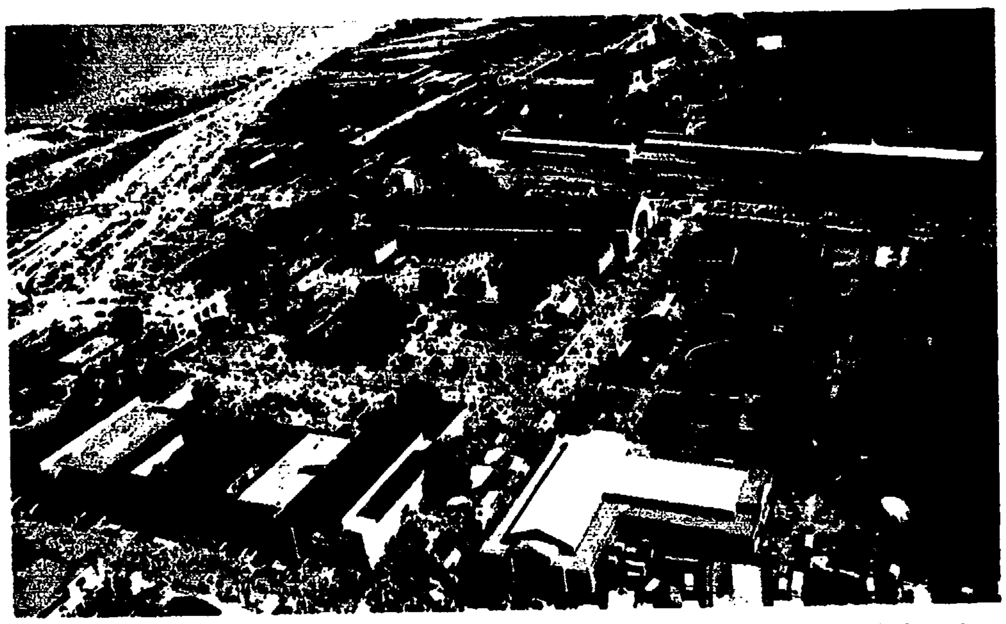

photo by Chapman-Nowak Associates

Figure 1. An aerial view of the New York State Fairgrounds in Syracuse reveals only half of the huge complex which attracts over 500,000 people annually. The New York State Industrial Arts Association's exhibit is housed in the State Exhibits Building at the lower right of the photo.

The New York State Industrial Arts Association's "State Fair Exhibit," a unique, "take-a-subject-to-the-public" activity, is much more than just another public relations effort. It is a unified statewide program of marketing industrial arts which has been a part of the New York State Fair for the last 20 years and is now the longest running educational exhibit in State Fair history.

It is now a state association function which marshals the talents of students and industrial arts personnel from the entire range of the profession. Although the stars of this show are the hundreds of students who through their demonstrations of activities portray an accurate story of industrial arts in our public schools, the scope of this activity requires support from teachers, regional industrial arts associations, the Bureau of Industrial Arts at the State Education Department, teacher educators, industrial suppliers, and school administrators. But this exposition of industrial arts at the State Fair was not always an association function, for its genesis was more than a decade prior to the formation of the New York State Industrial Arts Association per se.

HISTORICAL BACKGROUND

It began in 1950 when a small group of industrial arts teachers in the Central New York Industrial Arts Association considered putting on a display at the newly reopened State Fairground. While serving as chairman of the 1970 exhibit, I realized that I was involved in a program with an extremely rich heritage. Before we look on the contemporary scene, a tour of the records of the past will reveal the ideas, efforts, and individuals that have given momentum to this activity.

"We need to show the people of New York State what we are doing in industrial arts," commented one Central New York teacher. "It all began in 1949," reports Glenn Hess, a teacher who was involved in the first exhibit and all subsequent ones. Mr. Hess continued:

> "This was the year that the State Fair was started up again after being closed during the World War II years. Local industrial arts teachers noticed a lack of educational and school programs among the Fair exhibits. The Fair seemed to be an ideal place to show the people of New York State what was going on in the schools of the state, particularly in industrial arts classes. It was during an informal outdoor gathering that the men began to seriously consider putting on a show at the Fair. William Barnes, then president of the regional association, appointed Eustace Raulli as the first state fair chairman. During that first year, plans were made for a one-day showing in the State Exhibits Building on the fairgrounds. The superintendent of the building was a personal friend of Raulli's, and through this contact arrangements were made for the industrial arts people to use a corner space for a day that had been used previously by a science group. It was then on September 8, 1950, the last day of that year's Fair, that teachers and students from nine area schools gathered their machines, demonstration materials, and projects for display and assembled the original Fair exhibit. The building superintendent was so impressed with the showing that he invited the local association back for the next year, promising the same space."

It was during that first exhibit that Governor Thomas E. Dewey made an appearance at the Fair and made an unscheduled visit to the industrial arts booth to talk with the youngsters. Actually, the first chairman was quite a public relations man; he broke through the governor's guard and invited him to inspect the booth. It was also during that first year that the give-away idea was conceived and used as a public relations technique. Five thousand calendars were printed on a small press and given to the spectators. The back of the calendar read, "Visit the Industrial Arts Shop in Your Public School."

The success and excitement appeared short-lived. The local industrial arts association was told that since it was not a state group it could not sponsor the exhibit. So in 1951, there was no exhibit at the Fair. However, the following year support was sought from the State Steering Committee on Industrial Arts. The Steering Committee gave the use of its name to the project and also added financial support. It was also in 1951 that the Bureau of Industrial Arts from the State Education Department in Albany offered the services of a supervisor, Arthur Dudley, now chief of the Bureau.

This began a continued involvement from the State Education Department which still exists today. The New York State Vocational and Practical Arts Association added its support to the publicity venture. The success of the exhibit sounded throughout the state. For 14 years the Central New York Industrial Arts Association, together with its supporting agencies, provided the leadership to plan and coordinate this Labor Day Week project at the Syracuse Fair. In 1964, the New York State Industrial Arts Association was established and assumed sponsorship of the State Fair Exhibit. The transition was made and the annual industrial arts exhibit at the New York State Fair became a New York State Industrial Arts Association function.

WHY CHOOSE A STATE FAIR?

Why choose a state fair to promote industrial arts or any other subject? Records of the International Association of Fairs and Expositions show more than 2100 state and county fairs in the United States, not including community and youth fairs. Collectively, over 100,000,000 people visited fairs last year. Fairgoers in New York State come to the State Fair to get an annual picture of life and progress in the Empire State.

When one mentions the word "fair," excitement and interest are immediately generated through a picture that flashes in one's mind of colorful activities, displays, exhibits, competition, trading, amusement, and recreation. A good fair has something for everyone. Fairs educate as well as entertain; they bring people together... people having fun, people learning. The New York State Fair has been called the heartbeat of the state. During the week preceding and including Labor Day, it becomes the vehicle for conveying a vast quantity of thought and feeling to a great audience.

Each year well over 500,000 people come to the Empire State's "show and tell." Fairs are for the people and by the people. What better place to launch a major public relations campaign? The 350 acres of the fairgrounds portray the achievements and progress of man in his day-to-day world. The New York State Fair has therefore become a most effective means of promoting industrial arts as it focuses the people's attention on the subject's statewide achievements.

The New York State Fair is people, with well over 500,000 people attending each year to observe the hundreds of educational, industrial, agricultural, and cultural exhibits and displays. This combination of people exhibiting and people observing makes the Fair an exciting place.

With each succeeding year, the industrial arts exhibit at the State Fair has become increasingly successful in bringing industrial arts before the public eye. Selling is the name of the game, and that is exactly what the State Fair exhibit does. By bringing in the

photo by Chapman-Nowak Associates

Figure 2. Over 65,000 State Fair spectators flocked to the industrial arts booth—a simulated industrial arts laboratory—to watch students and industrial arts in action.

hardware that is basic to a general industrial arts laboratory—that is, the equipment, tools, and materials that are used daily—and then adding a most essential element, human resources, teachers create a simulated school setting. The State Fair exhibit becomes the point of convergence for hundreds of teachers and students with primarily one thought in mind—let's sell our subject to the public. Under the direction of their instructors, these students actually re-create a typical industrial arts environment as they demonstrate the activities, processes, and techniques that represent some of the finest programs in the state.

The public, in this case the over 600,000 State Fair visitors, are given the opportunity to observe in an almost first-hand manner what is happening in industrial arts programs in the schools. Fair visitors, young and old alike, actually come face-to-face with teachers and students "in action," working as enthusiastically and diligently as they do in their home schools. Performing before the public, they are given a big responsibility, and they handle the job beautifully. What salesmen these students are!

PLANNING AND COORDINATION

The scope of this exhibit required close to a year of careful planning and coordination on the part of hundreds of industrial arts personnel. The chairman of the exhibit, usually the person who served as co-chairman during the previous year, works very closely with the representative from the State Education Department, and these two men form the nucleus of the planning committee. The financial commitments of such a large-scale effort are met, in part, through the committee's budget and through donations which are solicited from the affiliated regional industrial arts associations in the state. The Exhibit Committee conducts a number of promotional activities such as presentations at local meetings and displays at conferences, including the State Convention, to solicit support of all kinds.

When the first State Fair exhibit took place, the teacher participants brought equipment and supplies from their own school shops. Gradually, local and national industrial arts suppliers began to donate materials and the use of major pieces of equipment. Today, these vendors are eager to assist in the educational venture and even send their representatives to the fairgrounds to help set up the simulated industrial arts laboratory. The equipment needed at the exhibit is determined by the specific activities the participating teachers wish to conduct. Those teachers wishing to demonstrate special projects merely let the chairman know what materials and equipment are necessary, and these are coordinated into the exhibit booth.

Prior to the 1969 exhibit, teachers from various parts of New York State would organize their students to perform certain activities during their participation at the Fair. Since different schools were represented each day, there was a wide range of representative industrial arts work.

In planning for the 1969 exhibit, chairman Charles Smith from Oriskany, New York, and Bureau of Industrial Arts Associate Herbert Ranney added a new dimension. Using the technical talents of industrial arts teachers, they coordinated the preparation of preplanned activities that would enable some teachers, especially those from schools great distances from Syracuse, to bring their groups of students to the exhibit and have them apply their talents to these organized activities. Those industrial arts instructors who wanted to bring special home school activities were urged to do so. This combination of committee-planned and individual teacher-planned industrial arts activities continues to present an accurate cross-section of industrial arts as it is in New York State's public schools.

EMPIRE HAPPENING

The theme of the 1970 New York State Fair was "The Empire Happening: People and Progress." Not entirely through coincidence, the industrial arts exhibit paralleled this theme as it presented what was happening in the industrial arts programs throughout the Empire State. From the beginning, "Exhibit 70" was destined to become an action-filled mix of human resources and interest, an interaction of people with people; students and teachers working together to promote their subject; spectators talking with students and teachers, asking questions about industrial arts; people observing enthusiastic students as they "sell" a very positive image of a "now" subject.

"The Empire Happening: People and Progress" had a record-breaking 601,478 visitors, and the popularity of the Industrial Arts Exhibit housed in the State Exhibits Center was indicated by the continuous crowds of spectators anxious to see what was happening in the booth. "Exhibit 70" generated a climate of genuine interest and spontaneity as over 65,000 State Fair visitors saw industrial arts in action.

Since an emerging concept in industrial arts is the use of manufacturing techniques as a method of teaching students about industry, this was chosen to be the emphasis in the activity booth during Exhibit 70. The industrial arts teacher consultants developed the chosen activities into workable experiences that students could easily demonstrate during the State Fair week. The mass production techniques, which included combinations of woods, plastics, metals, and graphic arts, placed the students on simulated assembly lines where they manufactured thousands of quality products as spectators watched in amazement. For example, 3,000 tic-tac-toe games were mass-produced during the seven-day period. A wood base moved along the assembly line, being machined at various stations and ultimately merged with the red and yellow pegs that had been injection-molded. Together, these components were sent to the packaging area where the shrink packaging technique placed the finished product in a pre-printed folder that carried a PR message. All of the manufactured items were given to lucky spectators.

photo by Chapman-Nowak Associates

Figure 3. Two young students operate a plastic injection molding machine as part of the line production of tic-tac-toe games which were given to the spectators.

Students and teachers from elementary, junior, and senior high schools from all areas of the state were coordinated for actual participation at the exhibit. Each day different groups of students representing from one to three school districts assumed the responsibility of demonstrating the pre-planned activities. The participants, numbering close to 170 students and 30 teachers, represented 13 school systems.

Some of the schools brought their own activities which complimented those that had been planned by the exhibit committee. Fifth graders from Maple Elementary School at Williamsville, New York, manufactured unique memo pads on their day at the Fair, and the enthusiasm ran high. Bringing these boys and girls to the State Fair was a cooperative venture sponsored by their school, the State University College at Buffalo, and the Western New York Industrial Arts Association. These students had operated a manufacturing enterprise back in their school as a result of an experimental program conducted by the college and now transferred their entire company's operation to the State Fair for a repeat performance for New York State taxpayers. Teacher educators, the school principal, and parent chaperones were all on hand to promote their project and, of course, industrial arts.

Another spectacular show was brought to Exhibit 70 by the teachers and students of the Greece Central School District No. 1 from Monroe County. Greece mobilized its forces to present student work in photography, plastics, power technology, metal technology, and construction. A photography exhibit included highlights of a core project which evolved into the design and construction of a press box and refreshment stand for the high school Athletic Club. The series of student demonstrations conducted by the Greece students using their own equipment included materials testing, engine analysis, solar cells, and thermo-electric generator and solid fuel rocket testing. These attracted large crowds of spectators, as did all of the activities.

The exhibit booth was like an ever-changing kaleidoscope as each new group of students performed their own or the pre-planned activities. Other instructors brought such activities as letterpress, offset, and silk screen printing, drafting, and metals fabrication. A parent of one of the Greece participants, who was the District Printer for the school, assisted the students in the use of the offset press in printing and producing memo pad souvenirs for the Fair visitors.

For the past two years, John Loss, an industrial arts instructor from Lewiston-Porter Junior High School in the Niagara Falls area and currently chairman of the 1971 State Fair Exhibit, has arranged for a student's parents to accompany his group to Syracuse. The father and son team effort and the ensuing adult assistance, guidance, and direction given to the other students was rewarding for all involved. Involving the parents in our communities in such an action program extends our public relations efforts a long way.

A large static display of student projects and activities from selected schools and regional project exhibits provided a colorful and eye-catching background for the activity. To one corner of this display, a sound-slide show presented an even broader image of industrial arts in New York State as programs from all corners of the state were projected.

UNIQUE OPPORTUNITY

The positive dimensions of the State Fair exhibit became infinite. The effect that it has on students, teachers, parents, and the general public could not be specifically identified. In many cases, the student participants would not otherwise have had the opportunity to travel to Syracuse and see the Fair. Meals were provided for all participants through the exhibit budget and were taken at the 4-H Cafeteria. Although they worked at the exhibit, the students were given time to see and visit the hundreds of cultural, agricultural, educational, and commercial exhibits and, of course, enjoy well-known celebrities and entertainers and the midway. The New York State Industrial Arts Association awarded each participating student a certificate of merit and an exhibitor's ribbon. These were sent to their respective teachers and principals for signing and distribution, perhaps during a school assembly program. The "Exhibit 70" committee also took pictures of each school group and coordinated publicity releases to the various hometown newspapers.

Students and teachers from all sections of the state were involved in a genuine interaction of adult and youth, working together to promote their subject. In addition to many lasting impressions formed by both teachers and learners as they worked together in a climate of mutual respect, it was obvious that the audience, sometimes lined up three deep around this beehive of action, was also fascinated as they watched these energetic and enthusiastic youngsters. One could sense the interest generated by the exhibit just by observation of the spectators. Many would stop to talk with the teachers and students, the discussions usually revealing a single most important reaction—if what is taking place here at this exhibit is actually what industrial arts is today, then indeed industrial arts is providing a happening, a rich educational climate in our public schools.

It is certain that each person who came within hearing range of this activity-oriented exhibit was attracted by the sounds of the equipment that the students were operating. It is also certain that each of the over 65,000 visitors took something home: a student-produced product, a visitor's card that they printed themselves, a pamphlet entitled, "Why Your Child Needs Industrial Arts," or a new and up-to-date understanding of what industrial arts is and why it is an important part of today's public school program. These tangible souvenirs or these ideas will long be remembered for they are the results of being exposed to a curriculum that was moved from the classroom to the citizens, from the school to the public.

The State Fair exhibit provided a magnetic environment of excitement and activity; it was characterized by a learner-centered atmosphere where student and spectator interest and enthusiasm prevailed. Many lasting and positive impressions were formed as a result of this blending of wholesome learning environment with the genuine interaction of teachers and students working together to promote industrial arts. Students will long remember this day at the Fair as they combined fun with public relations. Teachers continue to reflect on the opportunities they had to meet the Fair audience face-to-face and discuss their subject. Never was industrial arts presented to so many in such a brief period of time and with such realism.

These impressions would be time-tested, but it was certain that the industrial arts exhibit at the New York State Fair brought the public in contact with a subject that is providing a happening educational experience for youth in the public schools of New York State. Could such a public relations activity be one of your state association functions?

Mr. Figurski is a member of the Department of Industrial Arts and Technology faculty at the State University, Oswego, New York, and was chairman of the NYSIAA Exhibit at the 1970 New York State Fair.

IACC

Industrial Arts College Clubs

Pending Disaster—A Need to Reappraise Values

Raymond H. Larson

History records that the subject area now known as industrial arts has realized tremendous growth since its inception in the United States. There has been a steady upward movement of both the number of locations and number of students in the face of rather strong odds. There were times when the odds against this discipline threatened its survival, but industrial arts did survive and increased its influence in the public school systems of America.

Again today, industrial arts faces pending disaster unless it is able to cope with compromises from within the educational community. Two tendencies, if not checked, will abort industrial arts, at least at the senior high level. These two movements are the urge, because of federal funding, to become trade and industrial training and the return of the nondegree instructor to the secondary level.

Industrial arts was introduced into the United States as trade training for those who had not been committed to a reform school so that they likewise could learn a trade. The early manual training schools' main objective was the development of employable skills because of the tremendous expansion of American industry and the consequent breakdown of apprenticeship and the shortage of skilled labor. From this somewhat questionable beginning, the general education concept was to germinate.

The preoccupation of the Society for the Promotion of Industrial Education was to induce Mays (Ref. 1) to write that "in developing the propaganda work of the National Society for the Promotion of Industrial Education, many of its members seemed to think that it was necessary to discredit industrial arts in the eyes of the American public." Such antics were bound to have negative repercussions among teachers, administrators, and the public.

Passage of the Smith-Hughes Law had a far-reaching impact on the development of industrial arts in the public schools of the United States. This enactment created the dual teacher education departments. The chairmen of these departments were vocationally-oriented. The courses, of necessity, in order to gain reimbursement of the instructor, were vocationally slanted. Likewise, these institutions tended to employ staff who were vocationally oriented and certifiable. They turned out the bulk of those advanced to positions of leadership by virtue of the doctoral degree. The product was not always committed to the philosophy of industrial arts and most certainly not industrial arts as general education. The law also required state supervision, which was usually administered under the Division of Vocational Education. The industrial arts supervisor was actually an assistant supervisor of trade and industry. Typically, under these conditions, the industrial arts supervisor might visit an industrial arts program now and then—on the way to or back from an assignment normal for an assistant supervisor of trade and industrial training. The Smith-Hughes Law provided for reimbursement of teachers' salaries, the extended term of contract, and the payment of conference expenses, which tended to shift the working and financial status of the two areas in favor of the trade and industrial teachers.

The formation of the industrial arts section of the American Vocational Association tended to establish in the eyes of administrators, lay people, and some industrial arts teachers that industrial arts was, in fact, trade training. Many industrial arts teachers deserted to vocational education, believing industrial arts was doomed. Another factor in the many desertions was the potential of increased pay and other benefits by virtue of federal reimbursement of a portion of the vocational trade teacher's salary.

Sputnik, which was to startle the world, brought public, lay, and schoolmen's demands for greater emphasis on mathematics and science. Administrators and schools joined the stampede. We were told industrial arts would be phased out of the public school or drastically curtailed within five years.

The 1968 Vocational Amendments included the reimbursement of activities and functions usually thought to be the prerogative of industrial arts. We are told again, by vocational people mainly, that industrial arts would be phased out of the high school or seriously curtailed in the near future.

Industrial arts has always had to contend with the academic principal and guidance counselor who, because of their own prejudices and parental and social pressures, advised all able students to prepare for college. However, the general insistence on a college education by society—status, financial return, and the fact that one of the criteria for judging the quality of a high school was the percentage of the graduating class attending college—made it difficult for the principal and counselor to do otherwise.

In the face of these and other power-group pressures, industrial arts continued to grow in both quantity and quality of offerings. There can be little doubt that the diversions served to discourage many young teachers and caused a number of superintendents to consider the discontinuance of industrial arts in their schools; they also served to call to the defense of industrial arts many strong advocates of industrial arts as general education. These antics produced experimentation and encouraged what proved to be a most healthful discussion. Many teachers were led to re-examine the subject area carefully and to restate in more definite terms the values and aims of industrial arts.

The above has been reviewed merely to show that industrial arts has been able to resist the destructive forces from without. Will it be able to resist the forces from within? Or will the culminative effect of the product of the dual vocationally-oriented industrial teacher education departments prove too great a challenge? Without relinquishing its claim to great general education value, can industrial arts adjust to the modern needs of the secondary school youth of America?

History would indicate that industrial arts leadership has the ability and the defenders essential to meet the challenge.

Today society seems to have arrived at a concensus that not everyone needs or should have a liberal arts or the customary professional higher degree. Some of our most intelligent youth are among the drop-outs. Many of these young people could profit from and should be brought back into the mainstream of education. A restructured track is needed in the high school for those who do not yet know what they care to pursue as a life's occupation. There must be increased emphasis on guidance and occupational information. Our youth demand an increased emphasis on identification of the individual. The shorter work week is a reality. Earlier retirement, both forced and voluntary, is socially acceptable. Increased leisure time will be forced upon more and more individuals.

The Morrill Act (1862) "dignified applied education by establishing agricultural and mechanical colleges to prepare students for the ordinary pursuits and professions in life." These Land-Grant colleges were instrumental in establishing the general prevocational approach as an acceptable adjunct of secondary education. The development of entry skills in occupational clusters is favored rather than saleable skills in specific occupations, which should be mandated to post secondary area vocational schools.

Even so, there are some in education who would reduce industrial arts to the elementary and junior high school levels. It would be a disaster for our society to abort the general education concept of industrial arts at the secondary level, especially since the pressures among our youth seem to tell us otherwise. Our young are demanding more emphasis on how to relate to one another than on how to make a living. They want a greater understanding of our total environment. The shorter work week and earlier retirement, which now appear inevitable, seem to place a new responsibility on the educational system to adjust youth to these facts of life. All areas, not only industrial arts, will need to place greater stress on educating people to more fully utilize the time periods when they are not producing. It would seem guidance counselors could aid youth to a greater extent by considering more carefully the imbalances between aspirations and actualities, the patterns of education and the requirements of the jobs, and the college degrees and the pattern of employment of our citizenry. Research tells us success in college, or in life, for that matter, depends largely on how well a student achieved in what he did and not on a particular pattern of experiences. College preparatory tracks seem to be indefensible. There is evidence a vocational school graduate and/or drop-out can succeed in college or in life as well as a high school graduate. No experience is sacred. The quality of the experience is the important consideration. The newer educational approaches as reported in recent literature seem to provide a fertile atmosphere for new dimensions of industrial arts as a general concept at the secondary level.

Programs have been developing on the college level which indicate a renewed interest in industry as a social force. Undergraduate collegiate classes, broadly titled such as Modern Technology and Civilization, and college graduate courses, broadly titled Technology and Man, are attracting a major segment of the student body at both levels (Ref. 2). In fact, these offerings are growing faster than they can be adequately staffed. The purpose of these offerings is to show that technology exists to meet the needs and social goals of the people, to help people understand that technology can create problems while it attempts to free man from burden and pushes him further into an era of abundance, often at a pace with which he cannot cope. Man must be helped to analyze new situations, to develop rational and feasible solutions, and then to be able to communicate the results to all concerned. Every member of society must be vividly aware of the influences, reactions, problems, and advancements of the highly industrialized era of which they are a part.

The infectiousness of these courses at the college level taught by instructors with an industrial arts background can be duplicated at the elementary and secondary school level. Industrial arts has much to offer at the high school level, possibly more to offer the student who will enter the professions, since the high school will probably be the last place for such experience, while those entering the occupations will be living the experience. This is not intended to depreciate the guidance value of industrial arts—either positively or negatively—or the prevocational worth of a viable program of industrial arts.

Social stresses of our times demand professionally trained personnel on the elementary and secondary level. Persons educated in the psychological aspects of learning and working with this age group are the only individuals who can hope to meet the needs and aspirations of developing youth.

The Minnesota Industrial Arts Association passed a resolution which reads, in part, "that the Minnesota Industrial Arts Association urge that all industrial education for students in grades K through 12 be under the State Supervisor of Industrial Arts and be taught by teachers who hold a baccalaureate degree with a major in industrial arts or industrial education" (Ref. 3).

The return of the nondegree instructor to the secondary level is taking a number of forms. The specific vocational course within the regular high school and the vocational center (Ref. 4) concept represent two typical forms. The vocational center concept is an inter-district arrangement where students from several high schools are transported to one of the schools which by agreement among all the schools involved had been designated as the inter-district center. The concept makes prevocational training and entry level skill development available to school districts which would not by themselves have the means to provide an effective vocational program for their youth.

There is a strong belief among some educators that this activity authorized by the 1968 Vocational Amendments is good industrial arts. It is also suggested that vocational education leaders would be happy to confine their efforts to post-secondary education, leaving the secondary vocational-technical programs to industrial arts educators. For this to materialize, industrial arts leaders will have to discontinue attempting to work new ideas into old concepts. The changing needs of youth and society suggest the need of arriving at objectives in a different way.

Improvement is needed. Research, experimentation, and model programs are attempting to propose new directions, and they certainly are challenging the status quo. There is an active interest in modernizing teacher education programs.

Our literature delineates levels of industrial arts. However, our teacher education institutions have done little to bring this concept to fruition. Logical levels seem to be elementary, junior high, senior high, secondary vocational-technical, and special need specialists. Vocational-technical has been added because of the provision of the 1968 Amendments to the Vocational Act of 1963. The writer feels that secondary vocational-technical is industrial arts and that the Congress intended that this be so. Industrial arts needs only to have this reflected in the State Plans. The special needs specialist is suggested to develop a person with the industrial background to work with the disadvantaged. Actually, industrial arts is not a "johnny-come-lately" to this type of young person. Industrial arts has had years of experience.

Colleges and universities need to begin developing teachers for specific functions. We know that good senior high school teachers might be ineffective at the junior high school level and vice versa. Students at these levels are so different that they require teachers of different educational patterns and temperament.

Teacher-education departments need to begin preparing the elementary specialist with a pattern of experiences which includes a foundation level in four cluster areas: graphic communication, construction, production and manufacturing, and energy and power; a foundation level in elementary education; and professional competencies in guiding the learning experiences of this level of pupil. A junior high teacher's requirements for graduation should include a foundation level in the four cluster areas and professional competencies to work with this level of youth. This individual, without a great deal of modification, could be adapted to the middle school. A senior high school instructor should have a foundation level in the four cluster areas; concentration in two cluster areas; and possess 2000 hours of general work experience, wage-earning experiences of sundry kinds sufficient to permit an individual to relate to the world of work. A secondary vocational-technical instructor should bring to the classroom the experiences of a foundation level in the four cluster areas; a concentration in the cluster area of chosen specialization; 1000 hours of supervised occupational experience; and an internship at a post-high school area vocational-technical school.

Figure 1. Proposed Levels of Preparation for Industrial Arts Teachers in the Seventies

BASIC CORE: 60 Quarter hours professional and inter-area courses (16), technical courses in four clusters* (32), electives from other courses that will make the core meaningful to a specific level (12).

REQUIRED FOR ALL LEVELS OF CERTIFICATION

ELEMENTARY LEVEL:
24 Q.H. Concentration including approximately 12 quarter hours in each of elementary education and special education courses.

JUNIOR HIGH LEVEL:
24 Q.H. Concentration which includes specially designed professional courses for junior high instruction in innovative programs (12) and specially designed manipulative courses (12).

SENIOR HIGH LEVEL:
24 Q.H. Concentration two cluster areas of 12 quarter hours each plus acceptable wage-earning experience.

SECONDARY VOCATIONAL-TECHNICAL:
24 Q.H. Concentration including 1000 hours of supervised industrial work experience (16) plus six weeks full-time or twelve weeks half-time internship at an area vocational-technical school (8). The 12 elective credits in the core to be advanced industrial courses in the chosen area of specialization.

SPECIAL NEEDS SPECIALIST:
24 Q.H. Concentration including course work in special education totaling 24 quarter hours—disadvantaged, handicapped, institutionalized, and other individuals or groups needing special considerations.

*CLUSTER AREAS (1) Graphic Communication, (2) Construction, (3) Production and Manufacturing, and (4) Energy and Power.

Adopted from suggestions of Dr. William Kemp, Chairman, Industrial Education Department, St. Cloud State College, St. Cloud, Minnesota 56301.

Figure 1, Proposed Levels of Preparation for Industrial Arts Teachers in the Seventies, summarizes the backgrounds suggested at the various levels. A review of college catalogs reveals that the basic core of 60 quarter credits which would be required at all levels has more depth than is true today at a number of colleges and/or universities. The basic core is sufficiently strong to permit a person graduating with the requirements specified for the junior high, senior high, or secondary vocational-technical levels to teach in the general shop concept of the small school system. This person would be better prepared for this task than 90% of the industrial arts instructors doing this job at the close of the last decade.

The alternative at the elementary level of industrial arts negotiating a stronger input into the education of elementary majors should be considered. Some elementary school principals contend this is the more acceptable approach at this level.

There is the possibility of reducing the number of levels by combining the elementary and junior high levels. There is strong opinion that the young people at these age levels are more alike than different and that a person with a similar experience background could effectively guide the development of youth at these ages.

The generalist and the quasi-specialist are both needed at the secondary level. The generalist projects industrial arts for its guidance, recreational, and career awareness values to the total high school community. The objectives of this offering could well include an appreciation of industry and the people who make industry tick, a humanizing effect which would bring people together rather than increasing the polarization which is now plaguing our society.

The secondary vocational-technical teacher option including 1000 hours of supervised industrial work experience could be the most important development within industrial arts during the seventies. One thousand hours of supervised or directed work experience with a bachelor's degree would be far more than comparable to the longer trade experience required at the post-secondary level without the benefit of a professional degree. More vocational education leaders each year are accepting the bachelor's degree as a prerequisite on the secondary level. These vocational leaders are even more insistent that trade experience is a necessary qualification on a prevocational level. However, there is good evidence that vocational leaders are willing to accept a shorter period of supervised trade experience than they would of affidavited trade experience, especially when the supervised experience is an integral part of a baccalaureate degree.

Teacher education departments are exploring this concept, with programs varying from supervised trade experience (internship) of 1000 hours to as much as a full year of college credit toward the bachelor's degree for pre-entry journeyman trade experience of three years or longer. Teacher education departments need to move into the untried, innovative, variable patterns to accommodate the varying interests and needs of individuals and society.

The internship in an area vocational-technical school could be part of the student teaching requirement or negotiated as a para-profession with the schools involved. One thing is sure, the times ahead demand a more orchestrated approach to the education of our young people.

A rare opportunity has been presented to industrial arts through the Vocational Amendments of 1968. Aggressiveness, a willingness to change, a willingness to compromise, and a willingness to accept prevocational and entry skill development as a prerogative of industrial arts will clear the way for great advancements in the seventies.

Industrial arts has survived; it will survive again if it modernizes to meet the challenge of the changing times. There is now and always will be the educational need for industrial arts to make its unique contribution to general education—the interpretation of industry in our industrial society. Let us adjust quickly to the general education demands of youth and assume our rightful responsibility for secondary vocational-technical education. To do less will prove disastrous not only to industrial arts but to the total educational program. Let us not let those from within destroy what time, talent, and hard work has accomplished in the furtherance of the development of the young people of America.

FOOTNOTES

(1) Arthur B. Mays, The Determining Factors in the Evolution of Industrial Arts in America, The Bruce Publishing Company, Milwaukee.
(2) See Donald Lauda and Robert Ryan, "Industry 192," Industrial Arts Journal (January-February) 1969.
(3) MIAA Resolution, MIAA Report (March 1969) 9.
(4) The State of Minnesota proposes the development of 100 of these centers. For specifics of the program, write to the State Department of Education, Division of Vocational-Technical Education, St. Paul, Minnesota.

Dr. Larson is the Dean of the School of Industry at St. Cloud State College, St. Cloud, Minnesota.

Industrial Arts in Colleges and Universities of Texas

Jerry Drennan

Industrial Arts in the colleges and universities of Texas is comprehensive, innovative, and diversified. Pedagogically and geographically, Texas' industrial arts has something for everyone.

There are 13 institutions in Texas which offer degrees in industrial arts education. These schools, located in all areas of the state, and their respective departments and department heads are listed below.

Dr. Jerry Drennan, Head
Department of Industrial Ed.
Station ACC, Box 8107
Abilene Christian College
Abilene, Texas 79601

Dr. Welcome E. Wright, Head
Department of Industrial Ed.
East Texas State University
East Texas Station
Commerce, Texas 75428

Dr. Stephen V. Randel, Director
Department of Industrial Arts
Sam Houston State University
Huntsville, Texas 77340

Dr. Victor L. Bowers, Chairman
Department of Industrial Arts
Southwest Texas State University
San Marcos, Texas 78666

Dr. Charles Underhill
Industrial Education Edpartment
Southwestern Union College
Keene, Texas

Mr. William C. Leavitt, Head
Department of Industrial Arts
Sul Ross State College
Alpine, Texas 79830

Mr. James Leeth
Industrial Arts Department
Tarleton State College
Stephenville, Texas

Dr. Earle B. Blanton, Director
Department of Industrial Arts
Box 5326, NT Station
North Texas State University
Denton, Texas 76203

Mr. Walter J. Hall, Head
Department of Industrial Arts
Prairie View Agricultural and
Mechanical College
Prairie View, Texas 77445

Dr. James Boone, Jr., Head
Department of Industrial Ed.
Texas A & M University
College Station, Texas 77843

Dr. A. F. Gross, Head
Department of Industrial Arts
Texas A & I University
Kingsville, Texas 78363

Dr. William Forkner
Department of Secondary Ed.
University of Houston
Houston, Texas 77004

Dr. Wallace L. Johnston, Head
Department of Industrial Ed.
Applied Science Building
West Texas State University
Canyon, Texas 79015

The major bond between these institutions is the strong, active professional associations which incorporate the faculties and students of the colleges and universities. The sharing of ideas and professional encouragement is common.

The Texas Council on Industrial Arts Teacher Education is composed of the faculties of the institutions in Texas. Two major meetings per year constitute the itinerary. A two-day meeting in the fall provides time for presentations and discussions of topics of current activities and common concerns. A business meeting with some presentations takes place at the annual industrial arts teacher's conference sponsored by the Texas Industrial Arts Association.

The Texas College Industrial Arts Association is an organization of the industrial arts students at each of the institutions. The local industrial arts club is the charter organization. Two meetings per year occur, one in the fall and one at the annual conference of the Texas Industrial Arts Association. The fall meeting is an all-day affair which plans for the activities of the year. The winter meeting is primarily a business meeting.

Industrial arts programs in Texas vary from those which have a rich historical background of over 100 years to those programs which have developed within the last decade. All of the institutions offer basic laboratory courses in the areas of power, electricity-electronics, drafting, metals, crafts, woods, and graphic arts. Other course offerings include professional courses, design, instructional media, materials and processes, and other selected areas.

Each school within the state has the distinction of having developed expertise in some area or field. Some of these areas include metals, printing, aeronautical concepts,

Figure 1. Industrial arts students participating in social homecoming activities.

plastics, crafts, power, technical illustrations, design, ceramics, numerical control machining, mass production, foundry, cooperative laboratory work, photography, and others.

Much of the recent development of Texas industrial arts programs, both secondary and college level, can be credited to Dr. W. A. Mayfield, Industrial Education Department, Texas A & M University. Dr. Mayfield, former consultant of Industrial Arts of the Texas Education Agency, serves as a permanent advisor to all student-oriented organizations of industrial arts. He is often referred to as Mr. Industrial Arts of Texas.

Questions concerning industrial arts in Texas colleges and universities may be directed toward individual department chairmen, to Dr. W. A. Mayfield, or to Mr. Neil Ballard, Consultant of Industrial Arts, Texas Education Agency, Austin, Texas.

Dr. Drennan is a member of the faculty at Abilene Christian College, Abilene, Texas.

AIASA

American Industrial Arts Student Association

Evaluation of the Industrial Arts Program

Walter Comeaux

Throughout the past year, in which I have served as President of AIASA, I have had the opportunity to visit many places and meet some of the nicest people I have met in my entire life. Two interesting events which I attended were the 1970 White House Conference of Youth in Washington, D.C., and the Man – Society – Technology program which was held in Houston, Texas. These events, along with several others, provoked my interest in industrial arts. I saw not only the strong points in the industrial arts program, but also the weak points. The two major areas which need improvement are the communications lag in industrial arts education and promotion of AIASA club activities throughout the United States.

You know, one of today's most popular breakfast cereals came very close to being dropped by its manufacturer shortly after it was introduced. This incident occurred in the late 1920's, and the company concerned was a flour manufacturer who had decided to go into the cereal business. This company spent a great deal of money and devoted an extensive amount of time to develop what they believed to be the best new breakfast cereal to come on the market for many years. However, they made the mistake of using the same sales approach as in selling flour. Naturally, their cereal product did not sell. After much discussion and consideration, the company decided to make another attempt at selling their product, using their own home area as a test. Instead of the traditional selling approach, the company made advertisements on radio by using a catchy new jingle which was repeated over and over again. In just a short time, sales of the cereal in the test city zoomed.

The company found that even though they had a good product, it would not sell until they got the story across to the people who would buy it.

Beyond a doubt, this is one of the major problems facing industrial arts education today. This communications lag exists in all areas of our program, but as I see it, the three crucial areas are (1) public understanding of our programs, (2) professional opportunities, and (3) counselor information.

The lay public today does not understand our industrial arts programs, and no matter how much we talk about the similarities and differences between industrial arts and vocational education, they continue to group these together. To most people, industrial arts is nothing more than watered down vocational education. To industrial arts educators, as many of you are, this should not be so.

Even today, vocational courses are still considered second class education in many communities. There are many people who feel that these courses are needed, but in most cases they consider them needed for someone else's children, not their own.

My second point, professional opportunities, is depicted perfectly in a recent editorial which pointed out the inadequate number of industrial arts teachers and the fact that this problem will grow worse in the future if action is not taken immediately. While it is true that we lack teachers, there are many competent and qualified industrial arts teachers who are looking for better jobs. Since this editorial appeared, teachers have been saying, "Where do these openings exist?" A solution to this problem would be some type of system by which teachers could be matched to jobs. I have noticed that the AVA and the AIAA have made attempts to help employees and employers to get together, but I feel that these attempts have not been publicized adequately.

My third point of interest is counselor information. Industrial arts education has done an extremely poor job in making available to counselors necessary information with regard to training programs, job opportunities, and placement in the industrial arts education field. However, the teachers are also at fault. They have been slow in supplying counselors with the kind of information needed.

I have stated three examples of the communications lag which exists in our field. To overcome any one of these requires time, money, and most of all, interest from everyone concerned with industrial arts.

Finally, the second major area which needs improvement is the promotion of AIASA Club activities. To me, this is the most vital problem facing us this very day. The American Industrial Arts Student Association has been in existence for about six years, but I am sorry to say that it has not yet provided its club members with enough stimulating opportunities. The cause for this is the lack of concern among some of you who are sitting in the audience today. You are probably saying to yourself, "I don't have to worry about AIASA," and others might be saying, "Why should I promote AIASA? It will be of no benefit to me." But I must say you are wrong. It is you, the members of AIAA, who have the responsibility of seeing that AIASA exists. Several people have already assumed responsibility, Dr. Edward Kabakjian, Mr. Phil Schooley, Mr. Samuel Powell, Mr. Andrew Gasperecz, Mr. John O. Murphy, and Dr. W. A. Mayfield. These men have demonstrated their interest in AIASA, but alone these men can not bring about a change. They need the help of all of you, and they need it today.

AIASA is a very good student organization, but we are trailing most other national student organizations by far. If you do not think so, look at the other organizations. Take, for example, the Future Farmers of America. When a member of the FFA is elected to a national office, he not only has the privilege of serving as national officer, but he is provided with the most adventurous year of his lifetime. In only twelve months, the officers travel more than 200,000 miles to promote their organization's programs, and I know of no better way of breaking a communications gap than by having the students themselves making public appearances. Other clubs, like the Future Business Leaders of America and the Future Homemakers of America, provide similar opportunities for their officers and individual members.

AIASA will never be able to compete with these organizations or to offer industrial arts students these opportunities until it has a full-time professional person acting as an administrator at the national level. It is unreasonable to try to operate a national student organization with the same procedures as a committee of the AIAA. In other words, this association cannot progress until you and the members of the executive board of the AIAA recognize AIASA as an organization and not a committee. Furthermore, the progress of AIASA in comparison to business education, trade and industrial education, vocational, agriculture, and home economics youth groups reflects very poorly on the industrial arts education profession.

As you can see, we must begin to re-evaluate the direction in which we are heading. We must institute new practices and philosophies, but only lasting ones which will benefit club members for many years to come. If this is not done, then the chances for AIASA to survive are very slim.

AIASA can exist only with your support. Although it is a group responsibility, the opportunity for service is also an individual concern. You and I must begin now. We must devote time, and we must dedicate our lives to improving our organization. Each minute is a precious one, for it shall never be recaptured. We must live our lives, for we shall not pass this way again.

> "For yesterday is only a dream, and tomorrow is only a vision. But today well lived makes every yesterday a dream of happiness, and every tomorrow a vision of hope. Look well therefore to this day. Such is the salvation of the dawn."

Mr. Comeaux is president of the AIASA and is from Acadiana High School, Lafayette, Louisiana.

The Role of the Club Sponsor

W. A. Mayfield

The one factor that determines the effectiveness of student clubs seems to be the sponsor. If the sponsor is the key to successful student activities, how must the sponsor perform to achieve desired results? In attempting to answer this question, let us consider areas that frequently appear in the problem category.

First and foremost, the sponsor must function indirectly in almost every situation. From an indirect position, he must be involved in planning, organizing, leading, and in some instances controlling. The fewer the restrictions placed upon the participating students, the greater the potential of the group. This is not to imply that there should not be any group control.

Student club activities do not develop automatically. They must be planned and worked at very diligently. This also means activities are to be continuously evaluated. A successful organization requires more than just a group of officers, a membership, a constitution, and a sponsor.

The sponsor is charged with the responsibility of seeing that the club reflects a flexible system. He must be concerned about school, student, and community educational goals. He should be dedicated to promoting communication and interaction among its members. It is most important that solutions to organization problems come from within the organization when possible. It is the sponsor's task to make members aware of the spirit of consensus. When an organization provides challenges and opportunities for students, increased responsibility is an inevitable result. Shared responsibilities are the greatest training for leadership and citizenship a club can have. Student activities seem to insure dynamic change in the students' attitude toward education when integrated into the educational atmosphere.

Each organization should have specific objectives; however, the sponsor must be more concerned with objectives achieved by each student than with the total number of objectives achieved.

When students fail to perform as the sponsor feels they should, he needs to be concerned about changing their performance or changing his expectations.

The sponsor should use sarcasm, insulting remarks, criticism, and humiliating remarks very sparingly. He should be alert and not let punctuality be punished by waiting on tardiness. Sponsors should always strive to keep desired performance at a peak.

He should practice turning students on! "Mr. Doe, wasn't it great that we won first place on our float?" "Yeah, Bill, that was great. Every club member really put out 100% on that project." Do not turn them off! "Mr. Doe, we sure had a profitable night last night in the concession." "Yeah, but you guys sure made a mess with our leftover supplies. They were piled all over the room."

The difference between what students do and what a sponsor wants them to do is often prefaced by untimely statements such as:

"You fellows are just not functioning as you are supposed to."
"Some members of this club have a poor attitude."
"Our students don't have any respect for authority."
"You just can't depend on this group to do anything right."
"There is no initiative in our club."
"How do you get this group to cooperate?"

A good sponsor knows and practices professional sequence at the local, state, and national level.

When the sponsor functions at his peak, the next two problems that seem to plague an organization are communication and funds. Many communication problems are built in at the state and national level. Broad, comprehensive activity programs are usually curtailed by limited funds. Each situation involving the local, state, and national organization seems to insure different problems. There is evidence from other student organizations that our major problems can be solved if our industrial arts teachers will assume responsibilities beyond the laboratory and sponsor a student club.

A SPONSOR'S DREAM — A BETTER TEACHER

1. He is a teacher that students are attracted to.
2. He is a teacher who enjoys working with students.
3. He is a teacher who knows his students.
4. He is interested in every student.
5. He is able to listen.
6. He is able to communicate with students.
7. He is a teacher who challenges the future.
8. He is interested in tieing the school and community together.
9. He is a teacher who knows how to share with his students.
10. He is an asset to the profession.
11. He is willing to learn.
12. He is always searching for human potential.
13. He knows how to make students aware of the advantages of the system.

He is all of this and more because he chose to be a sponsor—because he wanted to be a better teacher.

Dr. Mayfield is on the faculty of Texas A&M University, College Station, Texas.

The Role of the Student

Vincent Kuetemeyer

Sponsors have, or should have, an indirect function in student organizations. Yet many advisors believe that they should have all the decision-making and planning responsibility of the organization. Generally, this based on the thought that there would then be no room for student error. This concept goes against both educational method and our experience. We have been taught that it is only by having the opportunity to make wrong decisions that pupils learn to make right decisions. If an organization professes to be student-centered and support student activity programs, then the student must not be left out of the development and planning of either the organization or its programs.

As is true in any group, everyone will not have the opportunity to be heard but rather will be represented by another. The student who represents his peers is the student leader. Where do student leaders come from?

Traditionally, there are three approaches to the selection and development of student leaders.

One method, which is incorporated most often, is that of "developing the elite." This assumes that student leadership comes from the more elite school inhabitants.

The second method, which seems more acceptable, is that of selecting and developing those students who demonstrate personal attitudes which tend toward leadership. The resulting effect is much the same as the previously mentioned method, individual leaders.

A third and more acceptable concept is that of developing group leadership techniques. This is a cooperative effort which involves more of the individuals in the leadership of the organization.

If we look at the basic reasons for student leadership study, to instruct new members, to continue development and growth of the organization, to build the philosophy of the organization, and to bring about more uniform practices between like organizations, then we can recognize that the group method of leadership more capably fits the situation. The development of group leadership does not mean that there will be more chiefs and no Indians, but rather that the Indians will be in a position to help and possibly assist with the responsibilities of the chief.

Learning activities in leadership should contain instruction in the organizational structure of the group or club, the objectives and purposes of the organization, and communication. Leadership development or training is a continuing process of the organization. All levels, national, regional, state, and local, have this responsibility.

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Mr. Kuetemeyer is Assistant State Advisor of the Texas Industrial Arts Student Association.

Representative Addresses from the Major Group and Special Interest Sessions

Aerospace Education

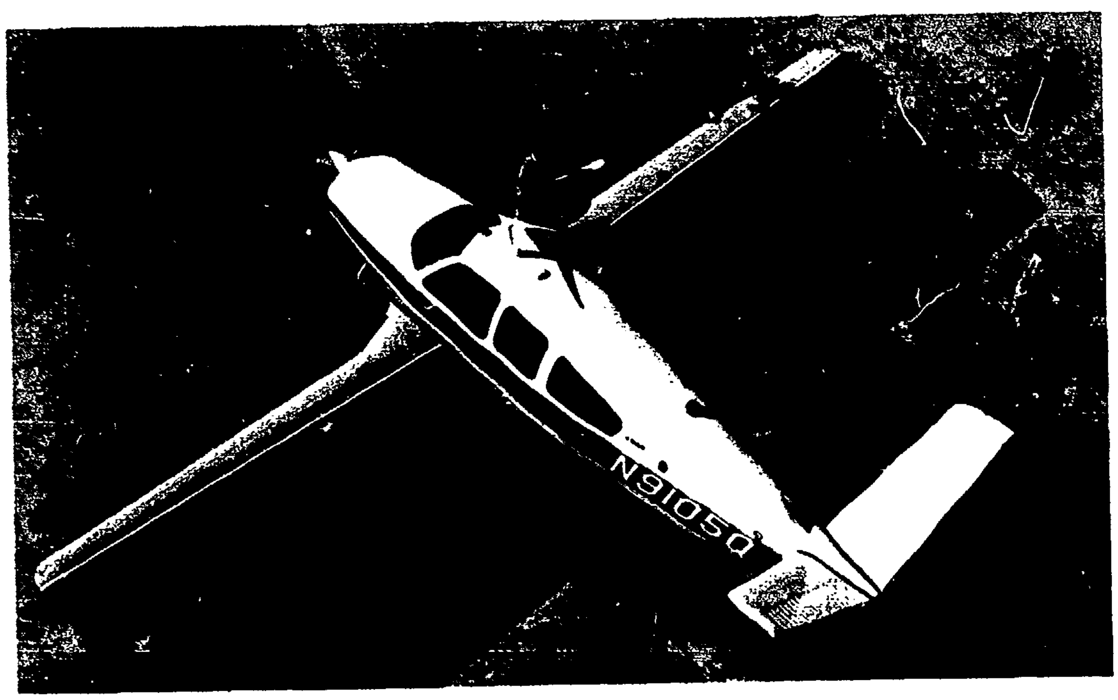
Aviation in Industrial Arts Education

Marion P. Stevens

The teaching of industrial arts has changed, just as the entire spectrum of education is changing. However, one cannot help but smile when we read today about making education "relevant." I think back to some of the ideas we studied 25 years ago, ideas by such men as Charles Prosser; ideas suggesting we educate the "other 60%"; ideas suggesting educational changes by men such as Bell, Wilber, Bouser and Mossman, Braden, Warner, Selvidge, and many others.

The last AIAA Convention I attended was in St. Louis in 1949 as a member of an Epsilon Pi Tau initiation team. The main convention speakers then were concerned with the "crisis in education." I believe we still have a crisis and evidently will continue to have one as long as we have education.

I am here today to speak to you about aviation education. Why should the AIAA be interested in aviation education, you may ask? There are over 1000 high schools today that offer aviation education courses. These are not courses to teach flying; they are



more of a general introductory, exploratory, careers type program. Many schools do offer a flight experience (not pilot training). Many offer shop experience in an airframe and powerplant mechanic program. Several schools now have avionics programs (avionics is a fairly new word coined from combining aviation and electronics.)

On the junior college level, there are 198 aviation programs, and we now have identified 27 four-year colleges with an aviation curriculum (not counting aeronautical engineering).

I have still not explained why the AIAA should be interested in aviation education. Forty-five percent of the aviation teachers in Kansas, which has 44 high school aviation courses, are industrial arts teachers. We find this figure holds true throughout the nation. The president of the Kansas Aviation Teachers Association is Mr. Verne Hendrixson, an industrial arts teacher. Aviation is tied in very closely to the industrial arts movement, and it should be. It is relevant to today's educational needs. It is not compatible with any theoretical ideology as advanced by a fuzzy-headed social science professor who has never been out of the classroom to see what makes this old world go around.

I would like to spend the rest of my time acquainting you with a new aviation organization which can be of tremendous help to you if you will just let them know you want information and help. The organization is GAMA (General Aviation Manufacturers Association).

January 5, 1970, the General Aviation Manufacturers Association, Inc. (GAMA), opened offices in Suite 1215, 1025 Connecticut Ave., N.W., Washington, D.C. The founding GAMA Board of Directors and member companies they represented were: John M. Ferris, Vice President, AVCO Lycoming Division; Malcom S. Harned, Executive Vice President, Lear Jet Industries; Frank E. Hedrick, President, Beech Aircraft Corp.; Norman G. MacKinnon, Director of Advertising, Grumman Aerospace Corp.; W. T. Piper, Jr., President, Piper Aircraft Corp.; J. Lynn Richardson, Executive Vice President, Continental Motors Corp.; Richard N. Robinson, President, General Aviation Division, North American Rockwell Corp.; Richard B. Smith, General Manager—Marketing Operations, Commercial Engine Division, General Electric Company; Ivan E. Speer, Vice President, The Garrett Corp.; T. E. Stephenson, President, United Aircraft of Canada, United Aircraft Corp.; Dwane L. Wallace, Chairman, Cessna Aircraft Co.

The purposes for which General Aviation Manufacturers Association was organized as stated in its Articles of Incorporation are "To foster and advance the general welfare, safety, interests, and activities of general aviation (including without limitation its relationships and responsibilities with respect to all elements of the public and government) and to carry out such lawful activities as may be in the common interests of its members." One of GAMA's first defined objectives is to create an awareness of the general aviation industry in the minds of the public of this country. The public affairs committee is charged with this responsibility, and I would like to share with you some of the material they have available which can be used in your school and classroom for the benefit of your students and cor munity.

A series of ads have been developed which are being carried in various national magazines such as Time, Nations Cities, Editor & Publisher, as well as airline publications such as American Airlines' American Way, and TWA's Ambassador. These ads are of interest to civic-minded individuals and carry such titles as "How To Land a New Industry." The copy points out that an airport not only attracts industry but also is in itself a major employer. The ad invites readers to write GAMA for more information.

The second ad is designed to educate community leaders to the fact that an airport fits in with an area's ecology...if, that is, it is thoughtfully planned. The copy advises that, if you're interested in your community's economic wealth, build an airport; if you're concerned about your community's ecological health, plan an airport.

The third ad has been released and the fourth is now in developme it.

"How To Land 60,000 New Jobs" tells about the economic benefits that communities have enjoyed since they embarked on airport/airway improvement programs.

The fourth ad is entitled, "How To Land More Tourist Dollars." It is designed to generate interest among communities that offer recreation and tourist attractions and tells how they could get more business by building or enlarging an airport to offer a quick, convenient means for travelers to get there.

Available to schools and the public is a folder called "An Airport is a Growth Industry." It briefly tells the story of general aviation, the coming boom in airport development, and the importance of airports to a community. It invites interested persons to contact state and/or federal officials and GAMA for more information. Seventy-five thousand of these pamphlets have been produced to answer inquiries and to distribute at meetings. Copies are available for you to take home from this convention.

Our new 12-page primary brochure, "How To Land An Airport," contains a great deal more information than the folder, including the local addresses of FAA and state aviation department offices. Twenty-five thousand copies have been printed for distribution to individuals who have more than just a casual interest in airport/airway development.

Our new general information kit is called, "How To Land An Airport in Your Community." The kit has pockets that will contain at least four basic brochures.

The "How To Land An Airport" brochure and three guidebooks are each filled with comprehensive information about general aviation and a wealth of information to help community groups initiate an airport/airway construction or expansion project.

One guidebook describes how to plan and finance airport projects. Another offers suggestions on how to build community support for the project. The third emphasizes the economic advantages of airports to the community. Pockets in the kit allow space to insert additional material—such as GAMA ad reprints—that may be considered suitable.

Five thousand of these kits have been produced and will be distributed selectively to state, county, and city officials and community leaders who express a serious interest in constructing or expanding airport facilities.

In addition to the materials just mentioned that are of interest to communities, I would like to present material that has been developed by the education committee of GAMA for your use.

Last year, a $20,000 grant was authorized for a study of aviation educational guidelines by the American Association of Junior Colleges. This study has been completed and accepted by GAMA.

The report in brochure form has been produced. Though its primary audience is junior colleges, the report will be useful to educators in full-term colleges and high schools that are planning aviation education programs.

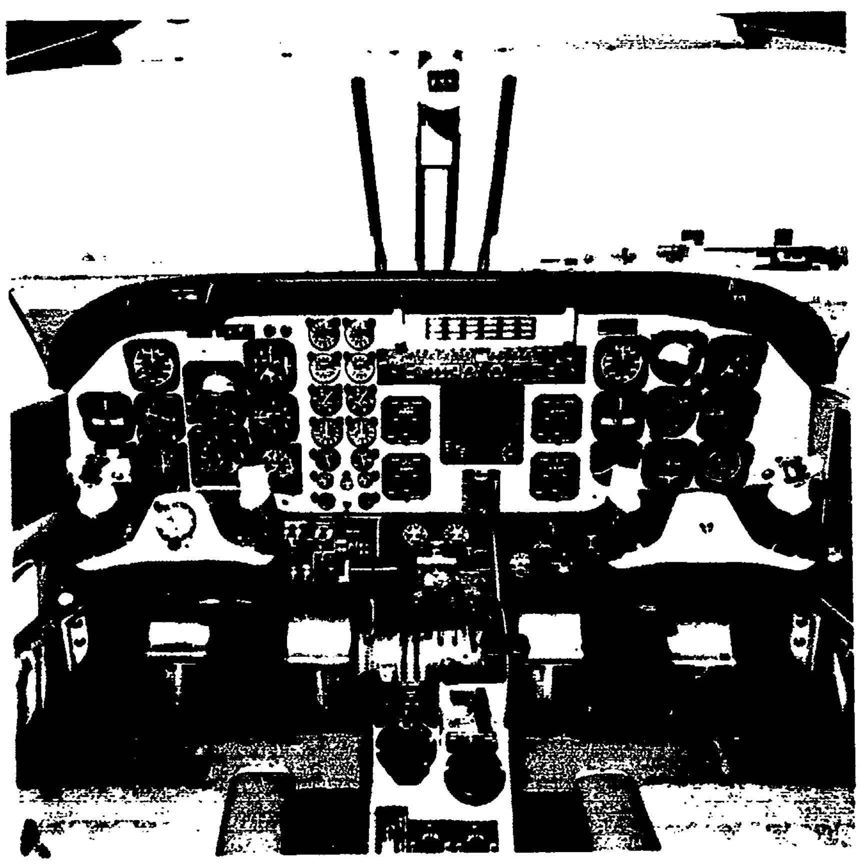
GAMA has purchased 3000 copies of "An Introduction To Aerospace Education." These books are being distributed to aviation workshops and other groups that are setting up air-age education courses. The response from teachers throughout the nation has been excellent because this material gives them a basic "how-to-do-it" approach.

Another outstanding booklet is called "Aerospace Educational Materials." It lists the films, literature, and other material available from GAMA members. To date, several thousand have been distributed at educational meetings and in response to requests.

During the year, our educational display was exhibited at four conventions. The exhibit has been manned by educational and public relations specialists from GAMA member companies. The display gives important exposure to our industry among leading educators. We plan to continue this program.

In connection with our aviation careers program, we have produced five brochures, each describing the opportunities in various phases of the general aviation industry. The brochures cover such different fields as "How To Land a Career Using Personal Flying," "How To Land a Career As An A&P Mechanic," "How To Land a Career As a Fixed Base Operator," "How To Land a Career As a Professional Pilot," and "How To Land a Career As a Flight Instructor." Ten thousand copies of each of these brochures are being offered to school officials for vocational guidance and counseling.

Financial support, grants made under our education program during the year, included $3000 to the 4-H Club to develop and test a formal nation-wide program of aeronautical instruction for its club members. A small grant has been made to the National Aerospace Education Council to further its work; another grant to the National Intercollegiate Flying Association is helping this association to expand its activities.



Materials for school use are available from most of the GAMA members. Cessna and Piper Aircraft companies have aviation education departments which send information upon request. We at Beech Aircraft have material in three fields of education—elementary, secondary, and college. On the elementary level, we send an Aviation Education Kit which has pictures of our aircraft as well as a section on "What Makes An Airplane Fly" and "The Parts Of An Airplane."

On the secondary level, we have a packet which includes a sample high school syllabus as well as related information. In addition, on the secondary level we have a film available through Beechcraft outlets or on direct loan from the factory. This film, "Discover Flying," takes a young teacher through her first flight lesson, explains how the different instruments work, and demonstrates the control surfaces of an airplane.

A booklet, Aviation/Aerospace Courses at Institutions of Higher Learning, is available on the college level.

Considerable assistance is available from the Federal Aviation Administration, from the manufacturers, and from GAMA for those teachers who are interested in aviation education. Please let us help you.

Mr. Stevens is Administrator of Aviation Education for Beech Aircraft Corporation, Wichita, Kansas.

Electrical Power Sources for Manned Space Missions

Welby T. Risler

Power is defined as performing work or expending energy within a specified period of time. Manned Space Missions have utilized the power of exhaust gases for propelling spacecraft. Pyrotechnic devices have provided the power necessary for cutting cables, breaking bolts, ejecting parachutes, etc. Another class of power used in support of Manned Space Missions is electrical power.

NASA has investigated a number of methods for the production of electrical power aboard a spacecraft. Some of these methods were batteries, solar photovoltaic cells, thermoelectric converters, fuel cells, turbine converters, and thermionic devices. Electrical power is produced by drawing upon other sources of energy and converting this energy to electrical energy. The power available depends upon the rate at which this energy can be converted. Many factors are considered before selecting a method: size, weight, efficiency, environment, waste by-products, etc. This paper will describe three different methods for producing electrical power: fuel cells used for converting potential chemical energy to electrical energy in support of the Apollo missions to the moon; thermopiles used for converting heat energy into electrical energy for an experiments package left on the moon by the astronauts; and solar photovoltaic cells which will convert the sun's radiant energy into electrical energy in support of the Skylab mission now scheduled to be launched some time in 1973.

FUEL CELLS

Energy is available whenever atoms or molecules combine with an exchange of electrons. When these electrons are exchanged upon contact, energy is released as heat and radiant energy. The process is called combustion. If the electrons can be exchanged through an electrical circuit, electrical energy is available. Batteries work on this electrochemical principle. The reactants combine using an electrolyte, but before one of the reactants goes into the electrolyte solution, it leaves behind a charge which will flow through an electrical circuit and enter into the reaction at the other electrode.

Man's first flights into space in the Mercury spacecraft were of short duration, with the maximum flight being three days. Batteries alone were able to supply the necessary electrical power. Batteries were selected that contained the largest amount of potential energy per unit of weight. Project Mercury used a battery having silver as one of the reactants.

The silver zinc cell has one disadvantage in that its discharge-charge life cycle is very restricted. This was no problem for Mercury, since the batteries were not charged in flight. The nickel cadmium battery has a discharge-charge life cycle reported to be 10 times greater than the silver cell. The nickel cadmium battery will be used on the Skylab Project where the number of available discharge-charge cycles are important.

A battery is needed that can keep supplying reactants on demand without need of recharging. A battery which can satisfy this requirement uses gases for the reactants. These batteries are referred to as fuel cells.

Fuel cells have been experimented with for over a centry and present an excellent example of where principles of operation were understood but where technology and economics provided the limiting factor. In 1932, Bacon in Cambridge, England, made a fuel cell that produced 5 KW of electrical power using hydrogen and oxygen as reactants to produce water. Oxygen combines with water in the electrolyte to form hydroxal ions ($O\bar{H}$). In doing this, electrons are taken in at the oxygen electrode, leaving it positively charged. Hydroxal ions at the hydrogen electrode combine with hydrogen to form water (H_2O) and give up electrons in the process, leaving the hydrogen electrode negatively charged. A fuel cell of this type is sometimes referred to as the Bacon Cell. This appears to be the answer to the noise and chemical pollution of the fossil-fueled automobile; however, after reading the following description of the fuel cells used on the Apollo spacecraft, it can be seen that the present technology would be a rather complicated one. The

Figure 1. One of the three fuel cells that power the Apollo spacecraft. It weighs approximately 225 pounds.

Apollo spacecraft has three Bacon fuel cells, each capable of generating 2 KW of electrical power. Potassium hydroxide (KOH) is used for the electrolyte and porous sintered nickel plates are used to separate the KOH from the hydrogen and oxygen gases.

The voltage produced by the electron exchange between hydrogen and oxygen is approximately 1 volt; therefore, each Apollo fuel cell has 31 individual cells in series to produce an operational voltage of approximately 30 volts.

The pore size of the sintered nickel plates varies. The holes exposed to the gases are of different size than those exposed to the KOH solution. The size of the holes is determined from the surface tension or capillary action of the KOH solution, the vapor pressure of the KOH solution, and the pressure exerted by the hydrogen and oxygen gases.

In order to keep the fuel cell volume within reason, the current area density must be acceptably large. This is accomplished by increasing the chemical activity and ion mobility in the electrolyte by applying high pressures and temperatures to the gas reactants and electrolyte. The oxygen and hydrogen pressure at the electrodes is approximately 4.5 atmospheres absolute. The KOH electrolyte is pressurized at 3.6 atmospheres absolute. The operating temperature of the cells is approximately 160°C (385°F). The KOH is pressurized by nitrogen which is accurately regulated. The hydrogen and oxygen pressures are regulated with respect to this nitrogen pressure.

The vapor pressure of the KOH electrolyte is limited by restricting its water content between 23 and 28%. KOH concentrations of this amount will be a solid at room temperature. The Apollo fuel cells must be preheated to liquify this solid KOH and water before elect power can be produced. Once electrical power is being produced, the electrochem a action of the cell will produce heat, and cooling must be provided for nominal mission loads. to restrict the internal fuel cell temperature. A water-glycol mixture is circulated through jackets in the fuel cell and from there to space radiators located on the outer surface of the Apollo spacecraft.

When the electrical power demand decreases, the temperature of the fuel cell will decrease. Temperature sensors measure this and by-pass some of the water-glycol coolant around the fuel cell in order to maintain the temperature. Since the hydrogen and oxygen are stored initially as liquids, the cold gaseous hydrogen is also used to provide cooling. In the event that the electrical demand decreases further, it becomes necessary to supply heat to the fuel cell. A hydrogen line valve is activated and the hydrogen gas is passed through a heater before entering the fuel cell.

Trace amounts of impurities such as argon in the oxygen and hydrogen gas will degrade the fuel cell performance with time, as little as one hour for oxygen and 10 hours for hydrogen. This is overcome by the purging or flowing of either hydrogen or oxygen gas across the electrode surface and overboard of the spacecraft. The purge time for oxygen is two minutes and for hydrogen 80 seconds.

Water vapor is produced at the hydrogen electrode, and this vapor must be removed. Hydrogen gas and water vapor are circulated through a water condenser which is cooled by water-glycol. The condensed droplets of water are separated out by a centrifuge, since there is no assistance from gravity out in space. A 2-KW power consumption for one hour will produce approximately 0.68 Kg (1.5 lbs.) of water.

The Apollo fuel cells have a low internal impedance in that a 20-ampere change in load current will produce only about one volt change in output voltage. The load current is maintained where the output voltage is maintained between 31 and 26 V.D.C.

A very difficult technical problem that had to be solved was a method for insulating electrically the metal hydrogen and oxygen gas plumbing from the fuel cell electrodes. A ceramic that could withstand the large temperature and pressure changes of the fuel cell without leaking was difficult to find.

The Apollo fuel cell has a high efficiency, approximately 82% at 2 KW power output.

SOLARVOLTAIC CELLS

A dependable power source for extended manned missions is radiant energy from the sun. A space mission is not confronted with clouds, and once the space vehicle is oriented to a particular attitude with respect to the sun, it will maintain this attitude except for slight disturbances. Earth orbit missions will, however, experience night and day conditions and, therefore, some of the sun's energy must be stored in batteries during the day time for night-time usage. A solarvoltaic or solar cell is a device which is able to directly convert certain photons of the sun's energy into electrical energy. Many are familiar with the name solar cell but are not familiar with its construction or principle of operation. Three common types of solar cells are selenium, cadmium sulfide, and silicon crystal. For space missions, the silicon crystal is used because of its high efficiency. A 14.4cm^2(0.1 ft.)^2 area will produce one watt of electrical power from the sun's radiant energy.

Silicon is the second most abundant element on earth, but in order to function as a solar cell it must be purified with its atoms arranged in an orderly structure or in crystalline form. Two differently modified silicon crystals are required to make the solar cell. The silicon crystals must be lightly "doped" or have their crystalline structures interlaced with another element. There are different doping elements that can be used. For the Skylab Orbiter Workshop solar cells, these elements are phosphorous and boron.

The silicon crystal containing phosphorous is called "n" or negative type, and the crystal with boron is called "p" or positive type. These modified crystals are part of a group of crystals called semiconductors. Some may recognize them as being used in the manufacture of transistors and diodes for the amplification and rectification of electrical signals. When a junction is made between p and n semiconductors, conduction electrons

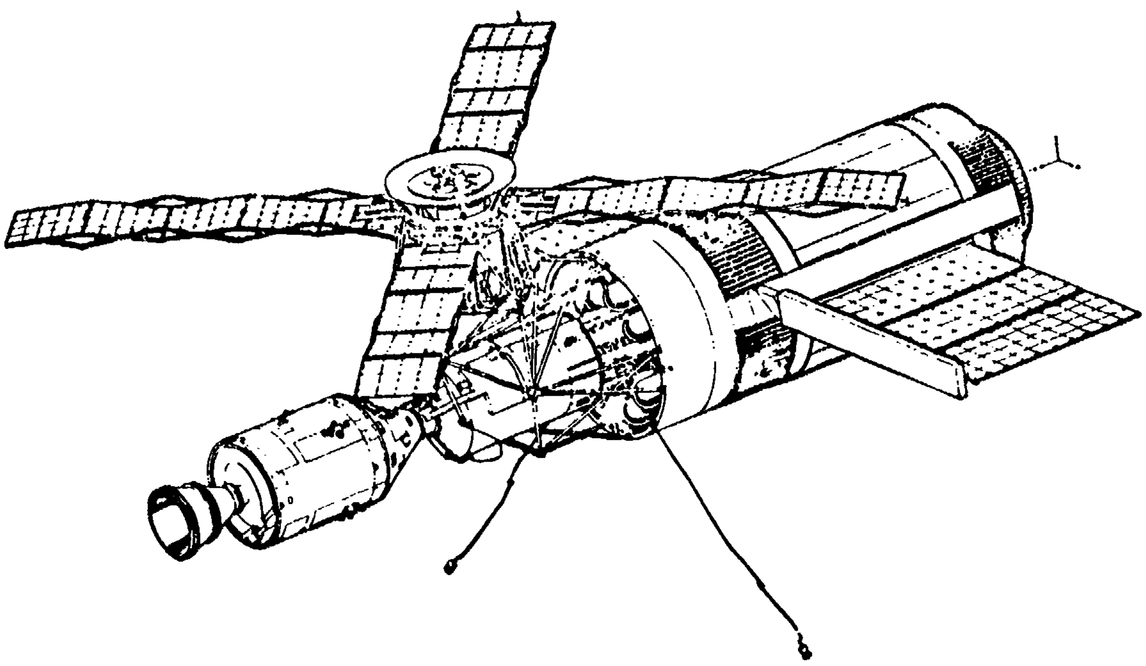


Figure 2. This is a sketch of the complete "Skylab." The workshop and associated solar cells are to the right. The "windmill"-looking object is a large telescope experiment also powered by solar cells. The Apollo vehicle is docked to the Skylab.

in the n material at the junction will migrate across and fill holes (empty energy states) in the p material. This produces an imbalance of charge on both sides of the junction. An electric field or voltage will build up across the junction to a value that will stop this flow of charge. It can only be mentioned here that atomic electrons are stable about a nucleus only at specified discrete energy levels, that no two electrons can occupy the same energy level, and that crystal semiconductors will have stable electron energy states that are associated with a number of adjacent atoms, not just one atom. If a photon of radiation of sufficient energy from the sun were to arrive near, or in the vicinity of, a p and n junction, this photon can be absorbed by an electron with the result that the electron is raised to a higher energy level creating an electron-hole pair. The forementioned electric field existing across the junction sends the electron and electron-hole in opposite directions before they can recombine. The result is an electrical current which flows across the junction.

A solar cell will be thin and flat, with the sunlit side of the semiconductor being very thin. The Skylab Orbiter Workshop solar cells have the n semiconductors facing the sun. A means must be provided to allow the sun's energy to enter the solar cell and yet have electrical contact made with this same surface. To accomplish this, 12 wire fingers or grids are printed on each of the n or sunlit sides of the solar cells. All electrical contacts for both p and n sides are silver and titanium. The Skylab Orbiter Workshop solar cells are 0.36 cm (0.014 in) thick. The semiconductor's electrons are capable of only absorbing specific discrete amounts of energy. Any of the sun's photons possessing more than this amount of energy will appear as heat, which must be radiated away. Since silicon has a low thermal emissivity coefficient, the solar cells are covered or fused over with 0.015 cm (0.006 in) of glass. This will produce a surface with a good thermal radiation coefficient and also provide protection against micrometeroids. The desired portion of the sun's energy spectrum is within the 0.6- to 0.8-micron (yellow to short wave infrared) wavelength region. Wave lengths longer than desired will pass through. Wave lengths shorter than desired will produce undesired heat and if in the ultraviolet range will produce damage to the solar cells. Coatings of films having one-fourth and one-half wave length thickness can produce filters that reject or enhance transmission of photons at these wave lengths. One such coating is used to provide better transmission at the desired 0.6- to 0.8-micron wave lengths. Another coating is applied with a thickness that will reject or reflect high-frequency photons in the ultraviolet region. The principle of operation of these coatings is similar to soap and oil films, which produce various colors by reflecting and transmitting different light wave lengths depending on the thickness of the soap or oil film. Since one solar cell of the Workshop type has an area of 2 cm by 4 cm, it produces only 248 ma of current at 0.475 volts at nominal temperature and sun conditions. This means it will take a number of solar cells in series to build up to an operational voltage, and a number of these series strings must be connected in parallel to build up to an operational current. There are 120 parallel strings of 154 solar cells connected in series to produce a power output capability of 1.5 KW. In all, there are eight of these solar cell groups. They can be independently connected to either of the two main electrical buses in the Workshop by means of manual switches. There are a total of 147,840 solar cells to provide the electrical power capability of 12,000 watts during the sunlit portion of the orbit. This also represents a total surface area for cells and bracketry of 128 m^2 (1,362 ft^2). This means that during launch the solar cells must be folded up for aerodynamic streamlining and support during propulsive flight. The Workshop looks like a giant bird with outstretched wings when the solar arrays are extended. The solar arrays are made up of 60 rigid panels, with 30 panels assigned to each wing. These panels are folded up accordion fashion into a slender housing, one on each side of the SIV B rocket stage. This housing is hinged and secured to the rocket along its longitudinal axis. When deployed, the housing swings forward like a swing wing airplane, and then the solar panels are extended from it until they lie in a flat plane. The panels are electrically interconnected by means of hinged connectors.

Since the voltage of each solar cell power group can vary from 55 to 125 volts depending on the power utilized, a means of regulating this voltage is required within the Workshop. The nominal bus voltage in the Workshop is approximately 28 volts. Whenever a voltage comparator detects that the bus voltage has fallen below this amount, it turns on a switching transistor which conducts electrical energy from one solar cell power group into a coil and capacitor which in turn discharges this energy onto the Workshop main electrical bus. When the main bus voltage climbs to a certain value, the switching transistor is turned off but the collapsing magnetic and electric fields in the coil and capacitor continue to discharge energy onto the main bus. When the coil and capacitor combination can no longer maintain the main bus voltage, a drop in voltage will occur and the process will be repeated.

For reliability purposes, designers must play a "what if" game. Suppose the switching transistor failed to turn on? The system can remain operable by having a number of them in parallel. In fact, for each solar cell power group, there are six voltage control networks just described in parallel. What if a transistor switch fails by shorting or fails to stop conducting? The voltage will rise and the current will rise until a point is reached wherein a fuse assigned to that transistor network opens and breaks the circuit. This high current and voltage could damage equipment. A shunt regulator is placed across the main bus to prevent this. If the main bus voltage rises above 32 volts, a voltage comparator turns on a transistor-controlled by-pass or shunt load. This shunting of current will cause the fuse in the voltage regulator to open without exposing the equipment to this excessive current. What if the shunt regulator transistor fails? Again, there are parallel shunt loads for each main bus. Each of these paths are fused for any excessive currents.

THERMOELECTRIC POWER SYSTEM

The Apollo Lunar Experiments Package (ALSEP) which is left on the moon by the Astronauts is powered by a plutonium-fueled thermoelectric power supply (SNAP 27). The SNAP 27 was developed by the General Electric Company and other subcontractors under an AEC contract for the Apollo Program. The SNAP 27 has a specification requirement to supply 64 watts of electrical power to the ALSEP for at least one year after a stowage period of two years. The plutonium isotope, 238, undergoes radioactive decay and in the process emits alpha particles, neutron particles, and gamma rays. The alpha particles possess much energy and because of their size (helium nuclei) are able to be confined within the radioactive fuel capsule. Some neutrons and gamma rays are able to penetrate the fuel capsule, but design holds this radiation to tolerable levels. The temperature of the fuel capsule is approximately 815°C (1500°F). Thermodynamic principles state that heat energy can only be utilized when there is a flow of heat from a warmer body to a cooler body. The SNAP 27 provides the cooler body by means of an outer shell and fins made of beryllium. These fins radiate waste heat into outer space. The fins are able to maintain the outer temperature of the SNAP 27 between 260°C

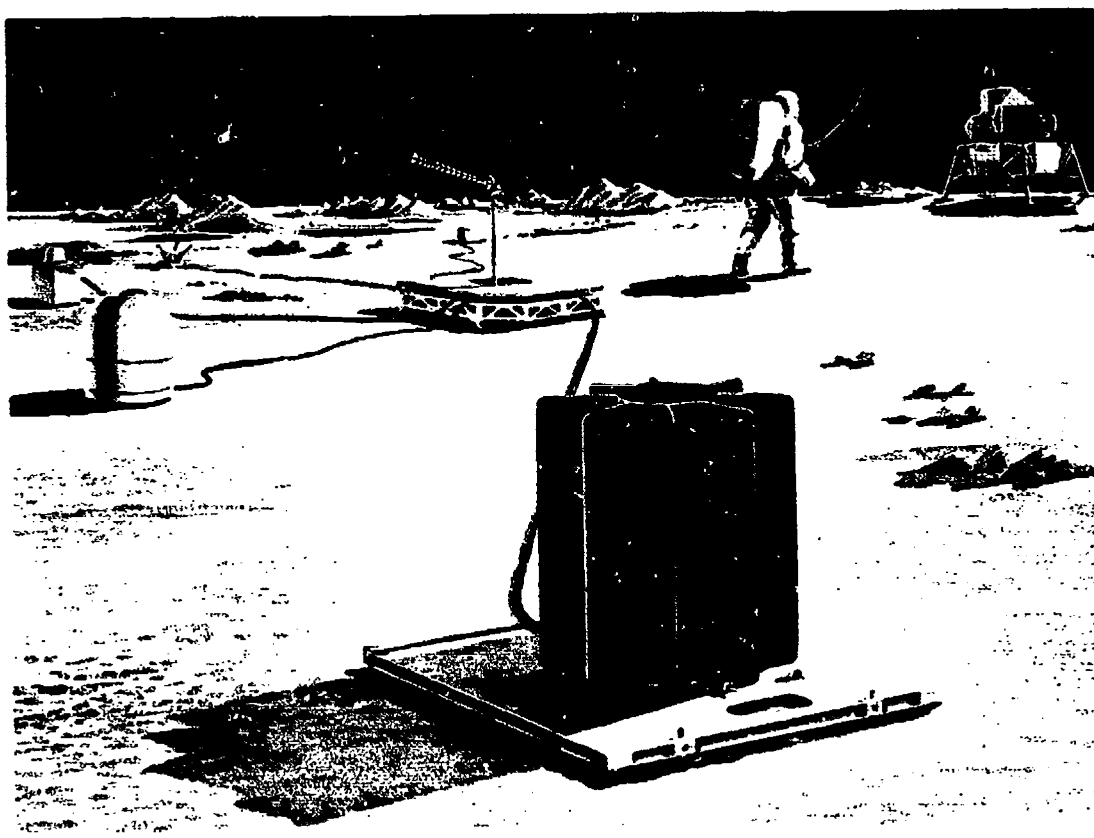


Figure 3. The thermonuclear-thermoelectric generator is in the foreground with the fins. It is the complete generator, and the other objects are experiments powered by it.

(508°F) and 227°C (442°F) during the lunar day and night. A device is needed to convert this flow of heat energy into electrical energy. In 1826, Thomas Seebeck discovered that if two electrical conductors of different materials are joined together at both ends to form a complete circuit and if each of these junctions are maintained at a different temperature, an electrical current will flow around the loop. In 1854, William Thompson (Lord Kelvin) discovered that the density of electrons along a uniform conductor varied as the temperature along the conductor varied. The thermoelectric property of a conductor is as much a bulk property as its resistance or its thermal conductivity. For a long time, the only practical use for these electromotive forces (e.m.f.) was in thermocouples used for the measurement of temperatures and radiant energy. This is because of the rather low value of e.m.f. produced by metal junctions held at different temperatures. When semiconductors entered the scene, their thermoelectric properties made it possible to consider them for producing electric power. The SNAP 27 uses lead telluride impregnated with lead and tin for the semiconductors. It still takes 442 of these semiconductor junctions in series to produce 16 volts of e.m.f. There are two of these series strings in parallel to provide the current capability. This device is sometimes referred to as a thermopile. Since the thermoelectric phenomenon is a matter of electron density in each semiconductor, the p and n semiconductors don't have to interface but can be joined by means of another conductor without a change in e.m.f., provided the same material is joining both junctions. This third conductor provides the high and low temperature point to the semiconductors. The efficiency or ratio of electrical energy to the total heat energy transferred is rather low, 4%. This is offset by the SNAP 27's small weight, 21.3 Kg (47 pounds), its over-all diameter of 39.8 cm (15.7 in) and length of 46 cm (18.1 in), and its reliable operation for a long period of time without attendance by anyone. Plutonium-238 has a half-life of more than 88 years. This means that during this time interval, the number of plutonium atoms undergoing fission per unit time will have decreased by one half. A SNAP 27 power supply placed on the moon in November of 1969 is still continuing to function, and it is estimated that it can operate the ALSEP for 10 years.

The plutonium heat source, unfortunately, cannot be turned off. There is no way to stop radioactive decay; therefore, the ALSEP is designed to utilize at all times 64 watts of electrical energy, even though at times the ALSEP equipment may be dormant. The power supply in the ALSEP has the capability of shunting this unused electrical energy through a heater buried in the lunar soil. If this is not done, the SNAP 27 would suffer a rise in temperature at its hot junctions.

The plutonium fuel capsule is carried on one of the lunar module's legs. In case of an unplanned reentry of the lunar module into the earth's atmosphere, provisions must be made to keep this fuel capsule intact. The capsule is carried on the lunar module inside a carbon container. This carbon container can withstand reentry heating and can also radiate the heat from plutonium radioactive decay during its journey to the moon.

Mr. Risler is Technical Assistant to Director of Spacecraft Operations, NASA, John F. Kennedy Space Center, Florida.

The Space Environment

Louie Melo

For hundreds of years, men have exhibited a strong interest in the environment beyond their immediate reach. As their sphere of knowledge expanded, some of the more venturous individuals often promoted exploratory enterprises to probe outside of the known environments. Even though many early ventures—based on a driving curiosity, fragmented information, and inadequate technological research—ended in failure, the few that did succeed continued to spur people toward new horizons. As a result of these driving forces, history reveals a rich store of detailed accomplishments that evolved as people emerged from the stone age through the iron age to the machine age, and on into our contemporary complex and integrated scientifically oriented technological age.

During the Fifth National Conference on "Peaceful Uses of Space," Dr. Hugh Dryder, then Deputy Administrator, presented a paper identifying some of the maturing problems of our space age. Several points significant to my discussion are, in order:

> "In examining the early history of science and technology, we find that more than twenty centuries elapsed between Aristotle and Galileo. From Galileo to Newton was one century, and in rapid order following Newton's time was a roster of the great modern mathematicians, chemists, and physicists, culminating with Einstein in our own time."

A few significant evolutionary scientific and/or technological accomplishments that have created major changes in the living and working environment of peoples might easily include:

1. The conversion of natural ores to usable metal alloys.
2. The development and refinement of technological tools to reduce human labor.
3. During more recent times, the extensive improvement of dimensional control that, in turn, has contributed to greater operational accuracy of man-made mechanisms.
4. The growth and blending together of mathematic, scientific, and technological talent into an integrated team, thus permitting people to restructure and/or blend basic matter into organic, or combined material structure, to meet the environmental and performance demands of the day. This has enabled modern man to develop mechanisms for almost any selected transportation, communication, and/or data-gathering research, or other problems associated with land, sea, or space activities.

It is, therefore, understandable, why nations exhibiting a rich heritage of scientific and technological accomplishments have been able to develop appropriate hardware to probe more deeply into that part of the space environment that had, during past generations, attracted substantial speculative attention. History will also reveal that often new material and/or design concepts developed for an exotic program will later become an integral part of mechanisms designed for domestic service.

COMMUNICATION BRIDGE

As educators, we know that efficient and meaningful communication is one of man's most difficult problems. A few thoughts presented by Dr. Dryden are worth mentioning in part:

> "Communication between the scientific community and the general public historically has been difficult and usually slow. It is difficult for scientists and nonscientists alike to adjust to new ideas, to evaluate them fairly, and to see their application to human affairs clearly.
>
> "In the past, we could, perhaps, afford a leisurely pace in adjusting and disseminating scientific and technological changes that would, in turn, meet our social, environmental, economic, and political responsibilities. Today, the pace of new discoveries has accelerated at such a rate that we are constantly faced with newness. And this stepped-up tempo imparts a quality of its own that requires new and more efficient methods of communication."

We would all agree that the world of tomorrow will continue to demand a closer working relationship between education and the scientific/technological complex. Mountains of data have already been accumulated relative to a wide spectrum of our domestic, hydro-space (oceans), and air space environments. We are also extremely aware of operational space crafts that provide us with traceable weather data, extensive television coverage and telephone conversations that include connecting links with other parts of the world, and others. In addition, a number of nonmanned instrumented crafts are currently gathering and transmitting more highly scientific data for future use.

THE OCEAN OF OUTER SPACE

Numerous volumes have been written describing the planet earth in relation to other visible planets. The more recent writings often refer to man and all other earthlings as members of the space ship called earth.

These writers further point out that our spacecraft is fully equipped with its own life support system, harnessing and converting the sun's energy through a complex series of physical and chemical reactions in order to maintain a balanced closed-looped life cycle system between the planet and all of its life systems. Its basic atmosphere, extending nearly 30 miles above the earth's surface, is an integral part of the entire earth's support system, holding or transporting the necessary life-supporting gaseous mixtures, water vapors, and chemical reactants. Other outer gaseous layers act as protective blankets or shields from strong destructive sun rays, external radiation, moving particles, and others.

In short, most of our activities take place on or near the bottom of this huge ocean of air.

The motion, pressure, temperature, and gaseous content of the space masses that extend for hundreds of miles above the earth's surface differ from one location to another as well as from one elevation to another. Thus, the materials selected for any man-made space mechanism must exhibit the ability to survive in these different environments.

For example, a few pertinent conditions that technological students should review when studying about space are:

1. While sea level pressures are nearly 15 pounds per square inch, they decrease as elevation increases. Likewise, the density of the air will also decrease as elevation is increased.
2. The life-supporting oxygen content at sea level is approximately 21%. However, at 6 miles elevation it will not support life, and at 12 miles the existing air mass cannot support fire or combustion.
3. In general, temperatures fall approximately $1^{o}F$ for every 200 feet in altitude. They continue to drop with readings of $-40^{o}F$ at 8 miles up and nearly $-75^{o}F$ at 15 miles up. The gaseous layers within the 20- to 35-mile elevation zone will include a range of chemical activity of ultra-violet light rays and ozone (O_3) and, as a result, will generate enough heat to cause a rise of space temperature to $\pm 85^{o}F$. This last broad and active zone is, in effect, the protective blanket that prevents the outer destructive rays from reaching the surface of the earth.
4. The space environment from approximately 40 to 200 miles above the earth's

surf.ce exhibits varying degrees of electrical activity. Within this broad band, the temperatures will again fall very rapidly. Changes in available gases will also take place at varying points above the surface. For example, a significant increase of atomic oxygen from 80 to 600 miles, helium from 600 to 1500 miles, and hydrogen to the 6000 mile mark have been identified (See Figure 1).

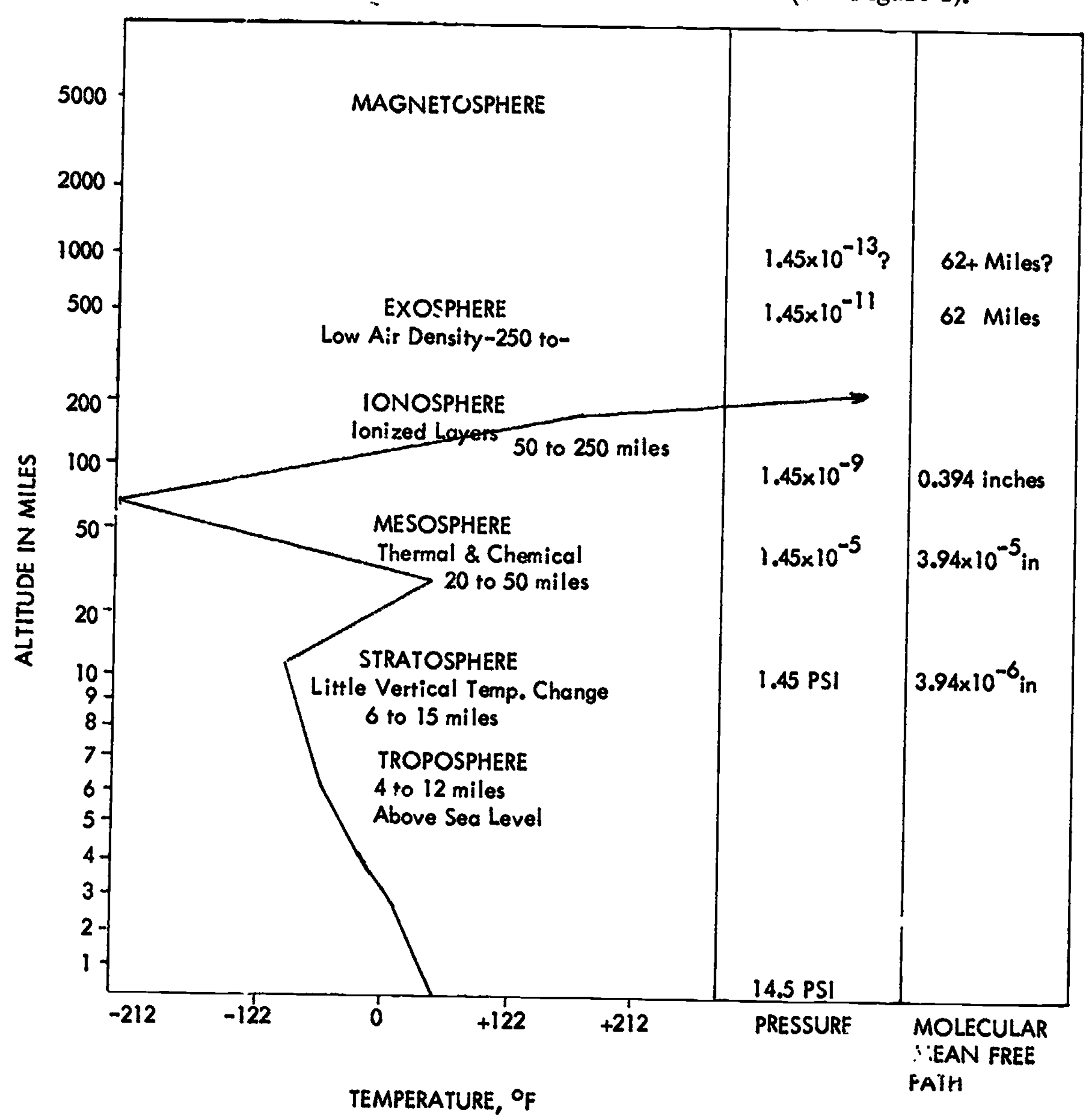


Figure 1. Some problems that must be understood when materials are selected for the space environment. (Diagram is not in scale.)

SPACE ENVIRONMENT AND MATERIALS

Even as we look at these brief and sketchy comments, we can easily note that space mechanisms and their respective materials are exposed to a wide variety of environments. Some significant ones include vibrations, aerodynamic heating, pressures, shear forces, shock waves, external and internal changing temperatures, thermal decomposition, varying vacuum, solar radiation, ionized and/or atomic gases, cosmic rays, thermal irradiation, magnetic fields, and many more.

Material science people, when planning a new mechanism, must, therefore, strive to take into account all possible known environments to which the mechanism and its many component parts will be exposed.

A review of our past space activities will also reveal that when a major national project is initiated and approved, we generally hear about its ultimate objectives, and then some months later, if it has generated public interest, we again hear about its mission and/or accomplishments. Considerably less is said about the many thousands of problems encountered and hours spent by highly specialized men to select, re-design, or literally develop the materials that were necessary in order for the equipment and men to survive in the often hostile environments.

For example, the Apollo 11 flight is said to have had the largest audience in history. The public's attention was focused on the flight itself and the excitement of sharing in its step-by-step progress from countdown to destination. When considering the numerous mentioned environmental problems that had to be overcome, we could logically state that Commander Armstrong's statement, "One small step for man, one giant step for mankind," certainly included a great scientific and technological step in material development and application with the exploratory phase of the mission.

THE EDUCATOR'S ENVIRONMENT

While we all agree that education should reflect the total integrated cultural, scientific, and technological patterns of the day, it is unfortunate that many of our schools still exhibit psychological barriers between one subject area and another. In this type of environment, the student is impeded from perceiving his studies as an integrated mesh toward understanding his operational world.

When surveying the evolutionary changes of man's living environment and the speeding pace of modern science and technology, it is reasonable to state that today's student will be a part of a very complex scientifically-oriented technological living structure. To cope with this problem the modern industrial educator must, as never before, think in terms of learning systems. Such learning systems would incorporate a group of related and integrated concepts that could easily require the talent of science, industrial studies, and mathematics teachers.

For example, we have, during a short span of 50 years, observed aircraft incorporation of a series of design modifications that included spruce wood beams, plywood, glue, and canvas to aluminum, special steels, titanium, special plastic, beryllium, special refractory metals, and others. During more recent years, highly specialized fiber-bonded composites such as boron and graphite are being considered to solve new environmental and operational problems.

Therefore, to make education relevant to the existing environment, subjects such as mathematics, chemistry, physics, history, industrial studies, and many others must be intermeshed as a working part of the real world the student lives in. Such team work should help students better understand the major space problems encountered by man and also offer knowledge that may act as the connecting problem-solving bridge between space and earth technology that is a part of his everyday activities.

The Fifth National Conference on "Peaceful Use of Space Technology" emphasized this point of view. Several points are presented.

> "The talents, the skills, and the resources required for space exploration are drawn from our society, and they feed back into our society on the forefront of scientific and technological progress. This new technology has enabled man to develop many new metal alloys, polymer structures, adhesive systems, lubricants, coatings, and others that have aided in developing more reliable and durable domestic and commercial equipment."

EDUCATOR'S AID

Numerous books, pamphlets, films, and other teaching aids are available through appropriate government and private offices. In addition, selected speakers are available in some geographic locations. NASA, for example, has already assembled some excellent material for industrial arts teachers. Their resource handbook, "Space Resources for High School," was prepared for industrial arts teachers, and among other useful data, devotes a full section to the dissemination of space information. This also includes speaker services, films, booklets, etc., that would be of interest to other related areas of the education structure.

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A Renascent Industrial Arts Aerospace

Herbert Siegel

The industrial arts aerospace program was last prominent some 29 years ago. At that time, all teachers and students were asked to produce scale models of fighter aircraft to be used in identification training for pilots and flight crews. Some 50,000 scale models were produced in those years. In-service courses for teachers supplemented the shop production and gave many elementary teachers an introduction to principles of flight. Two of the many aviation manuals published in 1943 and 1944 by the University of the State of New York were Junior Aviation Flying Model Aircraft for Senior High Schools and A Production Plan for the Scale Model Aircraft Project.

At the end of the World War II, all related aviation and model activity drifted from the shop to the home and the hobby clubs. "Sputnick" and our own space programs reawakened the nation's interest in aviation and space. In recent years aerospace, in all its implications, has grown to be the nation's largest group of employers. Aerospace industries, encompassing military, commercial, and general aviation, manned flight and scientific exploration of our solar system, and the accompanying governmental regulatory agencies, have produced a vast acervation of new industrial processes, materials, tools, machines, and occupations, many that were not thought of 29 years ago.

"The Dictionary of Occupational Titles lists approximately 500 occupations (in aerospace). The industry employs over 1.2 million workers. Commercial airlines expect to invest 2.5 millions in airport capital improvements through 1975. General aviation aircraft now number about 114,000. By 1980 they expect to have 100,000 more. By 1980 the nation's aircraft engine manufacturers will be producing 45,000 units each year" (Ref 1). With statistics such as these, we have an industry that must be represented in our curriculum.

All aspects of the industrial arts curriculum in New York City have been in the process of change to meet the needs of our students who will be entering the labor market in the late '70s and early '80s. Some of the new skills and knowledges are represented in the purchase of over 100 offset printing presses and cold type setting accessories delivered to an equal number of junior high schools. Each new junior and senior high school to be built in the near future will have darkroom facilities in addition to offset equipment. Federal funds for the past four or five years have helped us to introduce plastics technology: injection molding, vacuum forming, and rotational molding; and industrial ceramics: jiggering, jollying, abrasives, extruding, and screen decorating. It would therefore be logical that as we enter the age of moon and planetary exploration, we also prepare our industrial arts students in aerospace technology.

In establishing a basis for the change and for the introduction of a new area into the curriculum, much material was reviewed pertaining to the principles of change listed by Ovard (Ref. 2):

1. Establish the purpose of the change, isolate the problem.
2. Involve all the staff to be affected.
3. Use simple design; do not be too ambitious.
4. Use flexible patterns.
5. Provide personnel, facilities, equipment, and supplies.
6. Have a tentative approval of the district superintendent and cooperating teachers.
7. Be prepared to solve problems.

With the consent of the Board of Education and a determined effort to solve problems, a two-year program to reintroduce aerospace education into our industrial arts curriculum was undertaken.

Step 1

For the past 15 years, aerospace education has been sustained in New York City by the members of the Aerospace Education Committee of the Bureau of Curriculum Development of the Board of Education. The committee is now chaired by the Assistant Director of the Bureau, Dr. Daniel Salmon. The committee has had substantial support and assistance of the Aviation Development Council under the direction of Mr. Jim Pyle and assisted by Mr. Jack Shelly. Meetings, seminars, workshops, institutes, and extensive field trips for interested teachers and supervisors from the city and metropolitan area schools have been held periodically. The Aviation Development Council has designed and developed special teaching aids to be demonstrated at the Aerospace Resource Center of Community School District 27 under the supervision of the Science Coordinator, Mr. Bernard Spar. This center attracted over 5000 elementary and junior high students and teachers this past year for an introductory or perhaps a culminating program on aviation, flight, and space. It is similar in nature and intent, though not quite as elaborate as the Space Mobile program provided by NASA.

Preliminary discussions and participation in the organizations above suggested avenues of involvement by the Bureau of Industrial Arts and the industrial arts teachers of the city.

Step 2

A few of the most promising school districts for the initial teacher and student experimentations in aerospace were selected. The students were enthusiastic, and the teachers were experienced and have had several city-wide industrial arts contest winners. Supplies are ample, and school shops were well equipped. A strong rapport among the industrial arts teachers and supervisors was created, providing a climate for innovation and experimentation. Meetings with teachers and supervisors in each of the five junior high schools were arranged, where a demonstration of the Aviation Development Council's wind tunnel and other teaching aids were shown. Arrangements for a field trip through Pan Am's maintenance facilities at Kennedy Airport were made with their Director of Personnel Training, Mr. Al Terry. Additional special supplies were solicited from teachers in the city, and then the 25 teachers were asked to explore their areas for new projects and activities in industrial arts aerospace technology.

Our first fruits were rather meager. Three projects, an electronic anemometer, a rocket launcher, and a student-made wind tunnel to test balsa gliders were completed in two months. We did manage to initiate an experimental junior high school summer program. The six-week course taught by Mr. John Dannecker was the first trial of a semester-length industrial arts aerospace course. Mr. Dannecker taught theory of flight and principles of the internal combustion engine. He supplemented his instruction with several films and field trips about the city. Students made solid models, gliders, rockets, and a model gantry.

Step 3

About this time the Richmond, California, "Learning Through Aviation" (Ref. 3) program was brought to our attention. This is the first program of its kind to use flight training with ghetto junior high school students. The early successes of the Richmond program prompted us to propose a similar flight training program for the students of ghetto area schools in the South Bronx. A detailed proposal was worked out with four junior high school principals, several flight schools, and academic and industrial arts teachers prior to submitting it to the Community Education Council. A meeting with principals, teachers, supervisors, students, parents, and the Community Education Council representatives proved educational if not productive. The proposal was rejected for assorted reasons, including the following from the community superintendents:

1. Per pupil cost is $1500.
2. A program for 80 students at this cost penalizes the other 34,000 elementary and junior high school students.
3. Program seems to be a one-shot deal, basically exploratory with no follow-up.
4. No provisions for:
   a. selection of the pupils.
   b. special preparation of these students to attend special high schools.
   c. selection and availability of highly qualified personnel to operate the program.
   d. articulation and coordination between this program and the participant's regular school work.
   e. insurance liability and responsibility in the event of accident(s).

Step 4

A reasonable facsimile of the program was salvaged. Mr. Joseph Wolf and Mr. Morton Weinberger, assistant and principal, respectively, of one of the four schools in the flight proposal, envisioned sufficient merit in the plan to try it without the flying. Planning began on a core of industrial arts aerospace and academic subjects that would be put into operation during the following fall. At the same time, other industrial arts teachers about the city began inquiries as to the scope of the proposed programs and asked for some written directions and suggestions. To assist in planning new programs and to meet the above needs, our first Industrial Arts Aerospace Teachers Workshop was held in June 1970 at the Aerospace Resource Center in Jamaica, New York. We invited all the industrial arts teachers of the city who were to initiate a summer or fall aerospace program. We provided a recommended scope, sequence, and term plan for discussion. The teachers were able to see and operate the many teaching aids at the center. All the previously developed projects were brought out, along with some of the radio control, U-control, and glider models made by the participants of the workshop. Books, pamphlets, bibliographies, magazines, and government publications were reviewed for possible sources of information and direction. The failure of the flight proposal was discussed, and the proposed aerospace core program was explained. At this time we had the teachers review the specific goals for the program that were envisioned the previous year. These teachers (none of the original 25) and the ideas and concepts we discussed at the workshop would have to be developed over the summer and the following fall for the aerospace program to take hold.

Step 5

Four aerospace programs were in operation this past summer about the city. A time lag between ordering supplies and their delivery played havoc with some of them. Many students had to supply their own kits and accessories. The programs were recreational in nature rather than industrial arts. The students attended class for one and a half hours per day for six weeks. Related information lessons covered principles and history of flight rather than the tools, materials, manufacturing processes, and operations. In association with the summer shop programs, the Bureau of Curriculum Development provided writing time to assemble an experimental teacher's manual (Ref. 4) to be ready for September classes. Fifty copies were xeroxed and placed in the hands of interested teachers and supervisors by the first week of the new fall term.

The program at Dwyer Junior High School under the direction of the industrial arts teacher, Mr. Dan Parke, has proved to be our most ambitious and the one to produce the most interesting results. Thirty boys, selected by interest questionnaires, were assembled as our first aerospace class. The four academic teachers of social studies, language arts, mathematics, and science met with the two industrial arts teachers to organize a core program. Students were block-programmed so that they would be together for the year and assigned only to those teachers. They were to follow the just-completed industrial arts aerospace shop program and an additional drafting program. Their school schedule included:

5 periods social studies	5 periods science	5 periods mathematics
5 periods language arts	4 periods aerospace	4 periods drafting
2 periods gym	1 period guidance	4 periods Spanish

Mr. Parke prepared a detailed outline of his shop program for six-week intervals and distributed this to the academic teachers. They were to use the aerospace concepts to introduce, reinforce, and/or show implications in their regular academic work. Biweekly meetings of the teachers with the school supervisor kept the teachers informed of each other's work and the progress of the class. Preliminary tests and statistics after five months present an encouraging picture. The class, a heterogeneous group, began with a mean reading score of 5.1 on their Metropolitan Achievement Test Intermediate Form as of September 1970. They scored a mean of 5.5 on the same test, Advanced Form, in January 1971. Their mean score for their previous reading test, January 1970, was 4.9. Attendance figures for the previous year averaged 17 days accumulated absence. Some of the students were truants with 44^{14}, 48^{6}, 77^{6}, and 58^{14} total days absent. Aerospace 8AS-5 now holds the second best attendance record of the eighth grade in the school. Each teacher of the class and supervisors at the school have expressed extremely favorable impressions of the boys as attentive and business-like in comparison to the remainder of the classes at the school.

A similar program developed at the Enrico Fermi Junior High School under the direction of the industrial arts teacher, Mr. Melvin Goliger. While statistics are unavailable at this time, the school plans an extensive aerospace program with academic articulation next fall.

Four students from the Enrico Fermi Junior High School, in the Bushwick section of Brooklyn, and the entire aerospace class of the Dwyer Junior High School, from the Morrisania area of South Bronx, were invited to Republic Airport this past December by the Negro Airmen International. Black pilot members of the N.A.I. and several white members of the North East Region of the Civil Air Patrol flew their Piper, Cessna, and Beechcraft single engine planes around Suffolk County with our students as co-pilots and passengers. This was the first flying experience for many of the boys. Some of the written comments by the students of their flight experiences included: "Talking about nice time, we had a wonderful time. In fact, we had the time of our lives." "Then the pilot said fasten your seat belts and he asks permission to take off and the man in the control tower said permission granted so we went down the runway and took off." "When I got in the plane I was scared and when I got in the co-pilot's seat I felt like I was the only pilot in the plane and I was going to California."

Another approach to aerospace curriculum development was made by a new teacher at the Cardozo Junior High School, Mr. Howard Kelem. His efforts were toward developing teaching aids that would be representative of the principles of flight. His wind tunnel simulates throttle control, R.P.M., takeoff and landing, and yaw and pitch. His enlarged instruments, directional gyro, altitude indicator, and turn and bank indicator, are replicas of those found in a small plane. He has also developed styrofoam cutting wire machines to be used with that material in the construction of small model planes.

Some of the "old" aerospace teachers and several new teachers and supervisors, 22 in all, were in attendance at the Second Aerospace Workshop held this past January. Messrs. Parke, Goliger, and Kelem explained their programs, and we were given a tour and class demonstration in Mr. Kelem's shop. Several new "recruits" to aerospace are expected to start similar programs either in the spring or the following fall. One teacher from the original 25 has returned and expects to operate a program in September. At this workshop, too, we had representatives of the academic and comprehensive high schools who are preparing programs at their level to continue the junior high aerospace program.

The growth of interest in aerospace was due in part to the extensive publicity we were able to get for our experiments in education. Some interesting shop activities, the flight, field trips, and auditorium programs were publicized in several newspapers and other publications. Community School District 12's Toward a Dream followed us in their bilingual English-Spanish newspaper. The Daily News, Long Island Press, and the Amsterdam News carried feature stories and photographs on our activities. Staff Bulletin, the official publication of the Board of Education, followed our summer and fall programs. Hobby Happenings, published by the Hobby Industry Association of America, and Model Airplane News Magazine featured the special Delta Dart program at Mr. Kelem's school.

Step 6

Two of our Community School Superintendents, Dr. Edythe Gaines and Dr. Abraham Tauchner, have allocated federal funds for the purchase of flight simulators. Flight Products Inc. of Moonachie, New Jersey, is designing their flight simulator VISTA to meet our special needs. We hope to have delivery for the new programs planned for the fall of 1971.

Step 7

The problems remaining are many and important ones. We hope to resolve some of them in the months and years that it might take to develop the type of industrial arts program that represents the aerospace industry today and tomorrow.

Some of the questions we raised at the last workshop were:

1. To what extent can model building represent industrial technology?
2. What elements of research and development of the industry can we incorporate in our program?
3. Will flight training or simulator flight training be relevant to industrial arts? (We expect to re-submit the flight proposal this year.)
4. To what extent should we influence and direct the academic studies?
5. Are there sufficient opportunities in high schools, technical schools, and colleges for our students? Are the jobs waiting?

Experimentation, testing, and evaluation will continue until we find those experiences in the industrial arts shop that will have meaning for our students in later life. Dr. John Dewey stated it succinctly some time ago.

> "Just as no man lives or dies to himself, so no experience lives and dies to itself. Wholly independent of desire or intent, every experience lives on in further experiences. Hence the central problem of an education based upon experiences is to select the kind of present experiences that live fruitfully and creatively in subsequent experiences" (Ref. 5).

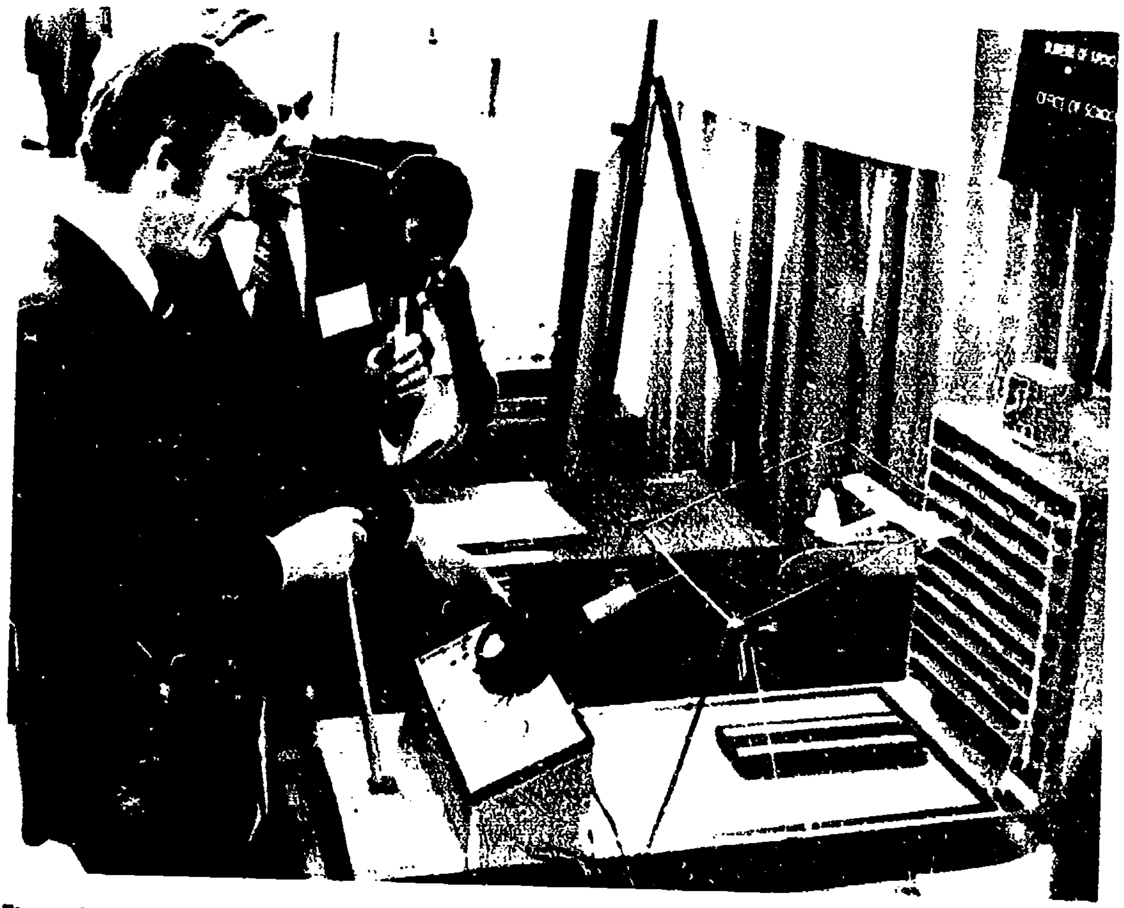

Figure 1. Mayor Lindsey operates a flight simulator as Supervisor of Industrial Arts Department Sam Garry and a student look on.

Which of our industrial arts aerospace experiences prove "fruitful and creative" may not be known for some time. Our teachers have made initial trials, and they are planning others based on their small successes. New York City's Bureau of Industrial Arts is committed to the support of the experiment. We are back in aerospace after 29 years.

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Implications for a High School Education/ Industry Correlated Model Astronautics Program with Exploratory Concepts

Richard A. Nygard

During the early history of man, the family assumed the responsibility of passing their culture on to the young. They were taught the practical arts of survival, hunting, fishing, and eventually how to work the land. When game was scarce or the land lean, man simply journeyed across the frontier in search of food, clothing, and other essentials.

Now we are living in an age which has assumed new dimensions. Instead of the slow progress and denoted tranquility of early times, we are engulfed in a knowledge "explosion," pandemonium, and unprecedented change.

Man must now satisfy the quest for his unending thirst for knowledge, ways to understand himself, and ways to adapt to the technology explosion that confronts our environment. The transmission of this new culture to our youth, education, has become a major industry charged with the formidable task of describing a culture totally unknown and beyond comprehension.

An examination of the knowledge explosion exemplifies this contention. The amount of knowledge in the world has been "...doubling every ten years and has been doing so for the past 200 years" (Ref. 1). Others have described the effects of the knowledge explosion as follows:

1. A. C. Monteith of Westinghouse Corporation states that

> ...an engineer how has a half-life of about ten years. That is, half of what he has learned will be obsolete in a decade. Also, half of what that engineer needs to know ten years from now is not available to him today (Ref. 2).

2. It has been stated that

> ...25% of all the people that ever lived are alive today; that 90% of all the scientists who ever lived are living now; ...throughout the world, about 100,000 journals are published in more than 60 languages, and the number doubles every 15 years (Ref. 3).

3. Don Fabun, in Dynamics of Change, states that

> It is quite possible that much of our current educational system is engaged in preparing young people for "jobs" that simply will not exist in our society by the time these students come into the marketplace. It is equally possible that a goodly segment of the "jobs" being performed in our economy today are simply avatisms of 19th century concepts of work which have little economic, social, or even personal value today, and will have even less value in the future as our developing technology changes the nature of the use of human energy (Ref. 4).

During this moment of reflection, there is reason to pause, as aspects of our educational system are cogitated amidst a troubled society led by staggering technological change. As scientists discover answers to the vistas of unexplored worlds, technology continually jets forward at an exponential rate. If we, as individuals, falter, it is perhaps because of an awareness of the magnitude of the problem so vividly related to us by numerous noteworthy scholars.

In Frontiers of Our Time, Harold Pluimer points out:

> No ancient mariner ever experienced a more hazardous or uncharted course than do the children of today...theirs is the first generation to be exposed to more dramatic events than their parents have experienced up to this time. This now means that parents and children have suddenly been exposed to a world we know little or nothing about (Ref. 5).

Being cognizant that these continuing, fleeting forces of change affect our society, we must outline and determine the objectives of the world we would like to live in. An attempt to guide the course of a changing society can be made by analyzing the forces of change around us and the causes of the originating forces. Then we must determine how these forces can be effectively used to carve a desirable future for ourselves. A flexible course must then be charted, striving to steer or attain the type of society we would like by working together.

Again, Don Fabun vividly clarifies this hypothesis by describing the "forces of change" as being:

> ...amenable to our guidance. If we seem to be hurried into the future by a runaway engine, it is that we have not bothered yet to learn how it works, nor to steer it in the direction we want it to go (Ref. 6).

This, then, is the answer to our dilemma.

INTRODUCTION TO MODEL ASTRONAUTICS

The launching of the first artificial satellite on October 4, 1957, marked the beginning of man's newest adventure, the conquest of space. The new era has resulted in astonishing feats in the fields of engineering, space research, industrial technology, communications, and subsequently dynamic changes in our educational structure.

In an effort to imitate the accomplishments of the professional space scientists, thousands of America's youth turned to a sport which soon became known as amateur rocketry. The new sport proved a natural outlet for prospective engineers, chemists,

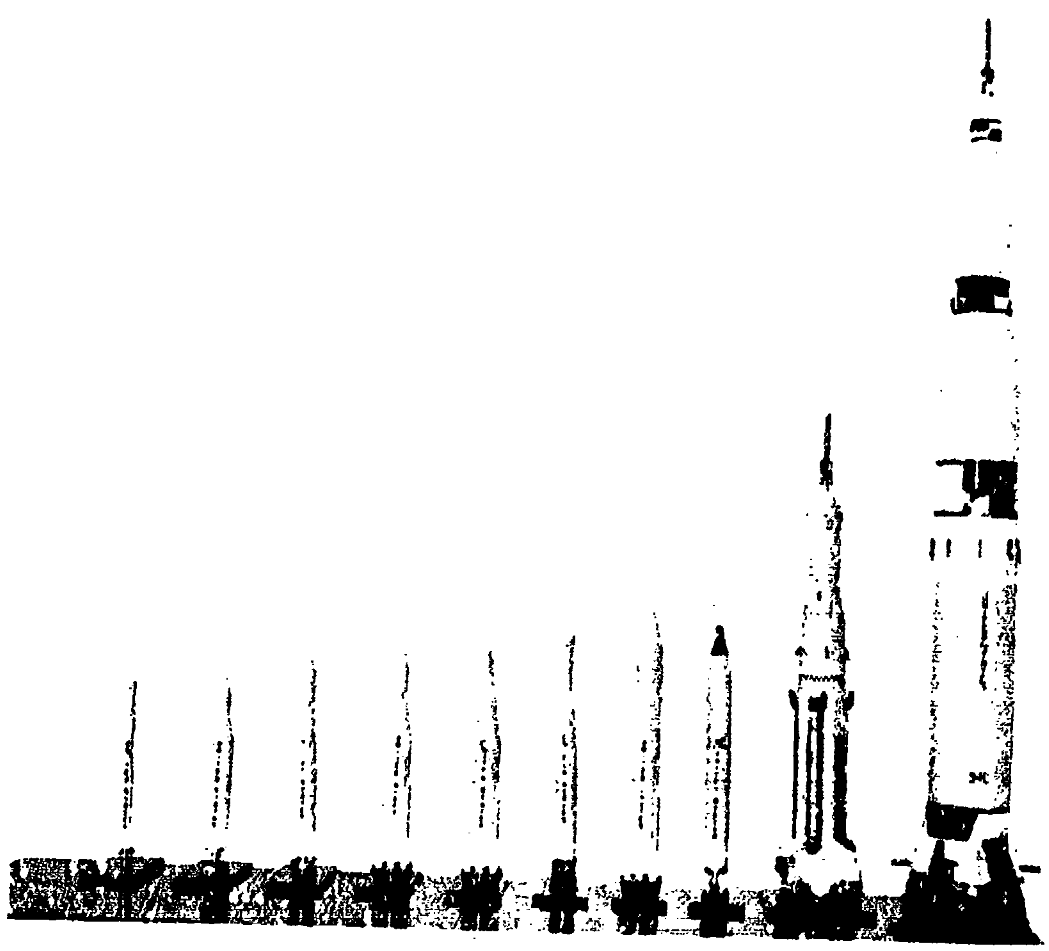

Figure 1. These models show comparative sizes of NASA launch vehicles. Left to right: Scout, Juno, Thor-Agena B, Atlas Agena B, Atlas Mercury, Thor-Delta, Atlas-Centaur, Titan II-Gemini, Saturn I, Saturn V-Apollo.

and hobbyists. However, the new sport met with tragedy as unsupervised amateur experimentation and inadequate safety precautions resulted in thousands of experimenters and bystanders being maimed and scores killed from the explosions of the makeshift pipes, tin cans, kitchen chemical mixtures, and from the awkward launchings of speculative scientific or educational value.

Nonprofessional rocketeers soon became classified as (1) basement bombers, (2) professionally supervised amateur rocketeers, and (3) model rocketeers. The basement bomber is usually found unsupervised in his father's basement, garage, or backyard stuffing broken match heads into empty CO_2 casings or mixing zinc/sulfur compounds for a metal-bodied rocket experiment. The American Institute of Aeronautics and Astronautics has estimated that this rocket amateur has a one in seven chance of being killed or maimed each year he experiments (Ref. 7).

The professionally supervised amateur rocketeer is typically a member of a group organized to study the scientific aspects of rocketry. The group is usually supervised by professional engineers from the local scientific community. They generally have access to 25 square miles or more of uninhabited desert area, upon which huge safety bunkers are erected and used during rocket launches. Though a few rocket societies have operated successfully under this category for years without an injury or accident, it's implementation in a high school program is strongly discouraged by the author.

The third category, known as model rocketry, is the group of nonprofessional rocketeers who have launched over 20 million rockets since 1958 without a single permanently disabling injury or death. The activity is a hobby, sport, or an educational adventure based on the study, design, construction, and flight produced by rocket engines, which do not require propellant compounding or loading by the user. Rocket vehicle bodies are made from balsa wood and paper products.

Model Rocket Fundamentals

A model rocket is an original design or real flying model of a research or space rocket. The model rocket is made from lightweight materials such as balsa wood, paper, or plastic. It contains a commercially-produced engine assembly as its propulsive unit. By modifying the basic parameters, including vehicle design, shape, size, weight, fin structure, or type of propulsive unit, the over-all performance capability is changed to conform with mission specifications. By a thorough understanding of aerodynamics phenomena, fundamental principles, rocket characteristics, and engine thrust capabilities, optimized space vehicles can be designed to fulfill specific space missions. Contrasting the basic concepts of model rocketry to various aspects of our current technology, a model astronautics program emerges.

Model astronautics is the realistic application of model rocketry as a motivational educational tool in the study of space science, industry, and other peripheral aspects of space technology.

Pre-flight Analysis

Prior to an actual launch model, astronautic students, like NASA scientists, verify engine selection and determine drag characteristics and other operational parameters associated with each student's particular flight mission.

The three primary forces that determine model rocketry altitude capability are engine thrust, gravitational force (determined by rocket weight), and drag. Static test stands are used to verify engine thrust, and wind tunnels are used to test aerodynamic performance characteristics such as stability, center-of-pressure, lift, and streamlining.

Based on data derived from the above tests, the flight parameters including maximum predicted altitude can be mathematically calculated using simple equations, nomographs (supplied by model rocket engine manufacturers), or by computer analysis.

Electronic instrumentation, cameras, and other devices are also functionally checked for operational capability under simulated flight conditions.

DESIGN AND CONSTRUCTION OF MODEL SPACE VEHICLES

In general, the appearance and design configuration of a particular spacecraft or space vehicle are determined by mission objectives, structural weight, whether the space vehicle is manned or un-manned, and reentry conditions (i.e., speed, deceleration, drag, heat, and duration) (Ref. 8).

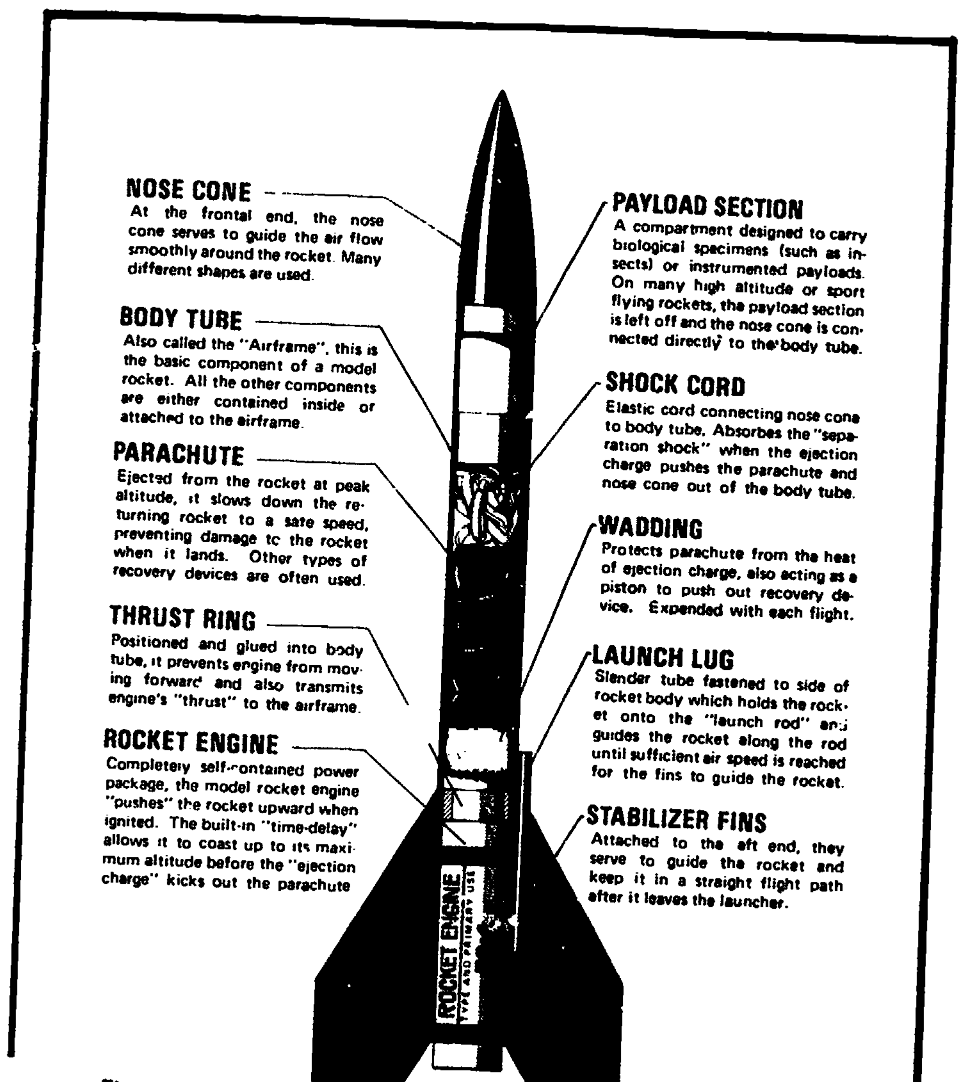

Figure 2. Cut-away view of a typical single-stage model rocket.

Like industrial rocket engines, model engines are classified according to their specific impulse or thrust-producing ability in a given period of time. Total impulse is defined as the average thrust in pounds multiplied by its duration in seconds. Expressed mathematically, the equation reads:

$\underline{I} = \underline{F} \times \underline{t}$

$\underline{I}$ = total impulse	(pounds/second)
$\underline{F}$ = average thrust	(pounds)
$\underline{t}$ = time	(seconds)

Model rocket engine casings are fabricated from nonmetallic materials like paper to eliminate potential shrapnel hazards common among basement bomber experimenters.

The primary material used for model vehicle construction is balsa wood. Its light-weight vs. strength ratio, ease of fabrication, and finishing qualities are superior to other known materials of this nature. Other materials applicable to model spacecraft construction include special lightweight plastics and paper products. Metal is discouraged in model astronautic construction due to its heavier weight and danger of becoming a safety hazard during flight.

When launch mission requirements dictate heavy loads or high altitudes, engine multi-staging or clustering techniques are used. A multi-staged rocket is composed of two or more engine booster stages stacked on top of one another. The primary objective of staging is higher altitude through jettison of expended engines, booster stages, and other dead weight, thus achieving a greater final burn-out velocity. Clustering is the arrangement of two or more engines within a stage envelope to permit greater thrust augmentation and acceleration for high-altitude flights with heavy payloads. Engine cluster arrange-

Figure 3. More than one million pounds of thrust streams from the F-1 rocket engine during a test.

ments expose students to the complicated problems of providing balanced thrust, simultaneous ignition, and stringent stability requirements.

An interesting facet of model astronautics is boost glider design. A boost glider is a model rocket that has vertical takeoff to peak altitude, upon which the engine ejection charge causes deployment of control surfaces permitting horizontal flight and subsequent glider performance characteristics.

The numerous design problems relating to stress caused by high thrust, aerodynamic flight behavior, and transition from vertical to glide configuration make this project an ideal challenge for advanced students.

FLIGHT OPERATIONS

Successful implementation of an educational model astronautic flight operation is dependent upon thorough understanding of the basic concepts relative to flight application. Safety, launch techniques, electronic instrumentation, photography, altitude determination, recovery techniques, data reduction, and post-flight design analysis each play an important part in the educational program.

During a space launch, NASA rockets commonly use a restraining device to secure the rocket to its pad until thrust build-up is sufficient to sustain a successful lift-off. Since thrust-time build-up for a typical model rocket is less than 0.1 second, restrainer devices would be rather cumbersome. A more practical approach is the use of a 36- to 42-inch launch guide rod or tower. The 0.1 to 0.2 second of guided flight permits the model rocket to attain speeds over 30 miles per hour, thus imparting sufficient velocity to sustain continued flight stability, assuming sound rocket design.

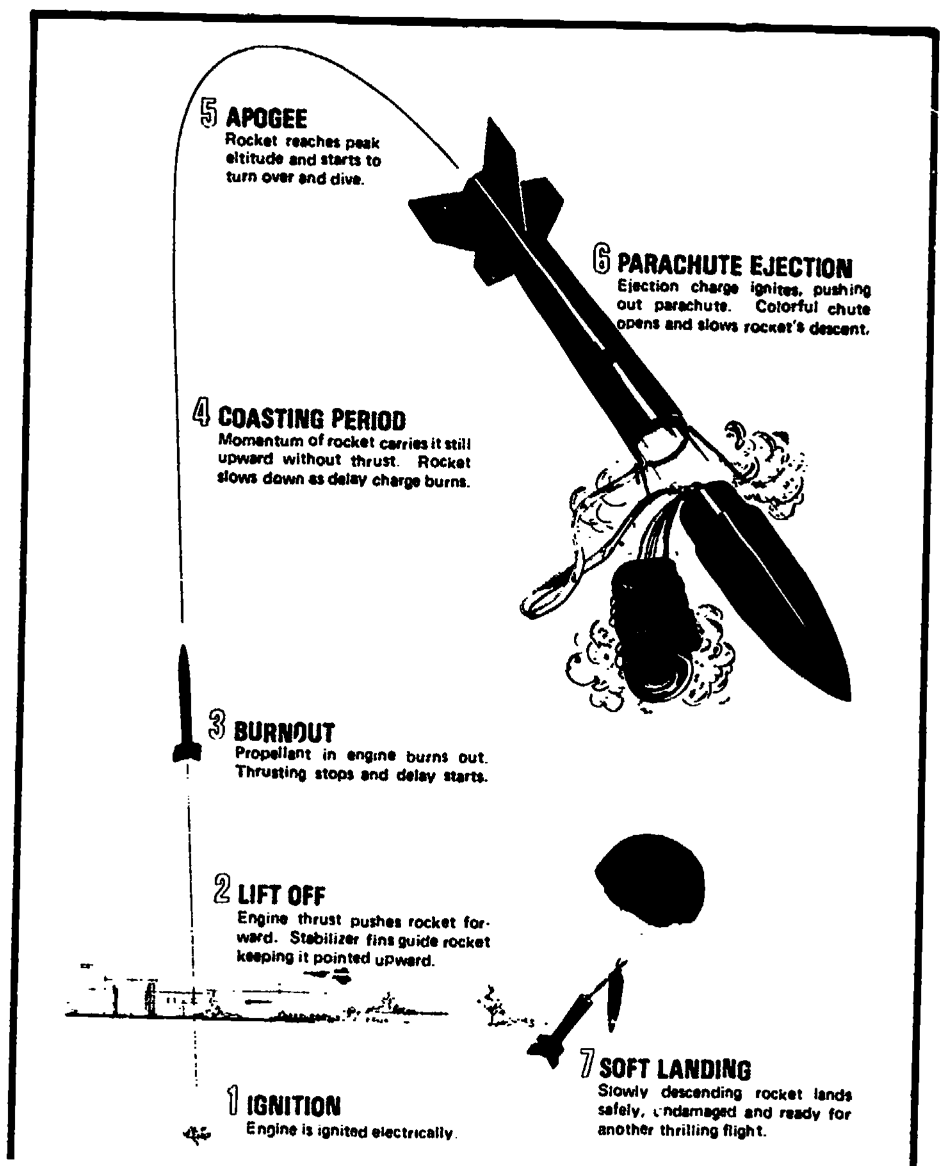

Figure 4. Stages in the flight of a model rocket.

Once a rocket leaves its pad, NASA tracks the rocket by radar, optical devices, telemetry, or a combination of the above linked to a computer.

Due to equipment complexity and high cost, a simple tracking method with a minimum of two tracking stations verify altitude accuracy for model rocketry applications. Each tracking station uses a simple theodolite from which each observer visually tracks the launched rocket to its peak altitude. Readings for elevation and azimuth angles are then phoned to the command post for recording and altitude computation using flight data reduction sheets.

Flight parameter-performance studies, guidance or control experiments, micrometeorology, and biological investigations are the main electronic instrumentation categories used for model rocket flight analysis. The dynamic parameters most characteristic of model astronautic studies are acceleration, roll rate, velocity, altitude, vibration, angle of attack, and oscillation. A small microphone, for example, coupled to the rocket transmitter can effectively monitor rocket vibration and dynamic oscillations immediately following lift-off. The microphone will also provide audible indications of rocket motor burnout, parachute ejection, and impact. If the received signal is tape recorded at the command post, it can be used for future laboratory analysis and comparison with modified versions of the same rocket.

An interesting avenue of research for students interested in pursuing photographic or optic careers is an exploratory study of the photographic aspects of flight, including aerial photography. For advanced photography studies, 8-mm movie cameras can be sent aloft to record panoramic views of the earth's surface.

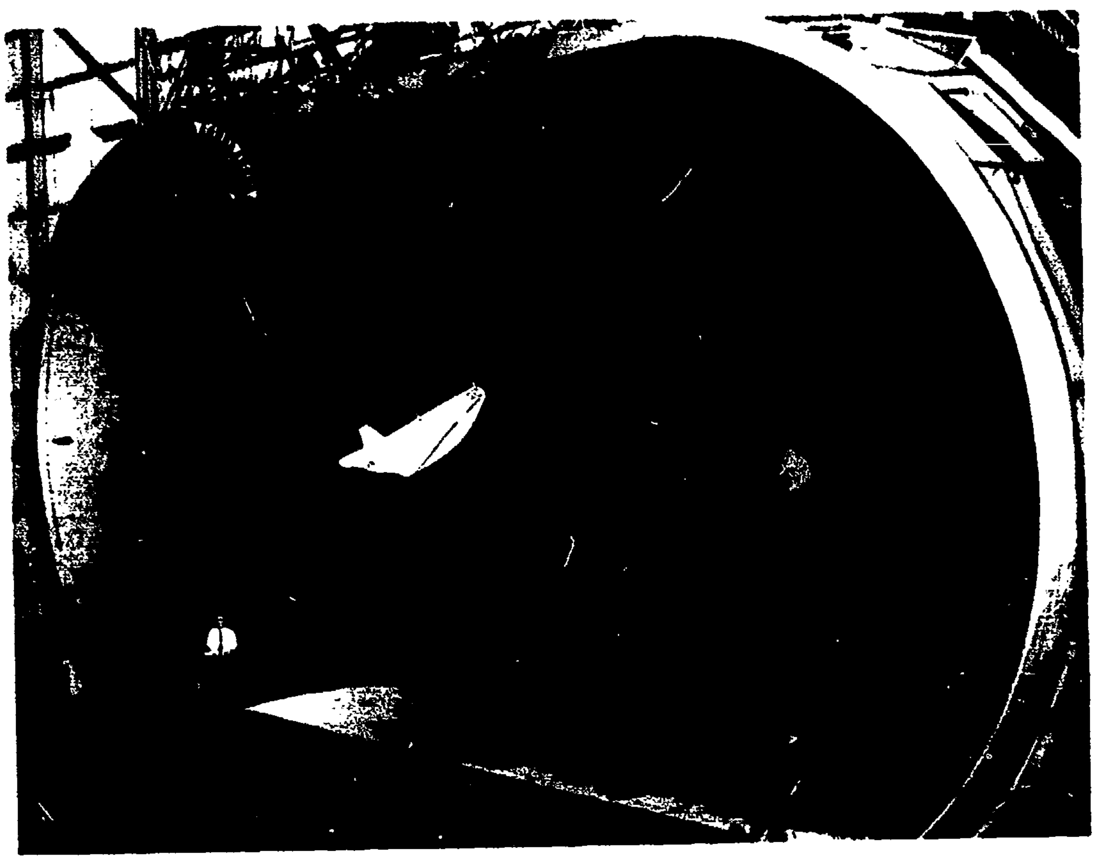

Figure 5. A model of the HL-10 lifting-body type reentry vehicle is studied in free flight in NASA's Langley Research Center full-scale wind tunnel to determine the low-speed dynamic stability and control characteristics of the vehicle.

Recovery Methods

Model rocketeers, unlike their big brother, NASA, recover empty rocket casings, payloads, and other space-borne hardware intact through parachute deployment of varied sizes, shapes, and materials. NASA rocket casings become "space junk" until disintegration in the earth's atmosphere. Only space vehicles or specialized scientific payloads are considered economically recoverable by means of parachute and retrorocket systems under the current state-of-the-art.

One of the prime reasons for model rocketry recovery is the prevention of potential free-fall accidents, and its employment also permits immediate re-launch capabilities merely by replacing spent engines. Parachute ejection is accomplished through the use of a model rocket's built-in delay and ejection charge. Careful pre-flight altitude determination correlated with appropriate engine delay charges and mission objectives are required to prevent premature parachute ejection.

More sophisticated recovery techniques worthy of investigation by advanced student experimenters include the prediction of landing location (with consideration for the prevailing winds), para-glider, and boost glider applications.

Data Analysis

An important phase of the model astronautics study is the final analysis of data gained from the flight experience to confirm pre-flight predictions and original design configurations. A comparison of original design characteristics, pre-flight testing, and altitude calculations with the actual flight performance characteristics permits students to self-evaluate their skills, analyze problems, and suggest design modifications for improved performance. Perhaps more importantly, the student gains the perspective and responsibility of managing a project from design conception, to material selection and fabrication, through pre-flight testing, and finally to verify these pre-determined performance parameters by the thrill of actual flight. The student also develops an appreciation and understanding of the importance of team work, proper planning procedures, organizational requirements, engineering trade-offs, and the myriad of practical problems that challenge completion of mission objectives.

Curriculum Suitability

Space technology encompasses and depends upon the integration of practically all disciplines, including engineering, management, business law, economics, technical operation, logistics, medicine, and judicial law. Similarly, model astronautics educators should teach realistic knowledge concepts on an integrated curriculum basis so that students understand the relationship of each discipline to an over-all project or mission objective.

Enumeration of the various aspects of astronautics indicates the interdependency of the various curriculum areas and the need for subject integration in order that the learner may be provided with unified knowledge concepts.

Mathematics

Measuring distance, time, and size. Graphing rocket flights and distance/velocity/acceleration/time relationships. Calculation of model rocket performance parameters, including thrust analysis, velocity, acceleration, time, and distance. Programming of model rocket performance parameters on an electronic computer or electronic calculator with an automatic plotting system.

Physics

Problems of coping with gravity, including mass and weight, weightlessness, and gravitational fields. Problems related to energy sources, including solar cells, electric propulsion, radio transmission, and telemetry.

Chemistry

Understandings related to atmospheric, lunar, and planetary chemistry.

Biology

Animal centrifuge experiments for determining acceleration effects on body functions. Bioinstrumentation of animals to secure instantaneous measurement of responses. Effect of Circadian Periodicity or irregularly cycled time patterns on body functions.

Astronomy

Problems of determining conditions in space, including time-distance relationships and interpreting starlight and wave motion.

Geology

Problems of determining the interior and surface structure of the moon and planets.

Sociology

The impact on society, including cultural lag, population trends, industrialization, and conservation of natural and human resources.

Psychology

Problems of man in space, including fear and isolation disorientation. Astronaut training. Rat maze experiments before and after animal centrifuge experiments for evaluating effects of acceleration.

Industrial Arts

Aspects of material analysis, material strain detection resulting from static tension. Observation and analysis of stressed and prestressed birefringent photoplastic test shapes. Application of wind tunnel, static, and temperature tests. A study of the tools, materials, and processes as applied to application and usage in space. Fuel cell studies. Space construction techniques for moon and space stations.

Methodology

The model astronautics program, due to its highly motivational nature, is amenable to many types of instructional methodology. High student interest correlation reduces the need for rigid disciplining restitutions common in most schools.

The various forms of instructional methodology include:

Group Techniques

By dividing students into groups, each group is able to study different aspects of astronautics. During frequent classroom seminars, each group is able to relate highlights, progress, and findings of their respective studies to the other members of the class. The remaining groups can evaluate the "presenting" group's problems and offer suggestions as needed.

The seminar approach additionally provides the students with experience in communication skills, often found lacking in today's industries.

Group studies should be extensively used, since each individual must learn to function as a member of a group in society. This early learning experience will do much to promote desirable attitudes toward other people. However, the instructor is cautioned that each individual must relate his thoughts, ideas, and opinions to the group rather than get them from the group.

Independent Study

The student essentially works on a special project of his selection with the approval of his instructor and a sponsoring industry. This approach is best suited for cooperative, high school student teacher, and independent research programs.

This aspect permits a student to discover his interests, potential, and ability to function as an individual in society. The individual is characterized by his self-reliance, resourcefulness, problem-solving ability, and creative drive.

This method should be discreetly used since it requires a highly self-disciplined, self-motivated student of high maturity.

Corporation Structure

One approach to unit implementation is to establish a realistic corporate structure with an imitative NASA-type agency and several industrial engineering industries. In this approach, students would be elected to assume responsibilities of various agencies and engage in role-playing as they perform the functions of technician, engineer, supervisor, manager, or president. By simulating this type of business atmosphere, the students gain competence in assuming responsibility.

Through the role-playing approach, the students have a chance to relate their interests and abilities to a multitude of potential career opportunities. This, perhaps, could permit students to establish early career goals.

SUMMARY

The creative acquisition of knowledge concepts, adaptive skills, and realistic environmental perception through implementation of a model astronautics exploratory program permits students to discover their own interests, talents, and capabilities.

Space technology involves adapting man to a totally new environment. In doing so, scientists have had to analyze man, his capabilities, and his limitations. He has also had to analyze the project characteristics of the space environment and adapt man to cope with it.

The education industry is no different. Men are educated to cope with and adjust to the forces of change governing their environment. The educator must understand the learning process and the learner, and be able to project facets about his environment which would be amenable to his adaptation to it.

In discussing the parallel between technology and education, we might refer to Einstein's well known theory: $E = mc^2$. To the scientist, it means that energy is equal to mass times the speed of light, squared. To the educator, it appears to have another interpretation entirely. That is education equals the mass of the instruction times the creativity of the student, squared, where mass of instruction is not necessarily the amount of words transmitted to the student, but the number of practicable knowledge concepts times the number of sensory experiences.

Space technology encompasses and depends upon the integration of practically all disciplines, including engineering, management, business law, economics, technical operations, logistics, medicine, and judicial law. Similarly, space age educators should teach realistic knowledge concepts on an integrated curriculum basis so that students understand the relationship of each discipline to an over-all project or mission objective.

Just as people fail to comprehend the myriad by-products of space research spin-off, educators fail to visualize the harvest of by-products which can be reaped through a realistic, imitative space study program. These by-products include:

1. Self-motivation.
2. Enhanced curiosity.
3. Creativity.
4. Development of adaptive skills.
5. Creation of an intellectual excitement or "need-to-know" attitude toward learning.

The role-playing experiences enable the student to identify himself and his particular role in society. By understanding himself, he is able to comprehend nature's basic laws and subsequently use his adaptive skills to develop heretofore unknown devices and processes, as did previous innovators in performing their selected roles in society.

Conclusions

1. Students pursuing careers unrelated to the space industry obtain the harvest of space education spin-off, including the gain of a layman's interpretation and understanding of the space industry and its technological, social, and economic impact on society.

2. The multi-disciplined approach to model astronautics permits a student to discover new concepts about the world and find his relationship to the society which will soon be his to control.

3. The program permits the expansion of a student's life space through interviews, technical discussions, and community involvement.

4. Self-evaluation, acceptance of responsibility, and success over failure drives result in early student maturity.

5. Utilization of problem-solving skills and examination of cause-effect relationships result in increased student creativity, comprehension, and practical applications amenable to real-life situations.

6. Students are afforded an opportunity to explore facets of the space industry according to their particular interests.

Recommendations

1. The summer hire of astronautics teachers in industry technology utilization programs, exposing educators to vast resources of knowledge and creative adaptive skills which will provide rewarding teaching skills for enhanced creativity during the ensuing year.

2. Instructors should become familiar with individual and group techniques for creativity to optimize the learning process.

3. The author recommends that schools employ curriculum integrators. Their function would be to integrate the various curriculum disciplines, providing a unified instructional approach for the development of meaningful exploratory concepts and experiences related to the real world. He would act as an interface agent between the "real world of the future," industry, and educators. He would seek, gather, and evaluate new knowledge concepts relative to industry and society for possible implementation in various aspects of the curriculum. Such an implementation scheme would ease the transition between being a student and being a participant in society. Realistic industrial and societal goals would be correlated as educational experience concepts so that the student is capable of adapting to the changing technology, rather than being ruled by it. The function of the curriculum integrator would be similar to the role of a space project engineer or project manager. Their responsibility is to integrate the system components, hardware, material, and man, into a reliable operational system capable of performing the desired objectives for a particular space mission.

4. Model astronautics programs are best suited for either science or industrial arts curriculum areas. However, maximum benefits of the program are achieved when it is integrated as part of the total school curriculum.

5. This study exemplifies only one avenue of educational adventure in our modern technology. Other educational adventures may someday adopt an annual theme coherent with the pacing industrial technology such as pollution, oceanography, transportation, or population control.

FOOTNOTES

(1) "The Principal and the Information Explosion," The National Elementary School Principal, May 1968, pp. 47-55.
(2) Neil W. Chamberlain, "Retooling the Mind," Atlantic Monthly, September 1964, pp. 48-50.
(3) Don Fabun, The Dynamics of Change, (Englewood Cliffs, New Jersey: Prentice Hall, Inc., 1968), pp. 1: 3-5.
(4) Ibid. pp. V-17.
(5) Harold P. Pluimer, Frontiers of Our Time, (New York: Vantage Press, 1968), p. 15.
(6) Fabun, Op. Cit., pp. 3-5.
(7) Peter Zimmerman, "An Open Letter to Amateur Rocketeers," (New York: American Institute of Aeronautics and Astronautics, 1963), p. 1.
(8) F. I. Ordway, III, J. P. Gardner, and M. R. Sharpe, Jr., Basic Astronautics, (Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1962), pp. 310-328.

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Industry, Agencies, and Associations

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National Association of Rocketry
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Communications

Communicating Technical Information in Industry

Elizabeth M. Bassett

Communicating is of itself extremely difficult. With even the simplest of words—with all the fog of writing left completely out—ideas tend to get lost. They write, but surely no one talks like this: "...with the immediate objectives of optimum utilization, it was deemed advisable that one should adopt a multidisciplinary approach to relevance and responsibility..." Ideas do tend to get lost!

Consider, for example, Mr. Ziegler's intended communication of a few weeks ago. The White House Press Secretary is reported by The Wall Street Journal to have responded to queries about a rumored thrust into Laos, "The President is aware of what's going on...that's not to say, however, that there is something going on."

Or consider the fact that even today there is at a Franciscan monastery in western Pennsylvania a large safe for treasured documents. For the convenience of those priests who may not have the combination handy, a sheet of detailed instructions for opening the safe is posted conspicuously on the door. Safe enough. The instructions are entirely in Latin. There are studied as well as inadvertent ways of thwarting communication.

Now, we're going to try some communicating this afternoon—about communicating technical information in industry. And, while I very much like humor and the light touch, I cannot hold with the opinions of so many program chairmen who indicate that if only they can obtain a personable speaker with a lively, humorous presentation, communication will obviously occur. In my experience, it won't obviously occur, for such a presentation is apt to impress rather than express. Nor can we communicate, on the other hand, if we are all tradition, all scholarship, all seriousness, all heavy vocabulary. Let me show you what I mean. I was struck by the following abstract at the beginning of a professional paper on the general subject of communicating information:

> In striving for effective information handling techniques, traditionalists have neglected factors of relevance that would transform information into meaning. A general theory and taxonomy of human communication is here discussed within which the information communicating propensities can be evaluated for relevance to the axioms of the science of communication.

Worthy of Washington, isn't it?

In the simplest of words, I'd like to say that perhaps most of us are aware that something besides computerization is going on in industrial technical information centers. Unlike the President, however, we may not be aware of its exact nature. And that's what we want to discuss with you this afternoon. For what is going on is designed not only to provide the information needed by managers, engineers, supervisors, technicians, and workers, but also to save their time, spare their effort, and to relieve them of the necessity of learning or relearning searching skills that are time-consuming and that they don't want to engage in anyway.

If, as Robert E. Bennis, President of the International Communications Association, has said, "People are the significant part of the cost of doing business," then all that will reduce people-cost will serve industry's purpose—to perform a valid service or provide a good product at a profit. We know that good communication of information increases the productivity of people. It orients them technically, moves them ahead in efficiency, ups production, and saves the company money.

There follows then, a short account of what a relatively few short years have wrought in communication, a few illustrations, and a subsequent first-hand report on the communicators, the receivers, and the activities of technical information dissemination in one relatively small company. We are directing it at those of you who may not know what you're missing.

As the director of Milgo's Technical Information Center, I derive great satisfaction. We who work in it consider our work an important service and take pleasure in rendering it. To tell you that our center is to be used, not viewed; that we disseminate information; we do not store it; that we in the center are not computerized, though we admire and appreciate the computer's complementing of our efforts; that we believe no item of information is too small nor any service too great for us to render if it will enhance the company's success and our colleagues' confidence in our services; to tell you these things will give you an idea of our philosophy. We are often amazed at the reactions of our visitors. A company this size—we did only $14 millions of business last year—a company this size has a technical information center?

Our center's status—whatever that is, it brings us visitors and occasional emulators (that's a fog word, but my thesaurus suggests only copiers as an alternative)—its status comes from the nature of our functions and their significance to those we serve. The image we project comes from our self-confidence that we can do the job required. Any esteem and appreciation that may have been accorded us have come only from our service, from our playing a vital role in the organization, from being not a storehouse of information but a spreader and verifier of facts and, when indicated, a transmitter of theories.

We are not going to discuss machine retrieval, computer printouts, nor indeed any highly sophisticated systems, as fascinating as they may be. Our emphasis is on people and the roles they play in gathering, categorizing, and selectively disseminating the information their receivers need. And as valuable an interface (ah, there is jargon) between originators and users of information as the computerized storage and retrieval system is, more valuable in the smaller company, we believe, is the interface represented by a warm, listening, understanding, involved, human disseminator who retrieves from all possible sources within and without the house the information he feels, knows, or has been told the organization needs or will need. The human disseminator sees to it that the right information consistent with requests—no more, no less—is delivered as quickly as possible to the environment of the user by whatever means are available at the moment.

Great innovations have come about in communications. Ever greater ones appear to be waiting in the wings. Transmission of information has come a long way from the talking drums of Africa or the dramatic line of flaming beacons along the southern coast of England that told Drake of the arrival of the Spanish Armada, from the homing pigeons of the ancient Greeks and the less ancient message senders of World War I, from the multiple magnetic needle system of Cooke and Wheatstone in the England of 1837 or the Morse code telegraphy of about the same time in this country, from the Baudot multiplex system of France in 1874, and from the cable telegraphy between the Old and New Worlds that began in 1865.

Our present electromagnetic telephone goes back only to Bell in 1876—not yet 100 years. Communications have travelled a distance, too, from Marconi's radio of 1901, from the closely following radio-telephone, man's only means of world-wide telephone communications until the eventual successful telephone cable-system across the Atlantic in 1956. Now, at the beginning of 1971, Canada and Great Britain have announced plans to lay a new 2840-nautical-mile cable to be completed in 1974, which will provide 400 more two-way telephone circuits across the Atlantic, and needed as back-up for satellite trans-ocean communications.

Communicators now have at their disposal a most remarkable complex of telegraphy, telephony, microwave, teletype, and facsimile. Received information is varied—via typewriter, computer-controlled impact or ink-jet printer, cathode ray tube, digital plotter, computer output microfilm or light-emitting diode display like the Pulsar wrist computer which digitally provides the time at the pressure of a demand switch. What is next? Who knows? Certainly not I, although it is my business to try to detect some glimmers.

Will it be laser communication? Probably. Recent advances by scientists working at Bell Telephone Laboratories in New Jersey, in new types of high-speed electronic circuits, have made it possible to send a million binary digits (bits, 1's or 0's, pulses or no pulses), a million bits of information—our jargon calls it a gigabit—a gigabit of information per second over a laser beam. Such speed is the equivalent of transmitting the binary coded information in 200 books per second, or a library of 50,000 volumes in about eight minutes. It is suggested by the scientists that a communications system so based would make it possible to send voice, data, television and video-phone signals all at the same time but in bundles 10,000 times larger than now possible.

Perhaps a totally new expansion of communicating means will be derived from that used in ARTS-1, Audio Response Time Shared System, to be offered almost immediately at Boston's Service Bureau for the Blind. Developed at M.I.T.'s Research Bureau of Electronics, time-sharing, computerized sensors and certain electromechanical devices will enable the blind who are studying or working at home to telephone the Service Bureau's computer at $1.00 an hour and interact with it, using either a standard typewriter keyboard, a stenotype board, or a keyboard in Braille. Response will come either by voice-recorded speech units of letters, digits, or appropriate words, or by a special fitting that provides a Braille printout.

The most remarkable communication, perhaps, would be telepathy. For the immediate present, however, there seems to be no substantial scientific acceptance of its practical or demonstrable use. That some form of brain communication bypassing other presently-known methods may transpire in our lifetimes seems probable. Some twenty-odd years ago, when I was working in Boston for three of that city's well-known neurosurgeons, one of our correspondent-colleagues in Britain was a Dr. William Grey Walter. He was then studying the geography of the brain and has continued together with a British research team to map its various sectors in the hope of an eventual cure of some brain disorders. Dr. Grey Walter was even then a leading authority on the brain's electrical impulses. He has not, I believe, surrendered that leadership.

Today, however, one of his more fascinating inquiries concerns the question of whether or not one's thinking can trigger off a physical happening outside the thinker's body. He and his researchers have found in the human brain a tiny electrical switch that operates unfailingly every time the brain makes a decision. They have coupled the tiny switch with an electric circuit (outside the body, of course) which can, with the help of a brainwave tracer or electroencephalograph and a computer, actuate a light switch, a television switch, or almost any kind of switch one can name. Dr. Grey Walter calls the tiny brain switch the "Wish-Switch." With it, he and his colleagues are now able to examine more closely the ways in which the various areas of the brain operate.

Using computers, which are obviously essential tools, Dr. Grey Walter and his co-workers have compiled extensive neurological data, that describing the wish-switch being but a small part. We knew back in my Boston days—and long before that—that minute electrical discharges accompany the efforts of the human brain. The sensitive electroencephalograph picks up and records those discharges in ways that allow neurologists to tell—because of the work of Dr. Grey Walter and others—from what part of the brain they come. The evidence of the brain's interest in a situation or problem appears to come from its frontal lobes. Thus, electrical discharges coming from them increase until the person makes whatever decision he intends. As Lampe, the Popular Science writer, records the next step, paralleled by my monograph from Dr. Grey Walter, "The instant the decision is made—ping! The current, having risen markedly and abruptly, cuts off."

Enough research has now occurred to demonstrate the wish-switch's effect. Called CNV (contingent negative vibration) by Dr. Grey Walter, wish-switch tests have been tape recorded and then measured. Amazingly, such measurements have revealed that the wish-switch works exactly one and one-third seconds before the wishers have reached their actual decisions. Exactly how that has been determined, according to both David Lampe's account and Dr. Grey Walter's papers, is too long a part of the story to relate here. Its significance, according to the neurologists, lies in the fact that when the thinker is confronted with a decision, his brain decides one and one-third seconds before he is aware that he will make the decision.

What will the wish-switch contribute to communication? The neurologists have ideas. Industry so far seems neither to know nor to care much about it. The only exception is a British Aircraft Corporation. Perhaps you, Mr. Industrialist, or you, Mr. Educator, will use or will have a student who will one day use CNV and the wish-switch. Will you remember, I wonder, that you heard about it first either by reading David Lampe or by hearing about Dr. Grey Walter's experiments at the AIAA Convention of 1971?

There's a story going round these days about a massive computer memory whose microminiaturized techniques reduced its massive data memory from a cubic mile to one card-file drawer. But an index had to be built to reference the knowledge. Then, of course, cross-reference files had to be built to access the data in a number of ways. Next, cross-reference index files to access the cross references. Soon, says the story, the number of cross reference and index files far exceeded the original data. Then a glitch occurred. With thousands of index file drawers, each referencing the other, the original one-drawer data file was mislabeled and somehow got lost!

Unfortunately, many information seekers suspect this may have actually happened as they are confronted by banks of card files and indexes. They come to distrust not the ultimate existence of the information, but any economical means, in terms of their time and effort, of reaching it.

Thus, while we in our technical information center make available the traditional means of access, we tend to agree with Mooers Law which asserts that an information retrieval system of any kind will tend not to be used whenever it is more painful and troublesome for a customer to have the information than not to have it. Our experience with average technically-oriented industrial personnel has suggested to us that our information services should reach into the immediate environment of the receiver and make his efforts to use the services as minimal as possible. Hence, while providing informal reading and study areas, we expect only their transient use. The Center—our Center—is one of action, not of silence except as occasional quiet may be required. Often the activity is so great that we feel like ping-pong balls in a hurricane. At other times we have an easy, if busy, atmosphere. We do not place the effort of searching on our users. Rather, we deliver almost at once to their environments, on which technical personnel are so dependent, by whatever means at our disposal, the requested in-house information and later that which we have had to gather in from elsewhere. We, then, are the search problem-solvers.

The sign on my desk causes amusement. It is, incidentally, an excellent ice-breaker. Best of all, it works. Where my name should appear is the usual name sign, but it says, "Betty, I have a problem." There is psychological catharsis for the young manager, supervisor, engineer, technologist, technician, or operator, who finally steps in for the first time and finds his approach all worded for him. For the corporate executive or older manager, the properly placed accent provides a light touch: I have a problem, or I have a problem.

Technical information, according to authorities Rosenbloom and Wolek, has no intrinsic worth. Its worth, they indicate, is determined by the social or industrial context of its worth. To us, its worth often appears to lie in its immediacy. Our kind of information center would disturb the purists in information science, some of whom are, in our view, more interested in order in their information universes than in achieving dissemination, use, and progress in what its use affects. Sometimes, when we violate the precepts of our training or bend the so-called inflexible rules for the sake of serving up almost instant information, there flashes before my mind the cartoon of a man sitting hunched and obviously deep in concentration before a blackboard upon which appears the incomplete equation $2 + 2 =$. In the background stand two distraught scientists. The legend reads, "Frobisher is questioning all our old beliefs."

But the goals of an enterprise do not exist in isolation, nor do the needs for information. If information centers are to serve industry, they'd better get in phase with the environments, timing, needs, and goals of those industries in which they are established. Thus, even control systems for technical information must be tailor made and as flexible as the situation demands. Books, reports, documents, statistics mean nothing so long as they stay on the shelves or in the files. Thus, borrowing periods mean nothing, and one only requests return if a copy can neither be found nor made. Books on a center's shelves serve no purpose at all.

It seems to me that our information flow is dependent on two factors: (1) communication between individuals, first between the user and me and then between him and any authoritative personal contact I am able to establish for him, and (2) the speed with which I am able to provide the required supplementary, reliable information.

What our center disseminates takes familiar forms: bibliographies, state-of-the-art reports, books, periodicals, journals, delivered papers, abstracts, extracts, excerpts, alerts, recommendations, current awareness bulletins, clippings, paste-ups, business and scientific services, documents, standards, and special contributions from the scientific societies in our fields of interest. The content of what we disseminate will depend first, on the goals or objectives of our organization at any given time; second, on the objectives of the requestors, what they are supposed to be doing for the company; and third, on what we know of how they propose to do it.

What the center delivers will attempt to partly solve the requestor's almost insurmountable problem of keeping up with the state-of-the-art of greatest significance to him. For our users we will scan constantly all possible literature at those levels of scholarly research or market intelligence that are consistent with the organization's goals, neither above nor below those levels. For management, we must consider over-all plans and policies only as they are disclosed to us. Nothing that we disseminate may imply a decision-making function but may include, if requested, summaries of curre ¿ industrial management thinking, articles, or reports on how other managements have handled problems or situations similar in nature to those now faced. In sum, the center is providing to management outside facts and philosophies upon which its decisions may in part be made.

In general, for all our users—whether top or middle management, supervisory, or operational—the cycle appears to be something like this: if requested, we suggest areas for browsing, confer to delimit the subject of inquiry, determine whether or not there are specific answers needed, whether or not a knowledge of prior work done or not done is important, what work has or has not paid off, who has been, is, or is likely to be engaged in the field of inquiry, what manufacturing facilities may be or could possibly be available, the status of competition, and, finally, the patent and trademark situations. Let me interpolate that in the case of the Technical Information Center in question, all company letters, patent, and trademark registrations are stored and controlled by the Center and correspondence with the attorneys concerning them is conducted by it.

Finally, we may attempt to bring together our requestor and anyone else in the company we feel may have much of the information apparently required. There is no substitute, says one authority, for a half-hour conversation with an expert in your field. Now and then we locate that authority in Texas, California, Canada, or Europe and find him unfailingly cooperative in conferring with us and our requestor. A most rewarding service, I might say, and one which brings to me, as well as those I serve, rare and remembered experiences.

Industrial arts educators are living examples of the person-to-person method. Nowhere else have I observed such eager exchangers of information and experience. The valuable, experienced person-to-person information-giver possesses, say those who are specialists in arranging such contacts in the scientific field, the ability to integrate past experience, filter it, and respond selectively to questions. Not only do active minds stimulate each other, but the details are better amplified than by any other information-gathering means.

The information specialist assists all who ask either directly or indirectly. He must have a discreet curiosity, an ability to absorb ideas about the direction, depth, time and quantity limitations, and the value of the information needed. He must, in a sense, operate by osmosis. He must often be the silent supplier, the forwarder of, "Have you considered this kind of information?" to those he serves.

What are they like, his clients? They are often in proprietary work. Their products are the property of the enterprise. They are not greatly interested in increasing the general knowledge as are those in research, but in inventing or improving products and processes and then in marketing them, against competition, at a profit. They may be secretive. They cannot discuss their work in ways that might reach potential competitors. They are interested in the information specialists' services only in terms of the degree to which he can satisfy their requirements. How the information was gained is to them of little importance. That it has been procured at costs within the budget is significant. They may approach the information specialist only as a last resort unless his prowess has been previously demonstrated to them personally. They will come when they have learned that using the information center will cost them less in time and effort than going elsewhere. Their use of many libraries or resource centers has cost them not only more time than industry users are willing to commit but has required a higher degree of searching skill and greater effort than they feel called upon to use.

The information specialist may not motivate his clients' need for information; perhaps he should not wish to. Success with the services of a good center and a knowledgeable specialist may, however, affect their need for knowledge in subtle ways. Some clients may, indeed, discover there the most basic meaning of the word information itself. Their knowledge needs may be given form and shape as in the Middle English origins of the word.

What will the client have done before he comes to the specialist? This needs to be known so that effort will not be unnecessarily repetitive. He will probably have consulted his friends—not necessarily the in-house experts, but those in or out of the organization engaged in similar investigations. He will have found that easy because they share the same professional language—or jargon, if you will. The user may well have gone to privately supported trade journals, to in-house project reports and manuals. He will undoubtedly have turned to old, familiar college texts. He may, indeed, have used vendor friends and an external consultant if his budget allows. He will certainly have plumbed the depths of his project director's memory, provided doing so will not threaten his own security. All these persons, you see, speak his language and have similar backgrounds of education, experience, and training.

The usual company librarian would probably not have those attributes; indeed, he would say he could not have them. But the information specialist, if not furnished with some parts, at least, of such a background, is bound to educate himself sufficiently along those lines to allow at least a modicum of rapport between his clients and himself. Telephony, a trade journal I scan, said it another way. The only substitute for an education these days, it said, is learning. Think about it, as our Laugh-In friend would say.

Information services must be marketed, must include certain aspects of redundancy so that varying sources may be cited on the same subject. Feedback must be encouraged, but subtly, so that one may know whether or not he has hit the mark. Information must be delivered skillfully, and whenever possible to the client's own environment. That environment must be carefully assessed. Is it all business, all organization, orderly, precise, neat? Is placement of the documentation and order of its arrival significant? Does the client work in an atmosphere that is silent, tense? Active or passive? Will it bear intrusion? Are discussions regarding the data brought welcomed then? Later? Never? Or is the client's atmosphere opposite in all respects? The information specialist had better get in phase with it, whatever it is!

If we must communicate with our client in writing, we shall, of course, provide later references and bibliographies that are concomitant.

In communicating information in industry, I wonder if we may not apply a statement by Peter F. Drucker in his book, Managing for Results:

> The pertinent question is not how to do things right, but how to find the right things to do, and to concentrate resources and efforts on them.

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Geometric Dimensioning and Tolerancing as Used by Industry

John D. Parr

In this contemporary age, we encounter many terms which express some of the current problems with which we are concerned at a particular time. I would like to discuss one that seems to be a problem all across our society. The term is "communication." Let us examine it from two different aspects. Namely, the line of communication which we as industrial education people have with our friends in industry, and secondly, a new technique of communication which is spreading through industry and is known as Geometric Dimensioning and Tolerancing.

First, let us discuss the interface we have with industry. We have heard speakers tell us over the years that we should be more cognizant of modern industrial practice, that we should seek help from industry so that we may re-examine our courses and make them more relevant to what our young people will be doing when they are on the job. We in the Saginaw area of Michigan made the effort, and it certainly was productive.

We involve people from industry on our Citizens' Advisory Committee. As we work with these people, we encourage them to hire our industrial education teachers in their plants for the summer months so that the latest techniques of industry can be observed and practiced. We like to think that our teachers become increasingly aware of the interface they have with industry and therefore will revise their course of study to include the new ideas gained in summer employment.

A couple of years ago, one of our teachers of mechanical drawing worked for Saginaw Steering Gear, a division of General Motors Corporation, during the summer. On his job he was introduced to Geometric Dimensioning and Tolerancing as used in that particular plant. During the fall, a discussion was held about having a workshop on this new technique.

The engineers in Product Design were contacted and asked if they would conduct the workshop. They were very receptive and helped us set up a 6-hour workshop. Invitations were sent to teachers in this geographical area. The response was overwhelming. We had two workshops, each having an attendance of approximately 45.

During the workshop, a complete presentation of the topic as presented in A Treatise on Geometric Dimensioning and Tolerancing (Ref. 1) by Lowell W. Foster of the Honeywell Corporation was covered. We felt that we had been exposed to the theory, but full understanding would require independent study.

I would encourage local associations or groups of teachers to contact industry in their own area about the possibility of assisting in organizing a workshop about this topic or any other new concept which is being used in industry today. In this way, industrial arts teachers can be updated on current practice, and they can think in terms of adaptation to their curricular area. We are often accused of being left behind by technological progress. In this way, we can make every effort to keep abreast of technological change.

The question can rightfully be asked, "What is Geometric Dimensioning and Tolerancing?" At this point, a brief history of this concept should be considered. During World War II, the aircraft industry and the American military inaugurated a new system of dimensioning which employed true position tolerancing of features and standardized definition and control of geometric features. Shortly after the war, symbols and standard drawing practices were developed to support these new systems of position and feature control. These first appeared in MIL-STD-8. Subsequently, the practices and symbols have been refined through national standardization activities in the United States, and they are now recognized in the latest international standards recommendation of I.S.O. Presently the application of true position and geometric tolerancing principles and symbols is rapidly increasing, replacing the former written notes and nonstandardized interpretations. Without exception, those who have converted to the new system report that they have been able to produce better products at less cost.

Who is using this system? In the General Motors Corporation, the following divisions are using this concept: Detroit Diesel, Allison, Saginaw Steering Gear, and A-C Electronics. Many implement manufacturers are also using this concept, as well as companies such as Honeywell Corporation. Engineers from industry report that more companies are changing to Geometric Tolerancing and Dimensioning.

"The primary medium of communicating the details of any engineering idea, be it a space satellite or just nuts and bolts, is via the engineering drawing. How effectively this idea is communicated through the engineering drawing actually determines to a large extent the success of that idea when converted to a product. The engineering drawing must communicate the total requirements clearly and concisely.

"With the advance of industrial technology has come an emphasis on diversification. This diversification has created a need to communicate the total requirements of each piece part on the individual drawing. No longer can we rely on the outdated techniques of doctoring parts to fit their mates or filling in by verbal communication that which we do not state on the drawing. One part may be made at one company or location, whereas its mate may be made, or procured, from another. The parts must fit and the only means of assuring this is the proper implementation of the engineering drawing. There must be a complete story on the drawing. Also, it must be specified in such a manner that it will aid in assuring proper function of the part or device and yet do so effectively and most economically.

"Resulting from this industry-wide need to build more preciseness and clarity into the engineering drawing comes an advanced technique of applying engineering drawing principles. This is known as Geometric Dimensioning and Tolerancing.

"Geometric dimensioning and tolerancing is not a magic formula to right all drawing ills nor to replace completely all existing drawing techniques such as the coordinate system of dimensioning. Geometric dimensioning and tolerancing is to be used where it can serve an effective purpose. It is the servant, not the master. In a broad sense, it is just part of the building blocks of good engineering drawing practice. However, its real reason for being and, in fact, the foundation principle of geometric dimensioning and tolerancing is the maximum material concept.

"Functional gaging techniques prevalent for at least a generation, and a generally familiar term, is based on the maximum material condition concept. However, until the recent past, this extremely advantageous technique had not been officially accepted nor used to any great advantage. It was simply that there was no organized method to say these things specifically on the drawing, no way for the designer or processing or production engineer to convey the true message to the shop. The features of parts in a given device once having been calculated for fits, clearances, etc., were dimensioned and toleranced individually and perhaps by dimensional coordinates, angles of arc, etc. Such things as tolerance accumulation, increase or decrease from feature nominal sizes, predictable opposite extremes of mating features, surface irregularities, etc., had to be considered and compensated for. The result had to be tighter tolerances on the drawing, more expensive tooling and gages, more problems in the shop, more scrap, less profit. Unless someone along the line took it upon himself to consult the designer for details of part function and recognized that what happened to one feature might affect another, little real consideration was given to these possibilities. In other words, it was left to chance or discretion by someone to introduce functional techniques with no back-up by the engineering drawings.

"Subsequent expansion and diversification of many companies caused the need for the pioneering of more precise and uniform drawing technology throughout industry. These larger companies (primarily auto, aircraft, and missile industries), the professional societies, the military, and the standards agencies of the American, British and Canadian governments have essentially collaborated over a period of years to evolve this basic system. International standards (ISO) are now being promoted also on this subject. On the surface it all appears new. It is, however, the old techniques now organized into a uniform system and expanded into new situations (Ref. 2)."

Geometric Dimensioning and Tolerancing is really two-fold. Let us examine both. First, we have replaced certain "time-honored" notations, used on drawings to represent geometrical part relationships, with symbols. The obvious advantage of symbolization lies in time savings, both in drafting and in reading the print. However, a more important advantage which we realize is the fact that the symbol leaves no room for misinterpretation. For example, we use notes like "ovality of this diameter may not exceed .030," which is very misleading, since we do not care whether the part is oval or not; we are really indicating not an "oval" condition, but an "out-of-round" condition. As long as the drafting room and the shop were close together, a byplay of interpretation was possible. Today we do not have this closeness, and our English language leaves enough loopholes so that misinterpretations can easily occur. When we use symbols, we define, in a national standard, what each symbol represents in relation to part configuration. As will be apparent to you when we begin to discuss the symbols, they can be divided into three broad categories:

1. Relationship of certain part surfaces to theoretically perfect surfaces.
2. Relationship of certain part surfaces to other surfaces on the same part.
3. Relationship of certain part features to other features on the same part.

Another facet of misinterpretation arises when our drawings are used in countries where English is not the basic language, so that we then have a linguistic problem as well.

Second, we now have a tool for dimensioning and tolerancing a part drawing with respect to the actual function and interrelationship of the part surfaces and the features which can be most economically produced. The use of this system tends to direct the thinking of designers and draftsmen along the lines of functionality and relationships of part to part, rather than along lines of ultimate machine capability regardless of part function. This permits, in many instances, liberalization of tolerances.

A few term definitions are in order here before we start our discussion:

1. Dimension—a numerical value expressed in appropriate units of measure and indicated on a drawing.
2. Tolerance—the amount of variation permitted in the size of a part or in the location of points or surfaces (Ref. 3).
3. Feature dimension—a dimension which described size of a part, or any section (feature of a part).
4. Location dimension—a dimension which describes the relationship of features to other features.

What is the advantage of this system over past practice? True position and geometric tolerancing offer a number of advantages, such as:

1. There is only a single interpretation for each symbol or combination of symbols, and these are documented in the accepted national and international standards. This minimized misinterpretations often associated with nonstandardized written notes.
2. Because of the explicitness of the system, the communication of the designer's intent to manufacturing and inspection is greatly enhanced.

3. True position tolerancing and maximum material concept makes available up to 57% greater tolerance on relative position of features, thus offering greater manufacturing economy.
4. The use of the system encourages thorough design analysis and eases communication between the designer and the detailer.
5. The symbols save drafting time and provide understanding of design requirements regardless of language.
6. The over-all clarity and simplification offered by true position and geometric tolerancing improves reliability of the product.

The importance of this whole concept to industrial arts teachers should be very apparent. Students in our classes should be made familiar with this new system. It is new, in fact it is only about six to eight years old, but it is spreading through industry both in this country and abroad. We, as industrial arts teachers, can provide our students with one more experience, one more bit of knowledge which will equip these young people for the competition in the labor market.

It is vitally important that we keep our curriculum up-dated so that it is relevant, that it is in accordance with current practice. I hope that each of you will consider this concept, Geometric Dimensioning and Tolerancing, for your course. Recently I read that people can be divided into three groups: those who make things happen, those who watch things happen, and those who wonder what happened. Where do you fit in these groups? I am sure that you are in the first group, and you will investigate and incorporate this new concept.

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The Silent Communication—in Teaching and Learning

M. James Bensen

People everywhere, under all types of encounter situations, are communicating with those who are around them. Whether we "formalize" our communication or not, we must realize that we are continuously transmitting and receiving messages. Man has a tremendous need to establish some means of communicating. Numerous people have later described the terrifying experience, after a stroke or other immobilizing factor, of not being able to interact with others. Even a small wiggle of a finger or a blink of the eye, which could then be translated into a code, brought about indescribable emotional release and returned happiness to the stricken person.

The written and spoken language has proven to be a tremendous aid in developing civilizations. The sophistication of our verbal system allows us to store, retrieve, and do all sorts of unique things with this communication tool. Though man has this precious tool, he has likewise found it necessary to develop a high-level nonverbal communications system. This has helped cut across language barriers and, in many instances, it is vastly superior to the verbal system.

As we look about ourselves each day, we come into contact with a fantastic array of nonverbal messages. Our whole traffic control system is heavily dependent on it. Sign shapes, center lines, lights, and lines on the road surface all inform us about the traffic environment. In other aspects of our daily life, the barber pole, weather vane, and the red fire plug all keep us tuned in, as do thousands of other devices each day.

Human encounter skills also are vastly important in aiding us through the day. When we walk down hallways, open doors for others, and get off elevators, we are constantly using our silent communicators. If we fail to pick up the cue that others give us, or if we become lazy ourselves and don't give these cues, we invariably find ourselves in embarrassing, comical, or aggravating situations.

As teachers, we use these skills in a planned way to bring about the desired terminal behavior in our students. The physical proximity between the teacher and his learners is a crucial factor. We can set up a very formal situation that does little for promoting interaction, or we can facilitate discussion and dialogue by removing many of the barriers.

The hand gesture also plays an important role. A pointed finger creates a threatening environment, while the open palm signifies a much more receptive atmosphere. Along with the physical gesture, the facial expression and the tone of the voice also carry much of the communications load.

Probably the most powerful communicator, other than the formal spoken word, is the use of a person's eyes. We constantly tell others how we are responding to a given situation by their usage. We can ignore, question, agree, debate, inform, and do all sorts of things with them. Though all of the above techniques are nonverbal, they usually are utilized in concert with the verbal, and thus the opportunity for very powerful interaction is made available.

Since many industrial arts teachers indicate that they are teaching students who are not highly verbally oriented, we need to be more creative in our approach to teaching. One endeavor which has returned large dividends in the professional sequence of our teacher education program has been the development of a sample nonverbal "mini-lesson." Future teachers are charged with the task of designing this instruction which will meet the specified outcomes they desire without using words.

The key elements in designing the mini-lesson are as follows:

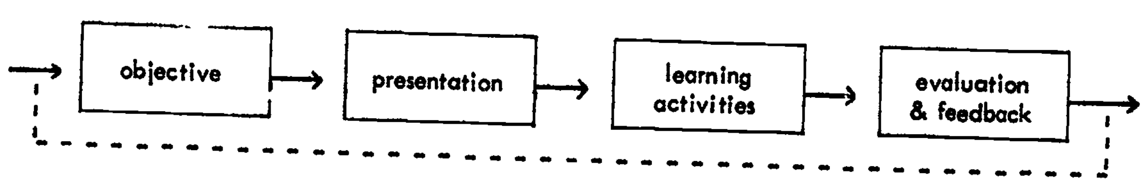
1. The Objective. A precise statement written in behavioral terms with a specified criterion level. Also they are to identify the taxonomy category(ies) at which they feel the objective is written. The identified mini-lesson should take from three to five minutes to master.

2. The Presentation. The method of presenting the initial concept or skill is to be planned by the teacher so that the message is conveyed in any way, other than verbal. Some ground rules are established so that a key word may be used sparingly—like a nonverbal picture does in supplementing a verbal text. However, the ma' portion of the material must be taught and learned nonverbally.

3. The Response. Students must be given an opportunity to practice the desired behavior to determine whether or not more study or activity is necessary. When they have mastered the objective, they progress to the next phase of the lesson. These learning activities may or may not be an integral part of the initial presentation.

4. Evaluation. Knowledge of results (KR) is highly important in the learning encounter. Without anv feedback, psychologists say that learning is virtually impossible. With even a limited amount of feedback, achievement scores skyrocket. With a planned, continuous KR strategy, learning should be greatly enhanced. Some source of feedback is thus designed into the materials to give continuous KR to the learner.

The nonverbal mini-lesson is an exercise in planning instruction in a closed loop system.



College students are many times highly frustrated when they initially confront the problem of designing this piece of instruction. This subsides, however, and in the long run they report back that it was one of the most enjoyable aspects of their curriculum course.

As industrial educators, we already utilize a wide variety of nonverbal communication devices. Everything from flow charts, maps, and graphs to working drawings are extensively in use each day in our laboratories. New and creative approaches such as awareness assignments, team design experiences, educational games, and simulation exercises, however, must be blended into our present programs. We are entering an exciting era of education. Never before have we had the resources at our disposal as we do today, that will make learning a fantastic experience. It will take hard work and creative teachers, but a sparkling future lies ahead if we capitalize on it.

What we must remember, however, is that we need to keep a balanced program. We must not over emphasize either the verbal or the nonverbal. We do not wish to reinforce the nonverbal student to continue to be so. Nor do we desire that the attainment of extensive verbal behavior patterns become so dominant that the student has no opportunity to develop creatively in other modes of thinking and communicating.

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Graphic Communication Processes: Their Identification and Classification

John T. Fecik

This presentation deals with a proposal for a fresh viewpoint of the graphic communication processes. These processes are basically concerned with the reproduction of graphic images or symbols for communicative functions. Essentially, these processes have been identified and recognized by others as relief, gravure, planographic, porous (screen), electrostatic, and holographic.

GRAPHIC COMMUNICATION PROCESSES

Man, his evolution, and the use of his capabilities have been described in many ways. It is only in recent years that a focus has developed on his sensory capabilities, particularly that of vision. Teacher educators and teachers in the area of graphic arts have wrestled with the technological changes and innovations affecting that area of industry. They decided to have students set type by hand and ignore photograpy and photography-related processes. Those processes which were not routinely identified with the relief, gravure, offset, or silk screen printing processes have also been shunned.

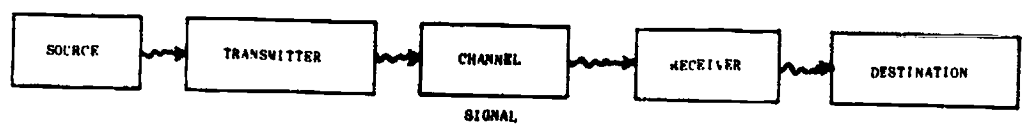
This paper will outline a structure or organization based on the reproduction processes and thereby constituting graphic communication. Graphic communication would be the generation or reproduction of graphic symbols, images, or elements on substrate materials for communicative purposes or functions. The structure developed in this study was a classification scheme using common elements from the processes which reproduced a graphic image. Although drafting and drafting media have been considered by some to be segments of graphic communication, they were not included as a part of this study.

COMMUNICATION

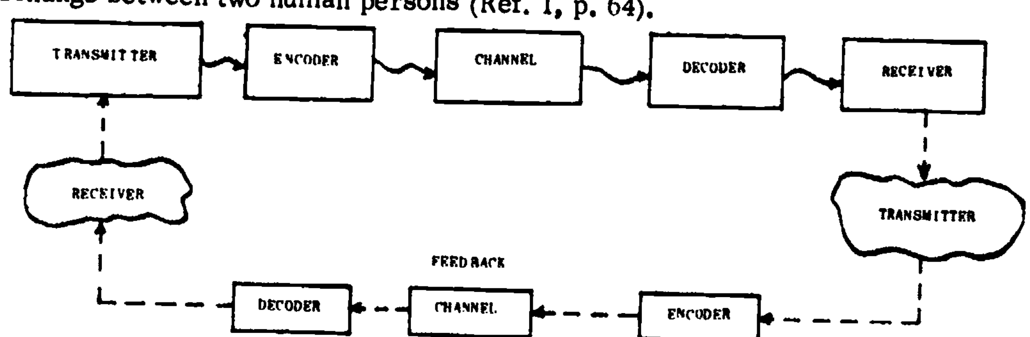
The nature of communication is represented by its transitions as it has been used or applied in any particular discipline. Each discipline has its viewpoints on communication. Communication has been concerned with the interchange, exchange, or transmission of information. Regardless of the discipline or source, this premise has been verified and accepted, ranging from Norbert Weiner and Charles Cooley to Theodore Smith and Ray Schwalm. A psychologist (S. S. Stevens) provided the behavioristic orientation when he defined communication as "the discriminatory response of an organism to a stimulus" (Ref. 15, p. 689). Sociologists interpreted this as an interchange or exchange of information. However, Park felt it was expression, interpretation, and response (Ref. 11, p. 168). Shannon and Weaver provided the mathematical or technical engineering theory to accompany this. As engineers researching the capacity of a channel to transmit messages, they represented the parameters of communication as mathematical entities (Ref. 13, p. 6).

$$C = \lim_{T \to \infty} \frac{\log N(T)}{T}$$

John Mann points out that such mathematical expression has developed into theory (Ref. 10, p. 112). Schematically, it was depicted in this fashion:



Wiener provided the concept of feedback (Ref. 18, p. 28), while Berlo described it as an interchange between two human persons (Ref. 1, p. 64).



A typical model of communication interchange

Berlo also interpreted each human sense mode as a channel for communication (Ref. 1, p. 64). Mann identified the eye mode of human perception as the most sensitive receiving instrument (Ref. 10, p. 116). Such findings seem to be the basis for the Visual Communications Program by Schwalm (Ref. 12, p. 9). But we are concerned with the visual mode of human perception and what is available for the eye to perceive. Cooley described the most important aspect of communication as a system of standard symbols (our alphabet) which exist for the purpose of conveying thought (Ref. 3, p. 145). These symbols or letters are mental or sound abstractions but are graphic in nature and static in display.

Historically, man has used his senses to communicate his ideas. DeFleur noted that the exchange and retention of information became restricted to the range of the human voice and the accuracy of the human memory. The complexities of society forced man beyond these capabilities (Ref. 5, p. 1). As Cremonesi described it:

> In more highly organized societies, a third need of civilized man takes its place alongside food and clothing. That third need is the printed word—the means of storing and transmitting man's knowledge; the means of bringing men within reach of other societies; the means of communicating with the past and the infinite future (Ref. 4, p. 4).

In composite fashion, Smith integrated communications as an exchange of information through a common set of symbols while using technology to convey or convert the information for human perception and interpretation (Ref. 14, p. 173). From a simple transmission of information by electrical signal, a sophisticated technology has been developed for immediate conversion of symbols or images for human interaction. This development of technology has permitted communication to be applied within a number of disciplines (Ref. 14, p. 174). A Department of Labor Handbook claimed that "Printing is an art, a great industry, and one of our chief means of communication" (Ref. 16, p. 289). Therefore, the printing industry had a challenge to accept a larger sphere of responsibility than the mere mechanics of printing. With the recognition of the term "graphic arts," printing was acknowledged as a large segment of that sphere (Ref. 17, p. 331). The printing process was described as communication when images were impressed on paper for human transfer of information. The capability of the computer as a processor of information led to a more efficient way of making those marks. Dukes focused on the computer, how it would influence the future of the printing industry, and its purpose when he reported that first and foremost, printing is intended to convey information. He felt that this was the primary purpose of printing or reproduction (Ref. 6, p. 10).

REPRODUCTION PROCESSES

Under the banner of graphic arts, the processes considered as printing are well known: relief, offset, silk screen, and gravure. By embracing this thinking, the newer developing forms of graphic communication are locked out since they cannot be considered printing processes. This was due to the limited terminology of printing and/or graphic arts. A great deal of overlap and repetition occurred. Brown, in a keynote address to the International Graphic Arts Education Association, described the old meaning of the term printing as inadequate:

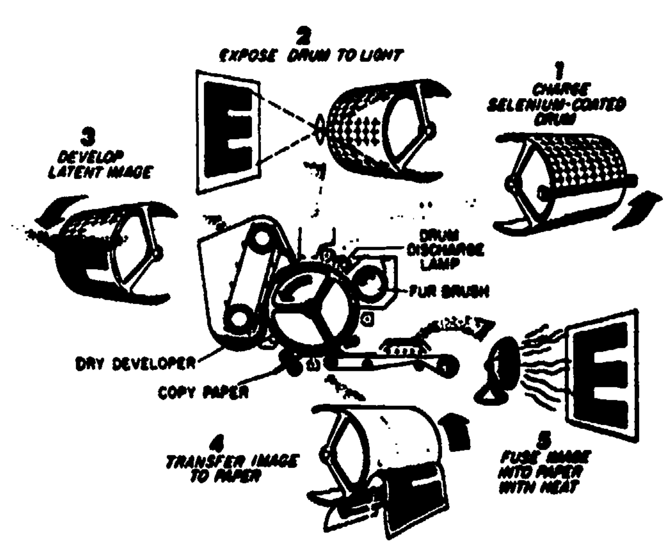
> Until now, printing has meant the art of impressing symbols on paper. . . But today printing is coming to mean the preparation of an idea for electronic treatment. The concept of pressure, always present in the meaning of printing, is disappearing (Ref. 2, p. 6).

He further directed the IGAEA to adopt broader terminology which encompasses the old meaning of printing as well as the new processes. This action would concur with the frontier of the printing industry. In a later keynote address, Gardner emphasized that the technological advancement has made graphic arts an integral segment of a much larger and far more diversified graphic communication industry. Therefore, he declared that the

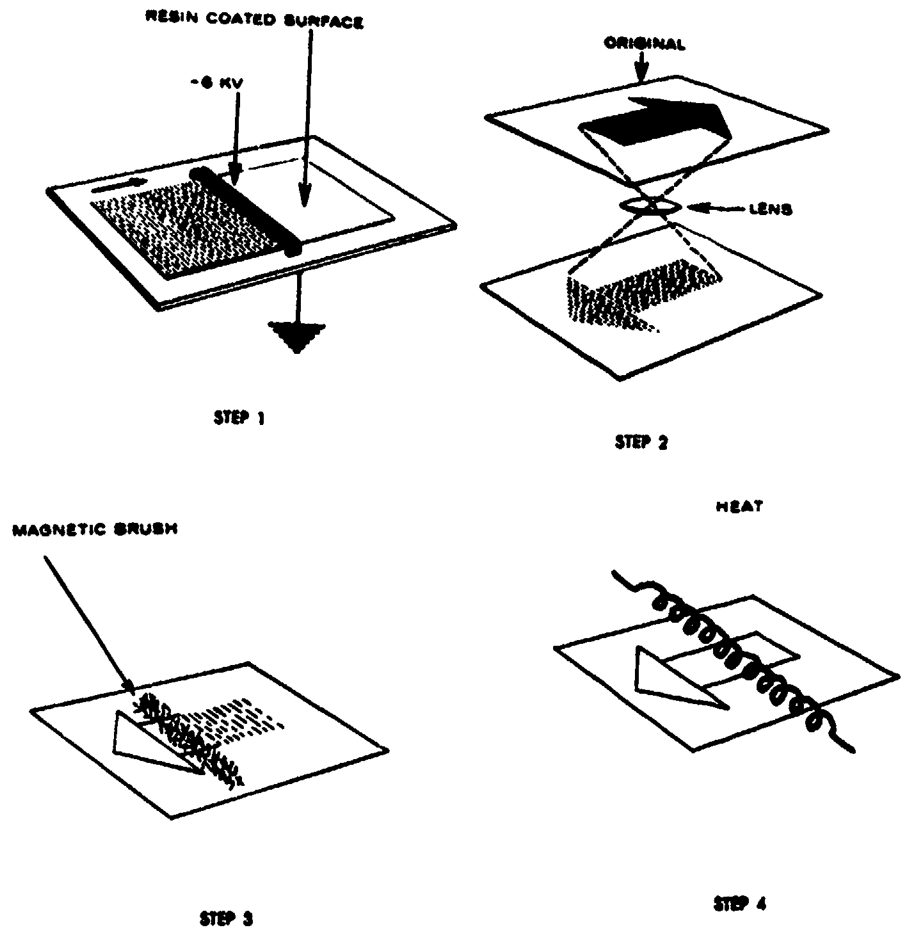
> ...curriculum must be drastically revamped to realistically reflect the industry as it now exists and to convey the exciting new directions in which it is headed (Ref. 9, p. 6).

The discussion centers on the inclusion of newer processes which results in accepting the more inclusive terminology of graphic communication. The printing processes are recognized as impact-oriented reproduction processes. Do we omit the non-impact processes as printing processes? Yes, but we must recognize them as non-impact reproduction processes. A reproduction process would be defined as a process or technique which uses impact or non-impact to reproduce graphic, but static, images in large quantity on paper or other substrate materials. Therefore, we may study and investigate the several varieties of electostatic reproduction techniques and the laser-activated holographic process.

The varieties of electrostatic techniques are based on the phenomena of static electricity and photoconductivity to reproduce graphic images. The best known electrostatic techniques are xerography and electrofax because of their similarity. Differing characteristics are applied in the videograph and Stratos systems as well as the conductive stencil screen.

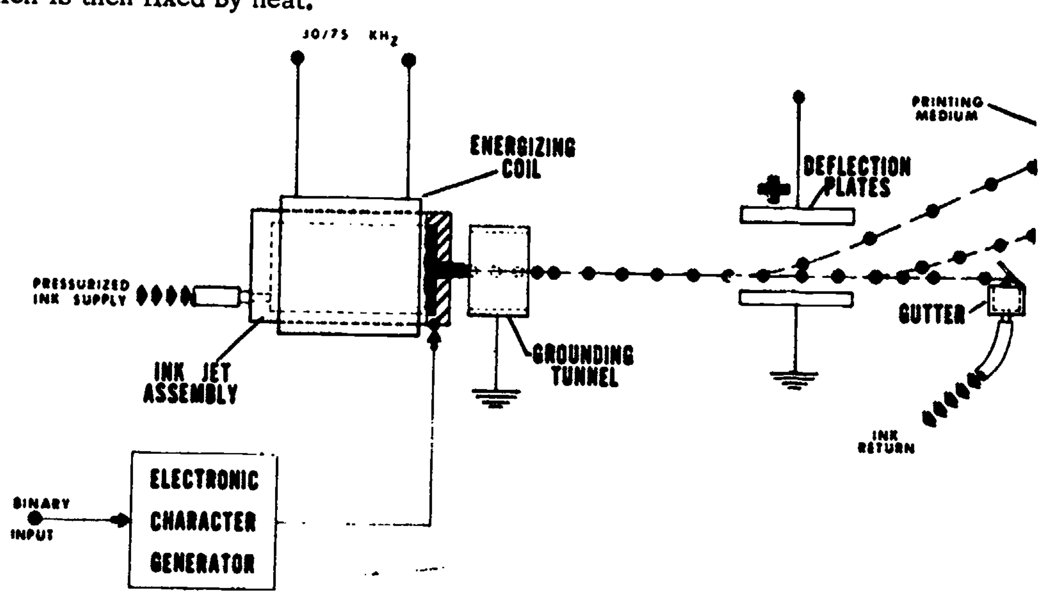


The five basic steps in the xerographic process



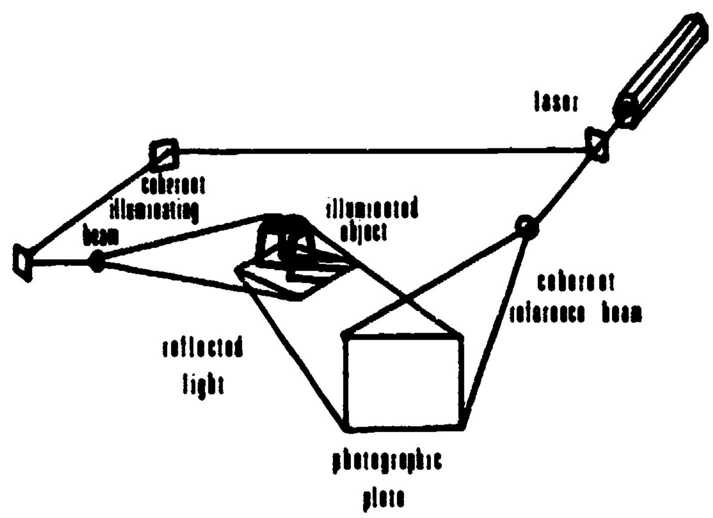
The electrofax process

Electrostatic attraction is based on the known fact that opposing electrical charges attract each other. Photoconductivity is a physical characteristic of a substance which retains an electrical charge while photographically sensitive to light. A metal layer or plate will be electrically charged; its exposure to light discharges the non-image areas and leaves a latent but charged image from a document on the plate. A toner compound adheres to this image until a sheet of paper with an opposite charge is positioned near the plate. The toner is then transferred to the paper by the attracting electrical charge which is then fixed by heat.



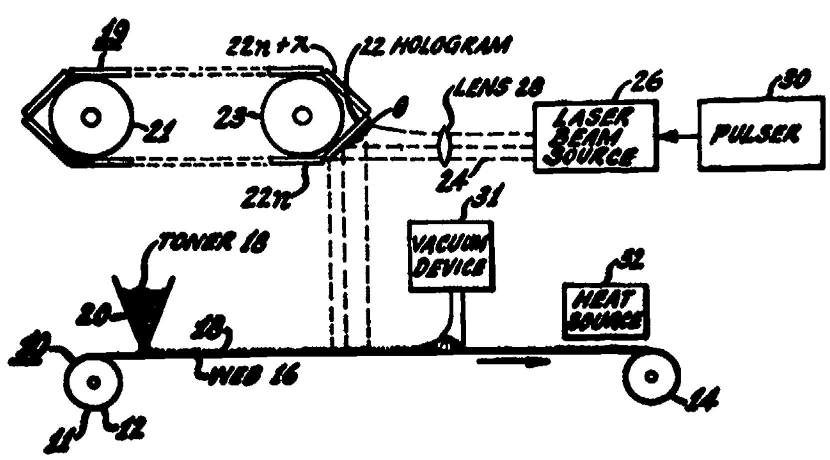
Videojet process

The use of a laser beam makes the holographic process exotic, and physicists and researchers are still experimenting with its possibilities both inside and outside the graphic communication field. The process of recording, on photographic film, the wave lengths from a coherent light source reflected from an object is termed holography.



Holography

The film, or photographic plate, is designated as a hologram. This recording of wave lengths, which may be broadly interpreted as a photographic technique, is but the initial step. The re-creation of the reflected object on the hologram which reveals the image, or object, in three dimensions is termed "wave-front reconstruction" by the physicist. Reproduction of the recorded image from a hologram has been achieved on a non-impact apparatus patented by Fischbeck (Ref. 8, p. 1).



This apparatus reproduces information from a hologram by reflecting a laser beam from the hologram to the paper. The image is bonded to the paper by the electrofax technique and has been termed "laserfax." This reproduction phase must be considered as experimental at this time, however.

Other possibilities to be considered as reproduction processes are thermal techniques (thermography), diazo systems, microencapsulation, silver image transfer (diffusion transfer), and skid printing.

Items within the framework of reproduction processes which have had variations or innovations developed: Cameron belt press, 3-dimensional offset or xography, screenless lithography, flexography, electrostatic assists, microforms, and optical character recognition.

STRUCTURE FOR GRAPHIC COMMUNICATION TECHNOLOGY

DESIGN

- **DESIGN PRINCIPLES**
  - BALANCE
  - PROPORTION
  - HARMONY
  - RHYTHM
  - CONTRAST
  - UNITY
- **TYPOGRAPHY**
  - TYPE FACE NOMENCLATURE
  - TYPE FACE CLASSIFICATION
- **COPYFITTING**
- **ESTIMATING**
- **SPECIFICATIONS**
- **PAPERSTOCK**
- **LAYOUT TECHNIQUES**
  - TYPES OF LAYOUT
  - DUMMIES
  - PASTE-UPS
- **COLOR THEORY**
  - COLOR TERMINOLOGY
  - COLOR SYSTEMS
  - PROCESS COLORS
- **PHOTOGRAPHY**
  - SILVER HALIDE EMULSIONS
  - (Continuous Tone Material)
    - BLACK & WHITE
    - COLOR

COPY GENERATION

- **ASSEMBLY OF CHARACTERS**
  - MANUAL MODES
    - HAND SET TYPE
    - PASTE-UP
    - STRIKE-ON
    - PAPER TYPE
    - PHOTOGRAPHIC APPLICATIONS
  - MECHANICAL MODES
    - LINECASTERS
    - PUNCHED MEDIA
  - ELECTRO-MECHANICAL MODES
    - PUNCHED MEDIA
    - MAGNETIC MEDIA
  - ELECTRONIC MODES
    - ON-LINE COMPUTER
    - OFF-LINE COMPUTER
- **STORAGE AND RETRIEVAL MODES**
  - MANUAL MODES
    - TYPE CASES
    - PAPER
    - CLIP ART
  - PUNCHED MODES
    - CARDS
    - TAPES
    - TAGS & COUPONS
  - FONT MODES
    - ACETATE
    - GLASS
    - METAL
  - MAGNETIC MODES
    - TAPES
    - DISKS
    - INKS
    - OPTICAL SCANNERS
  - FILM MODES
    - FRAMES
    - STRIPS
    - MICROFORMS
  - ELECTRONIC SIGNALS
    - CHARACTER GENERATION
    - OPTICAL SCANNERS
    - CATHODE RAY TUBES
    - MEMORY DEVICES

IMAGE CONVERSION

- **ASSEMBLY OF COPY COMPONENTS**
  - MAKE-UP*
  - PROOFING
  - ADAPT & SUPPLEMENT OPERATIONS
- **MANUAL CONVERSION**
  - HAND SET TYPE
  - SCREEN PROCESS
- **MECHANICAL CONVERSION**
  - LINECASTERS
  - PANTOGRAPH
  - DUPLICATION or MOLDING
- **PHOTOMECHANICAL CONVERSION**
  - PROCESS PHOTOGRAPHY
    - LIGHT-SENSITIVE EMULSIONS
    - (High Contrast Material)
      - COLLOIDS
      - PHOTOPOLYMERS
      - DIAZO
      - STABILIZATION
    - COLOR SEPARATION
      - COLOR CORRECTION
      - COLOR PROOFING
      - DENSITOMETRY
    - PROCESSOR UNITS
      - FILM
      - PLATES or IMAGE CARRIERS
- **ELECTROCHEMICAL CONVERSION**
- **ELECTROSTATIC CONVERSION**
- **ELECTRONIC CONVERSION**

*Stripping, Imposition, Layout are interchangeable terms. The terms vary according to the reproduction process. The process must be identified with the term used.

IMAGE CARRIERS

- **ADDITIVE UNITS**
  - HAND SET TYPE
  - LINECAST SLUGS
- **SOLID PLATES**
  - PHOTOENGRAVINGS
  - WRAP-AROUND PLATES
  - PHOTOPOLYMER PLATES
  - ENGRAVED or ETCHED PLATES
  - GRAVURE CYLINDERS
  - STONE LITHOGRAPHY
  - OFFSET LITHOGRAPHY
  - COLLOTYPE
  - LAMINATED PLATES
  - GLASS
- **POROUS CARRIERS**
  - FABRIC
  - METAL
- **DUPLICATE CARRIERS**
  - ELECTROTYPES
  - STEREOTYPES
  - PLASTIC PLATES
  - RUBBER
  - SIDE.'OGRAPHY
- **ENERGY CHARGED CARRIERS**
  - SELENIUM SURFACES
  - ZINC OXIDE COATED PAPER
  - METAL PINS
  - VIDEOJET
  - GLASS

REPRODUCTION DEVICES

- **IMPACT DEVICES**
  - RELIEF PRESSES
    - LETTERPRESS
    - FLEXOGRAPHY
    - INDIRECT
  - LITHOGRAPHY
    - OFFSET
    - COLLOTYPE
  - SCREEN PROCESS
    - MANUAL DEVICES
    - MECHANICAL DEVICES
      - FLAT BED
      - CYLINDER
  - GRAVURE
    - FLAT BED
    - CYLINDER
- **NON-IMPACT DEVICES**
  - ELECTROSTATIC
    - XEROGRAPHY
    - ELECTROFAX
    - VIDEOJET
  - LIGHT ENERGY DEVICES
    - LASER ACTIVATED

FINISHING OPERATIONS

- **BINDING OPERATIONS**
  - MECHANICAL BINDING
    - EXCHANGEABLE PAGES
    - NON-EXCHANGEABLE PAGES
  - CASE (Edition) BINDING
  - ADHESIVE (Perfect) BINDING
- **AUXILIARY OPERATIONS**
  - CUTTING
  - PAPERSTOCK
  - FOLDING
  - ADDRESSING
  - EMBOSSING
  - DIE-CUTTING
  - LAMINATING
  - PACKAGING
  - PERFORATING
  - DRILLING
  - PUNCHING
  - DECORATING
  - VARNISHING

A STRUCTURE FOR GRAPHIC COMMUNICATION TECHNOLOGY

The study culminated in a classification or organization of industrial techniques, termed as "structure," which were described in the literature. These techniques, or processes, were identified, examined, and analyzed for a common relationship. This produced major elements which then permitted the techniques to be classified according to sublevels for each element which included those identified in the selected literature and supported by authorities familiar with the level of technology in the industry. The nomenclature used was consistent with the literature so that the scheme of classification represented the various industrial techniques by which each major element was accomplished in the industrial setting.

The common elements which composed the structure of graphic communication technology are design, copy or character generation, image conversion, image carriers, reproduction devices, and finishing operations. Each were generalizations that seem justified from the literature with regard to the common elements of the graphic reproduction processes.

Design

The techniques used to translate ideas and concepts into an integrated yet comprehensive visualization by planning the arrangement and appearance of the desired graphic product were considered as design. The activities consolidated as design could be described as decisions or considerations which affect the subsequent performance of each stage in the reproduction process.

Character Generation

The generation of graphic images from a stored and retrievable source by the manipulation of characters as dictated from a manuscript is called character generation. The diverse range of these techniques and processes essentially constitutes two basic categories or functions: assembly of alphabetic or numeric characters and the storage and retrieval capability.

The assembly of characters was identified as the gathering and organizing of alphabetic and numeric characters as determined from a manuscript or original copy.

The modes of storage and retrieval were the means by which a stored matrix or mother source was retrieved in order to generate or originate character images. The storage and retrieval techniques therefore pertain to any means associated with copy generation which has a capability to store a matrix and from which the matrix may be subsequently retrieved for reuse. The matrix or mother source in this instance was alphanumeric symbols or images imposed upon a physical material with the intent of creating, producing, or generating images of those stored characters.

Image Conversion

The methods used to convert the generated copy or images from the previous stage of production to a physical form of image carrier was known as image conversion. The methods of converting the image were broadly classified according to the technique which produced the image carriers.

Image Carriers

Image carriers were the intermediate physical media used to carry or transport the reproducible image within or for the reproduction device. While the image conversion category was concerned with the methods used to prepare and produce the carriers, the image carrier category physically described the various types of carriers. The image carrier was critical to the reproduction process since the carrier had to integrate or attach to its related reproduction device. The image carriers were the materials which were compatible with the reproduction device in order to transfer its image to some recipient material or substance.

Reproduction Devices

The basic principle upon which reproduction techniques, machines, and devices reproduce or transfer a graphic image from an image carrier onto paper or other material was embodied in a reproduction device. The identification of printing as a means of reproduction and communication was critical. All printing or graphic arts processes depended on impact or pressure to transfer an inked image. Since reproduction processes

	ADDITIVE UNITS	SOLID PLATES	POROUS	DUPLICATE	ENERGY CHARGED
Relief	Handset Type Linotype Slugs Ludlow Sluga	Photoengravings Wrap-Arounds Photopolymers Engravera		Electrotypes Stereotypes Plastics Rubber	
Intaglio		Copper & Steel Dies Fine Art Media Gravure Plates & Cylinders		Siderography	
Plano-graphy		Stone Offset-Litho Collotype			
Porous			Nylon Wire-Metal Ceramic Cylinders		
Electro-static	Metal Pins		Metal		Selenium Zinc Oxide Pap. Videojet Metal Pins
Holo-graphy		Glass or Film Negative			Glass or Film Negative

did not depend on this concept of pressure, they could not be termed printing processes. The pressure concept, however, was acceptable as a reproduction principle as well as those processes devoid of the pressure concept.

Finishing Operations

The operations which modified, refined, or processed the image recipient paper (or other material) into its final finished form were termed the finishing operations. These operations produced a finished product for distribution and disposition.

CONCLUSION

These commor elements constitute the structure of graphic communication technology. Its essence was derived from the recognition of reproduction processes rather than printing and/or graphic arts processes. Selection of terminology was also critical in order to provide inclusive, not restrictive, interpretations. The term "graphic communication" is pertinent since the graphic symbols to be reproduced are static yet spatial abstractions of our language which are presented to the visual sensory mode. Therefore, the importance of these graphic stimuli relates to their generation, reproduction or processing in order to initiate the communication process.

To close, I will quote Elmer Brown (President of the International Typographical Union) when he addressed the ITU members:

> There should be no reluctance on the part of the union members to increase production either by performing a better job or by mastering new mechanical devices and machines. We ought not to stand in the way of progress, but use each new machine, each new device, each new invention or process...(Ref. 2, p. 6).

Then, addressing graphic arts educators, he warned:

> We are fast becoming teachers in the field of communications, not just in printing, for the old art is fast becoming an "old form of communication." To be sure, printing will continue to be an art and will be used for many years, just as there is still some hand typesetting being done. But to teach our young people only printing without insight into the newer developing forms of communications is handicapping our new generation of (graphic communications) workers. It is much like teaching transportation by limiting such knowledge to the running of river boats (Ref. 2, p. 6).

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Construction

Home Remodeling for Disadvantaged Students

Richard H. Buchholz

Let's give disadvantaged students experience in home remodeling. They, more than other industrial arts students, live in run-down homes and neighborhoods. As such, these students will have abundant opportunity to put the skills they learn to use. Home remodeling is a big business in this country because there is money in it and because it makes sense to remodel instead of always tearing down and rebuilding. Disadvantaged students come from families that lack the money and most often also lack the skills to do the remodeling or make the necessary repairs which would make their homes more livable and attractive.

"Disadvantaged" means black students, but by all means not only black students. Disadvantaged students are found in all parts of cities, and so the term should indicate any student who comes from a neighborhood that might be classified as low-income or ghetto. Ghettoes come in all colors, as do disadvantaged students. These students have one thing in common; they live in homes that are in bad need of repair and could certainly be improved by remodeling.

How do these students gain the skills that will be so necessary in their later life in maintaining their homes? Industrial arts education should take on that responsibility, and not only because these students could save thousands of dollars in their lifetime by becoming "do-it-yourselfers." If we give these students skills in home remodeling, they can use these skills to gain employment in many fields including repair, remodeling, and construction.

Industrial arts education has accepted this responsibility in Toledo. We are putting home remodeling and repair into the curriculum.

Many years before I became Supervisor of Industrial Arts Education in Toledo, I had an opportunity to work with some industrial arts students in remodeling a home. I had purchased the home after a $4,500.00 fire had swept the dwelling and was putting it into shape for my family. I asked the students in my metal shop class if any of them wanted to work over Christmas vacation to help me put the home back into shape. I offered them a lot of dirty work in return for $1.25 an hour and all they could eat for lunch. With their help and a lot of my work during the vacation, Saturdays, Sundays, and after school, I put the home back into shape for less than $450.00. The way these boys acted was a real surprise to me. I don't believe it was the $1.25 an hour or the hot dogs they seemed to relish that caused them to work so hard or to enjoy themselves so much. Some of the toughest boys to control in the classroom worked the hardest in the house. I gained a rapport with these boys on this project that I don't believe I could have gained in the typical classroom approach.

When I became Toledo's Supervisor of Industrial Arts Education, I explained some of my ideas about repair and remodeling to teachers and administrators and received warm approval from both groups. Since this type of program had never been undertaken in the city before, I had no background information available to draw upon. One thing was sure. We needed an old home to remodel, preferably in an area where students needed it most. The area picked was in the Scott High School district that has not only a great number of homes in need of repair but also a great number of students in need of this type of skill training.

We were lucky to find a local nonprofit remodeling firm that agreed with our idea. Community Rebuilders, Inc., was already remodeling homes in Toledo in their effort to relieve the urban housing problem. When they first contacted me after reading about the idea in the local paper, they were having an open house on their first remodeled home. I visited the home and observed many job samples that I felt our students could equal or surpass. The deal which was worked out was advantageous to both Community Rebuilders and the Toledo Public Schools. It was basically very simple. Community Rebuilders buys a home to remodel, pays for all the materials necessary to remodel the home, insures the students who will work on the home, and even gives us $100 to help buy the equipment we need to start the program. Toledo Public Schools only had to provide a teacher and the students. After a few months of looking at homes, one was picked within three blocks of the high school. In the spring, based on the assumption that we would have a home to remodel, we had scheduled some students into the course. We were ready to start the first day of school.

Students of the home remodeling class at work on their project.

Students were scheduled into the home as their classroom for three hours each day, either in the morning or the afternoon, with the balance of their time spent at Scott High School taking other subjects. Approximately 10 students were in each of the morning and afternoon classes. During the warm fall, students scraped and painted three sides of the home. A contract was let to put on a new roof and gutters. I made numerous trips to the house and was always awed by the work the boys did and the way they were doing it. The boys were removing plaster and rotted window frames, installing glass in broken windows, installing storm windows, painting the outside walls, gutters, and porch, removing a chimney, putting up drywall, installing new electrical service with a licensed electrician, and many other things too numerous to mention. These boys seemed to be behaving as the boys who helped me to remodel my home 10 years before did. They always seemed to be busy, and there were many things to be busy about. They were working on a six-bedroom home that had endured a lot of rough use. It was basically sound but needed many things to return it to its original condition. The students seemed to take pride in the jobs they did, and the old home soon took on new luster. It was our plan to give them experience in repairing the heating unit, bringing the plumbing up-to-date, helping put in all new electric wiring, plastering, patch plastering, installing drywall and wallboard, putting new floors in some areas using vinyl tile and carpeting, and painting both inside and out. They would also floor the attic, put in new kitchen cabinets, repair the walks, plant new shrubs and landscaping, install a new front door, and replace all the rotted window frames.

Before we had a chance to do all of these things, we came up with an unsolvable problem. The home we were working on really did not belong to the remodeling firm. This came to light when the owner saw a picture of the students remodeling the home in the local paper and called to ask how these boys happened to be working on her home without her knowledge. In late summer, Community Rebuilders had made an offer to purchase the home. The owner had signed it and accepted a down payment. In September, Community Rebuilders' financial secretary had an emergency operation before he took care of final papers of purchase. When he got back to work in October, we had already made many improvements to the home and he hadn't remembered to close the deal. When the owner saw the improvements in her home, she didn't want to sell the house at the price she had agreed to earlier. We found ourselves with two groups of boys and a teacher without a place to teach.

While legal arguments were being made, the students in this class helped put the finishing touches on a new communications laboratory at their high school. For about two weeks, they helped move some of the new equipment from storage into the lab and also move all the books that had been stored.

In the meantime, a church was found that needed some remodeling. This was also in the Scott district, near the homes of some of the boys. We had a classroom again. It offered the boys an opportunity to learn more skills in building some offices and con- ence rooms in the parsonage. Before they put the walls up right, they had to remove the good-intentioned bad job that some of the men in the parish had started. All in all, they worked in four offices and one conference room putting up new walls, painting some walls, paneling some walls, hanging doors, putting up acoustical ceiling, and installing new lights and new floors consisting of vinyl tile and carpet.

Another home in the Scott district was found, and this time we were sure we had the owner's permission. The home was to be remodeled through the urban renewal agency of the city in conjunction with Community Rebuilders and the home's owner. In this case, the owner would work right beside the students in remodeling his own home. They would provide him with all the help he needed to bring his home back up to par, and he could help them as a resource person because of the many skills that he possessed. In the first home, they had put up mostly drywall. In this home they had an opportunity to do more plastering because the home's owner was an accomplished plasterer, and he would be around to show them how it was done.

Our first year in home remodeling is just over so we cannot estimate to what extent we have reached our objectives. It will take many years of follow-up to find out how these boys used the skills that they learned in their future lives. Will they keep their own homes up better because of their experience? Will any of them use the skills they learned to break into the construction industry? Will any of them take up home remodeling as a business? These are questions that will take time to answer. But we know for sure that their horizons have been broadened. They have learned skills, attitudes, and work habits that will aid them in their search for any kind of work. They know what it is to make home repairs and improvements. They have not just read about it in books; they have had that hands-on experience so necessary for learning.

Industrial arts education should include courses in home remodeling and repair for disadvantaged students. You may have trouble starting a new program; we had some. In some cities it will be tougher than in others, but at least try with no thought of not succeeding. Action programs keep students enthused, and remodeling is an action program. Consider also that this is an inexpensive program to start. You need not build an addition to the high school or buy a lot of costly pieces of equipment. Your cost per class is the teacher's salary and a few hundred dollars' worth of hand tools and portable electric tools. If you want to start a program like this, get enthused. Tell your story, and watch your enthusiasm rub off on others.

Almost nothing is impossible if you try. The success we have had so far in this new program of home remodeling and repair is due to the fact that we have people in Toledo who are not afraid to try something new if it looks as if it will help students.

Mr. Buchholz, Director of Vocational Rehabilitation Center, was the former Supervisor of Industrial Arts Education, Toledo Public Schools, Toledo, Ohio.

Curriculum

Industry Looks at Articulation in Career Education

Morris Tischler

People end up in specific jobs by accident, through the process of elimination, controlled placement, or by careful career planning. Career planning is a system which can be programmed. Like the computer, the system utilizes many AND, OR, NOT, and INHIBIT control circuits. To be effective, the system's input should couple with entry learners at the beginning level of formal education (first grade). The system has several output terminals, namely, occupational (vocationsl), technical, professional, and random resource material with few specific skills. The characteristics of the career system are described by alluding to the water system concept.

Career planning must start early. Activities within the environment establish parameters and constraints which determine possible limits and functions of the controlled element. Our family consists of four older boys and one girl, age 6. The girl enjoys cutting wood, building projects, playing with mechanical toys and even playing with electronic parts and chassis. The primary school level is the period of awareness—level two. Level one, birth to formal education, is the period when the human system is adjusting to the basic mechanics of life adjustment.

AWARENESS LEVEL

This period starts with primary education, grade one, and extends to the middle school. It is a time of great individual involvement; learning is synonymous with fun, exposure to materials, practical techniques, and the development of concepts without limits. The child, when approached as a learning system, can store in its memory bank data from many sources.

The sense organs of the system can function as a five-input AND gate. Most current learning situations, however, cause the system to function as though it were only a one- or two-input AND gate; namely, gathering data by only sight and sound. During the awareness period (and long after) the sense of touch is an important input. To provide maximum input to the system, all inputs should be used as often as possible.

The curriculum structure, during the awareness period, appears to have been designed for a learning system that has only OR gates for inputs. During each hour the child will be taught reading OR arithmetic, OR history, OR - OR - OR. The accumulation of data, with a faster response time, can best be accomplished if the learning activities are interdisciplined. Arithmetic relates to measurement.

Measurement can lead to construction and hand tools; materials relate to resources; resources relate to reading, etc. Each area is tied with a golden thread which pulls it together into a system where each part is a subsystem or a component of a subsystem. We develop concepts by looking at systems. The completely assembled puzzle is a picture; the total automobile, the entire house, a whole wagon, are but a few examples of systems. Once the concept of the system is developed (a frame of reference), the pieces will fall in place with minimum use of the INHIBIT gates. The awareness period is an excellent time to introduce materials, tools, and related academic subjects. At grade one, a cluster of projects could be introduced as Level I. The cluster would make use of a variety of tools and materials. Cutting tools AND word tools, bending tools AND writing tools, number tools AND wood materials, NOT just reading OR writing OR spelling, OR, OR....

At level II, the cluster could contain experiences requiring a higher degree of skills development. The projects would contain words in the vocabulary determined by the reading readiness scales. At each grade level a new cluster of projects, making use of a wide range of tools and materials, would be introduced. By the time the learner reaches the middle school, he or she would have been exposed to the general usage of tools and materials used in many occupations. Skills development is not important, only what the tools are used for. Tools, whether they be grammar or saws, are merely ways of transporting abstract concepts into the world of reality.

The period of awareness is the time for broad base exposure integrated with basic methods of formulating systems. Again, the systems may be stories containing an order of written words and letters (system, subsystem, and components) or a wagon with wheels and axles.

CONCEPTUAL LEVEL

This period, the middle school, is when the broad concept of the world of work starts to narrow. It is a time of exploration, orientation, getting an overview, or formulating personal concepts. Major areas of work start to fall in place—engineering, teaching, business, manufacturing, construction, etc. In order to get the learner to understand the various areas, educators have used many approaches. Industrial arts programs, for general education, have offered exploration, the general shop, the World of Construction, American Industry, Anthropology, and others. Jerome Brunner speaks of the spiraling technique of narrowing in on a specific area. The conceptual approach is another approach which fits well on the yardstick of continuing education.

Concept learning looks at the various areas as subsystems rather than the components of subsystems. Course content is based on deductive reasoning rather than inductive reasoning. Careers in general are studied by analyzing the subsections of the career. It is a study of what rather than how. It's the first paragraph of a lengthy news story; it's conversational foreign language, playing the piano for the first time without reading notes; it's an enjoyable experience through learning. Learning that pays off now; it is not a prerequisite course required as a base for a hierarchy of future experiences (such as Algebra I for Algebra II).

The structure of the concept course includes topics taken from advanced vocational and technical courses. The subject matter is treated in terms of what it contributes to the over-all rather than the specific skills of mastery. The learner, using as many of his AND inputs as possible, evaluates subject content with minimum requirement of prerequisite courses, such as math and science. The material increments are short (usually one period for completion), highly motivating, and relate to complex ideas and principles. Entire systems such as receivers, transmitters, computers, complex machines, construction, etc., are offered. A major career area might well be covered in 30 to 90 teaching periods.

The intent of the course is to provide classroom counselling for careers, the narrowing down from many possible career choices to a limited cluster group. Specific skills development is to be offered through vocational/technical or professional training. General skills and the use of materials are included in the concept courses. The middle or junior high school is the proper level to introduce conceptual courses since they serve as prevocational guidance.

Consider the view from a mountaintop. One gets an over-all view or effect. Consider further a winding river in the valley with a canoeist at the entrance to the river. The canoeist sees only what lies in his immediate path. Every protruding rock, every turbulent turn is filled with anxiety. What lies ahead can only be seen by the observer on the mountaintop. The canoeist is learning how to navigate, even though he may not know where he is going. The canoeist who is not properly prepared may turn over—a dropout. He may try again or, if the experience was really bad, he may give up completely.

The teacher may be considered as the viewer. From his vantage point and as an experienced canoeist, he sees the over-all situation. He knows where the problems are and the required skills to properly navigate toward the career objective. The learner, on the other hand, is the canoeist. Since they are separated by time and space, communications are difficult. The student is often taught how to develop a specific skill even though he knows not where he is going.

Concept learning starts by placing the student on the mountaintop with the teacher. Together they view the career river. The student may never get in the boat. From the vantage point, the student simulates some conditions (equivalent to rocking in the boat). He sees the system of the river, the subsystems (sections), and how they relate. He sees what is happening and where it leads. What is not how. In the boat, he will learn how. If after some simulated experiences the learner expresses no interest, then, while still looking down from the vantage point, attention can be called to other career systems and their required experiences.

As anyone knows, a view from a mountaintop is exhilarating, motivating, and exciting. Conceptual courses are structured to provide similar experiences while working with tools, instruments, and materials.

In electricity, the course starts with the big concept—the conversion of energy. Electricity produces light, and light produces electricity. Electricity produces motion (motor, relay, bell), and motion produces electricity (generator). By studying energy conversion (transducing), the applications of transducers are learned. This leads to controls—controls for lighting, controls in appliances, industry, power distribution, etc. Concurrent with the laboratory measurements, practical experience (application of knowledge) is gained by working with tools and materials in a directly related assignment.

In metal working and metal processing, the beginning learner starts with machines (designed for entry level students) so as to simulate the machinist. He must start at the beginning to feel like the person he may want to be in the future. He can use the lathe, vertical mill, horizontal mill, even a numerical control machine. Squaring a metal block with a mill file is out.

In construction, it's an entire house, a system, the design of the house and its many subsystems. It's not just cutting a board or mixing cement and piling bricks.

The woodworking shop might become a model shop where the student is faced with design problems. Some problems might best be solved by using plastic and molds; others might require latex or metal molding. Still others might require wood. If wood only is to be studied, then the study begins with a system made of wood. As an example, a special cabinet, table, or box with unique joints can be used. The project is first taken apart to see what was done and why. This project is followed by a series until the entire career area has been presented. The birdhouse era is out.

In the automotive area, the entire vehicle is first studied. Rather than a real car, a model which can be dismantled might best be used. If possible, a wide range of vehicles, including trucks and tractors, should be studied. Airplanes and other similar vehicles should not be included here but might make up another career study.

Once again, the concept study answers the question what. It leads into the study of how—vocational education. When properly structured, it is unique. As the student goes forward in his study of how, he can reflect back to his conceptual study as his frame of reference. Without the concepts, he must be told that he will use the how sometime in the future. It's like driving a car. Most of the time you look forward, but sometimes you look back. "How" study, without concept study, is open-loop instruction; it has little or no feedback. When both methods are used, the learning system has negative feedback, which smoothes out instability. The result: better student response.

BASIC SYSTEMS

Awareness education develops the broad concepts which lead to the narrowing of career concepts. Before proceeding into career preparation (vocational education)—the how—some discussion concerning systems, in general, is worth considering.

The word system has significance when we consider that a system contains only four major parts. The input to the system (called input transducer, which changes energy from one form to another), the output (again a transducer which changes energy from one form to another), a means of control (between input and output transducers), and some source of power or fuel. In other words, a system contains input, control, output, plus a source of power. All systems contain the same basic ingredients. Man can interrelate systems because he can arrange for the output of one system to properly match the input of another system. Man is able to transmit his voice because the loudspeaker of a telephone (ear piece) or radio matches the ear of the listener and the microphone matches the voice of the person talking.

All systems developed by man can be interrelated and analyzed in terms of the four major parts. Since all systems need power (in various forms), it need not be considered in matching systems. Only the input, output, and control sections have real significance.

Consider the major input and output transducers to the human system when distant communications are involved. The major inputs are the eyes and the ears. The major outputs are the voice and mechanical motion of the limbs. All other sensory organs provide for the acquisition of information in an area closely surrounding the individual.

The ability to speak and the mechanical movement of the limbs enabled man to transmit information over long distances and for the development of a system whereby man himself would be transported. To transmit a voice by wire or wireless, only two output transducers are required—the voice and the motion of limbs (to construct the system). To receive the information, only one input is required—the ear for sound. Like the human, all industries are interrelated when one considers the systems that they form. An automobile system has wheels as its output transducer; but the wheels must match the roads which are part of another system, highways. A complete family of systems exists, therefore, in which lie all of the trades developed by man.

An understanding of systems enables the learner to develop a concept of the interrelationship of careers.

CAREER PREPARATION (Vocational)

Career preparation programs usually start in the 10th or 11th grades. Their structure, usually single track in design, contains the how. It is the grammar course which goes from simple terms to complex operations (inductive). In such programs, provision must be made for those learners who choose to change their career direction. One suggestion is that of using a turnpike plan. With this arrangement, students can get off at various terminals—work—and then re-enter. Courses are first arranged to lead to one terminal. After certain basic courses, a junction is reached where another series of courses lead to another terminal (requiring a higher degree of skills). A second junction, taking off from the second track, leads to a third track. The process can be continued, depending on the terminals (careers) to be reached.

This process can be used to establish a cluster of careers involved in a specific industry. For example, the hospital could be considered as a system containing a cluster of careers. Refrigeration, elevator mechanics, heating and air conditioning, laboratory equipment maintenance, communications systems, medical electronic systems, and food/laundry equipment service are a few of the occupations in the cluster. While the hospital was used as an example of a system, it is obvious that many of the occupations have application in other major systems.

The metal cutting industry, with its wide range of complex machines and occupations, could be structured into a curriculum plan having many terminals with varying degrees of required skill development.

In planning such programs, consideration should also be given to the cluster of jobs that may be available at various levels of skill development. An assumption must be made that not all students will complete the program they start. As in industry, some material will enter the economy as semifinished, subassemblies, and scrap. The structure of courses can be arranged so that intermediate terminals can be established. Each of these terminals should indicate the cluster of typical occupations available.

The United States Department of Labor's Dictionary of Occupational Titles (42,000 occupations) can be used as a reference to establish clusters. Clusters can be arranged in terms of levels. Level I will require occupational training, coordinated with the related academic requirements. This information is available from the DOT. When the total curriculum plan is prepared in flow chart form, with job levels indicated, it should be displayed in the laboratory for student use. It is the road map to careers. As a further incentive, each cluster level might be assigned a dollar and cents value. Usually, the degree of training required to reach higher levels of jobs pay more; hence, regardless of course content, the payoff is seen in potential dollar income. Education pays. The now generation requires this type of positive direction.

PROGRAMS DESIGNED FOR TOTAL PERFORMANCE

Prior to World War II, vocational programs were arranged in two major parts, namely, theory and shop practices. The student usually built from components each test circuit to be studied. The work was very time-consuming, but since the number of students and subjects were limited, the program worked quite well. During the war, laboratory activities changed from heavy use of individual components to breadboards and prewired subassemblies. The subassemblies enabled a speed-up in training to take place. Great emphasis was placed on measurement and analysis. While the breadboards with clip leads enabled one to construct circuits faster than with loose components, they had and still have several drawbacks:

1. Time is taken for wiring which could be more wisely spent on measurement and circuitry analysis.
2. Work is very repetitive. Once a student can read circuits, little is gained by the repetitive wiring.
3. Loosely wired circuits are limited to frequencies below 5 MHz. Hence, most work is in the audio range.
4. Circuits, not systems, are studied. A student can learn all about components and circuits and yet not analyze or build a system.

The subsystem or modular design provides several advantages:

1. Systems or individual circuits could be studied in shorter periods of time.
2. There is almost no limitation on frequency.
3. Circuit parameters can be easily changed.
4. Maximum emphasis can be placed on measurement and the use of test instruments.
5. Circuits can be more easily traced and studied.

A disadvantage is that this type of equipment is slightly more costly to prepare, but this is offset by the greater depth of learning.

The technology, as it now exists, makes great use of integrated circuit modules. Systems, not circuits, is the emphasis in electronics today.

Since the technician still needs experience in working with discrete components, the assembling of circuits cannot be eliminated. This practical work however, must be integrated into the theory and laboratory measurements study. The practical work should include the basic use of tools, working with metal, fiber boards, and printed circuits. Circuit design, system analysis, and troubleshooting are advanced levels of practical skills. The activities should cover all areas of work to be encountered in industry.

Regardless of whether information is to be offered on a conceptual or comprehensive level, a learner, like a worker in industry, requires a balanced diet of activities. A classroom situation in which the student is continuously exposed to abstract topics is no more exciting than a shop worker performing repetitive operations without any understanding. A well-balanced program contains three major areas of activity; these are theory (abstract information), student self-evaluation (validation), skill development and application of information. During each week of study, if a student is exposed to all three phases of the program, he will not only find the activity challenging and motivating, but will show a greater willingness to participate.

The first phase, abstract information, is usually presented to the student by means of a teacher, book, film, slides, or other media. Self-evaluation, phase two, is a laboratory experience wherein the student evaluates by testing the principles provided in the abstract information. The laboratory experience permits the student to personally verify that the information does truly work and is functional. In other words, in this phase, the student is checking the teacher and media material presented.

The skills development and application of information, phase three, enables the instructor to observe whether the learner can apply the abstract and measurement techniques to problem solving. Learning, to be effective, must be applied so that the student can see its real value.

During each week of study, all three phases of the program are in operation. The student devotes a certain number of hours weekly to theory; he then proceeds to the laboratory to perform directly related measurement exercises. When these two phases are complete, he then starts with practical shop practices. In some areas, phase three may start before phase one or two. The time allocation varies with courses. The student is evaluated in all three areas.

The three-part, balanced program can be utilized on both the conceptual and comprehensive levels. Depending on the specific needs of an individual or a group, more time can be allotted to one area of study than another. For example, the program can be adjusted so that a slower trainee receives less practical problems while a faster student receives additional enrichment work in either laboratory measurement or practical problems. The program is extremely flexible, and easy to adjust to individual needs.

The three-part balanced plan can be applied to other areas of vocational training. In the metal cutting area, the student can study machine component design in theory. In the laboratory, an existing assembly can be measured and evaluated. The practical work could relate to the student design and the making of the metal part or parts.

CAREER TECHNICAL EDUCATION

Career technical education is semiprofessional. The total program includes college-level academic courses correlated with technical subjects. It is the final phase on the continuum of formal education, prior to the world of work.

The technical program should articulate with the secondary level pretechnical curriculum. Courses in basic electricity and electronics or similar courses in other course areas should be offered as remedial courses for students coming from general education (having had no similar courses). Technical and advanced technical courses should be offered. All too often, programs at this level appear to be the same as courses offered at the secondary level. Redundancy of subject matter usually results where complete articulation has not been planned.

Courses offered at this level (especially the second year) should be designed to meet industrial requirements. Courses in computers, advanced communications, numerical control, and process control are typical of those to be offered.

Some students may take only one semester or one year and then transfer to a four-year engineering school. Here again, it is important to develop a concepts course for engineering orientation.

SPECIAL PROGRAMS

The Area Vocational Centers, better titled Career Centers, usually operate on the secondary level. Because of the additional training hours, these schools can provide in-depth training. Except for the level of the academic related studies, the technical material may cover subjects similar to those offered by a combined secondary/technical program. Unlike the technical level, greater emphasis is placed on the maintenance of systems and specific machine tool skills.

Adult education and/or in-plant training is a continuation of either the career center or community college (technical). This training is specific since the types of work and machines are known. This is in contrast to formal education where the specific job requirements are not known.

In-plant training is similar in design to military training. Courses are usually short, and nice to know subjects are often omitted.

SUMMARY

The planning of an educational system in a community or on a state level requires that the entire system be considered. Heretofore, programs planned piecemeal (junior, area vocational, community college) did not articulate. The result has been redundancy resulting in many wasted hours and the absence of academic dignity.

A completely articulated plan provides for an awareness level (grades 1-6), a conceptual level (grades 7-10), a career preparation level (grades 11-12), and a technical level (grades 13-14). At the awareness level, broad concepts are formulated. These concepts are narrowed at the middle school (or junior high) to major career opportunities. Preliminary preparation for advanced study takes place at grades 11 and 12 (sometimes starting at grade 10). The subject matter is detailed (comprehensive rather than conceptual) and provides the how rather than what.

In developing the concept courses, subject matter taught at the career level (even the technical level) is streamlined (many details removed) and offered at the middle school level. The course provides insight for decision making, high motivation, and an established frame of reference for future study.

Courses offered at all levels must be a balance of abstract, student evaluation, and practical application of information.

SUGGESTED ADDITIONAL READING

(1) Systems Approach to Industrial Training, M. Tischler, Electronic Aids, Inc., 2175 Greenspring Drive, Timonium, Maryland 21093.
(2) Learning Concepts, M. Tischler, Electronic Aids, Inc., Volumes I, II, and III.
(3) The Process of Education, Jerome S. Brunner, Vintage Books.
(4) On Knowing, Essays for the Left Hand, Jerome S. Brunner, Atheneum.
(5) Education and Ecstasy, George B. Leonard, Delacorte Press.
(6) New Look at Education, John Pfeiffer, Odyssey Press.
(7) Instructional Systems, Bela H. Banathy, Fearon Publishers.
(8) Teaching as a Subversive Activity, Neil Postman, Delacorte Press.
(9) The Cognitive Processes, Harper, Anderson, Christensen, Hunkam, Prentice-Hall.

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Performance-Based Instruction

Thomas E. Lawson

Currently, within all educational realms, there is significant progress in the precise specification of instructional objectives. Many individual instructors, schools, universities, and training centers have recently instituted, and in some instances completed, the task of specifying student performance objectives for their instructional programs. Important issues regarding the instructional feasibility and desirability of objectives have been raised as a consequence of this interest. These explicit goal declarations ostensibly imply an operational base on which to make systematic decisions regarding instructional design. Popham (Ref. 6), for example, has enumerated the specific advantages associated with the existence of precise objectives for instructional decision-making.

Instruction directed toward behavioral attainment generally follows an intuitive, unanalytic method. This paper is a first approximation to a more systematic approach to objective achievement. However, it represents a rather limited approach to curriculum realization and, therefore, does not constitute a major rationale for such an activity. Subsequently, primary emphasis will be directed to the content and processes of learning associated with instructional design. Many additional interacting and interdependent factors affect the attainment of desirable achievement behaviors, as has been schematized by Banathy (Ref. 2) and is shown in Figure 1. The peripheral segments represent information source variables as they affect terminal student achievement. Essentially, the "analysis and formulation of instructional procedures" factor implicates the heuristics for facilitative instructional development.

The primary purpose of any instructional exercise is to change human behavior, developing a performance competency of which the student was formerly incapable. Students

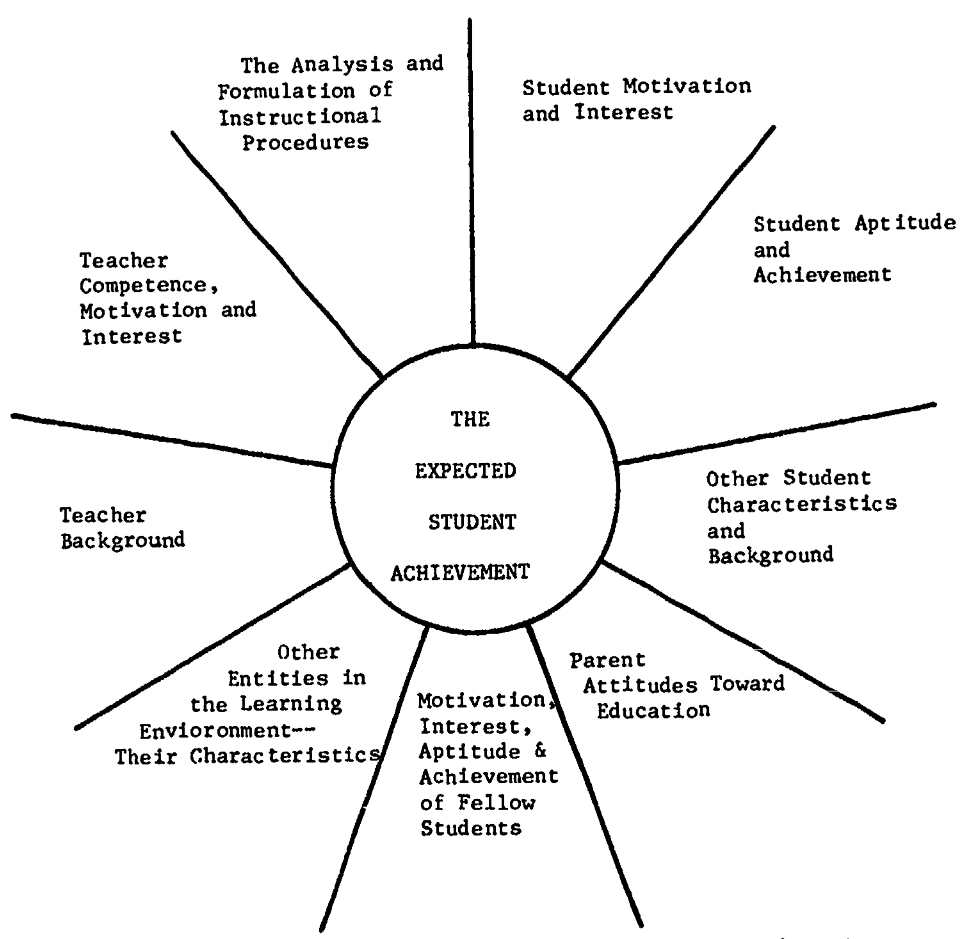

Figure 1. A schema illustrating the sources of achievement information (Banathy, 1970, p. 26).

should, as a result of instruction, be able to exhibit identified skills and knowledge in a specific school, work, or life situation. In most educational settings, pre-defined objectives represent these desired performance outcomes. Appropriate learning activities are to be structured only after the terminal achievement expectancies have been specified. Precise statements of performance outcomes place no undue restrictions on instructional design. A general misconception is that once an instructional objective is stated in performance terms, it is easy to develop the necessary learning activities. Terminal performance outcomes certainly place limits on teaching methods, but they do not directly prescribe the selection of specific learning activities. Statements of student performance do not tell exactly how to attain each objective, though they will often contain suggestions for appropriate learning experiences.

LEARNING AND SKILL TASK ANALYSIS

As a requisite for any performance-based instructional planning, each behavioral objective needs to have a "learning and skill task analysis" performed to determine the sequence and appropriate inclusion of enabling behaviors. (Enabling objectives are not instructional goals in and of themselves. They are dependent upon terminal objectives for their realization and are the necessary student learning tasks that bridge the gap between existing student ability and each derived terminal objective (Ref. 1)). Structurally, enabling objectives compose a learning and skill task analysis which can be accomplished by asking: "What pre-requisite capabilities must the learner possess in order to master the terminal objective?" or "What would the student have to know to do in order to perform this task?" A successive approximation is made reflecting these subordinated capabilities by beginning with the terminal objective and working backward. Each separate task description should be translated into behavioral terminology including explicit specifications of the task behavior, task conditions, and success criteria. An analysis is operationally terminated when the most basic sub-task element (enabling objective) approximates the entering behavioral requirements. Ultimately, this behavioral hierarchy of sub-task elements should indicate, in sequence, all of the enabling behaviors which a learner must exercise before successful achievement of the terminal behavior.

The sequencing of instructional activities in accord with the order in which knowledge and skill competencies should be learned is difficult but important. The various tasks a learner must acquire during instruction are dependent one upon the other; i.e., mastery of one task transfers to another. Via learning and skill task analysis, irrelevant tasks would be quickly tested against the terminal objective and discarded. Figure 2 depicts the relationship of analysis to entry and terminal capabilities.

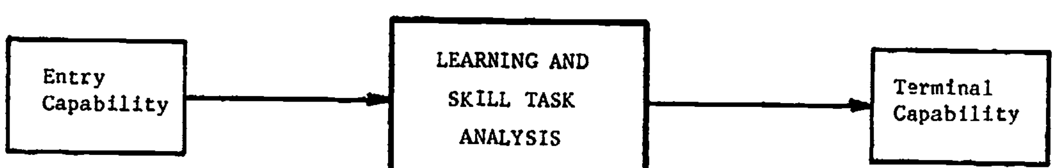

Figure 2. Serial relationship of learning and skill task analysis in reference to entry and terminal capability.

A method of learning and skill task analysis is applied to conic sections involving graphic solutions in Figure 3.

After each sub-task has been identified and stated in behavioral terms, it must be analyzed in order to determine all of the things the student must do to complete the task. The tools, job aids, materials, equipment, directions, demonstrations, and significant objects necessary to facilitate the accomplishment of each sub-task competency must be identified. The types of behavior required and the statements of performance must be included.

These analytical efforts will indicate the necessary activities leading to performance specifications. Learning and skill task analysis for any given terminal performance objective must be established according to the following criteria:

1. Complete (all components included)
2. Detailed
3. Substantive relationship must exist
4. Consistent with terminal performance outcome
5. Classroom tryout imperative

TERMINAL BEHAVIOR	1.0 Given the necessary information, graphically construct, with the use of instruments and drafting media, any two (2) of the three (3) listed conic sections: a. parabola (intersection method) b. ellipse (four-center method) c. hyperbola (intersections method)
ENABLING OBJECTIVES	1.1 Demonstrate graphic solutions for each conic section (a, b, and c)
	1.2 Identify graphic solutions for given conic sections (intersection and four-center)
	1.3 Identify and explain types of conic sections
	1.4 Define "conic sections"
ENTERING BEHAVIOR	1.5 Essantial drafting instrument skills; understanding of "geometric plane" construct

Figure 3. Learning and Skill Task Analysis for Conic Sections Involving a Graphic Solution

DIAGNOSING PRE-INSTRUCTIONAL BEHAVIOR

The effects of education tend to focus on the individual student. However, in the majority of instructional situations, both classroom and laboratory, very little attention is given to the skills and knowledge already possessed by the individual student. A criterion pre-assessment test should be given before instruction begins. Travers (Ref. 9) indicates at least four classes of pre-instructional variables which should influence the instructional design—excluding personality-type variables: (a) the extent to which the student has already learned the behavior to be acquired in instruction; (b) the extent to which the student has acquired the entering behavior requisites for learning the knowledge or skill to be acquired; (c) learning sets which consist of antecedent learnings that facilitate or interfere with new learnings; and (d) aptitude-like variables which consist of the ability to make discriminations necessary to profit from instruction.

A criterion pre-assessment test must be contingent on both the representative enabling and terminal objectives. Each assessment measure must be in performance agreement with the type of objective, reflecting either learner behavior or a behavioral product. It requires that a change be made in context and/or stimulus from the proposed activities afforded to the learner during the instructional sequence. The three structural components of the task, per se, are important.

Consider the following task: Given the necessary information, identify, in writing, the three (3) major activities criterial to the technique of microfilm reproduction.

The performance to be exhibited by the learner is that of identification; this performance should be initiated on the basis of given information and requires that three major activities common to microfilm reproduction be identified in writing. Thus, a criterion suitable for assessment of the above task could possibly be a written description of a microfilm reproduction process stating that the learner, after reading the passage, identify in writing the three major activities of the described system.

INSTRUCTIONAL CONCOMITANTS

Once the enabling tasks involved in terminal behaviors and the pre-instructional conditions of the learner are described, the instructional sequence can be undertaken. The following three instructional concomitants represent treatment variables (intervening) consistent with performance-based instruction.

Practice of Performance

One of the best methods is practice of performance. This principle implies that the learner be given opportunities within the instructional process to engage in the skill called for by the performance objective (Ref. 7). Moreover, the learner should practice only those skill components of the tasks contingent on the behavior for which he is being instructed. Popham and Baker contend that practice of performance situations, based on the learning and skill task description, can be of two major types: equivalent and analogous.

Equivalent practice refers to the practice of equivalent skills implied by the action term of the objective. The student, in a practice exercise, is given an opportunity to physically assimilate the behavioral element called for in the terminal outcome. This principle seems obvious, but many instructors fail to realize its potency and to employ it. Research clearly indicates that an individual can only incorporate into his response repertoire those responses he has been allowed to make.

The other type of performance practice, analogous practice, arises when the learner is presented a practice situation wherein he is required to behave in a manner which is analogous but not identical to the terminal behavior. In these activities, the learner's response is similar to the terminal response called for in the objective but the overt behaviors in the two situations differ. The essential intellectual operations required by the objective and the learning experience are the same, but the physical manifestations are different.

Smith (Ref. 8) lists six factors which contribute to the effectiveness with which performance is practiced:

1. Distribution of practice and rest
2. Verbalization during practice
3. Pacing
4. Overlearning
5. Mental practice
6. Preparation for practice

In conclusion, practice of performance activities represent psychomotor experiences critical to the manifestation of the performance objective. Any instructional configuration formulated on skill behavioral repertoires must proffer practice of performance.

Practice of Knowledge

Practice of knowledge, as an instructional treatment variable, differes from practice of performance in that the learner has an opportunity to practice the knowledge (cognitive) components of the task rather than the skill elements. Typically, the knowledge components would refer to such mental constructs as machine nomenclature, descriptions of step-by-step procedures, safety rules for the laboratory, schematic diagrams, and principles that apply to many tasks (Ref. 8). Whereas the practice of performance requires equipment, tools, and materials, practice of knowledge requires paper and pencil.

Before knowledge can be practiced, it must be presented to the student. Naturally, presentation modes may differ considerably. Smith writes that:

> ...presentation and practice of knowledge are differentiated on the basis of one-way vs. two-way relationships between the student and the media used in presenting and practicing knowledge. In presentation, there is a one-way flow from media to student. In practice, a knowledge cue is presented; the student responds and then is provided knowledge of results (Ref. 7, p. 22).

Subsequently, in the practice of knowledge, small amounts of content will be presented during the practice exercise. The purpose of presentation, as described in the next section, includes only the uni-directional flow of knowledge from the media source to the learner.

The knowledge component of the representative task should be analyzed to determine the behavioral stimuli and responses so that the learner may learn efficiently (Ref. 4). This activity should precede the design of materials and techniques for the practice of knowledge. Moreover, the type of analysis is dependent on whether the knowledge component falls into one of several behavioral classes. For each kind of cognitive behavior required as a basis of a task or terminal commitment, various learning strategies are offered (Ref. 4). These conditions for learning serve as a basis for structuring practice of knowledge materials.

An example might help clarify practice of knowledge. Consider the following objective: When presented a picture of the Multilith 1250 offset press, the student will differentiate between the controls indicated by verbally stating their name.

In the above task, the knowledge component is differentiate. More specifically, differentiation is a form of discrimination learning wherein the learner is presented a series of cues, each requiring a different response. The picture of the press with the controls indicated would be the cues, and the names of the controls, the responses.

Presentation of Knowledge

In the practice of performance and knowledge, the learner makes responses that can be corrected if they are wrong through knowledge of results. However, in the presentation of knowledge, the learner is simply receiving the information, not overtly responding nor receiving any form of feedback. The effectiveness of the presentation is somewhat limited as a means of teaching because of the passivity of the student. Ultimately, the most critical basis for selecting a presentation mode is the relationship of the specific knowledge offered by the proposed medium to the performance outcome (Ref. 3). Smith (Ref. 7) cites six major modes for the presentation of knowledge. Singly or in combination, the choices include:

1. Lectures or demonstrations by the instructor
2. Film
3. Television
4. Tape recordings
5. Books and other written material
6. Training aids

Unequivocally, it is easier to design learning experiences for presentation than for practice, and Smith (Ref. 7) has pointed out that presentation serves four purposes: providing orientation to the student, providing organization and meaning to knowledge items, guiding practice, and presenting knowledge to be learned.

The instructional concomitants briefly discussed in this paper are depicted in Figure 4 to illustrate their relationship to the over-all specifications for performance-based instructional design.

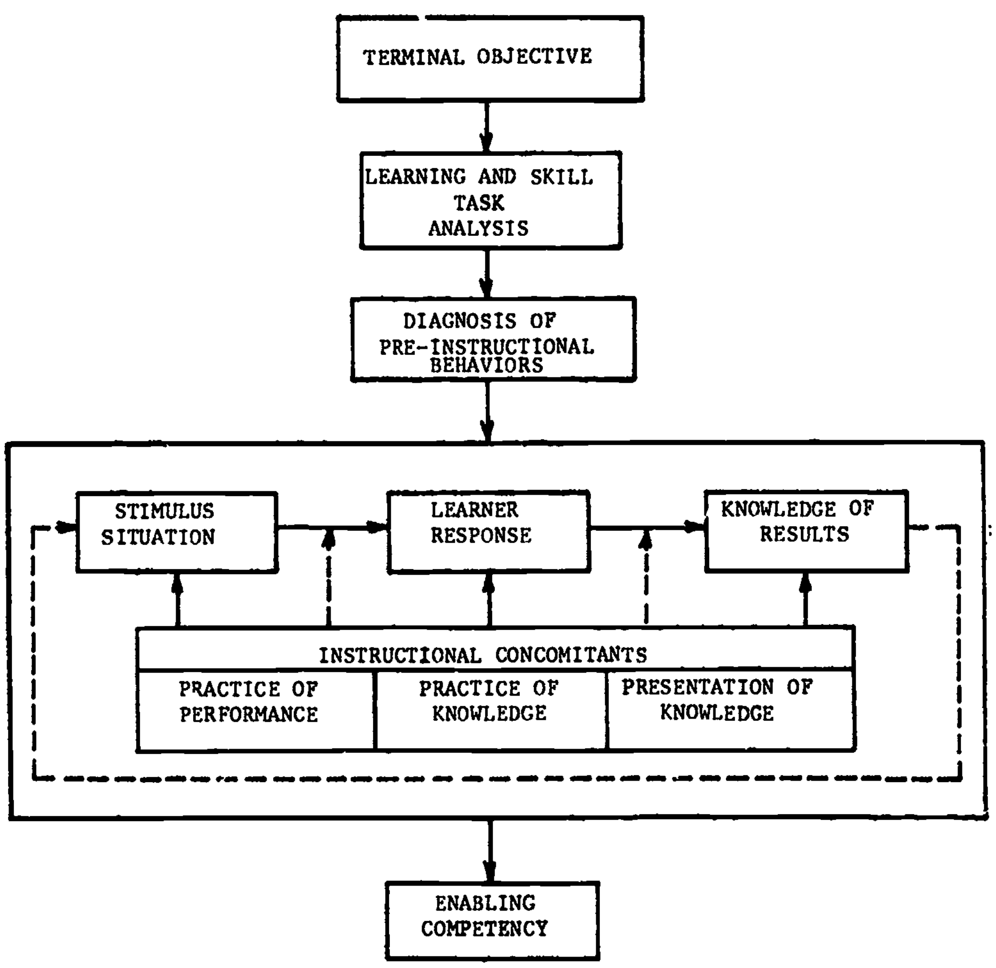

Figure 4. Procedures for determining critical treatment variables for instructional design.

CONCLUDING STATEMENT

Traditional curricular design, as a growing number of instructional psychologists have recognized, has to a considerable extent lost its legitimacy as a result of the steadily increasing emphasis on utilizing behavioral objectives. A quiet but intensive search for a new construct of legitimacy is underway at the present time.

This does not, of course, prove conventional curriculum undertakings to be empirically invalid. But it does imply that educators from all disciplines are presently experiencing a significant reversal in ends/means instructional solutions. In the final analysis, the measure of value an instructor places on any instructional objective is to be sought not in what is said about it, but in the care devoted to obtaining and using a means without which it cannot be realized.

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Individualizing Instruction: A Challenge for Teacher Education

Kenneth L. Schank

Educators have long recognized the need to adjust the teaching-learning situation to fit the student. While many teachers give lip-service to this concept, there is limited evidence that individualized instruction is an on-going methodology. Many of the secondary industrial arts programs using the most widely publicized newer approaches provide little consideration for the individual needs of students; however, the colleges and universities should take a second look before pointing an accusing finger at the secondary programs. McGeorge Bundy, President of the Ford Foundation, recently said, "The colleges themselves could move away from this extraordinarily rigid insistence on 120 credit hours and measuring their bachelors' degrees by credit hours." The general public is aware of the lock-step system of education wherein chronological age, even adjusted by the day on which a child is born, controls his entering school and for the next 12 years governs his education. Educators have talked of educational readiness, and yet few are ready to grant a variance in the speed in which a student may progress through an educational program.

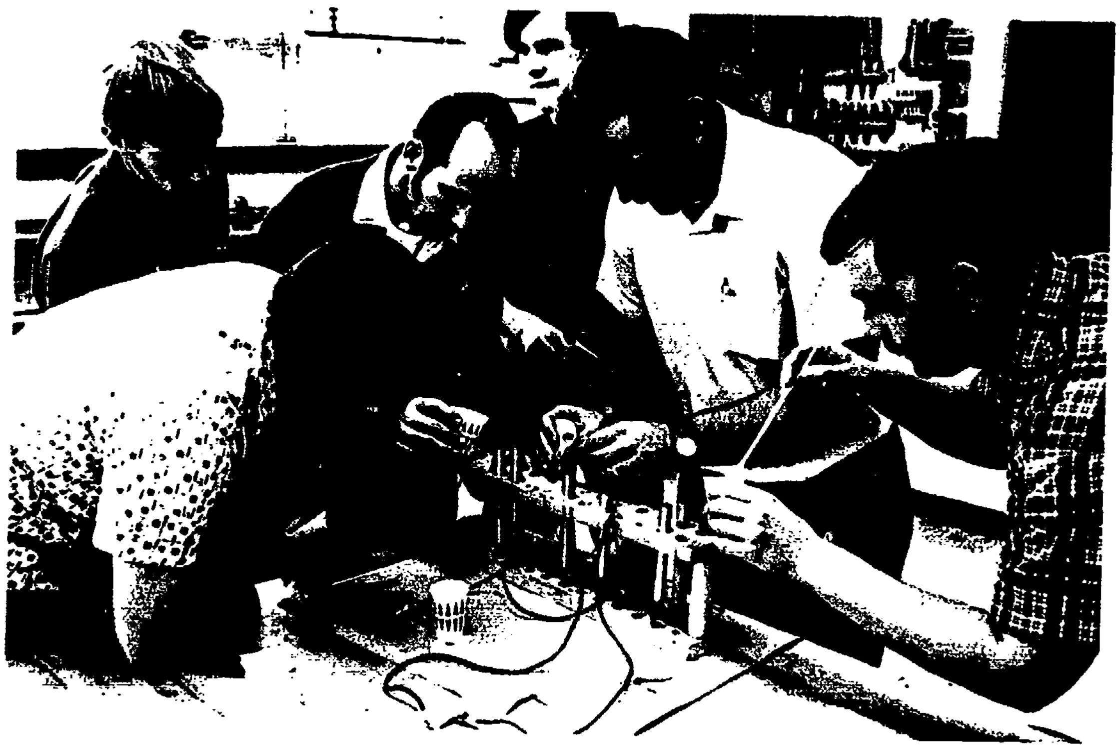
What can, and should, the colleges and universities do for those who elect to seek a four-year baccalaureate degree? Should the "cookie cutter" system prevail, expecting all to follow the same set pattern of required courses?

Some attempts at answers might be:

1. Establish course challenges in which the brighter student could be rewarded for doing some independent study and then testing out on written/performance examinations.
2. Accept college-level courses taken in high school and thereby reduce the college courses, again using standardized written/performance examinations.
3. Develop mini-courses, getting away from the sanctified semester time elements.
4. Provide selected lecture-lab sections plus supervised open lab times for those students requiring repetition or skill-oriented activities.
5. Develop multi-media resources such as videotapes, closed loop films, audio-tapes, etc., which could be readily available either as "hands-on" or dial access.
6. Provide a course early in the college program on the basic skills of how to learn for those who need that information. Individualize it to the extent that it could be open-ended and available only as long as the student needs the services.
7. Inculcate the philosophy among the faculty that they are resource people and not the fountainhead spouting out the verities in 50-minute four-meetings-per-week monologues.
8. Develop computer storage and retrieval systems (and training for the students in the use of E.D.P.) for industrial arts covering the various bodies of knowledge in breadth and depth.
9. Make decisions on course content which will keep the students up-to-date in this age of exploding knowledge. Evaluate the materials on criteria predicated on constant up-date relating to the changing needs of the field.
10. Produce systems approaches in all subject areas, clearly defining objectives, thereby allowing students to set learning goals for themselves and grades determined on established proficiency levels.
11. Devise instructional packages conceptually based in multiple levels of depth.
12. Provide an internship in student teaching, with the methods and practice being experienced simultaneously.

A very important factor which seems to be overlooked or played down by many educators is goals. Not enough time seems to be spent on letting the student know the foundations and where he ought to be heading. The goals of the faculty member and the student are not necessarily the same, and because the professor has accepted certain precepts and lived them for several years, he might not stress the point with every class. With a thorough understanding of direction, the student can plan his course of action, capitalizing on his strengths and shoring up his weaknesses.

One might ask what brought about current consideration of the individualization of instruction. Sidney P. Marland, Jr., U.S. Commissioner of Education, stated in the November 1970 Phi Delta Kappan: "The teacher, now committed to a bargained arrangement with management, must accept the economic consequences calling for productivity and accountability." The key words are productivity and accountability, and so it behooves the teacher-preparing institutions to provide the best possible program for each student. The answer to the challenges of productivity and accountability lies in the individualization of instruction, not only for the college student, but to inculcate the concept so that he will go forth and do likewise.



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Individualized Learning Packages

Lee H. Smalley

The indivualization of instruction has been a much-discussed goal of educators for years, but the enormity of the task prevented most teachers from doing anything about it. Now there is a plan, a strategy, a technique which "packages" a number of principles, concepts, and ideas that many people feel have the potential of improving education. It is not "the" answer, as nothing else is either, but it is one small improvement in the educational process.

Let us go through a number of these ideas to see the implications of some of the changes that would be necessary in packaging instruction.

1. The goal of education is to teach 90% of the selected content to 90% of your students. The acceptance of this concept will probably require the most reorientation by the average teacher. We have been used to throwing out all kinds of content in the hope that some of the students will learn some of it. This will require a more rigorous selection of content, as well as more perseverance to see that it is learned.

2. The teacher must be a director of learning, not just a dispenser of knowledge. Knowledge can be gained in many ways, and the responsibility for learning must be the learners'. Teachers are getting paid too much to just act as a walking textbook

or video tape. The teacher must spend more time in organization, evaluation, and motivation and less time in lectures and demonstrations.

3. Teachers must improve their diagnostic skills.
We must realize that student errors are opportunities to teach. As we compare student behavior with a model, learning difficulties will appear. We then need to do as the medical doctor does, diagnose the difficulty and prescribe appropriate treatment to move the student closer to the proposed model.

4. Performance must be held constant with the time variable.
This is another area where a change in thinking will have to take place. We are used to devoting a constant amount of time to a topic, then allowing, even expecting, that the level of performance will be varied. We then go on to another topic, rather than continuing to work with those people who have not achieved satisfactory results.

5. Objectives must be operational.
They must be written in terms of observable student behavior. There has been a lot of material written on this topic, and it takes practice to write them in this way; but once written, it can be of real use in selecting content and for evaluation. They should include the intent, the conditions under which the student will exhibit this behavior, and the criteria upon which they will be evaluated.

6. Students must have access to the objectives.
Why would you want to keep them a secret? If you want the student to be able to trace the air and fuel flow in the carburetor, then let him know about it so that he can help to achieve this. These also will provide him with the final test.

7. The level of each objective should be classified.
As we become more specific with our objectives, it becomes more important than ever that the level of learning be considered. Bloom's taxonomy of educational objectives in the cognitive domain provide one format for doing this. The six levels proposed are knowledge, interpretation, application, analysis, synthesis, and evaluation.

8. Students should know, before the teacher, if they can achieve the objective.
If students have access to the objective and a self-test to see if they can achieve it, then the teacher merely verifies what the students already know—that they can perform to the level specified in the objective.

9. Multi-media activities should be suggested.
If the student cannot achieve the behavioral objectives, then there should be a variety of activities available for him to choose any or all of them until he is able to achieve the objective. Individualization comes in the activities and time, not in the level of performance or the content.

10. Discard the curve of normal distribution.
Nothing will impede progress in education more than reliance upon the theoretical curve of normal distribution to award grades. The normal curve is based upon chance and sample. Good teaching should be by design, not chance, and the results should not approximate a normal curve. If your data approximates a normal curve, then you have not applied any treatment (teaching), for the treating of the sample will skew the curve.

11. Grades should reflect mastery of the objectives.
Grades should be recorded as A, B, or incomplete. A "B" is when a student has successfully completed the objectives. An "A" is when the student, in addition to the objectives, helps someone else achieve them (who ordinarily wouldn't have) or else completes additional work. An incomplete is given when the student has not achieved the objectives.

12. Questing activities should be encouraged.
Numerous questing activities should be available for students after they have achieved the objectives. These can be either broader or more specialized. Students who have completed their work "early" may elect to do some questing while others complete the objectives.

Packages rely on multi-media for individualizing instruction.

All of these concepts can be included in a package of instruction. You will need to see some samples and write some yourself before you really understand all of their implications. If you do decide to package some of your instruction, I think you will find that this technique will provide the greatest in-service experience that you have had. As fast as changes need to be made in education, we cannot rely upon only the new teachers to be competent in handling these concepts. We will have to mount a widespread in-service program so that teachers now teaching may learn of new techniques. If you are terribly pleased with the way you are teaching now and the results you are achieving, then individualized packaged instruction will probably not interest you a great deal; but if you feel that you can and should become more effective as a teacher, then the application of the ideas I have suggested here will be a good place to start that improvement.

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Using Learning Packages

Dennis M. Benson

The Model School Project of the East Allen County, Indiana, school system designs educational approaches by using large group presentations, small group discussions, and independent study as methods of learning. Independent study has two dimensions, the minimum essential knowledge and skills required for a subject and the enriching knowledge and skills known as depth in education. Independent study offers different forms of learning for students, since student learn differently. A variety of learning methods should be provided for within the subjects offered. It is through this concept that the learning package evolves.

What is a learning package? Dr. Gardner Swenson, Past Director of the Unipac Bank, says, "A learning package is a self-contained set of teaching-learning materials designed to teach a single idea, skill, or attitude and structured for individual and independent use." The Directors of Nova School in Ft. Lauderdale, Florida, Dr. Arthur Wolfe and Dr. James Smith, refer to learning packages used in their school as "providing each student with a plan for learning."

This includes a careful programming of a series of learning activities which seem most relevant to the student's interests and goals at any given time. The package includes a clearly defined rationale for the selection of the particular concept or major theme, a carefully selected range of behavioral goals, opportunities for student self-assessment, and teacher evaluation inventories.

The learning packages used in my programs are based on a single component of an idea, skill, or attitude to be learned. The remainder of the package is composed of a pre-test, the behavioral objectives, a series of lessons with learning activities, self-tests, the post-tests, and the opportunity to delve deeper into the concept by quest. I offer two courses in Architecture Drafting, programmed with learning packages at the present time. Home Design, a beginning course for house planning, has nine required learning packages within a learning sequence. Architectural Design, an advanced learning sequence, is composed of ten learning packages.

The learning package is a teacher-made set of materials designed to be used independently by individual students for self-paced learning. It is written for students with similar needs and focuses on one major idea and its component parts.

Students select the learning packages according to their progress on the learning sequence program from a file cabinet. The concept of a package is based on a skill, an attitude, or an idea to be learned by completing the learning package. It is the first component of the package and indicates to the student the purpose of the package.

The student's next step is to take the teacher-made pre-test for the learning package. The level of success on the pre-test dictates the direction and extent of independent study for a learning package. When the student has completed the pre-test, he presents it to a student secretary for scoring.

A conference between the student and teacher will follow the scoring of the pre-test. During this conference, areas satisfactorily achieved are determined, and those areas the student did not score as well in are discussed. The areas of the pre-test where the student scored poorly indicate his lack of ability to perform or lack of knowledge of the concept for the learning package. The teacher then determines the specific lessons that should be studied by the student within the package. Some lessons may be omitted where the student displayed a strong knowledge of the material.

The behavioral objectives are desirable and measurable behaviors which the student is able to demonstrate upon completion of a set of educational experiences. These should be stated so the student knows exactly what is expected of him after he has completed the lesson. A well-written behavioral objective will say three things: what a student will be able to do, under what conditions, and to what extent.

The next component of the package is a series of lessons developed around the major concept of sub-concepts of the learning package. Each lesson has at least one behavioral objective as the main theme throughout the learning activities within the lesson. The learning activities offer a variety of approaches to mode, media, activities, and contents to the lesson. This allows a student to choose those activities from which he learns best and gains a better understanding, knowledge, or skill in order to meet the objectives.

The learning activities used in my packages vary from reading materials, listening to taped lectures, making drawings, viewing overlays and slides, discussing architectural topics in groups, reporting to groups, and sometimes visiting commercial establishments relating to the concept to be learned.

At the conclusion of each lesson, the student may test his development of the knowledge, skill, or understanding by means of a self-test. The self-test is a teacher-made instrument which the student informally takes to assist him in determining his success in achieving the stated behavioral objectives. If the student feels confident about his achievements, he may continue on to the next lesson or test. Should the student not feel confident about his learnings or unsure of the learning activities, he should then continue to study the concept by other activities before a grade is rendered on his efforts. This allows the student to salvage any failures and achieve the highest possible scores.

The last part of the learning package is the post-test. This is a teacher-made instrument designed to formally evaluate student achievement of the behavioral objectives of a learning package. The post-test is not physically a part of the learning package used by my class. It is checked out to the testing center by the student taking the test. Upon completion of the test, the student takes it to the student secretary, who grades it. She then forwards the score to me for recording the achievement of the student on that particular learning package. If the score for the post-test was below 70, a failing grade, the student would not continue on to the next lesson, but would recycle the lesson just completed and repeat those parts that caused him trouble. This recycling prevents students from failing and lets each one progress at his own learning rate.

Some students find that the material in the learning packages is motivating and desire a deeper study of the subjects. This is permitted and allows enrichment in the area of study. This section of the learning package provides the student with suggestions for in-depth learning in the area related to the main idea of the package. Most of my students complete the entire learning sequence and then return to do quest activities in subjects they desire to study more about.

The basic concept beneath the use of these learning packages is that students will learn better if they are told what they will be able to do as a result of the learning experience, given a set of learning experiences helping them to learn what is expected of them, and then asked to demonstrate their newly acquired skill, knowledge, or understanding.

The physical facilities of the room used for these courses is basically a traditional rectangular room that has housed 35 students for many years in the traditional approach to teaching drafting. Two years ago the room was rearranged to create different areas of activities for the functions to take place in the room. Since individualized instruction was the key behind the change, independent study areas for studying and drawing were created. This was accomplished by placing 4 ft. x 8 ft. sheets of paneling between the desks used for drawing and arranging study tables in the center of the room for reading and studying. Two testing stations used for pre- and post-tests were also included in this part of the arrangement.

In a small room located at the rear of the main room, a small group discussion and listening area has been created. In this area, students listen to pre-recorded lectures and discuss various aspects of architecture. This room has storage cabinets for equipment and papers, and a sink for cleaning drawing equipment.

An area for display and construction work is located in a corner near the front part of the room. Here students construct models of their architectural drawings and display both the models and drawings in this area. A group activity of a community project is currently being set up for the model area, and some residential drawings are shown on the portable display board.

The key to the program is the resource center, containing many materials for study, reference, and research that are required by the learning packages. A reference table for textbooks, periodicals, and pamphlets is the backbone of the center. A file containing advertisement brochures of over 500 architectural products from suppliers is continually being updated and expanded. A bookcase for specialized resource books is located opposite the file cabinet. The cassette tapes and tape recorder are stored next to the teacher's desk along with overlays, special charts, and architectural plans. The teacher is also a resource person in this method of teaching and is a part of the resource center. The blue printer is located in this area for students desiring copies or drawings that are beneficial to learning on their own. When a large group presentation is being given, students sit around the center study desks. This allows for full visibility to the speaker, demonstration, film, or overhead screen, which is located above the printer table.

Individualized instruction with learning packages can take place in your school as it has in mine if three things occur. <u>You</u> take the initiative as the teacher to write the learning packages. <u>You</u> create the facilities in the room. <u>You</u> sell your program to the administration so they will finance it.

Writing and revising learning packages is a continuous task, since updating and new packages are created for quest opportunities. The creation of the facilities is not a great expense to the school board, and it offers a better system of education for your students. The change from a traditional classroom to this type of program was done for less than $300.00

Since these classes have been classified as experimental in our school system, the following records have been kept for research and evaluation of the program. This is my fifth year teaching drafting in this school. During the first three years, 168 students were confronted by traditional teaching, while only 122 students have been under the individualized instruction and learning package system. There are three significant points of interest in the statistics showing differences in grade averages, number of failures, and number of students doing quest or extra credit work. Under the traditional approach, the grade average was 2.3 compared to a 2.8 achieved on the learning package approach. This is based on a 4.0 system of grading. There have been 14 failures in the traditional approach and 0 failures in the learning package system because when a student fails a learning package, he recycles until he successfully passes it. Seventy-one students have done quest work, while only 43 had done extra credit work during the first three years. The percentages are higher for students of the learning package teaching method for continuing and specializing in drafting as they progress in their educational life.

This new approach to teaching has been very gratifying and exciting, as it has developed a desire to learn and a spirit to create in the students. It has made teaching a rewarding challenge, not just a job.

Mr. Benson is a member of the faculty at New Haven High School at New Haven, Indiana.

Effects of an Individualized Curriculum Systems Design in Graphic Arts

Kenneth T. Smith

Industrial educators throughout the country are becoming concerned with individual differences that exist among students they educate. These concerns revolve around the various entry level skills obtained by students from previous educational experiences, both formal and informal in nature.

In order to meet the needs of students who have a variation of entry level skills, individualized instructional systems have appeared as possible sol. on for educational environments.

According to Nevin Frantz, a need exists "to develop models and strategies for individualized instructional systems that are applicable across the breadth of industrial education at the elementary, secondary, and post-secondary levels" (Ref. 1).

One method of developing a curriculum system employable in an industrial education program would involve the construction of learning activity packages.

A learning activity package is simply a curriculum vehicle predominantly used for individualizing instruction. It does not teach the student but rather guides him in the selection of mediated paths for selected educational objectives.

What does a learning activity package contain?

Variations exist from package to package as individuals constructing the packages differ. Even regenerations of packages take on a unique personality as weaknesses are located during implementation.

Flynn and Chadwick perceived the learning activity package as:

> ...a form of organized instruction ordered in units of effort which can be completed by students in varying lengths of time. The ideal LAP is organized to contain a clear statement of objectives, alternate routings through the presented materials, and opportunities for student self-evaluation and teacher evaluation. While there are several variations in practice, the student in a LAP class can work largely on his own at a pace which is appropriate for him; and when he completes an assigned unit, he can move on to a new one (Ref. 2).

During the 1970-71 academic year at the University of Northern Colorado at Greeley, this writer implemented the curriculum vehicle known as the learning activity package in four course offerings in the industrial arts program. The four courses included IA 41, Graphic Arts Fundamentals; IA 141, Graphic Arts; IA 142, Photography; and IA 243, Theory and Practice of Offset Lithography. Approximately 40 packages were developed covering the major concepts or processing involved in the traditional offerings in the graphic arts program.

Included in each package were the following subsystems:

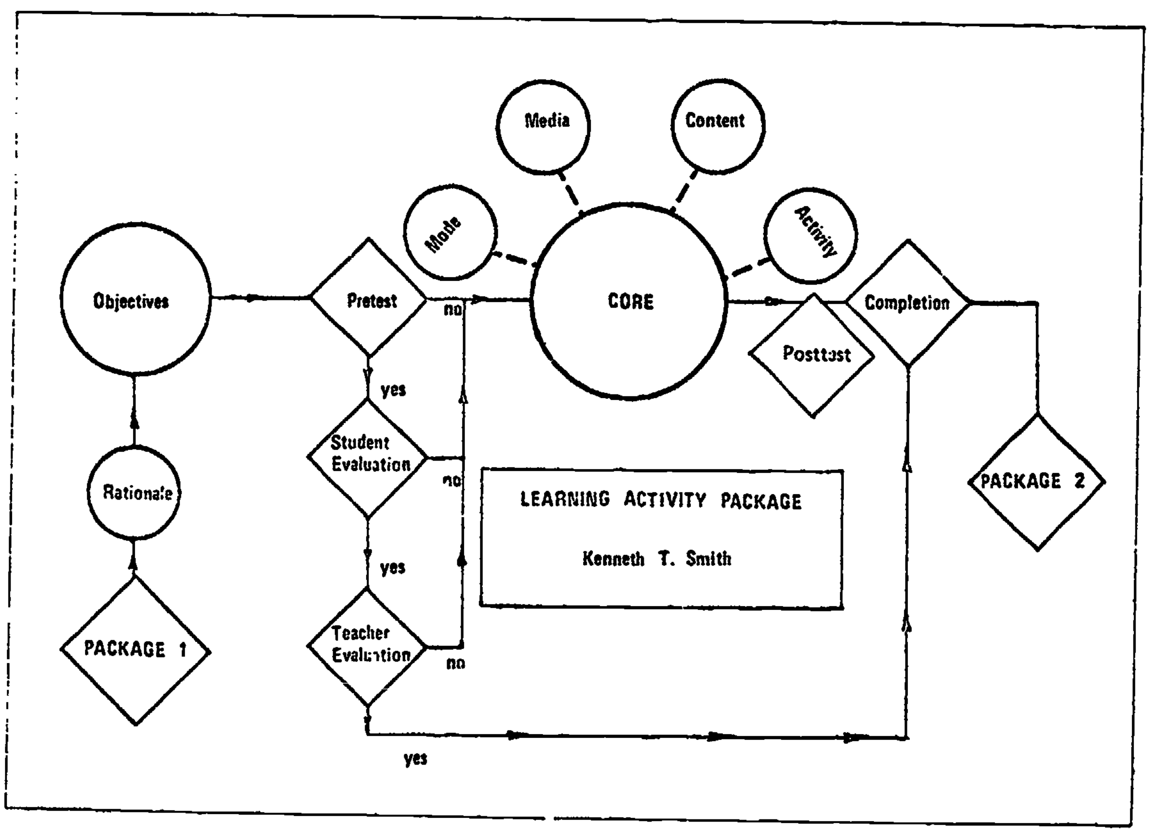
1. Rationale. A justification presented to the student of why a particular concept, process, or primary idea was being studied and where the particular learning activity package fit in the total scheme. It also served as a motivational device for the student.

2. Objectives. The specific educational goals were constructed in behavioral terms (a) defining the overt or covert act the student would perform; (b) describing under what conditions the learner would demonstrate his competence; and (c) stating the criterion references or standards of performance expected of the student.

3. Options. This included the student decision-making subsystems where opportunity was given to make various selections. Included in the options was the ability to pre-test and exempt the package upon successful performance if he had previous skills and knowledge of the objectives. Other options included the means under which he may obtain the necessary information by both print and non-print media.

4. Self-test. A criterion referenced instrument developed for the student's use to see if he has the necessary cognitive skill to ask for the teacher's final evaluation of the package.

5. Pre-test/Post-test. Instruments used to determine the cognitive, affective, and/or psychomotor skills specified for specific behavioral objectives.



Included as an extremely important phase of the curriculum system was the implementation of both print and non-print media. The non-print media employed included slide-audio tape and super 8-mm motion pictures.

All media applications were developed under the assumptions that follow:

1. An educator's primary purpose is to facilitate learning by establishing the appropriate environment that is conducive to learning.
2. A less important purpose of an educator is to present information, since the mere presentation of information does not guarantee learning.

3. If learning does not take place, it is possible to obtain the desired learning through appropriate changes after an examination of the learner, method, media, and environment.
4. It is important in an effective and efficient educational system to find out where the student is on the ladder of learning and proceed from that point without gaps or overlaps.
5. If the learning objectives of a particular course could be definitely stated and if all of the learners achieved these objectives, they would all receive "A" or some equivalent symbol indicating 90% to 100% achievement.
6. Some learning objectives cannot be defined specifically but can be described as a result of other specific observable and measurable behaviors.
7. Undefinable learning objectives which cannot be tested for existence or cannot be described in terms of other observable and measurable behaviors should not be included as a course requirement for grading procedures.
8. Grades based on undefinable objectives and temperament of the grades do not contribute to an effective and efficient educational system (Ref. 3).

Unfortunately, due to the time limitations placed on the writer to develop effective media programs and implement the curriculum systems design, much of the professional quality in the media needed was sacrified. Even though quality was at a low ebb (an intuitive evaluation by the writer), the individual student attitude changed noticeably.

Media carrels were designed and constructed in conjunction with Scott Engineering Sciences in Pompano Beach, Florida, for testing and evaluation for the commercial market. Modifications were suggested to the manufacturer and changes were made.

Kodak slide projectors and Coxco/municators were obtained from the university instructional materials center and employed as the major dissemination devices within the environment. Audio tape decks (reel to reel) were mounted in carrels and used very little by students obtaining information. Additional projection equipment was obtained for silent super 8mm motion pictures and a camera to construct the necessary media programs.

What was the students' reaction to individualized instruction?

To gather data concerning the students' attitudes toward the learning activity package and the effectiveness of the curriculum systems design employed, a questionnaire was administered midway through the quarter.

Table 1. Student Responses to the Statement: The learning activity package is an effective curriculum procedure and should be continued in IA 41. N=30

Response	Frequency
Strongly Agree	33.3%
Agree	43.3%
Neutral	13.3%
Disagree	10.1%
Strongly Disagree	0.0%
	100.0%

Students involved in using the learning activity package overwhelmingly support the continued use of this curriculum vehicle in IA 41. With 76.6% agreeing with the above statement and only 10.1% in disagreement, major emphasis should be considered by the Department of Industrial Arts at the University of Northern Colorado to design and implement a compatible curriculum systems design in each content area.

In relationship to specifying behavioral objectives, students gave the responses to the question stated in Table 2.

The use of bahavioral objectives as a pertinent part of the learning activity package is strongly recommended, as it tells the student what is expected in specific performance terms.

What impact does media have on students in an individualized program using learning activity packages?

Both print and non-print media are an integral part of individualized instruction. Content areas are using more non-print media applications to meet needs of individuals.

Table 2. Student Responses to the Statement: The behavioral objective stated in each LAP is a vital part of the curriculum systems design. N=30

Response	Frequency
Strongly Agree	13.3%
Agree	63.3%
Neutral	20.0%
Disagree	3.4%
Strongly Disagree	0.0%
	100.0%

Brady R. Duffy sums up the use of non-print media in math as follows:

> It is well known that ease of teaching and speed of learning varies considerably among children. The perplexing question is how to meet the needs of individual students with their variety of learning levels. The question implies that it is impossible.
>
> There is one effective approach, however, that has worked well for me and does meet individual needs. This approach involves the use of the tape recorder, earphones, a student response sheet, and prerecorded tape lessons. Using this media has freed me to work with individuals or small groups of students in the class, acting as "consultant" for each learning situation at each step in the learning programs. Prerecorded teaching tapes permit flexibility in grouping and encourage success for individuals (Ref. 4).

Many studies have been accomplished regarding implications of various forms of non-print media and their effectiveness as a portion of a curriculum systems design. Leslie J. Briggs states:

> ...the central rationale for the proposed solution to the problem of how to choose instructional media rests on the assumption that various educational objectives require different kinds of learning. These kinds of learning, in turn, are established by different sets of conditions. The sets of conditions of learning, in their turn, are made possible by the manipulation of instructional events. The way of providing or producing these instructional events is to apply appropriate stimuli. The sensory mode to be stimulated and the detailed characteristics of the needed stimuli together are considered in order to select the mechanisms of media to be employed to present the stimuli. Media are thus vehicles for stimulus presentations (Ref. 5).

Nevin Frantz is cognizant of a multimedia approach in individualized instruction and states:

> Efforts have been made recently to prepare polysensory learning systems for industrial education, using a multimedia approach (Allen and others, 1968; Nish, 1967; Hill, 1967; Sergeant, 1968). The great need, however, is for a total individualized instructional system designed to determine where students are from the outset of instruction, as well as student utilization of various instructional modes and evaluation of student achievement based upon performance objectives (Ref. 6).

Both print and non-print media are only as effective as they relate to the specific objective being studied by the student and the quality of the media productions. Emphasis then must be made in matching media with the specific behavioral objectives being implemented and the audiences that will utilize the media.

In Table 3, student responses rank various items in relationship to effectiveness in accomplishing the stated behavioral objectives using LAP's.

Teacher demonstrations were considered by the students responding to the questionnaire as the most effective non-print media application employed. Other non-print media selected as being effective include slide-audio tape, followed by 16 mm motion pictures. Audio tapes were considered to be the least effective by the students.

Table 3. Student Evaluation (N=27)

MEDIA	Response: A (Most Valuable)	B	C	D	E	F (Least Valuable)
Audio Tapes	1	2	2	5	6	11
Teacher Demonstrations	20	2	1	1	1	2
Slide/Audio Tape	4	10	4	3	3	3
Super 8mm Motion Picture	1	2	7	9	6	2
Video Tape	1	4	6	6	6	4
16mm Motion Picture	0	7	7	3	5	5

Print media included as part of the learning activity package received overwhelming support. The responses are shown in Table 4.

Table 4. Student Responses to the Statement: The information sections of the LAP's are seldom used and should be eliminated. N=30

Response	Frequency
Strongly Agree	0.0%
Agree	6.0%
Neutral	6.0%
Disagree	33.3%
Strongly Disagree	54.7%
	100.0%

THE TEACHER'S ROLE IN INDIVIDUALIZED INSTRUCTION USING LEARNING ACTIVITY PACKAGES

Individualized instruction has various effects on the teacher's role. Time spent in various tasks has a tendency to change in relation to the teacher's role in traditional lock-step classes.

John Flynn and Clifton Chadwick compare teachers using learning activity packages and the traditional approach in relation to time spent doing specific tasks. In this summary, Flynn and Chadwick state that compared to teachers in traditional classes, teachers using the learning activity package spent:

(a) less time presenting subject matter information to students;
(b) less time in the management of cognitive activities through the use of noncognitive direction, requests, etc.;
(c) more time in traffic control (e.g., taking roll, directing student's whereabouts, etc.);
(d) more time using various non-instructional materials to aid in the management of students;
(e) more time getting supplies and materials for students;
(f) more time making evaluative comments about students;
(g) more time giving grades to students and discussing grades;
(h) more time in housekeeping chores such as cleaning equipment;
(i) more time giving directions to students regarding aspects of the educational environment;
(j) more time directing students to do logistical tasks (e.g., having student get supplies);
(k) more time in events coded as "no observable relevant activity;"
(l) less time asking questions and selecting students to answer questions; and
(m) less time asking questions and selecting (Ref. 7).

Flynn and Chadwick further clarify the discrepancies between the LAP teacher and the traditional teacher and state:

> An interesting finding was that LAP teachers and traditional teachers both spent about the same amount of time interacting with individual students. Yet traditional classes were so categorized because the teacher characteristically worked with the entire class as a unit. The explanation seems to be that in traditional classes the teachers tend to interact with individual students in front of the entire class while in LAP classes they interact without involving the other students (Ref. 8).

Teachers' roles are being changed through the use of individualized instruction, and they must obtain skills to perform the new required tasks. These tasks seem to be going in a more humanistic direction.

David L. Jelden describes the role of the teacher in individualized instruction as being

> ...a resource person, another source of information that the student can utilize in achieving his goal. The teacher takes on the role of an educational counselor whose primary responsibility it is to make suggestions, pose questions, and guide the student to the various resources which enhance and increase his understanding of the topic or problem at hand. The teacher does this by utilizing the information of the individual's personality and aptitudes obtained in the individual evaluation (Ref. 9).

Generally, the notion of the teacher's role in individualized instruction seems to be those functions that are diagnostic and prescriptive for students. He also tends to be involved in more logistical tasks of providing a multiple of stimulus sources.

Since evaluation of prescribed objectives for individuals is a basic function of the teacher in individualized instruction, the teacher must be knowledgeable in handling testing and measurement devices.

How do students compare individualized instruction to group instruction?

Students responding to a questionnaire favored individualized instruction over small- or large-group instruction. The tabulation of response is shown in Table 5.

Table 5. Student Responses to the Statement: In rank order, place the method of instruction you believe would be the most beneficial to you as an individual in performing the required objectives for this course, A = Most Beneficial; C = Least Beneficial; N=30

	Responses		
	A	B	C
Individualized Instruction	18	10	2
Small-Group Instruction	10	20	
Large-Group Instruction	2		28

Large-group instruction received the largest number of responses as being the least beneficial. With this kind of response toward the lock-step program using large-group instruction, an indication could be derived that subject matter areas being predominantly psychomotor in nature should attempt the LAP and individualization.

SUMMARY

With industry developing more sophisticated hardware and getting involved with the development of software for compatible machines, there will be a greater trend to involve more non-print media in industrial arts programs. Modern industrial arts programs will incorporate the use of both commercially developed programs and those developed in-plant.

The learning activity package will become more apparent and through an evolutionary process give way to a more sophisticated instrument, making educational objectives available to a greater number of learning styles.

Education will become adaptive and prescribed to each student rather than just a prescribed element. The teacher hopefully will be more hum... to each child he comes in contact with.

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The Vocational-Technical School's Responsibility With Respect to Industry

Peter C. Zanetti

Within the last decade there have been many hopeful signs that the educational community is awakening to the needs of industry. One of the most hopeful is recognition of the need for continuous teacher education, continuous re-adjustment of curricula and methods of meet the geometrically expanding advances in knowledge, and the swift changes in technology such advances impose on industry.

This is why you and I are here today. By our dialog... by our continuing dialog... we can do much together for the betterment of our children, of our country, and of our own personal situations.

Where can we start? Let's start with your end product, a young man or a young woman graduate of your school who has elected not to go, at this time, to college. Perhaps he or she has decided to skip higher education altogether, or perhaps the intention is (or the financial need dictates) night school. At any rate, here is your graduate standing on my doorstep looking for a job in my plant.

Bear in mind that this young man or woman is your end product; just as I have the responsibility for making my end products attractive in the market place, so do you. Just as I have to know, not guess, what the market place desires, so do you.

So maybe it will help you to know how our company thinks and what we look for in a new employee. And, believe me, what we think and what we look for is not very different from other manufacturing companies. Furthermore, the kind of man or woman we seek is seldom easy to find, a fact for which I hold you at least partly responsible.

As a company, we pursue excellence. No one talks about this much, perhaps because it seems so obvious. But maybe the pursuit of excellence is not so obvious. Certainly far too few of our customers, suppliers, or competitors seem to recognize its importance, judging by the trouble they go to to achieve it or by their willingness to pay for it. We only hear about excellence when our products don't perform up to snuff.

We all want excellence in what we pay for but quite often we are unwilling to provide it in what we get paid for. When it comes to selling a product, yours or ours, the passing grade is 100%, not 65%. And this is a fact that should be driven home to your students time and time again. It's what a company must provide if it is to remain in business.

To excel means to surpass or outdo. As applied to the products we make, the pursuit of excellence can be defined as the attempt to do a better job than anyone else. This isn't easy. There are a great many smart and energetic people in the educational hardware market. We compete for an amount of business which isn't enough to keep all the capable groups as busy as they would like to be. This makes excelling all the more necessary.

To effectively outdo the competition, an individual or an organization must achieve five things:

1. Full employee recognition of the need to do a better job.
2. Ability to do a better job.
3. Desire to do a better job.
4. Working conditions which permit doing a better job.
5. Will to keep up the effort without let-up.

It is rare to achieve all of these in fullest measure, but each is necessary, and the success of our organization depends on all five. The same may be said with respect to each individual in the organization.

Looking at these requirements individually points up the job to be done in vocational and technical education in general.

The first of these requirements is to achieve full employee recognition of the need to excel. From the standpoint of the collective group, the company or the division of the company, the need is apparent. From the standpoint of each individual in our company, one would think it would be equally obvious. But it seldom seems to be. Through our products we are responsible for innovations in education. They demand our finest efforts. Excellence is expected of those supplying devices whose purpose is to develop independent understanding and judgment in technical students.

"The ability to excel" isn't given to all equally, but that doesn't mean we can't do better than we ordinarily do. There is a close relation between ability and desire. Those who are anxious to excel very often do. You find that the most successful people are just as likely to have ordinary ability and an outstanding desire to excel as they are to have ordinary desire to excel and outstanding ability. Of course there are those who have plenty of both, but they take care of themselves.

In an organization, "the desire to excel" is like "the will to win" of a football team. It's hard to develop and to measure, but its results are easy to see. It is not enough for a product manager to be determined to do a better job than anyone else has ever done. His work and its success depends on the efforts of many people. Unless they have collective "will to win," the chance for creating a new, salable product is slight.

By "working conditions which permit doing a good job," I do not mean keeping the office well lighted or paying a high salary, although these factors are neither unrelated nor unimportant. I do mean creating and keeping a psychological environment that promotes and welcomes best effort by even the least employee. This is one of the most important responsibilities of management. It calls for many things, including but certainly not limited to these:

1. Recognition and appreciation of the special abilities and efforts of each individual.
2. Assignment to each individual of the maximum amount of the most difficult work that individual is capable of doing.
3. Scrupulous insistence on fair treatment of all concerned, including the customer.
4. Establishment of policies which are consistent and understood.
5. Setting up objectives which are recognized by all concerned as worthy.
6. Insurance that decisions are made, insofar as practicable, on the basis of overall best interests of the appropriate largest group, the product, the company, or the market, rather than to promote the interests of individuals or cliques.
7. Avoidance of sincere proposals unlikely to be successful or of products unlikely

to be fruitful even after receiving the best efforts of the personnel on the company's payroll.

All this may sound unduly pious. But I really believe that achieving the above pays off in very practical ways.

"Sustaining the effort" is probably the hardest of the five things to satisfy. As with other homely virtues, when effort is continued most consistently, it often seems appreciated least. There is no substitute however, for the persistent expenditure of extra effort, otherwise known as "hard work."

As in the case of almost all important accomplishments, notable success stems 10% from inspiration and 90% from perspiration.

To sum up! When your product is before my door asking for a job, I am going to be making value judgments. Does he already possess a good working knowledge of the imperative need to excel? Is he likely to put forth the extra effort to see that he personally excels in the job I want him to do? And to do what he can do to see that our product excels in the market place? Only when my answer to such questions is "yes" will I be interested in the graduate's skill level. Note that I said skill level. Not knowledge level, for what you teach him is obsolescent today before he opens my front door.

While preparing for this talk, I examined the curriculums offered by some of the technical schools and found them to be excellent from the technical point of view. The student in the future, however, will have to receive not only this technical background presently being offered, but he will have to supplement it with leadership training and numerous communication skills. I don't believe communication skills need more emphasis than to simply say that if the technician cannot communicate his ideas or work, he is not worth having on the job.

Perhaps the most important aspect of the new technician will be his responsibility for a group and the ability to make decisions using only the best information available at the time. As a group leader, he will be required to seek the best data available at the moment, analyze this data, and make decisions. After all, this is what leaders are for.

How well prepared to make decisions is the student of today? I wonder if he is prepared at all. Don't the schools today give the student an outline of the work to be covered, the problem to solve, the formula for solution, and then tell him that, to remain in school, he need only to mechanically grind out the problem three out of four times correctly for a passing grade?

I submit that a 3 out of 4 average in industry is unacceptable. If it's unacceptable in industry, how can it be acceptable in schools training people for industry?

What does this have to do with the student of tomorrow? Well, I would like to suggest that the student of tomorrow be prepared to go to work when he starts school. Note, again, please, I said when he starts school – not his first job.

Let's now suppose that your product makes the grade and starts to work.

Starting to work is a tremendous experience, the beginning of an important new venture, the development of oneself to play a part in the economic life of the country. Opportunity, adventure, or necessity; whatever the case, it is essential that the individual be prepared and know what to expect.

Who at the school explains to the student that selecting the right job, rather than just any job, makes the difference between a happy, successful, constructive life and one which is disappointing, frustrating, and dull? Who at the school explains to the student that he, and only he, can determine which of his abilities can be matched to the best job available? He should be told that he must be honest with himself in his judgment. Who at the school explains to the student that interests, aptitudes, likes and dislikes, training, and physical and mental abilities must all be considered in seeking and accepting a job? Who at the school explains to the student that work touches almost every area of life in important ways? It usually is the main source of income. It usually determines where one lives, with whom one associates, and perhaps even how leisure time is spent. Who explains these reasons for carefully choosing a job? Who at the school explains to the student the rule of "job future planning" in the selection of a job? Who points out how one job may pay more at the start than another, but that the job with the lower starting pay may offer better chances for promotion and advancement?

Who at the school explains to the student that when he starts work he will be paid for something called "production?" And who tells him it simply means that he is paid for the amount of work done in a certain amount of time, and that employers, by interviewing, get a pretty good idea of a prospective employee's potential and establish the pay rate accordingly?

Who at the school trains the student in job application techniques: how to fill out an application form, why it's important to answer all questions legibly, completely, and honestly? Few applicants realize that the job application is important, that it tells almost as much about one as one can tell about himself during an interview. Who advises him that it becomes a permanent part of his record when hired? Who at the school explains that the student should be prepared to be interviewed first by the personnel director, then by a department head?

Preparation for such interviews is necessary. As one prepares for an interview, there are two main things to keep in mind: the employer wants and expects one to be interested in the job and the company; and the employer will be paying close attention to determine whether or not a person appears to have the attitudes, the skills, and the personality suited to the position.

Who at the school works the students in school as they should be worked in industry, including the white shirt and tie, daily?

Who at the school encourages the students to work out their own ideas in the beautiful labs now available? (Let them prove out original ideas, not the canned experiments we use today: experiments for which the solutions have been worked out time and again; solutions that are available to the lazy students either from older brothers who did it last year or from fraternity files readily available to all.)

Who at the school develops programs for future students that require original ideas and logical conclusions, even if these conclusions prove the original hypothesis incorrect? After all, in industry every idea generated is not the best answer and every idea certainly isn't put into practice. Shouldn't the student be given an opportunity to think through his own problems and reject his own bad ideas?

Lastly, who at the school explains to the student that when he gets a job in a company, anywhere from a few to many thousands of people have invested their savings to create the job, and they expect a return on their money?

It is my belief that we should continually put before the student on posters, school bulletin boards, and in his classes questions that he will be asked when looking for a job, such as: What did you like best about school? How was your attendance record in school? Do you have any previous experience for your job? Do you have any special skills or abilities? Why do you think you would like this kind of work? Would you be willing to work nights or Saturdays? What would you like to be doing 5 years from now? Why do you think you qualify for the position? When can you start work?

If we ask these questions in every grade all the time in subtle fashion, we are likely to reduce our dropouts both from school and from life.

To get such considerations across to the student in meaningful ways, some changes are indicated. Changes of the kind I have in mind do not require dictators or revolutions. But with a world in crisis, they are imperatives, and the time is right to advance them. Like the words "change" and "crisis," the changes I suggest are also "c" words.

It is not enough today to look for a job. Students should be oriented to and prepared for a career in the field of their choice, even those who have elected not to go to college. It's a sure bet that the things and methods they learn now will be obsolescent overnight. They must become able to shift and dodge in the prize ring they choose by a firm grasp of fundamental concepts and general procedures.

What concepts? What procedures? In addition to the whole concept of career choice, there are three other "c" words under which we can group the more important concepts and procedures... communication, calculation, and culture.

Communication means to me the passing on, and reception with ease, both orally and in writing, of thoughts and ideas not only in this, but in other countries. One is often appalled at the difficulty which so many supposedly educated people have in expressing their ideas simply and hearing and understanding the ideas of others.

By calculation, I mean the capacity to use mathematics in a practical manner. In the world of 1980, one feels sure, the capacity to use a simple calculating machine and a working understanding of the binary system will be more important than many of the older mathematical procedures and perhaps more valuable than the current fad for working with sets and groups.

As for culture! Don't forget that it includes not only the arts but also the sciences. A cultured person today is one who, in addition to being well informed on the arts, is also well informed on the sciences. Further, he needs to understand what he knows well enough to reason in these disciplines. And surely, in a modern society, his ability to act effectively within that society implies an informed working knowledge of that society and how it functions. What is it, really? How does it operate? How and why was it developed into its present form? How can it be adapted to change without loss of its basic strengths? In today's society, the role of technicians and electronic engineers is fully as great as the role of philosophy. Both are here to stay, and your students must be prepared to deal with them.

From the viewpoint of career choice, it appears very important to me for the schools to educate their students for industrial careers in particular. It is nonsense to advocate, as is being done, that education today should deliberately seek to aim children away from industry and toward social science and welfare. Both have their place, and children should be so advised from grade one up.

There is one aspect of the preparation for industrial careers which calls for special comment. Short as we are today of students with an industrial orientation, we are facing even greater shortages in the future. Foreign countries are seeking our people, recruiting in our schools, and therefore, we need more than early industrial indoctrination and preparation. Students should be encouraged to postpone their career decisions until total preparation has been acquired and until they have enough knowledge of the world to make a wise choice between a career in U.S. industry and one abroad.

Let us try to place one more, and perhaps meaningful, dimension to the explosive increase in knowledge going on today.

When I graduated from a good high school in New York City a little over 30 years ago, I had managed to make the most of my opportunities. Four years of mathematics, four years of English, two years of Italian, two years of French, one year each of biology, chemistry, and physics, and miscellaneous courses in music, government, history, economics, woodworking, and touch typing had given me a useful share of the accumulated total knowledge of man. It took 8 years of elementary school preparation and 4 years of high school to acquire that knowledge.

I am unable to say with accuracy what percentage of the total knowledge then available to man I had acquired. The real point is that according to the best estimates available, if anyone were now to attempt to acquire the same percentage of man's present total knowledge, he would have to devote most of his lifetime to study, and the curve is not flattening out.

This imposes a major change in the objectives of educators. The Aristotelian approaches are no longer valid. Today, each and every educator should be promoting ways and means for students to "learn how to learn." This task must be performed so well that the student will automatically apply this knowledge for the rest of his life on his own, whether he ends his education as a sixth grade dropout or a PhD. If this is not accomplished, even the PhD will be running behind competitively within 2 to 5 years after graduation.

How can students be shown "how to learn?"

Here are nine practical suggestions:

1. Acquaint your students with the skills, the processes, and the devices used by as wide a variety of industries as you can.

2. Introduce students with special aptitudes to appropriate opportunities in the technological fields in which those skills are needed.

3. Replace, in a logical fashion, the theoretical approaches in science and math with approaches that arise out of "dirty hands" technical experience.

4. Promote understanding of the interdependence of various fields of endeavor.

5. Equate the courses prescribed for graduation with the specific industrial and cultural needs that have caused those courses to be selected as basic graduation requirements. This should be done by directly involving the student in real situations from industry.

6. Get students having a wide range of abilities and skills involved in the same classroom in realistic problem-solving situations so that they can become aware of the strengths and limitations of all persons in common situations.

7. Provide vocational orientation through cooperative industrial participation and proper guidance.

8. Make students aware of current problems in various vocations; shortage of special skills in certain occupations; the need not only for skill training, but also for retraining.

9. Promote understanding of principles and techniques as opposed to encyclopedia knowledge.

What I have insinuated up to now is that there is more than ever to learn; therefore, there is more than ever to teach.

You are as aware as I am of the present information explosion. New textbooks are written, curricula are revised, and supplementary materials are prepared almost faster than you can absorb them. I am sure that you often feel that you are simply a data transmitter in your efforts to advance your students to the next rung up the educational ladder.

Unfortunately, just transmitting information is not enough. Students, to keep up with the world into which they will graduate, must learn in school how to keep learning through life, how to use information effectively, how to keep on top of the changes that are inundating the unprepared. The present situation in the classroom may be likened to that of a teacher attempting to teach his students all of the words in the dictionary. But this is an Alice-in-Wonderland dictionary: the terms change as you look at them, and so do their definitions.

Because this condition exists, you must realize that it is we who must continually self-renew ourselves in order to develop self-renewing people.

To meet the objectives of a self-renewing educational system, self-renewing behavior should pervade the entire system, including that of the students, teachers, school officials, school board members, and state and federal education leaders.

As instructors, we must have open minds and look closely into such devices as the talking typewriter, the computer, the concept of tailoring a lesson for each student, teaching machines, central resource centers with random access, and multiple programming.

This notion that the teacher is being replaced by automation is an incorrect one and a misconception. Instead you are going to become increasingly professional. No longer will it be possible to say that anybody can instruct or teach. Teaching is becoming a technical job and will become even more so as educational technology develops. You are going to get better because you will be supplied with tools for your profession. This is what automation will do.

Mr. Zanetti is president of "Automatic" Sprinkler Division of Scott Engineering Sciences.

Articulating Industrial/Technical Education

Kenneth R. McLea

Building

I watched them tearing a building down
A gang of men in a busy town
With a yo-heave-ho and a lusty yell,
They swung a beam and the side wall fell.

I asked the foreman: "Are these men skilled—
The kind you would hire if you wanted to build?"
He laughed and said: "Why no, indeed,
Just common labor is all I need;
They can easily wreck in a day or two
What builders have taken years to do."

I asked myself, as I went my way,
Which of these roles have I tried today?
Am I a builder who works with care,
Measuring life by the rule and square,
Shaping my deeds by the well-made plan,
Patiently doing the best I can?
Or am I a wrecker who walks the town,
Content with the labor of tearing down?

Author Unknown

One cannot run the whole gamut from elementary through secondary to advanced education, be exposed to all sorts of facts, opinions, and attitudes, and emerge from the ordeal with the inner essential man unchanged and yet consider himself totally educated.

Education is a continuing process, cradle to grave, where one will continually assess all facts, opinions, and attitudes, constantly learn new facts and gain new insights throughout his life.

Forty-seven thousand, eight hundred and seventy-three students are enrolled in the elementary schools in San Francisco. Forty thousand, six hundred and sixty-seven students are enrolled in the secondary schools of San Francisco. Thirteen thousand, one hundred and eighty students are enrolled in the industrial/technical education program. Sixty-four percent of all San Francisco public high school students are seeking higher education. Sixty-three thousand adult San Franciscans make their way to classrooms in 144 locations throughout the city each week. Eighty-seven thousand, seven hundred and sixty-one students in San Francisco age 18 to 80 are striving for further education. These enrollment figures multiplied by the number of institutions throughout the nation truly bring forward an astronomical figure; therefore, it is essential that we have close articulation between curriculum and grade levels.

The 1970-71 budgets for San Francisco were as follows: Steps 1 through 4, elementary through secondary—$100,000 plus; for industrial/technical education at the secondary level $43,000; Step 6, the San Francisco State College Design and Industry Department—$17,040; Step 7, the Adult Education Division—$5,000,000. This brings the total educational budget, in San Francisco alone, to over $124,000,000. Education used to be just for the kids. Today, education is everyone's business, building the need for closer articulation between all levels and aspects of education, including the teacher, parents, employer, employee, child, teenager, young adult, adult, and oldster. It has been said that the man who is totally and truly educated puts to the best use what he does know in reference to his environment and the society of which he is a contributing part. Henry Thoreau said, about the educated man, "Which is the best man to deal with, he who knows nothing about a subject, and what is extremely rare, knows he knows nothing; or he who knows something about it, but thinks he knows all?" Solon, an ancient Greek, adds, "I grow old learning still."

Since the beginning of man's time on earth, he has strived to better his situation. This driving forward has always meant that man had to discover, invent, learn, and teach the new ways as he progressed. Man's first requirements are food, shelter, and clothing; although he spent 90% of his time supplying the required food for his early existence, he had only his own energy and ingenuity to call upon for survival. As man educated himself about the principles of nature, it enabled him to better provide for his needs. He discovered, invented, learned, and taught the use of weapons and tools to perform specific tasks. Man continued to learn as he domesticated animals for his food and clothing and also to assist him in his daily work. But his great technological breakthrough was the discovery of fire, which led to the smelting of ore and a tremendous jump forward. This process of discover, invent, learn, and teach was slow, due mainly to man's inability to communicate effectively and to pass knowledge on to the next generation. It was not until the late centuries that man realized that the ability to read and write efficiently would hasten his progress. After all, man's educational needs had increased beyond the hunting and fishing stage. Education would free man, free him to learn, free him to think, free him to develop his way of life. As the industrial revolution developed, the need for articulated education and training trebled. The call was for men with skills, men with the ability to operate the mass production, automation, and computerization of the machine age.

How has today's education kept up with changing technology? In most cases, try as we may, we have not. Closer articulation—the closer jointing—of all levels of education could be the answer: better communication, through involvement to develop a total program, a total articulated experience, would be the answer to keeping up with the changing technology. Dr. George E. Ditlow states in the January 1971 Industrial Arts and Vocational Education magazine, "It is conceivable that we as professional educators should be concerned and involved with 'educational programs' at all levels of one's life span—cradle to grave." Dr. Ditlow went on, in the article, to develop his philosophy of a total program. Change has created the need for closer articulation in education. But we have always had change. The difference today is that the rate of change is greater than ever before. We must, as professional industrial/technical educators, increase our rate of change by developing an articulated program with flexibility.

Let us follow the steps of a typical articulated program from elementary through adult education. The area I have selected is graphic arts. The location, of course, is San Francisco. Step 1: In the elementary school, the process of showing and involving the students in manufacturing processes or developing some respect for skills requiring hand manipulation is desirable. At the Frederick Burk Elementary School, children are involved in graphic arts activities such as linoleum block cutting, hand typesetting, and the production of finished printed copies. Step 2: At the junior high school level (seventh and eighth grade), a broad exploration with tools, materials, and processes provides for orientation of the individual in terms of elementary skills, interests, aptitudes, and adaptability. Students are guided through a series of experiences such as bookbinding operations, advanced hand typesetting, rubber stamps, and elementary platen presswork. Step 3: At the ninth grade level, the industrial arts program involves study, experimentation, and application. Students learn through participation in activities in which they use industrial/technical tools, machines, materials, and processes, as in using offset lithography to produce the school newspaper. They also use mathematics, language, and the sciences in solving meaningful problems. Step 4: In senior high school, more stress is given to advanced techniques in both letterpress and lithography along with occupational practices and the dissemination of employment information relating to the specific subject area. The advanced techniques developed in these courses approach the procedures used in industry. Students in high school who demonstrate aptitude and career interest may be enrolled in a separate but closely related program of occupational preparation which trains students to enter the specific industry. Steps 1 through 4 in graphic arts lead to and are of assistance to the student wanting to further his education at the community college level or the four-year college level. Step 5: The two-year curriculum in printing technology at the community college level is designed to train students for entry employment in the printing industry or transfer to a four-year college. A wide spectrum of instruction is offered in four areas: image preparation; photomechanical preparation; presswork and finishing; and production planning and control. The program is offered with the student's needs in mind, whether he wishes to enter the industry after graduating from the two-year program or continue his education at the four-year college level. Step 6: At the San Francisco State College level, the graphic arts program is further articulated by offering adult classes in the evening, using the community college facilities. They offer courses in camera, presswork, stripping, and bookbinding. Step 7: One phase of the "Total Program" that seems to be missing is the ability to train, upgrade, or retrain the public who are not able to or motivated to attend a lengthy formal educational course of study. All that they may need is a one-day seminar. How can we provide an educational facility that is completely flexible to the needs of everyone in a world of fast-changing technology? A group of men, educators and industrial people, pondered this problem which we believe exists not only in San Francisco but throughout the nation. Many meetings, discussions, and discouraging evenings passed before the "Inter Technology Foundation, Inc." emerged. Its task is to fill the gap, educationally and training-wise, which has been created by the technological rush forward. Can we afford to leave anyone behind? The need is there. The foundation can be as flexible as is required, with the manufacturers supplying the machinery for training on a loan basis; with industry supplying the expertise for instructing; and with industry, education, and the community supplying the people who are in need of supplementing their education and training in order that they may move forward with technology.

Thus, I believe, we have articulated an industrial/technical area and created the total program which will cover one's life span—cradle to grave. So - - -

I told myself, as I go my way,
This role I have tried today.
To be a builder who works with care,
Measuring life by the rule and square,
Shaping my deeds by the well-made plan,
Patiently doing the best I can.

Mr. McLea is a member of the Printing Technology Department at San Francisco Community College, San Francisco, California.

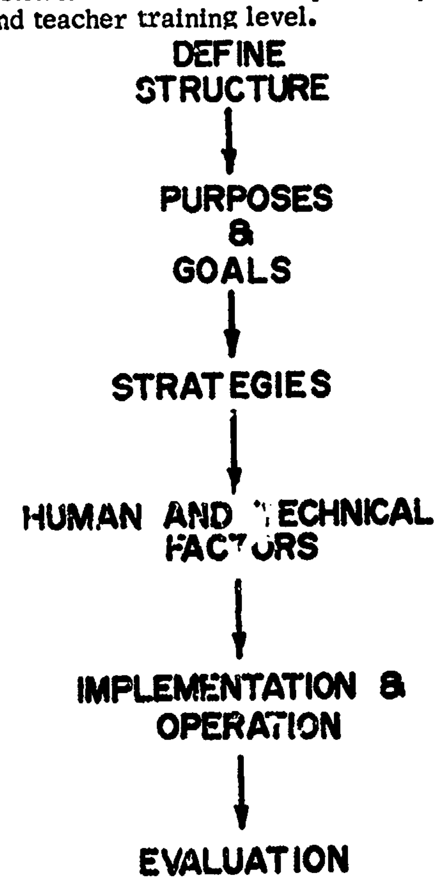
Conducting Instructional Enterprises in Public Schools and Teacher Training Institutions

Dennis C. Nystrom

My primary objective today is to provide you with an analysis of the curricular content of the Enterprise: Man and Technology program currently offered at Southern Illinois University and with some of the experiences we have had in conducting instructional enterprises at the university and junior high school levels. I also hope to describe, in some detail, the specific types of activities that constitute the Vocational Exploratory Experiences (VEE_1 and VEE_2) at both the junior high and teacher training level.

Figure 1 illustrates the basic elements or stages around which the various instructional units have been designed. This framework has been utilized in the development of these units in the technology areas as well as the vocational exploratory experiences (instructional enterprise). A little later, I will show representative units for both the junior high school and the teacher training institution. For now, let us simply keep this structure in mind as we describe the specific curricular content of the E: M&T program as offered at S.I.U.

Considerable thought and research has gone into the development of the Enterprise: Man and Technology curriculum. Many of the required courses for future Enterprise teachers are taught within the Department of Occupational Education. Other required courses are offered by various departments on the S.I.U. campus. Figure 2 lists the required technical courses in the E: M&T option.



ENTERPRISE STRUCTURE
Figure 1

INTRODUCTION TO ENTERPRISE

This four-quarter-hour course is designed to provide college freshmen and sophomores with a brief orientation to the total E: M&T curriculum as well as a lower-level experience in conducting an instructional enterprise. This is the first vocational exploratory experience (VEE_1) offered to our students.

COMMUNICATIONS

The communications segment is a two-course sequence designed to provide students with basic skills related to communications in modern business enterprises. Sample units are technical sketching, projections and developments, graphic symbolism, printing, photography, information retrieval systems, computer programming, and others. At the public school level, this would be one of the four technology areas we have defined.

ENERGY CONVERSION AND POWER TRANSMISSION

This two-course sequence is designed to provide the student with information and problem solving abilities in the area of energy and power. Sample units are basic physics; power generating equipment; internal combustion engines; atomic, solar, and chemical power sources; mechanical, pneumatic, and hydraulic transmission systems. This is the second of our four defined technologies.

COURSE	HOURS
Introduction to Enterprise	4
Communications	3.3
Energy Conversion and Power Transmission	3,[illegible]
Materials and Processes	4,4
Electronics and Instrumentation	4,4
Economics	
Macro	4
Micro	4
Industrial Psychology	4
Industrial Sociology	4
Business Organization and Management	4
Organizational Behavior	4
Enterprise: Man-Machine Systems	4,4

REQUIRED TECHNICAL COURSES FOR ENTERPRISE MAJORS

Figure 2

MATERIALS AND PROCESSES

This is also a two-course sequence designed to provide students with basic understandings of the nature of various materials and the characteristics of enterprise processes. The first course in the sequence is composed of units such as the nature of industrial materials, their physical properties, structure, natural state, extraction, and processing. The second course provides the students the opportunity of visiting various types of production and service enterprises and analyzing the various processes utilized by each.

ELECTRONICS AND INSTRUMENTATION

This two-course sequence provides students with a basic understanding of electronics and instrumentation. Specific units are studied in relation to electronic systems rather than individual components. This is the fourth technology area defined by the Enterprise staff.

ENTERPRISE: MAN-MACHINE SYSTEMS

This two-course sequence is based on the study of man-machine systems in a variety of enterprises with emphasis on teaching children and youth to understand the world of work. The first course provides the students with study in specific areas related to the modern business enterprise. Units in quality control, time and motion study, linear programming, business law, accounting, and labor relations are representative samples. The second course is based on the operation of an instructional enterprise (VEE_2) in which students assume the roles of various workers in the operation. A product or service is designed, produced, and marketed, with proceeds going back to the students or other investors.

To date, the higher-level instructional enterprise (VEE_2) has been conducted three times at S.I.U. The first enterprise, Deco-Plaque, produced unique plaques in remembrance of Old Main Hall. The total run of plaques was sold to a local gift shop. The students and others who purchased $5 worth of stock received a return of approximately $16.00 on their investment.

The second enterprise produced and sold desk-top name plaques. This project, called I.D. Enterprise, returned $7.50 on a $4.00 investment.

The third enterprise produced a fishing guide to Southern Illinois and was financed through sale of stock and advertising space in the guide. The students and other investors received approximately $13.50 on a $5.00 investment. This service was quite well received in the Southern Illinois area. We have even received requests for the Guide from as far away as Florida. This enterprise was very successful from the public relations standpoint, and this is particularly important for all educational institutions today.

The enterprise courses are designed to synthesize the skills learned in the technology and the "man" aspects of the curriculum so that students will be able to provide meaningful vocational exploratory experiences to public school children regarding their future occupational environment.

The aforementioned courses, with two teaching methods courses and student teaching, compose the offerings required by the Department of Occupational Education. The "man" courses come from other areas on our campus. The Enterprise student is required to take two economics courses, two management courses, a course in industrial psychology, and one in industrial sociology.

Let us now refer back to Figure 1 and see how this program is reflected in the junior high school curriculum.

The E: M&T curriculum at the junior high is based on an efficient combination of the following commonly used scheduling techniques.

	1 Year			
Marking Periods	1	2	3	4
Units	VEE_1	TECHNOLOGY		VEE_2

Nine Week Scheduling Technique
Figure 3

Figure 3 represents the scheduling procedure that may be utilized if the school year is divided into nine-week marking periods. The first nine weeks would be devoted to conducting a lower-level enterprise or VEE_1. The second and third marking period would be equally divided among the four technologies. The final marking period would be utilized in conducting the higher-level enterprise or VEE_2.

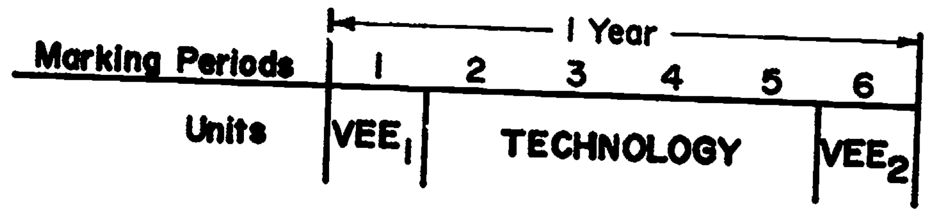
Figure 4 represents the same nine-week marking periods, but over a two-year period.

Figure 5 represents a six-week marking period procedure for one year, and Figure 6 represents a six-week marking period over two years' duration.

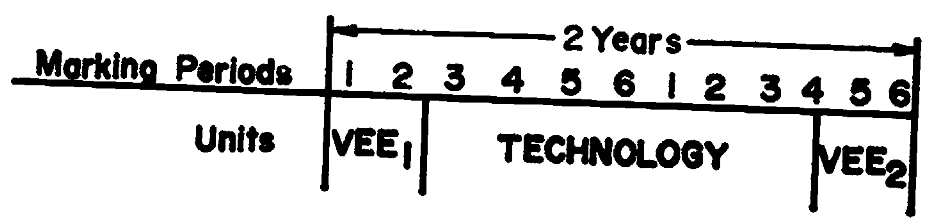
	2 Years							
Marking Periods	1	2	3	4	1	2	3	4
Units	VEE_1	TECHNOLOGY					VEE_2	

Nine Week Scheduling Technique
Figure 4

Of course, local school needs and individual instructor wants may alter these procedures. For this reason, one of the primary considerations in the development of the unit learning packages is flexibility. The experimental unit packages in the four technologies and enterprise are designed so that the individual instructor may discard those units for which he may not have enough time, interest, or expertise. Equipment will not be a great limiting factor since each unit will consist of learning guides, data gathering instruments, and equipment for each lesson.



Six Week Scheduling Technique
Figure 5



Six Week ~cheduling Technique
Figure 6

Figure 1 represents the structure around which the enterprise or vocational exploratory experiences have been designed. The specific elements composing the total unit will, of course, vary. The elements studied at the teacher training institution will, in most cases, be more specific and greater in number than those studied at the junior high school level.

Keeping in mind the over-all structure of the enterprise system, Figure 1, let us compare some representative elements of a VEE at the college level with those at the junior high level.

ANALYZING STRUCTURES

This element is the essential first step in establishing an instructional enterprise. The teacher trainee will study units in enterprise analysis, business law, occupational analysis, and economics to provide essential information to help him define various enterprise structures. The junior high school student will conduct an analysis of various businesses described in a slide/tape series to differentiate between service and durable goods production enterprises. For the junior high school student, it may be enough to know that some enterprises produce goods while others produce services and that in most instances these enterprises depend on one another.

PURPOSES AND GOALS

The college or university student will study units in sociology, economics, and psychology to provide a sound understanding of enterprise purposes and goals. The junior high youngster may use the aforementioned slide/tape series in analyzing the goals of the various enterprises described.

STRATEGIES

Once again the aspiring teacher may study units in management, sociology, and economics while the junior high student discusses the difference between short, intermediate, and long-range plans.

HUMAN AND TECHNICAL FACTORS

This is most likely where the greatest differences occur between the specificity of the college level enterprise and the public school enterprise. While college students will study units such as quening theory, industrial psychology, linear programming, and others, the junior high school student is studying the basic concepts of mass production and plant layout.

IMPLEMENTATION AND OPERATION

This is the area of least difference. The basic production system used in printing, marketing, and distributing a college-made name plaque will differ only slightly from the system used in making and marketing plastic bracelets at the public school level. It is conceivable that the efficiency of each operation will be quite different, but the procedures will remain relatively constant.

EVALUATION

The evaluation procedures at both levels will be much the same both qualitatively and quantitatively. The success of the instructional enterprise will rest in most cases with the individual student. At the junior high level, the information and experience gained about the various groups of occupations involved will depend on student involvement. At the teacher training level, the success of the enterprise experience will depend once again on the involvement of the student. The monetary rewards of both enterprises, while important motivational factors, are of little consequence to the success of the instructional enterprise.

I certainly hope that this brief overview of instructional enterprises has proved both interesting and of value to all of you. The Enterprise: Man and Technology program represents several years' effort on the part of the Occupational Education faculty at Southern Illinois University.

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Developing Vocational Exploratory Experiences Through Instructional Enterprises

James A. Sullivan

The Enterprise: Man and Technology program at Southern Illinois University prepares teachers for new and existing industrial arts laboratories. It offers one answer to the need for prespecialized occupational education in the public schools where course objectives center about intelligibility of the world of work, occupational crystallization, self-direction, and self-actualization.

The "Enterprise" program design at Southern Illinois University (Bortz, Erickson, Kenneke, Lyons, Stadt, Sullivan, 1969) integrates a simulated gaming experience for prespecialized occupational education with the clusters concept of occupations given priority by the State Plan in Illinois. Simulating occupational gaming techniques supported by the literature put into context a dynamic rather than static setting for the development of occupational awareness, skills, attitudes, and the development of necessary abilities for informal occupational choice selection and training. The design is characterized by relevance, student involvement, and student awareness that the educational experience is to lead ultimately toward occupational specification and self-actualization. Vocational exploratory experiences are designed around problems that are student-initiated and solved in a simulated occupation experience, and at the same time are closely related to occupational information and the dynamics of the world of work and society in general. Ideally, it is a problem-solving experience where the individual functions in a realistic occupational setting, makes decisions, initiates overt actions, and possesses instruments and criteria for evaluating the results of his behavior.

The primary learning vehicle at all student activity levels is the instructional enterprise. Students manage real enterprises within a simulated enterprise structure using real money, real technical and human skills, and share real emotional and social pressures which result when human involvement and material investment are combined in an enterprise venture.

The secondary learning vehicle is an experimental structure to learn about technology as it relates to an enterprising society. Four technological areas have been defined: Energy Conversion and Power Transmission, Materials and Processes, Electronics and Instrumentation, and Communications.

ASSUMPTIONS AND DEFINITIONS

There are several assumptions and definitions which clarify the structure of an enterprise curriculum.

1. An enterprise may be defined as business-like activity toward pre-established monetary and social goals. It may be carried on by one or many persons. Gas stations, barber shops, hospitals, farms, schools, churches, computer centers, banks, the Red Cross, and General Motors are all examples of enterprises.
2. An enterprise originates from an idea centered about a product, process, or service for which there is a potential need by society. If the product, process, or service is not consumed or its need ceases, the enterprise also ceases.
3. Man is an active being and in his occupational role is primarily an enterpriser.
4. The World of Work is a system of enterprises.
5. Corporate organizations are extensions of man the enterpriser and are themselves enterprises.
6. Management defines the rules by which an enterprise operates. Management gets things done through people. Effective management techniques make for efficient enterprise organizations.

DESIGN OF THE HEURISTIC MODEL

A real enterprise, a business, is generally well organized. What it produces and sells is greater than the sum of what it buys as a resource (unless it is subsidized). Its output may be manufactured products, a repair service, or any other service for which people have a need and are willing to contract. The success of an enterprise may be measured in terms of job satisfaction, monetary profit or loss, or by the importance of the product or service to other people. It is a socio-technical economic system with objectives based on profit, social need, and satisfaction motives.

An instructional enterprise simulates selected conditions of real business-like activity in the working world. Its objective is to help young people choose a satisfying occupation by defining the learning activity in a realistic or simulated game setting that permits the playing of work roles. The instructional enterprise encourages learning about occupations by using occupational information to define work roles that are a part of the instructional enterprise, by acting out these work roles and thereby developing work role expectations, and by becoming involved in an enterprise that allows students to partially control their destiny in the learning activity and measure the effect of each student's contribution. The monetary asset or liability value of the enterprise is the property of the students. The instructional success of the enterprise is measured by how realistically the student can transfer work situations in the working world, by how well the student can identify the requirements and role expectations of real jobs that have been simulated in the instructional enterprise, and by how realistically the student can specify occupational choices that compare favorably with his interests, aptitudes, and developing aspirations.

Specific instructional objectives include these four:

1. To prepare for entry into productive society by participating in productive instructional enterprises.
2. To understand productive society as interrelated enterprises by comparing real enterprises and their parts to simulated enterprise models in school.
3. To define occupations as productive units in enterprises by observing work roles in real enterprises and evaluating job requirements, work conditions, behavior patterns, and job contribution to the enterprise effort.

4. To specify occupational choices based upon occupational aptitudes, interests, and developing work role expectations by acting out work roles in the instructional enterprise and by observing similar work roles in real enterprises.

Real and instructional enterprises require working relationships with people and technical know-how. Enterprise: Man and Technology implies that enterprise, as an instructional program, is a business-like activity and depends upon working relationships with people and technological resources (i.e., it is a socio-technic system). Working relationships with people (strategies) and technological know-how may be taught during the instructional enterprise activity. Man requirements, such as labor relations—or technical requirements, such as product materials—are developed as they are needed. When handled separately, working relationships with people may be taught as industrial psychology or industrial sociology (or just human relations) units. As separate disciplines, the technologies may be taught as units in Energy Conversion & Power Transmission, Materials & Process, Communications, and Electronics and Instrumentation. Each of these areas adds technological know-how to the enterprise activity and serves to relate man and technology to an enterprise structure rather than man to technology as an unrelated discipline.

A typical junior high school-year with four marking periods may be scheduled as follows:

MARKING PERIODS	1	2	3	4
UNITS	1st level Enterprise	Man & Tech (4 technologies)	Man & Tech	2nd level Enterprise

The technology units may be taught similarly to those now taught in general shop laboratory or science class settings. The man units may be taught as human relations units during the operation of the instructional enterprise or taught separately as part of a human technology unit.

The success of the instructional enterprise is partly determined by an organizational structure which lists and sequences typical tasks necessary to start, run, and terminate the business activity. Success is also dependent upon the product or service to be marketed and by the interest, motivation, investment, and commitment on the part of the student. The organizational structure identifies occupational information necessary for the student to act out particular work roles. The student must have access to written descriptions of these occupations and actually observe these work roles in the community for verification. This prepares the student to accurately act out selected work experiences in the instructional enterprise. It also makes the student aware of the position that this work role occupies in relation to other work roles identified in the instructional enterprise and in real-world enterprises.

CONDUCTING AN INSTRUCTIONAL ENTERPRISE

Student-conducted enterprises develop in stages which structure the learning progression. Similar stages are also used to define and analyze real and existing enterprises in the world of work. The progression includes defining the enterprise structure and its purposes, developing strategies, isolating necessary human and technical factors, operating the enterprise, and finally, evaluating the learning experience by comparing outcomes with stated purposes.

Stage I

The Structure of Enterprise. The student learns what enterprise is all about, what a work role is, how occupational information is used, how individuals and organizations conduct enterprises, and how individuals contribute to the success of an enterprise in their work roles.

Stage II

The Purpose of the Enterprise. Students define in clear terms what goals they want to achieve as individuals and as an organization. These include monetary, social, and work satisfaction goals. Self, work, and organizational images begin to surface which project individual and group self-concepts into work role-concepts. The teacher and guidance counselor serve in information resource and guidance capacities.

Stage III

Strategies. Students define how they plan to achieve their goals, what investments and commitments are required, what organizational structures are necessary, and what management techniques should be adopted to operate the enterprise as efficiently as possible.

Stage IV

Human and Technical Factors. Students isolate what human and technical resources are necessary to maximize productivity. Work roles, worker profiles, technical skills, and equipment are defined, isolated, and made ready for active participation in the enterprise.

Stage V

Operating the Enterprise. Students apply the game structure and begin to manufacture or initiate service-related productive activity. Work roles are acted out, job expectations are formed, products and services are marketed, and time, motion, and synergistic effects of worker contribution are realized and evaluated.

Stage VI

Evaluation. Students evaluate performance with respect to objectives, complete reports related to occupational roles, including job descriptions in community enterprises, and define how these jobs contribute to productive society. The enterprise is terminated, the books are closed and returns are posted, market data correctness is calculated, and the instructor summarizes the instructional enterprise for the class.

LEARNING ABOUT TECHNOLOGY

Units in technology add know-how to the enterprise and are used as resources or technical factors in the production of goods and services. Selected technological units may be incorporated in the enterprise or are grouped to form nine-week or semester units of instruction. Learning about technology follows an experimental structure whereby students solve problems and draw conclusions about data gathered during the exercise.

Thus, experimental learning in the laboratory requires students to solve structured problems from selected units in technology. In each case, the problem is introduced and defined; examples are cited; related occupations are described; performance objectives are established; demonstration equipment is selected; the procedure, data to be collected, and problems to be solved are determined; and the solutions to these problems are extended _via_ questions which crystallize important concepts. Finally, an evaluation of the learning experience is made by comparing expected student performance with observed student performance.

Expected student performance during experimental learning in the laboratory can be predicted with greater assurance if the format for the experience is structured. That is, the discovery should be open-ended, but directed. Other factors also must be considered when structuring a learning system where the student contracts to solve several of many available technical problems. Laboratory time, student performance level, student interest, and the knowledge that the problem can be solved within the time allotted with available resources are variables in the matrix which defines each learning encounter between the student and the problem.

A model to structure experimental learning in the laboratory is shown in Figure 1.

Problem Isolation sets the stage for student involvement. The problem is defined, the purpose is stated, needed technical information about the problem is supplied, examples of applications and related occupations are stated, necessary instructional hardware and software materials are made available to the student, and additional references are listed.

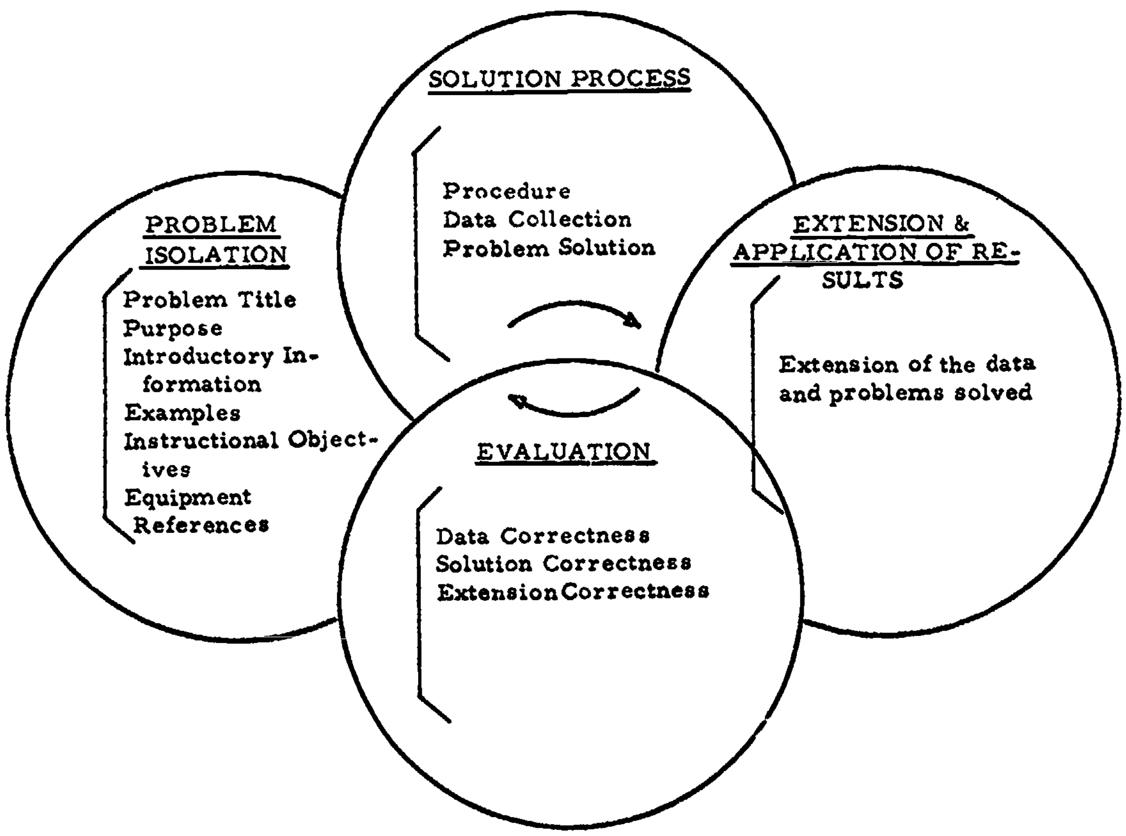

Figure 1. Laboratory experimental learning guide model.

The Solution Process actively involves the learner in gathering and organizing data and in solving related problems. Data is collected using instructional equipment and software materials which demonstrate, sense, measure, display, and otherwise organize pertinent information. Problems are solved by computing and graphing the data so that it solves the defined problem. It is important that solutions to the problem be derived from the data collected and not be a reiteration of information given.

Extension and Application of the data and solutions answers the question, "so what." It crystallizes learned concepts and allows the student to apply results to similar problems and cases with which he is familiar. This is accomplished by questions which pose similar problems or require the application of similar solutions. The student is asked to perform in a fashion similar to that required during the Solution Process stage, using the same or similar data upon which to base conclusions.

Evaluation compares students' performance with the level of acceptable performance stated in the objectives. Evaluated are: the goodness of the data collected during the experiment, the correctness of the solution to the problems solved, and the correctness of answers to the questions which extend the data or apply results to similar problems.

Experimental learning in the laboratory, then, is directed problem solving. The problem must be isolated and solved, and the solution extended to include similar cases which are familiar to the student. Learning hardware and software materials are utilized to assist the student in collecting, organizing, and applying data toward problem solution and application extensions. Structuring the learning sequence increases the probability that student performance can be predicted and matched with stated performance objectives. Student performance level and interest, time availability, and instructional equipment cost also must be considered to increase student motivation and encourage school participation.

FORMAT GUIDE

1. Title—identifies in one generalized phrase what the student will do during the experiment.
2. Introduction—gives the student the needed technical information to attack the problem; describes situations where problems of this type are solved and where solutions have

application; and describes occupations and typical paid work assignments related to this unit of technology.

3. References—books, pamphlets, articles, and papers in bibliographical form by author, title, and page, which provide additional information about the problem.
4. Purpose—a generalized statement that explains what the experiment is intended to teach the student.
5. Objectives—phrases describing what the student will do during the experiment. These are categorized by particular and identifiable types of behavior such as: collect data, draw graphs, answer questions, etc.
6. Equipment and Materials—defines instructional hardware needed to set up and conduct the experiment.
7. Procedure—tells the student how to set up and operate the instructional hardware or otherwise get ready to collect pertinent data.
8. Data & Calculations or Problem Solving—tells the student what to do in sequence to collect pertinent data, what solutions to perform, and what graphic or other illustrations are to be made to illustrate the problem solution.
9. Formulas & Conversion Factors—a list of definitions, formulas, or other tabular, numeric, or verbal data necessary to perform required solutions.
10. Questions—relate to similar problems and are intended to extend the data and crystallize what the student has learned. The same or similar data collected during the experiment should be used. Questions related to occupations or product applications also are in order.

SUMMARY

Summarizing, the Enterprise: Man & Technology program at Southern Illinois University prepares teachers for new and existing industrial arts laboratories. The program has two major learning vehicles--enterprise activity and units in technology. Learning during the enterprise activity follows in stages beginning with the structure of enterprise and ending with an evaluation of the productive activity and occupational translation of the experience. Learning the technologies follows an experimental procedure developed from a problem. The student gathers data, establishes findings, and draws conclusions about the data by answering related questions. Technical units of instruction are used as resource content for the enterprise activity and may be taught as part of the enterprise or separately as units in Energy Conversion and Power Transmission, Materials and Processes, Communications, and Electronics and Instrumentation.

The program is action-oriented, students are actively involved in determining what is to be learned, student commitment is elicited by material and emotional investment, and continuous evaluation is closely related to student role playing, work role expectations, and occupational translation commensurate with interests and aptitudes.

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A Middle School Approach to Industrial Arts

Charles E. Campbell

The middle school is a relatively new concept. It has only recently become fashionable to speak of the "middle school" as a serious change in the philosophy of the educational process.

The Brady Middle School has the philosophy that the middle school should be as flexible as is possible to provide many unique experiences for the student. These experiences should above all put the child at the center of the curriculum. This is true not only in industrial arts but music, art, and home arts. The Brady Middle School industrial arts curriculum attempts to do just that.

There are many ideas about the middle school concerning place, philosophy, and type of industrial arts curriculum to follow. One which is most impressive is that of Mr. Theodore Moss, who goes so far in his book Middle School as to say that industrial arts as a study of technology should be included as an academic discipline, rather than an art. It is his feeling that tradition more than anything else has so classified it as an arts area.

I will attempt to briefly describe to you today the historical foundations of the Brady Middle School program. This is an attempt to describe the historical foundations of technology in education and to place them in proper perspective as to the middle school program which I will describe.

The roots of industrial arts penetrate deep into man's past. Man fi[illegible]arned to drink from streams by lying on his stomach, then by splashing water [illegible] mouth with his hand, and finally by cupping his hand. Then, after a period of time, he perhaps found a shell to drink from, and after many more years he learned to make his own drinking vessels by shaping clay and baking it in the sun. Man's hands were his first tools. Stones, wood, bones, and clay were man's early materials, and the early processes that he performed on them are thought to have been done more by accident than by [illegible]ganized methods or imitation.

Through millions of years, man gradually refined these accidents into organized processes built on his past experiences and learned to record his history through cave writing, drawings, and stone tablets.

It was not until 400 B.C. in Greece that man began to study his processes as a discipline. It was in Greece that drawing was first introduced as a university subject. The fall of the guilds brought the first indications of general education by introducing the individual to all branches of the trades.

The opening of the seventeenth century and the age of realism brought new philosophical ideas to light. These ideas indicated a method of new discovery. Francis Bacon in 1605 used the term "manual arts," a term generally considered to be of recent origin, rather than from the age of realism.

Another educator of the time, John Comenius, was advocating teaching according to the order of the arts. He felt that the subjects taught must not be too hard for the children to comprehend, and the order must be according to the order of nature. This he conceived to be: Educate the senses, the memory, the intellect, and last of all the critical faculty (mind). "The child perceives through the senses. Everything in the intellect must come through the senses." This was, in fact, the early forerunner of Froebel's kindergarten. In this school, play was utilized as a means of education. This indicated that Comenius did not advocate the teaching of the handicrafts in the curriculum, but the use of these handicrafts as a rational method of teaching the school subjects of his time.

John Locke included the manual arts in his pedagogy. Locke was one of the first to be educated in the atmosphere of scientific thinking. It was his idea that "education should fit a boy for practical life," whether it be for a trade or a profession. A study of Locke's series of letters known as Some Thoughts on Education indicates that the principles behind the details of his schemes were capable of general application.

The next influential thinker to affect the nature of educational processes was John Pestalozzi. Pestalozzi was known for his work among the poor and the orphaned. He set up five different schools for children in Europe which were designed to improve their morale and give them a feeling of worth, that there was dignity in their labors. Pestalozzi was known as the father of manual training and is remembered for his short works, How Gertrude Raises Her Children and The Evening Hour of a Hermit. Pestalozzi died a bitter man. He had outwardly failed at all of his schools, even though he had seen success at all five. The reasons for his failure were many, but basically they were a combination of politics and lack of sufficient funds to efficiently operate his schools.

Fellenberg established his farm and trade schools after the ideas of Pestalozzi. Agriculture was the main activity, providing the bulk of the program. There was, in addition to pure agricultural work, the manufacture of farm implements. Most manual training was taught by methods of imitation and apprenticeship. The most striking feature of Fellenberg's pedagogy was that he was the first to seriously consider the environment of which the child was a member and in which he was destined to live.

It was in 1830 that the Russian system of teaching the "mechanical arts" was brought to prominence by one Victor Della Vos. The Russian system was built around the unit shop philosophy, with a curriculum based on a series of exercises that increased in difficulty.

The Russian system soon gave way to the Sloyd of Scandinavia. This was a system of exercises developed by Otto Salomon designed for the making of useful objects, analysis of processes, and educational method. The Russian system was designed with the strict purpose in mind of training skillful and intelligent mechanics, strictly vocational, whereas the Sloyd was quite the contrary, designed for general education, valuable for every child. The Sloyd system was designed to provide and enrich the education of all children, recognizing individual differences in learning capabilities and speeds of learning. It was an individual production system for learning, not a mass production system of general education.

The pedagogy of industrial education in the United States was influenced by methods which had been tried in Europe. The early phases of industrial education in the United States were influenced by several men. The most notable among them are Calvin Woodward, who was first credited with the use of tools as a method of teaching, and John D. Runkle, who established the "School of the Mechanical Arts" designed after the Russian system.

Mr. Charles F. White established the Manual Training School Program in St. Louis in 1880, the first school to offer manual training at the secondary level. This school filled a need in the educational structure of the American school system. All was not well, even with the popular success of these programs. The conservative educators of the time feared a break-down of educational standards already established. A controversy raged until finally there was a uniting of efforts. During this same period, many other schools were started and patterned after the St. Louis school.

Other leaders in the industrial education movement became well known around the turn of the century. These were men such as John Dewey, who advocated placing industrial occupations at the very center of the school curriculum, and Frederick Richards, who suggested in 1904 that the name manual training be changed to industrial arts. Thus the term "industrial arts" came into being.

Industrial arts has its roots deep in man's past; as a discipline, it draws heavily on the arts and crafts movement, the manual arts, Scandinavian Sloyd, and manual training. As with most good things, the good aspects of these programs have carried on. Our heritage has not let us keep up with the times.

The problem is, what types of programs can we as educators embark upon which will reflect our cultural heritage, yet proceed to follow the four basic tenets that we have built general education around in America? These basic tenets are nationalism, capitalism, democracy, and science. What type of middle school program will put the child, the student, at the center of the curriculum? We, as industrial arts educators, have recognized that we are a part of general education, but all too often do not want general education to be a part of industrial arts.

The program which I advocate is one which is student-oriented, not teacher- or project-oriented. It is our responsibility as educators to prevent the child from turning off and letting his mind go to sleep. We must wake up the student and show him how technology and education are entwined with his life experiences. You will see shortly a middle school program designed to do just that. The seventh grade program which I will speak of first is one of history and technology.

The student was placed at the center of the activities, his individual likes and dislikes considered. The next consideration was the amount of time devoted to laboratory experiences, related information, and presentations during a semester. It is in the related activities that the student is able to look at history and the technological advances of man other than unrelated instances in the time continuum. He is able to understand the reasons for studying history, math, and science, and how they are relevant to man's tools, materials, and processes.

He is able to associate cave writing with present-day drawing, drafting, writing, and history. Science becomes more than just a subject; it is a method of history, of recording events, and experimenting. Tools in the hardware take on new dimensions such as scrapers, clubs, levers, and boring stones. The student becomes more aware of processes involving the mind as a process and the hands as manipulators of mechanical devices, such as our modern tools. He is capable of applying old information to new situations. All of this and more provide the student with an understanding of the society of which he is a member. It is hoped that students will see the relationship of history, math, and science to tools, materials, and processes which, when combined intelligently, will be increased in value.

A seventh grade program based on a study of history and technology lends itself to the interests of the student of this age. Students of this age are, by nature, inquisitive and for the most part eager to learn, particularly if they are stimulated by a doing activity. The doing activity of which I speak is constructing models of inventions that have technologically made life easier for man. The student is first provided related information which he will use in the selection and designing of a particular project. As an individual, he has found interest and worth in an idea of which he desires to make a model. He will eventually write and present an oral report concerning his model.

Students begin their search in the library for an idea for a project, using a broad topic approach such as communication, power, architecture, tools, machines, and weapons. After a survey of the great number of ideas available, he proceeds to choose a specific invention which he will draw to scale, figure the cost of, and eventually construct a scale model. As students begin working with tools, they find that their understanding of the tools, materials, and processes is questionable. The are eager to learn through demonstrations provided as the need arises. The student becomes involved with his particular project and all of its identifiable characteristics and intricacies. Perhaps for the first time in his entire educational process, he is an expert on something. He has the confidence to go before the class, present his report and model, and demonstrate its uses.

Some, not all, students have shown greater than average rates of improvement in many of their other subject areas. A science and math teacher reported to me that "the boys were easily two weeks ahead of the girls in these areas at mid-year." This program was originally designed for the middle school by Mr. Donald F. Smith, who is now at the University of Maryland. I have encountered no particular problems during the transition from his influence to my dominance as the instructor.

I will now turn to the eighth grade mass production manufacturing program. This is not new. Xenphone makes mention of this same type of program in 400 B.C., concerning the manufacture of shoes. This is a program designed to enhance the student in his understanding of American industry and yet have a cultural base in the concepts upon which general education was founded, nationalism, capitalism, democracy, and science.

The students select their own product, order needed materials, advertise their product, design and build their own jigs and fixtures, and plan and organize their own production line from the cutting of the first piece to packaging and distributing their product to the consumer.

This program is unlike another popular Ohio-based program which is instructor-dominated from the selection of the product to the design and building of the jigs and fixtures.

The objectives are not outstanding, only the methods used to implement them.

Industrial arts has yet to receive its first public assistance dole, yet it has penetrated every school system in the United States. While industrial arts has in the past survived and thrived under the most threatening of circumstances, it is time for change.

Industrial arts is faltering significantly in many sections of the country. I submit to you that it will soon pass as a discipline known as industrial arts. General education will no longer be known as general education because there is nothing general about our present technological culture. We will see existing programs pass from the contemporary scene and be replaced with a type of education that will educate all to those experiences that may affect one's future life and development. This will probably take the form of studies in technology or technical education.

Here are a few examples of the types of programs that I believe the future will bring to the secondary school scene:

- 7th A study of the history of technology
- 8th A study of mass production manufacturing techniques
- 9th A study of the strengths of materials and their uses
- 10th A study of modular construction and design problems, both in buildings and machines
- 11th A study of automation and industry
- 12th Individualized research into problems of the future:

Housing	Recreation
Transportation	Food Processing
Communication	Recycling Processes
Ecology	New Sources of Power
Education	Electronics
	Automation

In closing, I am more concerned about those processes through which a student proceeds to find a solution to a problem than I am the final solution. This enables the student to use his natural creative abilities to a maximum rather than cluttering his mind with the memorization of isolated facts, soon to be forgotten.

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Preparing Individualized Instructional Materials

Harold S. Resnick and Earl S. Mills

It is the purpose of this session to present a set of individualized instructional materials prepared by 24 Fellows at Wayne State University in Detroit. The 1969-70 Experienced Teacher Fellowship Program was the third and final program of this type conducted by the Department of Industrial Education at WSU. The ExTFP, as it is called, was funded through the Basic Studies Division of the Educational Professions Development Act of 1967, in cooperation with the United States Office of Education. All Fellows participating in this program fulfilled the requirements for the M.Ed. degree at Wayne State University.

The Fellowship staff consisted of: Dr. G. Harold Silvius, Director; Dr. Harold S. Resnick, Associate Director; Earl S. Mills, Industrial Coordinator, and Dr. Roy W. Krause, Public School Coordinator.

The 24 Fellows represented 11 states and a total of more than 200 years of teaching experience. In an effort to develop curriculum materials that would be functional, they chose to conduct an in-depth study of the 1968 revision of the American Vocational Association booklet, "A Guide to Improving Instruction in Industrial Arts." This study included a review of the stated objectives, followed by a comprehensive set of instructional packages designed to aid in the implementation of a curriculum established to meet these objectives.

This curriculum is based on the belief that every individual has dignity and worth and that all individuals should receive formal educational experiences to the extent of their ability and desire. Education is a lifelong process, and a total educational experience prepares individuals not merely for a living, but for life.

Modern industry is conceived as that institution which produces and services the material goods required by man. Modern technology is the science of the application of knowledge to practical purposes. Industry and technology, as a combined institution, have a greater impact on man than any other system in our society. Since modern industry and technology have such a great impact on the lives of men, a curriculum designed for careful study of this institution is essential for successful preparation for life, both in terms of functioning in a technological society and in selecting an occupation within it. A broad base approach to occupational education, therefore, consists of a study at all levels of the functions and occupations related to industry and technology.

It is becoming increasingly difficult for an individual to view the totality of modern industry, due to the increased specialization of the nature of occupations. In this curriculum, an attempt has been made to bring industry and technology to students in the classroom. This is accomplished through a series of simulated experiences employing the procedures of instructional technology to provide an individualized program to meet the needs of each learner.

These materials are divided into 10 major units. The unit into which each instructional package belongs is identified above the title to the package. The unit is also reflected in the letter preceding the number of each package. Listed below are the letters used and the unit each one represents:

A - Industry and Civilization
B - The Industry
C - Organization and Management
D - Research and Development
E - Planning for Production and Manufacturing
F - Production or Manufacturing
G - Distribution
H - Service
I - Hand Tools and Simple Machines
J - Sophisticated Machines

A numbering system is used for identification of packages within each unit. They are not necessarily listed consecutively, nor is there any implied order or degree of difficulty.

These materials have been color-coded to indicate their intended use. White sheets are student packages—*i.e.*, packages which may be handed to the student and provide activities for his direct participation. Yellow sheets are used for Teacher's Reference

Information, which is a listing of any special materials or tools needed, or any other special arrangements needed in order for the student to complete the activity prescribed in the student package. Green sheets are used for Teacher Packages—i.e., packages which the teacher uses to conduct lectures or direct other activities which require his involvement.

The packages have been designed so they may be used within a total curriculum encompassing seventh through twelfth grades. Certain sections may be used as an introduction to the study of industry in the elementary grades. They may serve as an introduction to certain sections of industry at the higher levels, or as a complete study of a section of industry in the lower grades. The packages of instruction have been developed so that the student may progress at his own ability level and rate.

These packages are designed to make a flexible approach available to the teaching of industrial education. The individual teacher determines the course content by the packages he chooses to use, reflecting needs dictated by the geographical location in which the class is being taught. The selection of packages also provides flexibility and adaptability to any subject area in industrial education.

One might utilize some selected packages from each unit, and with the establishment of a company, provide the students with an exposure to all the operations that take place in industry, from organization and management to the servicing of industrial products. Students can work in those areas in which they have greater interest, and each individual need not progress through the same activities. For example: a student with an interest in Research and Development could concentrate his efforts in that area; however, he would acquire an exposure to the over-all operation of industry as he makes his personal contribution to the operation of the company.

The formation of a corporation need not represent the total activity for any given course. Concomitant activities for the course might include individual or class projects. In this case, selected packages could provide reference and guidance to individual students. The use of packages to supply information and direction to the student can help to free the teacher from time-consuming menial tasks.

While this approach toward teaching industrial education lends itself toward providing students with an over-all view of industry, any teacher could certainly adopt individual packages that might be used to meet other course objectives. For instance, packages dealing with tools and machines might be selected to give students the skills needed to perform required laboratory activities. Another application could utilize packages from one area, such as service, where the goal might be to expose the students to a variety of service procedures or occupations.

Regardless of the approach, these packages do provide for a number of needs from the implementation of a total program to a partial program where packages function as an aid to the instructor.

Three types of information are provided by these packages. First, student packages contain a direct assignment to the student. (Note: Teacher preparation may be required to make tools, materials, or films needed by the students available for completion of these packages.) Second, teacher packages provide direction to the teacher for an activity requiring teacher participation. The teacher involvement may vary from class discussion to organization of a student committee or the directing of an activity using the information provided. Third, teacher reference information outlines special preparations or materials required for either student or teacher packages.

Students can be given assignments on an individual or small-group basis without the need for the involvement of the entire class. This means that the student will not have to sit through lectures or discussions not pertinent to his needs. Each individual student would be able to progress at his own rate, limited not by the ability of the class, but only by his own interest and ability.

Individual packages have not been structured into a formalized curriculum because a specific program would have reduced the flexibility already mentioned and would make updating or modification difficult. Teachers can use the flexibility and resources obtained in these packages in the following ways: first, to develop new packages using the ideas acquired from the packages already developed; or second, by utilizing the basic resources of packages already developed, a teacher may adapt an existing package to meet the specific needs of his course.

An examination of the packages shows that the majority are entitled "For the Student." This designation means, in most cases, that the package can be given directly to the student. He should then be able to perform the activities described in the package on his own.

The use of individualized instruction wherever possible has a great number of advantages. Certain types of materials, however, do not lend themselves well to individualized instruction. The Fellows recognized this, and designed teacher packages for these instructional units.

One of the more important advantages of the individualized instruction plan is that it allows for individual progress. How often have teachers set up a learning activity only to find that some of the students are finished while the majority are still occupied with the challenge of the activity? Educators have found it disastrous to expect these more capable students to bide their time with "busy work" until the others catch up. Of course, there is the common escape of having the advanced student lead and assist the slower ones. This method, although better, still does not take full advantage of the individual's efforts, abilities, and time.

In the field testing of these packages, the students at first had difficulty in working with them because they had not been previously oriented for individualized instruction. They were not accustomed to taking the initiative necessary to forge ahead without direct contact with the instructor. They were reluctant to follow written instructions on the packages without the verbal reassurance of the instructor in charge. It took some time before the test students broke the bands of traditional educational methods and felt free to perform without direct teacher supervision. When the students finally did acquire the confidence to work alone, things began to move very smoothly.

It is most necessary, therefore, for the instructor to set the mood (stage) for individual instruction. The student must be exposed to an extensive orientation not just to the curriculum of the program, but also to the mechanics of its operation. It is much like learning how to drive with a manual shift and then getting into an automatic shift car. It takes time to get accustomed to the new way of performing.

Any given package would not apply to all grade levels. An attempt has been made to prepare materials that could be used in a great number of different situations. In some cases, the instructor may find it necessary to adapt the existing package to match the level of the students with which it is to be used.

No attempt has been made to label the packages according to individual grades because of the many variables in different school situations. The individual instructor must make the judgment as to which packages can be successfully used in his particular situation. In some cases, perhaps, just a few words of instruction are necessary to make a package applicable. Regardless, the original package should provide an excellent stepping stone toward developing your own materials.

A person who controls, directs, conducts, guides, and administers is called a manager. The teacher who hopes to use these materials in an effective, efficient way must perform these functions. This program was not designed to replace the teacher or place him in a secondary role. To the contrary, it will take a great amount of effort on the part of the instructor to make this program successful. It is hoped that these curriculum materials will make it easier for the teacher to have a program that will be more meaningful for the industrial arts student.

The teacher will find himself very busy in this situation. He will need to exert a new kind of effort in order for this material to work successfully. The level of effort put forth by the instructor will determine the amount of success enjoyed by the program.

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Power Technology

Walter C. Krueger

The Greece Central School District is located in a large suburban area of 77,000 population. The school district has 13 elementary schools, three junior high schools, and three senior high schools. Total student population is 14,000. The three senior high schools are very similar, except for building design, and their student enrollment averages 1100-1400 students. The high schools are organized on modular scheduling, which consists of 26 mods of 15 minutes each. My Power Technology and Transportation classes meet four mods, twice a week. During this time, lessons and demonstrations are given; there is open lab time. However, students are expected to devote extra time during the week to complete their work. This type of system allows me to work independently with students, giving more individualized instruction.

The entire program revolves around the following six criteria which are felt to be consistent with the over-all philosophy of industrial arts, as well as that of the school district.

First, industrial arts must be open to all students with the basic assumption that, regardless of the ultimate vocational choice, the experiences gained in the program will broaden the student's perspective and increase the validity of that decision.

Second, the program must contain a systematic study and exploration of the world of work that will assist in preparing a student for a realistic and satisfying career selection when the time comes for serious vocational preparation. Students' interests vacillate through high school because vocational maturity and adequate understanding of self vary greatly and are often slow to develop; therefore, it was agreed that a breadth of experiences should be provided as a basis for eventual career selection.

Third, the content must come from industry and be relevant to the facts, principles, and concepts of modern technology. There was general agreement that the program should be devoted to the study of tools, materials, processes, and products of our American industries and, as such, should be designed to acquaint students with the technological society in which they live and must make their living.

Fourth, industrial arts must become an integral part of the total education picture rather than isolated from the rest of the school curriculum in its content, activities, and program. Consequently, all areas were developed with an eye toward interdisciplinary activities that could assist a student having difficulty verbalizing or thinking on the abstract level to learn essential concepts more effectively by presenting the material in more concrete forms and allowing him to demonstrate knowledge manipulatively.

Fifth, in order to avoid over-specialization and in-depth instruction, it became important to concentrate on broadening student experiences in selected areas of study. For example, rather than have a course in machine shop where the total emphasis would be on machine operations, a course in metal technology was developed to offer students experiences in such areas as heat treatment, materials testing, precision measurements, and fabrication.

Finally, maximum flexibility not only in the selection of student activities, but in effective teaching techniques employed at each level of instruction was desired. This is an essential element in a program designed to meet individual needs, interests, and capabilities. It seemed fruitless to establish valid content while ignoring the best techniques in motivating students to create the desired behavioral changes. The activities selected by both students and teachers should eliminate any locked-in feeling and provide the latitude necessary to accommodate individual differences while not losing sight of the identified student outcomes.

The junior high school industrial arts curriculum is designed to provide the broadest possible exposure to industrial concepts for the greatest number of students. Instructional units in the eight selected technologies of plastics, drafting, woodworking, metals, power, graphic arts, electricity, and manufacturing are designed to provide meaningful activities that enable each student to develop basic conceptual understanding related to the tools, materials, processes, and products most commonly associated with our current technologies.

In the senior high we are organized on a three-level basis. Level I semester courses are offered on an elective basis in the areas of woodworking, drafting, electricity, metals, power, graphic arts, and plastics. These courses are open to all students, grades 9-12. The major goals of this level are to provide a broad general survey in each of the selected technologies centered around manipulative activities, provide an opportunity to investigate the tools, materials, and basic processes that are unique and common to each technology in relationship to our contemporary society, and assist students in exploration of likes and dislikes and discovery of aptitudes which should help with educational, vocational, and occupational guidance.

The Level II courses are designed to help the student broaden his knowledge in a selected technology from the superficial introductory level to the more concentrated in-depth studies that will point out relationships on the inter-disciplinary level that will further assist him in realistic preparation and selection of a satisfying career. Emphasis is placed on inter-disciplinary activities and total student involvement centered around an identified area of study. Offerings at this level include: construction, technical drawing, electronics, metal technology, transportation (power application), graphic communications, plastics technology.

The Level III program is designed for those students who have an avocational or vocational goal that cannot be reached through the established Level II or B. O. C. E. S. offerings. The student has three options at this level: independent study, cooperative work experience program, or a choice of special offerings.

I would like to start by putting out to you a few questions. Hopefully, I will answer these and more by the time we are finished. What is Power Technology? What are the various areas that should be taught? What type of equipment and software are necessary to teach it? What type of class structure works best? What kind of facilities are necessary to teach it? What type of instructor can do the best job? These are the kinds of questions we had to ask ourselves when the Power Technology program was being developed in the Greece Central School District.

In originally organizing the Power Technology program, we decided not to be satisfied with a program narrow in content. Contemporary society demands more than the ability to take apart and put together internal combustion engines; however, this was not eliminated. We needed a program that would be relevant and keep the interest of the students, while giving the student opportunities for active involvement on the manipulative level as well as the theoretical level.

In the junior high, an exposure to power in the form of small engine disassembly and repair procedures is all that is possible in a five-week exploratory program. In the Level I program we have 20 weeks, allowing us to cover a much broader area than before.

During Level I we cover small engines, which involves disassembly and advanced repair procedures, performance testing with a dynamometer for horsepower, torque, and air/fuel ratio. In large engines, we cover basic repair and maintenance procedures, tune-up, and trouble shooting on test stand engines. In the area of Rocketry, the students construct a basic kit and fly it when completed; they also calculate flight duration and maximum altitude. Each student static tests a rocket engine and calculates maximum thrust burning time, specific impulse, and thrust horsepower. The area of electric motor theory includes testing A. C. and D. C. motors on a dynamometer for horsepower, torque, amp draw, power consumed, and basic maintenance procedures. In the area of future power sources, students work with a solar cell and thermoelectric generator, as well as touring a nuclear power plant. We have a unit in research and experimentation where a student can select an area of interest and research it more in depth. This type of broad coverage gives the student an excellent look at the field of power. He is no longer channeled down a narrow path. Each of the areas in Power Technology have hardware and software to teach them. In some areas simulators are used, but in most cases the real power source is used by students. Student activities are integrated with a worksheet, which continually questions what they are doing. The need for having many student stations per activity is eliminated by having several areas operating at the same time. However, a well-run laboratory system is necessary here.

The Level II Power Technology program is devoted to the study of transportation, with specific emphasis on power application. The major goal of the course is to help the student develop a broad knowledge of the world of transportation through active involvement in a variety of activities related to the practical application of power and transportation that will further assist him in his search for a satisfying career selection.

Because the automobile is a prime motivation for many students, its subcomponents are used as a nucleus for many of the laboratory activities. However, these components are used primarily for the purpose of teaching broad concepts as opposed to specific technical skills. For example, the purpose of the unit in transmissions is to teach concepts related to power control as opposed to specific repair techniques.

The areas covered in Level II are transportation problems. In this unit, the students select a topic and research it in depth. In the unit of engine testing and analysis, the student can become involved with theory of the basic types of internal combustion engines, such as four cycle, two cycle, rotating combustion, and diesel cycle.

The student operates and tests each of these engines for horsepower and torque, air/fuel ratio, specific fuel consumption, engine thermal efficiency, and volumetric efficiency. In the area of electrical power systems, the students become involved with ignition systems, generating and charging systems, and lighting systems. The students work with large engines doing repair, tune-up, trouble shooting ignition, and carburization. Students work with single barrel, two barrel, and four barrel carburetors. In the area of marine transportation, students work with outboard engine analysis, craft application problems, and economic effects and problems. In the area of fluid power, the students get involved with theory, operation, and maintenance of hydraulic systems. In the area of transmission of power, students work with clutches, fluid couplings, standard and automatic transmissions, differentials, brake systems, and front end alignment problems. Body maintenance and repair also are covered. Students work with surface preparation, sheet metal metal repair, flexible body filler, and painting. Space age power is also covered, involving vehicles and flight, craft and application problems, and economic effects. The final unit covers career opportunities in the field of Power Technology, job entry skills required, and economic opportunities.

The students are receiving a broad coverage of many phases of Power Technology and Transportation. From this exposure, the student can select his area of interest and continue his career development in Level III or the B. O. C. E. S. center.

In Level III, the student and instructor organize an outline for the student to follow on an independent study or advanced specialization on a structured basis. The student can work in the labs or go on observation cycles to reach his objective.

This is the type of program we are teaching and the many new things we are doing. I hope I have given you some insight into the field of power, and I hope you can take some of these ideas back to your schools and put them to good use.

Mr. Krueger is an Instructor and Curriculum Leader of Power Technology, Greece Athena Junior-Senior High School, Rochester, New York.

Design and Problem Solving— A Teaching Method

Billy L. Windham

Industrial arts has a rich history in the making of projects which the student can take home. Too often the individual student's project has been the end product rather than a means to a learning process. In like manner, it has been hard to find industry in many industrial arts programs. Too often the course is centered around project building rather than a study of industry and its impact on society as studied in a laboratory situation. This hypothesis is reinforced by the large number of curriculum studies being conducted in industrial arts.

This type of situation can be changed to meaningful educational experiences by directing process-oriented courses involving problem solving techniques such as those developed by Alex F. Osborn, founder of Creative Education Foundation. Two techniques which are used in this method of guiding learning experiences are group action in solving problems and a logical sequence of steps followed when solving problems.

The term process-oriented instruction will be used in this paper to identify a curriculum centered around methods by which learning takes place. There have been many writings in recent years on this topic. Design is defined as the process of translating ideas into a satisfactory solution related to a specific need. More specifically, industrial design relates this process to the products of industry.

However, the purpose of this paper is not to present a philosophical discussion of terms, but to show a teaching method that can implement the study of process, design, and problem solving.

To do this, I would like to describe a course of study which is offered at Southwest Texas State University and give examples of the process applied to the traditional industrial arts curriculum.

The first unit is a study of visual composition. The arrangement of positive and negative elements are developed to produce visually pleasing compositions. The elements represented are lines, planes, solid forms, and surface treatments. The combined elements and the understanding of the relationships that develop are identified by the poetic terms of rhythm, balance, emphasis, proportion, harmony, and unity. The student's task begins with the arranging of black rectangles, triangles, and/or circles on a white background to produce visual compositions. As the student progresses in his understanding of the elements and their relationships, he is allowed more freedom in the selection of media to express his ideas.

Unit two is a study of the history of contemporary industrial design. This begins with the Red-Blue chair (1917) design by Rietveld. Emphasis is placed on the men who were first to create new ideas and new uses for existing materials. The following list is representative of those studied: Walter Gropius—Bauhaus; Marcel Breuer—steel tubing; Charles Eames—molded plywood; Eero Saarinen—molded plastic; Henry Dreyfuss—dimensions of man; Thomas Lamb—study of the human hand; Norman Bel Geddes—general industrial designs; and many more. The men who influenced contemporary industrial design from the related fields of art and architecture are also studied.

In the study of how the various designers work and produce ideas, the students are guided to analyze the sequence of activities employed by each man.

The third unit is directed toward the development of a logical sequence of steps that may be used as a pattern for solving the student's own design problems. The phases of industrial design problems generally included are initiation, research, possible solutions, analysis, experimentation, final solution, production, evaluation, and redesign. The final unit consists of design tasks in each of the traditional industrial arts areas. The assignments include both individual and group activities.

The slides used in the presentation illustrated the process applied to drafting, woods, metals, and graphics at college, high school, and junior high school levels.

The bibliography for this course includes over 200 books and periodicals and is, therefore, not included with this summary of the presentation.

Mr. Windham is a member of the faculty at Southwest Texas State University, San Marcos, Texas.

Behavioral Objectives and the Manufacturing Enterprise

M. Duane Mongerson

Even as we enter an era of accountability and performance contracting, few industrial arts programs have been developed which are specific and measurable. This inadequacy makes it virtually impossible to evaluate the effects of instruction. In addition, increasing demands are being placed on educators to evaluate both the instructional and cost effectiveness of educational programs. The United States Office of Education and the nation are demanding that the schools be held accountable for student progress. Although curriculum theorists maintain that teachers should develop competence in the assessment of specific individual skills, contemporary approaches to evaluation are typically subjective and vague.

Essential in the analysis of a curriculum program is the development of a set of behavioral objectives or tasks. A behavioral objective is a specific statement of student performance that is measurable or observable. Most specifically, a behavioral objective includes the following components: it implies action, it identifies conditions, and it defines levels of performance. Consider an example of an atypical behavioral objective such as, "Each student will be able to leap tall rocks in a single bound." This objective implies action, but does not state the height of the rock in question. Perhaps this ludicrous behavioral objective could be improved by rewriting it in the following manner: "When the student is given a running start, he will be able to leap over a five-foot rock."

Frequently, educators use very general terms in stating educational objectives or goals. How often have you heard or read a list of objectives which are similar to the following:

To understand science
To appreciate music
To know how to solve problems
To enjoy leisure time activities

These classic statements are acceptable; however, they do not identify overt behaviors which are measurable. They should be classified as general objectives or goals. Measurable objectives begin with such terms as to list, identify, compare, differentiate, construct, or solve.

For example, a student in the seventh grade would be asked to list six of the eight basic needs of a manufacturing enterprise. These basic needs include the elements of equipment, material, space, labor, time, capital, organization, and product idea. Another example of a behavioral object is as follows: Each student will be able to differentiate between the two concepts of adhesion and cohesion by defining each in a sentence. In a later section of this paper, additional examples of behavioral objectives will be stated.

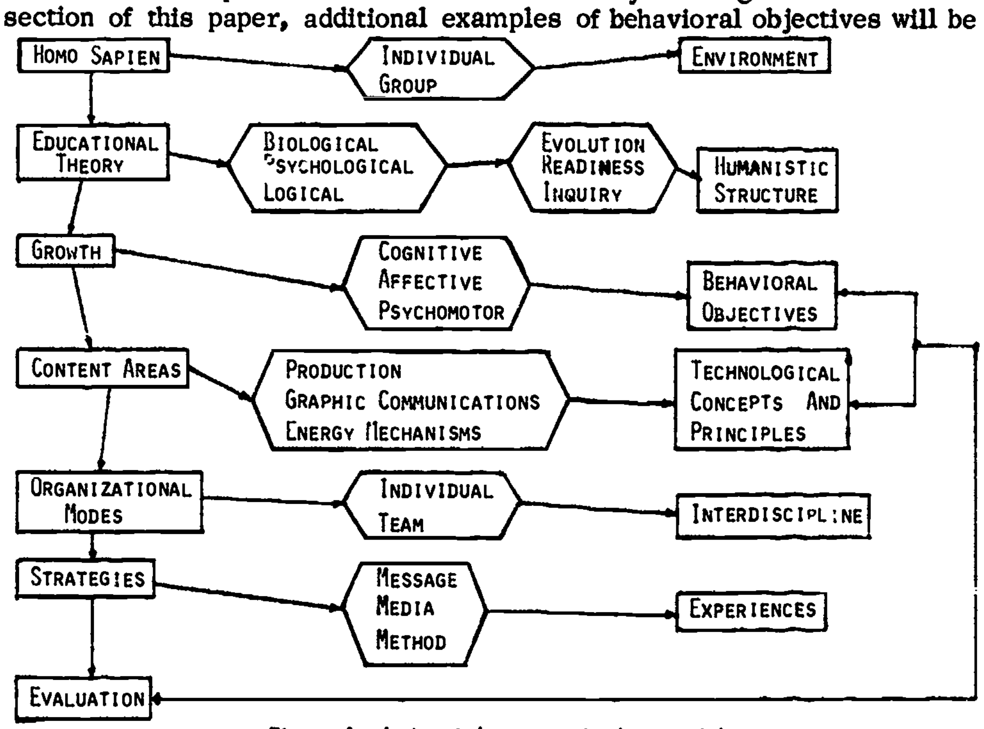

Figure 1. Industrial arts curriculum model.

INDUSTRIAL ARTS CURRICULUM MODEL

In Figure 1, an industrial arts curriculum model is presented. It represents a generalized model for developing and implementing a secondary school industrial arts program. The primary focus of the curriculum model deals with man's interaction with his environment. Curriculum variables such as educational theory, goals, objectives, teaching strategies, and evaluation are included in the following assumptions:

1. An educational theory which reflects a humanistic structure of education should be incorporated.
2. The growth of the individual student should be considered in terms of behavioral goals and objectives which are based on the three domains of learning—cognitive (intellectual or mental), psychomotor (physical), and affective (social and emotional).
3. The content of industrial arts should reflect the technological concepts and principles of production, graphic communications, and energy mechanisms. For clarification, each of the content fields are defined as follows:

   Production—represents the many manufacturing and construction industries which form a management structure to design, plan, control, produce, and market products or structures.

   Graphic Communications—represents the planning, organizing, designing, drawing, retrieving, and reproducing of visual materials that are used in all industries.

Energy Mechanisms—represents the study and application of scientific principles in the development of power sources such as nuclear, fuel cell, steam, and electrical systems.

4. Course behavioral objectives should be drawn from the identification of the content fields stated in assumption three.
5. Whenever possible, an interdisciplinary approach should be used in organizing the course or courses.
6. Teaching strategies should be based upon the message or content, media, and methods which challenge the student's potentialities and capabilities.
7. A major part of the evaluation of an instructional program, whether it be science or industrial arts, lies in the student's attainment of the performance criteria or behavioral objectives established for the course.

With reference to the preceding curriculum variables, the manufacturing enterprise will be presented in terms of course description, course goals, behavioral objectives, and evaluation.

COURSE DESCRIPTION OF THE MANUFACTURING ENTERPRISE

The manufacturing enterprise represents a simulated production experience in which the students have the opportunity to participate in role-playing activities in organizing a managerial structure to design and produce marketable products. Concepts dealing with materials, equipment, and production processes are studied. The course content is also supplemented with basic scientific and mathematical principles such as adhesion, cutting, fastening, expansion, squaring, and measuring. In Figure 2, major aspects of the manufacturing enterprise are identified in the system model.

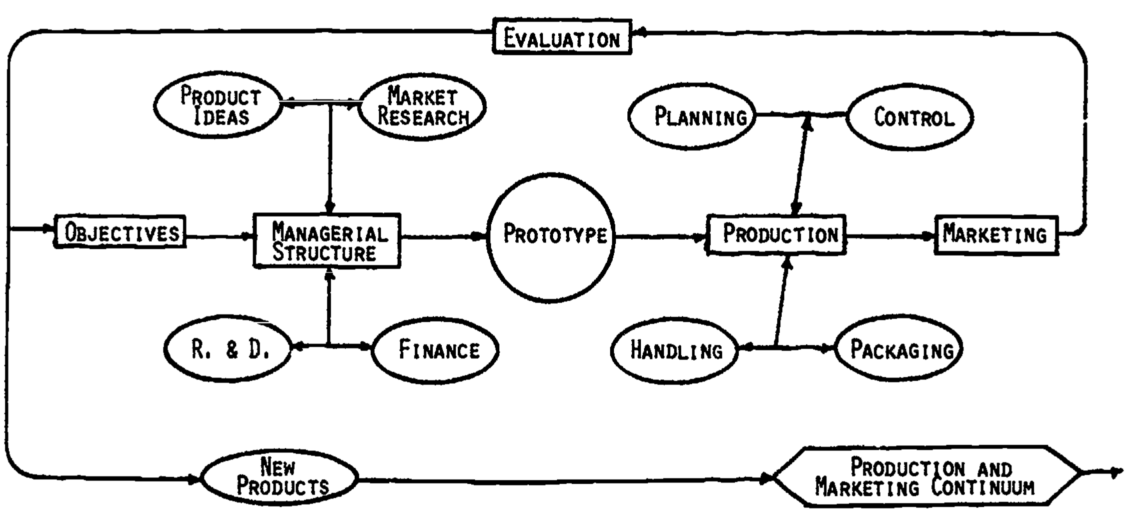

Figure 2. Manufacturing enterprise system model

COURSE GOALS

The course goals for the manufacturing enterprise are very general in nature and are as follows:

1. Explore and identify the many ramifications of the "neo industrial era."
2. Discover and develop an understanding of principles and concepts of industrial structured subject matter.
3. Develop in each individual student a reasonable degree of skill in using various tools, machines, and testing apparatus in the laboratory.
4. Develop an understanding of the applications of science and mathematics in industry.
5. Augment the development of skills in retrieving information for the solving of industrial problems.

BEHAVIORAL OBJECTIVES

The specific behavioral objectives are based upon the three domains of learning, that of the cognitive, affective, and psychomotor. A listing of selected behavioral objectives which each student is expected to express in an overt manner is extracted from the content areas of Management (Organization), Materials, Equipment (Tools and Machines), and Production Processes.

Each of the ensuing behavioral objectives should be prefaced with the statement, "Each student will be able to:"

1. Sketch a flow diagram of the organizational or managerial structure of a typical enterprise. The sketch should include at least five of the six managerial positions found in a typical enterprise.
2. Identify and describe in one sentence each of the three basic types of ownership.
3. Determine which of the three types of methods analysis is most appropriate for the industrial arts laboratory.
4. Demonstrate the squaring principle on various materials, including at least metal, plastic, and wood.
5. Compare the two major classifications of wood by defining and giving an example of each type.
6. Identify and describe in one sentence the two major classifications of plastic.
7. List three of the five major types of material-handling equipment.
8. Demonstrate four of the five band saw safety rules.
9. Identify and describe in one sentence each of the three major components of any machine system.
10. List the five classifications of hand tools, and identify two tools from each classification.
11. State three safety rules for the drill press.
12. Describe in one or two sentences the concept of jigs or fixtures.
13. List the three major classifications of processing.
14. State three of the four major ways in which materials may be fastened, and list an example for each.

EVALUATION

Design, implementation, and evaluation are the major stages in developing a comprehensive curricular program. The most neglected stage, whether it be associated with a traditional or innovative industrial arts program, is evaluation. Basic in the evaluation of a specific set of learning activities is the behavioral objective. For example, in New York State a few public schools, notably the Greece Public Schools in the Rochester area, are developing programs in mathematics and reading for assessing student progress. This approach is entitled Comprehensive Achievement Monitoring (CAM). Within the CAM approach, specific student learning tasks are identified and periodically tested. In applying CAM, an individual learning profile is developed for each student and serves as an accountable measure of student progress. Variations of this method have been developed, but the approach in each would be similar.

In terms of the manufacturing enterprise, major aspects of the CAM approach will be incorporated. Fifty behavioral objectives have been written, and four test items for each of the objectives are in the process of development. A pool of 200 test items will need to be developed in order to provide periodic feedback on individual students. From the pool of test items, a pre-test and post-test will be constructed. Parallel test forms will also be developed and given to the students at the end of a two-week period or at the end of ten class periods. Consequently, CAM or its modification provides a systematic procedure for assessing student progress on a continuous basis, which facilitates instructional decision making on an immediate and long-term basis. For a more detailed description of CAM, refer to Training Manual for Comprehensive Achievement Monitoring by W. P. Gorth and R. P. O'Reilly, New York State Education Department, June 1970.

Dr. Mongerson is an Assistant Professor of Industrial Arts Education at State University College of New York at Buffalo.

Students Conduct Real Business Enterprise

Jere M. Cary

This special interest session is about students operating their own business enterprise. The two students with me will tell you how their business began. I would like to tell you why we are here.

Early last fall, shortly after school started, the class was getting itself organized. In the process of setting its goals for the year, the subject of budget arose. Based on the experience of previous classes, it was soon decided to budget:

(a) $200 for an industrial arts scholarship. This was not necessarily to be an academic scholarship. It was to be one a student might use to help meet the costs of vocational school, cost of union dues or tools necessary to enter industry, or it could be used in the traditional sense to help finance the recipient's education.

(b) $100 for next year's class. There are initial expenses to get the class going, and they felt they wanted to assist in this matter.

(c) $100 for stockholders meetings and field trips. Sometimes a field trip extends into the lunch hour. At those times, a milkshake and hamburger are just the thing. At "stockholders meetings", discussion and decisions are almost always easier over a doughnut.

(d) $200 for the annual banquet. Two years have made this a tradition. It makes a nice climax to the year to have a fine banquet at an excellent restaurant. In the past, we have had a dinner speaker and invited certain businessmen and school administrators as our guests.

(e) Some of the students in the class were "veterans" of the previous year. They felt strongly about the program and thought others might benefit from a similar experience. It was soon decided that a presentation to other industrial arts teachers might be the method for their "missionary" work. Letters to the AIAA Convention planners soon earned them an invitation. $600 was budgeted to send two students here to Miami Beach to tell the story.

With the invitation in hand and the money budgeted, the wheels began to turn. This presentation has been made to several local high schools and civic groups in preparation for this performance.

Now it gives me pleasure to introduce to you the Production Superintendent, Mike Sorensen and Ted McCulla, Millwork Foreman of the Industrial Woodworking staff.

Mr. Cary is a member of the faculty and teaches woodworking at Meadowdale High School in Lynnwood, Washington.

Students Conduct Real Business Enterprise (Part 2)

Ted McCulla and Mike Sorensen

Meadowdale Industrial Woodworking is located in Lynnwood, Washington—near Seattle—at Meadowdale High School.

The class is organized as a business with each of the students having those responsibilities found in the typical industry.

The history of this class goes back several years. At that time Mr. Cary, our instructor, realized that the traditional woodworking class offered little opportunity to practice those industrial concepts of mass production, jigs, estimating, cost accounting, and others. Mr. Cary felt a need to give students a more realistic experience related to the industrial world and the concepts just mentioned.

With these broad goals in mind, details were worked out with the school principal, Mr. Karnofski. The next step was to obtain approval of the school board for a one-year trial. (At the end of the first year, the course was evaluated and then made a part of the regular curriculum.) This is the third year the class has been in operation.

Fine details of the class organization were left up to the students.

We decided that a diversified operation between custom work, such as cabinets, and speculative items would give the company the best opportunity to succeed in our objectives.

We have just told you a little about our history, organization, and the kind of work we do. Now we would like to go into detail on how a custom job moves through our company. Custom items are those which are built to the customer's order and specifications.

It may begin when a potential customer calls to inquire about a job. Other times the customer may come to the shop with his inquiry.

The job may require that the designer and/or some of our other administrative personnel go to the site to secure information. When this is necessary, students often use their own cars and are paid mileage.

When drawings are complete, bills of material and plans of procedure can be developed. With this kind of information, the bid can be figured and sent with the drawings to the customer for approval. If the customer approves the bid, it is recorded and worked into our production schedule.

When the time arrives for production to begin, the superintendent and/or mill work foreman go over over the plans with the production worker assigned to the job.

As materials are needed, they may be purchased from the school stock and are recorded on requisition forms.

At times, the materials may be ordered direct from the supplier through our accounting department. The cost of all materials is charged to the job and recorded in our books by the same department. At the end of each day, time is recorded by the superintendent and it too is charged to the appropriate job.

As mentioned before, custom work is only half of our production. We would like to go into some detail concerning the other half, speculative items, those we build without orders and hope that we can sell when they are complete. They are usually many of a kind and give us the opportunity to apply the techniques of mass production.

Product ideas are discussed at stockholders meetings. When agreements are reached, plans are developed through our design department.

Next, models or prototypes are built, which are discussed and modified by the class. When modifications are final, the necessary jigs are built and production begins.

In both custom and speculative work, the individual workers are responsible for inspection, but final inspection comes from the shipping foreman or sales manager before the product leaves the shop. The last step the product takes is the delivery. A customer may personally pick up the item but on other occasions we deliver it. Now that the job is complete, records can be brought up to date and information prepared for a future stockholders meeting.

We have attempted to show you how our class operates and what we do. We feel that it has been an educational and financial success. Educationally, it has helped to prepare graduates to contribute on a high level to industry and society. Financially, we feel it has done as well by showing a profit each year.

1968-69	$1000
1969-70	$1497
1970-71 to 3/17	$1100

Ted McCulla and Mike Sorensen are industrial arts students at Meadowdale Senior High School, Lynnwood, Washington.

Ecology

Human Ecology

Edward H. Silverman

The word ecology first appeared in the English language in 1873. Almost 100 years old, the word has become especially popular in the past few years. In its pure form, it is a designation for study that deals with the relationship of living things to their environment and to each other. This relationship is always viewed by man, who can be perceived of as having an environment or as part of the environment itself, depending on how we define man or environment. In earlier years, the word ecology was hardly known. It has become an emotional word largely because life, both human and nonhuman, is threatened more seriously than ever envisioned throughout man's civilized history. Actually, man's perception is not too different than primitive times. In more isolated, rural communities in earlier times man thought he, or his community, was the only one that existed, and he experienced similar threats. However, now through improved communication, man can actually see the threat as much more serious and finite. Man, in an attempt to overcome his own extermination, developed certain technology, the very same technology that is to be his threat. It is not the technology that threatens man, but man himself who has created his present dilemma. Today we hear much about air pollution, water pollution, noise pollution, over-population, etc. However, what people do about these things depends on how man views them. The nature of the way man perceives the universe is most important to survival. Whether man is an observer looking at the universe, whether he is the center, or whether he sees the universe and himself as one as has been the case with many philosophers of the East determines what man does. What we sometimes mean by ecology is man's relationship to his environment, as if man were not part of the environment itself. This concept is important, for this very separation of man and the environment enables us to make one or the other more or less important. It is through symbolization of the real world, frequently by the way of language, that we make this separation. More recently, man has almost deified symbolic language at the expense of the real thing. Among the young people today desperately seeking alternatives, some have returned to organic materials by farming and renewed interests in pottery making, leather work, etc., which might be interpreted as an attempt to regain contact with reality or with nature.

Over-population is a most important issue. However, this seems secondary to a person's becoming aware that it is even an issue. This awareness is a mental state. It is necessary that man be able to see "what is" before he can adequately deal with "what could be" and avoid the frustrations that come from demanding "what should be." Today, one frequently asks the questions, "Is my meaning or place in life going to come from some externalized worth?" or "Will my joy come from external means?" Such thinking is precisely the kind that makes one run for the golf course to experience delight when he has a good score and displeasure when he doesn't. This very same kind of thinking causes one to seek a college education without knowing who he is or why he is there. This is the very same thinking that causes the white business executives to run home for their four o'clock cocktail or the young person to seek chemically-induced euphoria. The masses, at least in this culture, continue to become more affluent and insensitive to poverty here at home and especially abroad as they continue to deceive themselves, seeking immediate gratification and joy from the benefits of technology at a much greater expense without awareness of how costly their instant joy is becoming.

There are several aspects of human behavior which are not sufficiently emphasized that affect how man relates to others and to his universe. I would like to relate these to education and more specifically to industrial arts.

Man generally attempts to define what the universe "should" be, "ought" to be, or what it "must" be without recognizing that the universe "is" and will continue to be what it is regardless of the demands that human beings make upon other human beings and nonhuman aspects of the environment. I am speaking not of what one animal does in the more primitive jungle when he kills another for food. Feeding off another in the purest sense is natural, just as both identified and nonidentified minute bacteria eat away at every other living organism. However, only humans make demands on fellow humans as well as other forms of life and the inanimate. And when these demands of what "should" be overshadow the vision of what is, man creates a dilemma, whether this be the husband demanding what the wife should be, the teacher demanding what the student should be, or a person demanding that a tree should be something more than a tree. When one is motivated to produce something in accord with demands, one is motivated by perceived deficiencies based upon some definition. One soon loses touch with the natural flow of things that are meant to go together to keep things in balance, such as fish and water, the lungs and air, etc. In education, more specifically industrial arts education, I think it is not enough to show that certain things go together and certain things don't. When certain things don't work or harmonize, we might give up the demands that they "should," whether it be trying to make some natural material into something it is not meant to be or trying to make some child fit into a pattern of thinking for something he is not meant to be. This point may seem at first irrelevant; however, not until a generation of young people emerge who are free from what "should" be can there be those with the vision to clearly see what is.

Another point related to this, although not the same, is the need to be aware of what really is and when one is projecting. In our Western culture, much if not most of our description of another being or an object is projection. Our education is quite different from what is practiced in the East by Zen students and others. To simply see something and experience it as it is, is to be able to see another person without projecting one's own father or mother into that person. To be able to see, smell, feel a piece of wood without calling it walnut or cedar is as valuable as classifying materials. I am not suggesting that we give up all labeling, for it does have its conveniences. However, we should understand that as we teach people to label, we also teach people to experience through symbols, avoid dealing with what is, soon lose touch with reality. If a child learns only through the world of symbols representing the real, the child may grow with the advantages of language and at the same time become insensitive to real danger. As far fetched as it may sound, the primitive child did not need words to call the attacking animal by a name in order to know of the danger. His need for the label, a "lion" or something else, came into being as he communicated this to another. However, he communicates little if the other has not had a somewhat similar experience. Unless man can see the real dangers, e.g., what loud music does to the ear drum or cigarettes to the lungs, knowledge will have as much relevance as a child watching a blood-thirsty battle on television has to the young man who must enter into a combat situation. Meaningful education will provide much greater opportunity for students to fully experience, and even more important, to realize that the experience is the reality and that talking about, conceptualizing, and labeling all occur in the human mind.

This leads us to a point foreign to this culture; namely, that the "I" or the "me" and the "universe" are one, and that it is through the invention of language that we separate these. At the risk of sounding absurd, I knew this as an infant, for it was only through the development of language that I began to differentiate myself from the universe just as a cell in my body is very much a part of my body, and another cell could do the same if it had language. And when I think of a group of cells that comprise a finger, or an arm, I gain some appreciation for them, for I have some appreciation of myself. But the appreciation is not just with words, it is that I see all this as me. However, when I begin to cut trees, pump oil, and dig coal because I see myself as separate from these things due to Western teaching, I begin to lose my appreciation for these things and think not only in terms of "okay, so some germs hack away at me and I will hack away at some other things," but instead it is as if it is all out there for me to use. My examples may sound absurd; however, I am attempting to show that with the mind we can justify anything and soon lose sight of what really is. Not only can we justify anything with the mind, a form of self-deception, we can also lose ourselves since we have that fantastic capacity for being deceived and deceiving ourselves.

Getting lost in the system that we invent to serve us is, in my opinion, as important a means of self-destruction as the physical pollution around us. In more primitive times, systems and institutions were less complex, and man's existence was largely a result of his interaction with the organic surroundings such as growing food, building his own shelter, making clothing, etc. As population increased and man became more sophisticated, he built institutions to serve him. Institutions like education, government, corporations, marriage, the very institutions he builds to serve him may and frequently do become his master without his awareness. For instance, does man exist for the corporation, or does the corporation exist for him? Is technology the servant of man, or is man the servant of technology? Is medicine for the benefit of man, or do people now exist in order that the practice of medicine can continue? The very institutions we build take away our own responsibility. We can become so over-sophisticated that we soon exist for the sake of the speciality. Is it possible that man can prevent himself from being swallowed up by the institution, which is essentially a conceptualized phenomenon that he believes to be real? At one time, men performed work purely for survival. Then came the period when men seemed to become one with their work, and some kind of satisfaction came from this inter-relationship between man and nature, whether it be growing food or making pottery. Now we seem to be in a period where we speak of job satisfaction, prestige positions, the feeling of importance, economic wealth, and we become slaves to these very concepts.

Education has a role to play, although there is a paradox here. Education is one of the very institutions to which man has become a slave. With all of the superficialities of grading, testing, and emphasis on the world of symbols, I think that we need to get back to an educational process which helps us recognize that man needs to see the world as it is in order that he can see what man is doing to it. To do this, I think he needs to return to working with raw materials—namely, the infant who has not been brain-washed, the tree which has been untouched, the gems which have not been cut and polished—and he must not lose his appreciation for what "is" and what "is natural." He needs to recognize that as he changes any of these things, he must do it with caution because there is always a price to pay.

One might try to envision a glass of water filled to the mid-point and then he might ask himself, "Is the glass half empty or half full?" If he answers either way, he is projecting his own pessimism or optimism onto the glass. For the labels half-empty or half-full are mere evidence at that moment that the observer is not seeing what "is," but making something out of what he sees. In a sense, he has lost the awareness of himself. He separates himself from the universe and then projects an image. If not careful, he might even say that it should be half-full. The industrial arts and certain related fields like the fine arts and music have a historic tradition of being close to what is. It is my hope that the industrial arts educator does not lose sight of his contribution to understanding reality in that he becomes too much like most professional educators in order to gain some kind of respectability, for with this he loses sight of his closeness to what is real. While helping to interpret this technological age, one may need to return to an appreciation of the universe and of life itself, and to show that not all technological advancements are either necessary or desirable and in fact can be detrimental if in order to gain from technology it is at the expense of losing our senses.

Dr. Silverman is a psychologist at the Family Guidance Center, Reading, Pennsylvania

Technology, Environment, and Industrial Arts Education

Delmar W. Olson

Technology, environment, and industrial arts education, in verbal and academic proximity here, suggest the possibility of real live relationships. It is to the latter that I wish to direct our attention. To see relationships, we must see the individual identities of the three. The first, technology, while a common term in today's vernacular, is probably less understood than we suspect. Definitions given by anthropologists, sociologists, economists, and industrialists are different enough to suggest that each largely reflects the discipline to which it applies. I propose that we examine it rather fully. As we understand it, we can see potential relationships with environment and industrial arts education.

Technology is the multi-faced phenomenon in materials created and advanced by man to free himself from enslavement by nature, by environment, by technology itself, as well as by man. But when it is undisciplined, it enslaves its creator. Technology antedates Homo sapiens and is considered by a school of anthropology to have begun with a pre-man quadruped. He used pebbles as tools to crack mussel shells. The use of his forelimbs for grasping and pounding is thought to have been causative in the physiological development of Homo erectus, the biped. Man the tool-user preceded man the maker, Homo faber. This latter role is thought to have contributed to him becoming Homo sapiens. Philip K. Buck reasons that early man through his invention of tools and techniques was making himself more intelligent without realizing it. The more sophisticated his tools and techniques, the greater were his chances for survival. Eventually brains became primary to survival, replacing physical strength, speed, and agility.

In the 1000 centuries since his debut as Homo sapiens, man has so advanced his technology that he is presently being forced to pause and to ask himself if it is good for him. From the simple original pebble tools and techniques, technology has become a multi-faced cultural phenomenon in materials functioning in many roles. Eight of these are offered herein.

FACES OF TECHNOLOGY

Among the faces of technology we find its identify, its nature, its design, and its potential. Reading each face tells us something about technology. But for each face there is a counter face. These show technology as complex and intricate in its impact on man, environment, and culture. They focus on a nose-to-nose confrontation, and in this we find possibilities of collision and conflict, as well as of compatibility. Both face and counterface are necessary for adequate identification of technology.

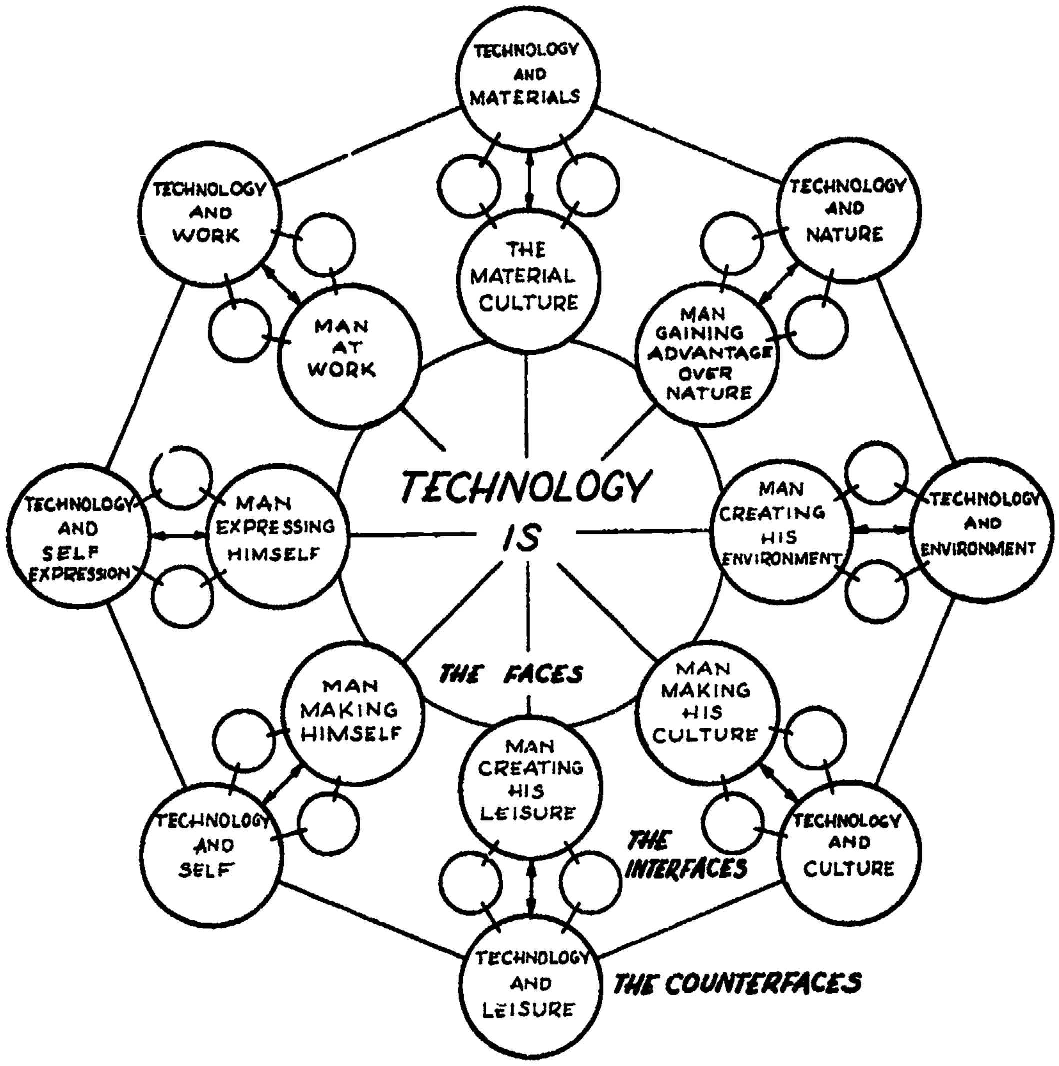

Figure 1. Technology: its faces, counterfaces, and interfaces

Technology is the Material Culture

Technology is the accumulation of what man knows about and does with materials. It began with tool using and has a history as old as pre-man. Its future will be as great as man's imagination, for it is from this that it emerges. Within the material culture are the techniques, the traditions, achievements, knowledge, and experience accumulated over thousands of centuries. Out of this has come the science and art of materials and processes, the theories and practices of engineering, the techniques of the craftsman, and the production of industry. It is this material culture which provides the technical content for industrial arts education.

Technology is Man Gaining Advantage Over Nature

The brain possessed by Homo sapiens enabled him to solve problems required for his survival. Lesser creatures instinctively ran away to avoid danger. Learning to tie a stick onto a rock gave him an advantage over the rock held in his hand. Learning to transport fire and then to make it prepared the way for advanced inventions and discoveries with materials and tools. Technology is man's means of taming a hostile nature. Today he makes his own climates within his buildings. He travels where he will, overcoming forces of nature. He creates materials when nature has not provided what he wants. He replaces muscles with machines. What he creates in his technology, nature has not provided for him.

Technology is Man Creating His Own Environment

The early hominid survived only in a hospitable environment. Nature covered him with fur for protection against the cold. In shade he could escape the burning sun. With the development of the brain, early man learned how to cover himself with fibers and skins for protection against the weather. With its further development, he was able to transport and eventually to make fire which gave him warmth. It also opened the way to exploitation of nature as he discovered the effect of heating on materials. The construction of shelters increased his chances for survival. Early man's primary goal was survival and existence. His technology gave him an advantage. Where man cannot control an inhospitable nature, he creates an environment with his technology to gain an advantage. His challenge and answer to nature is his technology. Today he builds what he thinks are earthquake-proof structures. He controls climate within his buildings. He constructs lakes and reservoirs and reroutes streams and rivers. He has developed a portable environment in his transportation vehicles. He uses these to change one environment for another. He builds cities, suburbs, megalopoli in which to live and to work. Roads and air routes tie his environments together. He demolishes an old man-made environment and replaces it with a new. He destroys the natural environment and replaces it with his own. He is designer, builder, consumer, and judge of his own handiwork.

Technology is Man Changing His Culture

Technology with all of its materials and things is manifestation of culture to an anthropologist. Culture is the conventional knowledges, understandings, customs, standards, practices, and processes which are transmitted from one generation to the next and involve the process of learning. Culture itself is intangible and unseen, but it is known. Technology the tangible, then, impacts on and changes culture, the intangible. The airplane, automobile, radio, and television are changemakers not only in environment but in culture itself. Each is an idea, a conveyor of ideas, and a generator of ideas. New ideas collide with the older culturally accepted patterns. In our time, we are seeing the collision and wondering about the survivors. Without technological advance, culture change is slowed.

The classic example of technology-induced cultural revolution in this century is likely to be Japan. The oriental culture of World War II days has largely been replaced by the occidental.

Technology is Man Expressing Himself

Technology, no matter how primitive or advanced, is man-conceived, man-made, and man-used. From its beginnings, technology has stood as a symbol of achievement and as experience in self-fulfillment. Man, by nature a creative creature, finds materials the natural medium for the expression of ideas. The making and using of tools and materials must have provided pleasurable experience for early man. Had it been otherwise, he would likely have avoided it. While much of the emphasis in today's organized technology is on the economic, man is still by nature a builder and creator. Man will express ideas with materials for the satisfactions he gains, without profit or necessity as the motive. When he has time to do what he really likes to do, expressing himself with tools and materials is high on his list. His tools may be a saw and hammer, a camera and a darkroom, a boat and trailer, a chunk of clay and a wheel, or other. Those of us who observe boys and girls at work with tools and materials in industrial arts know that the experience is pleasurable. We sense the feeling of achievement and fulfillment gained, and we see that the experience is highly educative whether the child realizes it or not. It is natural for man with his physiology and his intelligence to create and to manipulate.

Technology Is Man Making Himself

Man is by nature a builder and a creator. He can find himself and his reason for existence in these creations. But his "thing world" causes him to change his conventional patterns. He wants to use what he has created. In society, the pressures to its use are economic, political, social, or other. As technology advances it changes the culture; it changes the way man thinks and lives. It takes over more and more of individual man's responsibilities and skills, replacing him with machines. Man's goal in machines is to reproduce himself: in mechanics, electronics systems, and circuits, witness the computer. Each generation of computers becomes more like its creator. Man is making this machine in his own image. He doesn't know at this time what he will become as his creation takes over his own identity, but he is currently beginning to wonder.

Technology Is Man at Work

Technology can be seen as man at work in an organized institutionalized manner, producing quantities of goods and services for mass consumption. When done for profit rather than for pleasure, he calls this effort industry. Man, being by nature an active organism, has traditionally used work to satisfy the urge to activity, as necessary to existence and as reason for his existence. One's work has been a symbol of his social acceptance. The Protestant ethic gave meaning, purpose, and value to work with a Christian religious ethic. To certain religious orders, work, especially manual labor, has been considered next to Godliness.

Technological advance has changed the nature of work as well as of skill. Jobs become obsolete and new jobs are created. The emphasis on the economic as a national goal has no doubt tended to minimize the personal, spiritual, and emotional values in work. The greater the income, the more material things can be purchased.

Technology Is Man Creating His Own Leisure

Ever since man was able to gain enough advantage over nature to have and to know leisure, the sociocultural purpose of work has been leisure. Technology throughout its history of advance has minimized, simplified, and eliminated work. If man's purpose in work is leisure, it can be seen that the purpose of technology is to provide that leisure and at the same time to produce those things with which he can use his leisure. The increasing hours and dollars spent in leisure in this country bear this out. The decrease in the length of the work week, the increase in the length of the week end, and the increase in the frequency of vacations with pay identify a fundamental change in our culture. We are currently involved in what is likely to be the most significant revolution in all of history—the change from a work-based culture to that of a leisure-based culture. Much of the public pressure for the preservation of the natural environment within this decade has originated with recreation enthusiasts. In a leisure-based culture, man will have the time to do what he chooses and to become what he has the talents for. This could be the real Golden Age of Man.

TECHNOLOGY COUNTERFACES

For every face of technology there is at least one counterface, an area of confrontation in which we find technology taking on alternate identities which are causing difficulty for man. These which follow seem to be particularly pertinent for our study in industrial arts education.

Technology and Materials

The planet has been man's source of materials for the development of his technology. When nature did not provide them in readily usable form, he devised ways to do it. He melts down rock to get pure metals. He converts wood into plastics. He created elements in atomic fission. After the 1000 centuries of consuming his planet, man finds himself in a position of materials depletion. He also finds that the waste created in his technology is clogging his streams, lakes, and oceans and polluting the air he breathes. He is finally acknowledging what was taught him in his high school science, that matter cannot be destroyed. It can be changed and displaced. The technological waste materials are also his mass production. To this, both the factory and the consumer contribute. Thus, he has two great problems in materials: the depletion of the planet's raw resources and the abundance of waste. It is apparent that he must now devise means of using less of the former and reusing more of the latter. While recycling of materials has been practiced in certain manufacturing, it now becomes essential in general practice.

Technology and Nature

The challenge to man of gaining advantage over nature has spurred the advance of technology. Now its control has become his goal. He digs, fills, and builds where he will, using and consuming the natural environment indiscriminately as though it didn't matter to nature. At this moment, he is finding that he is only one part of the ecological system and that this system if out of balance is hazardous to him. Nature, he is discovering, in the long run dominates man. Man is only part of nature. Nature is not a part of man. Man's wanton destruction of nature to produce his own environment, his technology, is backfiring. He can deplete his oxygen, destroy his fresh water and wildlife, contaminate his food, and eliminate himself just as positively as with his hydrogen bomb.

Man and Environment

Man's efforts to create his own environment to suit his own desires have produced monumental achievements with materials. Technology is man's tool and his strategy for satisfying his own desires. It is his tool for shaping the natural environment to suit himself. The environment he produces, however, molds the culture and defines the quality of human life possible within it. He is finding that nature has its ways of expressing its design and demands. The man-made environment has the capacity of choking out human life, although man did not intend it so. The waste, pollution, litter, junk, and garbage are competing with him for space on the planet. Fresh water supplies are diminishing and the ecological balance in nature is in danger. Overdoing his handiwork, as pleasurable as it may be, with over-exploiting the natural now faces man with the challenge to survive. If survival is possible, he has no alternative but to re-order his environmental priorities.

Technology and Culture

Advancing technology impacting on the culture and changing it literally pulls the rug out from under the people. It undermines the ethical and moral values system. The customs, manners, mores, norms which through time and usage provide the cohesives and adhesives in a society are subject to destruction, question, and eventually replacement. But technology by itself is not responsible. It is only the agent of change. Our national goal of an increasing GNP keeps pressing technology to advance and to make earlier technology obsolete. The measure of health and well-being of the nation has come to be this increasing GNP. Greatness and goodness are marked with dollar signs. Technology redirected toward a qualitative goal in living rather than the quantitative consumption of things is being called for. Such a redirecting will cause major cultural change. Many evidences of this are accumulating. The concomitant shock is being felt in economics.

Technology and Self-Expression

The counterface for self-expression in materials must be self-discipline. A disciplineless self-expression breeds acceptance of all production as good. "Whatever I create is good. It is good because I created it." The disciplined expression inquires about the identity of good, the marks of excellence. And excellence becomes relative to more than the creator. It must be relative to now as well as to the future. It is relative to the social, the economic, the moral, the spiritual, and the cultural. Technology disciplined only by the economic has brought us the highest level of materialism. To redirect this will require a national discipline.

Technology and Man

If man has the capability for making himself, he may well have to ask himself what kind of man he would be and where he should get the specifications. Once these are accepted, he can design his technology accordingly. And with this technology he can make himself. While this may sound overly hypothetical, man is faced with just this problem at the moment. Is he designing himself against his will? Can he agree on a design for man? Will he ride his technology, or will his technology ride him? Indiscriminate technological advance is pushing man to make decisions that he may not yet be qualified to make. He has yet to be able to understand the power of the technology which he conjures up out of materials.

Technology and Work

Technology through the centuries has provided man with activity and with work. His input, muscle power and brain power, has yielded him income with which to purchase the things which technology produces. Technology thus has provided man with reason for existence. He has had to work to live. But advancing technology has brought about change in work, in skill, and in attitude toward work. One century ago the workweek in industry was approximately 65 hours. Today it is approximately 37. This is nearing a 50% reduction, and the trend continues. The most rapidly-growing sector of occupations today is that of the services through which technology is kept operable. The all-round versatility of the early craftsman with his command of materials and tools, his inventiveness, and creativity is no longer typical of work skills. Such competence is more likely to appear in recreational activity. Technological advance, then, seeks to eliminate work as we have known it, even though numbers of jobs have increased through the years. In eliminating minimizing work, it changes the nature of work and of the skills involved. With man unable to find his fulfillment in work, his attitude toward it changes. His paycheck then opens the doors to what he seeks out of life.

Technology and Leisure

One of the major socio-cultural problems of our time is that great masses of people have more discretionary time than they can wisely use. The two generations presently in the wage-earning role are products of a work-based culture, with their life goals and activity largely work-oriented. Even though the ultimate purpose of their work may be leisure, work regulates much of their lives. Though the job serves increasingly less as man's means to self-fulfillment and self-expression, to look elsewhere for this takes some doing, especially in leisure with its traditional connotation of time for play. When discretionary time can be used for purposes of re-creation with the accompanying discovery of self and development of new interests and talents, the shock of the change is eased. This may well become society's major problem and challenge in the immediate years ahead—to make optimum use of a maximum of discretionary time.

Technology and Environment

As has been postulated, technology is man creating his own environment. This is the environment of the man-made. Today's environment is the technology. The slum and ghetto are man-created, including the shabbiness, filthiness, and junkiness. The environment of business and industry is all man-made. The suburban developer creates the kind of environment that he can market. The farmer reorganizes the natural environment to give him the advantage he needs. Wherever man settles he creates his own environment, and in our country this is the technology.

If technology and environment are one and the same, man has made them so, not nature. The natural environment can exist without technology, but technology must exploit nature to be. The relationship between them depends on the degree of the exploitation. However, nature has its way of asserting itself. We are aware of evidences which suggest that "Nature is going to get us if we don't watch out."

Must technology and nature be in conflict? Can they become compatible? Is there a technology which can support nature (and this includes man)? At this point in history, we have no choice if man is to survive on this planet. It is by no means certain that he can move to another when he has destroyed this one. The technology of the future is the new technology. It is new in that it co-exists with nature and is subservient to it. Before advance is made, the long-term consequences for nature and for man are considered. Man becomes a student and champion of the natural environment because he must. Of course, the acceptance and development of this new technology will not be easy or immediate. Because it calls for a reordering of national as well as personal values, it is total, inclusive, and consuming. It is at once destructive and creative of culture. The new technology accompanied by the new leisure offer man a kind and a quality of living entirely new to him. The alternatives are rather obvious, but it is man who must make the commitment.

INDUSTRIAL ARTS EDUCATION

Industrial arts education has come through the years with a variety of emphases and definitions, but the common thread continues to be the technical. In the past two decades, the inclusion of the term technology has appeared with increasing frequency. For purposes here, it appears that industrial arts education must include the technological if there is much of significance to be made from any relationship to technology and environment. To place it in an educational posture, industrial arts education is seen as the interpreter of technology for the American school. And this, then, makes it the interpreter of the man-made environment, according to our earlier assumption. Such a role gives industrial arts reason for existence that becomes increasingly significant with time and technological advance. Industrial arts education now takes responsibility for a basic, fundamental education which every American needs because he lives in a technological environment. To interpret means to bring out the meaning of, and to do this technology becomes the discipline and the curriculum for industrial arts education. The following definition for such an industrial arts is offered. We call it a new industrial arts.

"Industrial arts, a discipline in general education, is the study of the technology: its origin, development, advance, and impact; its technical, social, economic, occupational, cultural, recreational nature and influences, involving the student in study, research, experiment, design, invention, construction, and operation with ideas, materials, tools, processes, products, and energies. Its purposes are to acquaint the student with the technology, the technological culture and environment, and to aid him in the discovery and development, release, and realization of his own native potential therein, enabling him to better cope with cultural change caused by technological advance. In this role it becomes the interpreter of technology for the American school."

PURPOSES OF THE NEW INDUSTRIAL ARTS

The purposes of the new industrial arts are seen at two levels, primary and secondary. The primary purposes are those by which industrial arts functions as general education for all students. From these the secondary purposes are derived. The primary purposes are:

(1) To assist the student in interpreting the technology; to bring out its meaning, origins, development, role, impact on, and consequences for man, culture, and environment.

(2) To assist the student in the discovery, development, release, and realization of his talent-capability within the context of the technological culture and with the media of technology: materials, tools, machines, products, ideas, and energies.

(3) To assist the individual in learning to cope effectively with a culture continually in impact with himself and with technological advance.

The secondary purposes include those objectives of the individual teacher applicable to and appropriate for specific courses or areas of subject matter as well as those peculiar to and for his individual students. They include what are commonly called behavioral objectives. Among them are the goals of the individual student as he seeks to find himself within industrial arts. Secondary purposes are best set by the teacher and the individual student in consultation and commonly include the acquisition of knowledge and skills, the formulation of understandings, and the development of appreciations, all relative to the student and his technological environment.

A CURRICULUM FOR INDUSTRIAL ARTS

Man creates the technology; both combine to effect the technological culture and to affect the natural environment. This threesome, man, technology, and culture, constitute the source of subject matter for the new industrial arts within the physical context of the environment.

THE TECHNICAL COMPLEX: The means and media of technology, the environment of technology. The following are typical curricular components as major areas of study and experience.

Materials	Handcrafting	Construction	Operation
Processes	Manufacturing	Industries	Controls
Products	Power	Engineering	Records
Tools	Transportation	Facilities	Service
Machines	Communications	Consumption	Manpower

THE HUMAN COMPLEX: Man is by nature a creator and user of things. The following are typical curricular components as major areas of study and experience.

Ideation	Research	Purchase	Operation
Imagination	Development	Consumption	Occupations
Invention	Design	Aesthetics	Safety
Creation	Principles	Organization	Recreation
Planning	Theories	Legislation	Evaluation
Experiment	Selection	Health	Interpretation

THE CULTURE COMPLEX: Technonogy is a man-made force changing man, culture, and environment. The following are typical areas of impact and consequence for interdisciplinary study.

The historical	The political	The occupational	The scientific
The economic	The individual	The recreational	The industrial
The social	The educational	The religious	The ecological
The aesthetic	The environmental	The international	The philosophical

Such a curriculum takes the form of a fluid rather than the conventional solid because as technology advances, its impacts and consequences on man, culture, and environment change.

INDUSTRIAL ARTS, AN EDUCATIONAL CONTINUUM

Industrial arts is a continuum from kindergarten through twelfth grade and beyond. Each level is essential for optimum student growth and development. The curriculum is drawn from the three preceding complexes, the technical, human, and culture. It is proposed as an effective general sequence of study and experience, considering student needs and readiness. The sequence at the junior and senior high school may be altered with an interchanging of areas. The totality as a continuum is essential for optimum educational value.

THE ELEMENTARY SCHOOL: technology as the World of Things, the man-made environment:

Kindergarten: the child meets technology
Primary: technology and the home
Intermediate: technology and the community
Upper: technology and the world

THE JUNIOR HIGH SCHOOL: technology and the Age of Materials and Machines:

Graphic arts	Ceramics	Tools
Paper	Plastics	Mechanisms
Leather	Metals	Machines
Textiles	Woods	Systems

THE SENIOR HIGH SCHOOL: technology and the Age of Man:

Power	Construction	Research and Development
Transportation	Manufacturing	Industrial arts recreation
Electricity-Electronics	Services	Technology-Man-Culture
Communications	Management	

PROGRAMS WITH SPECIAL EMPHASIS: technology as learning and as therapy:

The gifted	The slow learner	The dropout-prone
The culturally deprived	The underachiever	The handicapped

TECHNOLOGY, ENVIRONMENT, AND INDUSTRIAL ARTS EDUCATION

A functional relationship of technology, environment, and industrial arts education puts the latter in the role of interpreter of the other two. In this capacity, industrial arts education has both challenge and responsibility of such magnitude as to require a substantial re-design of its structure as well as its purpose. Seeing it as a new industrial arts in no way minimizes its earlier nature and contributions any more than a new model automobile reflects poorly on an antique model. Rather, it suggests that industrial arts education can grow with the times, increasing its sophistication as it improves its service to mankind. In my thinking, there is no greater role for industrial arts than that of interpreter of technology. It appears to me that this function comes naturally to industrial arts because of its traditional acceptance of materials, tools, and machines as having educational value for boys and girls. We will do well to let it grow and develop into its natural potential, giving it all the assistance needed. The obvious first step for a teacher who is fascinated by the concept is to get acquainted with technology as the socio-cultural phenomenon that it is. From this vision of curriculum, methodology, projects, and facilities arise. And we need greater visions in industrial arts.

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Improving the Environment *Via* Industrial Education

John P. Sellarole

The improvement of today's environment and the preservation of an effective ecological system is the concern of today's society. The secondary school student is bombarded with information concerning the deteriorating environment he lives in. All day, in and out of school, students are exposed to propaganda depicting our suffering ecological system. Pollution, ecology, environment, community involvement, run-down cities, etc., are part of life today for the young and old of society. In and out of the classroom today, students learn of society's positive and negative aspects. TV, newspapers, magazines, students' peer groups, etc., all display concern for society and its environmental problems. The student cannot escape exposure to today's problems.

Teachers concerned with many various subject fields talk to and enlighten students on this timely subject. The industrial education student has the know-how and hardware to do something creative to improve his fellow man's environment. The industrial education students in three East Side Union High School District schools (Mt. Pleasant, William C. Overfelt, and Andrew P. Hill) in San Jose, California, felt that most people who were doing the talking about problems really did not have any immediate, constructive, creative ideas to work toward the elimination of today's environmental problems.

Today's young men in industrial education classes are keenly aware of brotherhood and helping their neighbor. Many educators have always felt that the industrial education

student had to build a project he could take home to his family. This is not true. The students in the three schools mentioned above helped to build projects which they did not take home—they took them to their community. They felt because of their background in industrial education that they were "doers," not just "talkers." The teachers and students held that the schools must become involved in the community more deeply in order to help improve their local environment. The days have passed when the schools can operate separately from the rest of the community.

In order to get this particular project underway (School-Community Project), the students met with teachers, college professors, and supervisors. The key to the success of this environmental improvement project was that the students were involved from day one. They brought up problems, made suggestions, and helped to formulate decisions and develop a system of attack for this project. Initially, many ecological projects were discussed. The students felt that there were enough problems in their own community without looking beyond.

Many possible projects were discussed: developing playground equipment for local parks, building attractive bus stop shelters, toys for local children's centers, bulletin boards for supermarkets to be used to display items of community interest, to name a few. The list went on and on. After a few meetings, the group decided that they wanted to improve their immediate environment via the local children's centers, in which young children are housed for day care purposes. The students visited the centers and found them lacking in toys, toy storage cabinets, and furniture.

They met with the directors of the three children's centers in order to ascertain exactly what was needed at each individual center. A long list of priorities was set. Storage units, room dividers, various toys, and a large sign for two of the centers were among the first projects undertaken.

Initially, funds were obtained with two small grants received by Dr. Howard S. Decker, Chairman, Industrial Studies Department, San Jose State College.

Students and teachers from the various schools approached the project differently. Some worked during class time, while some decided to work only after school and on Saturdays. Others combined both approaches.

The vigor displayed by students involved in this project was astounding. One teacher who had a few "problem students" got them involved in the project. They felt that they were accomplishing something concrete via the project. The attitude change of these students in class was tremendous. Many students commented that environmental projects such as this make school a "lot more interesting." It has been obvious that industrial education students enjoy applying their knowledge, skills, and techniques in order to help to improve the environment of their community.

The student of today must know why. He must be involved in the curriculum.

Now that most of the items for the children's centers have been completed, the students have decided they would like to improve the local parks. The parks need benches and barbecues in order to make them workable family centers. Contacts and meetings

have been underway with the San Jose Parks and Recreation Department to discuss plans, priorities, and funding. The Santa Clara County Board of Supervisors has also been involved in the project since county funds will be involved. The county, city, teachers, and most important, the students, want to keep the School-Community Improvement Project underway. The reason this project got started and is still working today is because the students had a "part of the action" right from the first day. They met and conferred with adults, educators, and community people in order to discuss problems, develop a plan of attack, set priorities, and make decisions. They did the work, and as an end result, have seen the ecological scale of their community rise. They improved their environment via industrial education.

"They didn't just talk about it—they did it."

Mr. Sellarole is the Industrial Education Coordinator for the East Side Union High School District in San Jose, California.

The Role of Teacher Education in the Environmental Crisis

Lee H. Smalley

Arnold Toynbee, the English historian, says that the responses made by individuals and institutions to challenges will determine which civilizations gain in power and which ones fade away. Education in the past has not responded rapidly to changing social conditions. This has not always been the fault of educators, for they need societal support for the implementation of their changes, but they cannot escape some of the responsibility.

Americans are confronted with problems concerning the quality of our environment. This is the challenge—What will be our response? This presents to educators another opportunity to test our values, to try out our machinery for change, and to answer the students' charge of "irrelevant" and the public's cry of "ivory tower." Some of the subjects in schools are working around the edges of this problem, but what about the responsibility of industrial arts? Our objectives, our mission, our goals, and our definitions all point up the responsibility of industrial arts to things technical. Many of the environmental problems are technologically oriented, so the challenge, the opportunity, and the responsibility seem clear. Industrial arts teacher education must present a model of the kinds of values, behavior, activities, and expectations that we have for the industrial arts teachers in the public schools.

This is a simple charge but a difficult assignment. We are so used to telling students, "Do as I say, not do as I do," that this is troublesome. We cannot build in a 40-year lag between the time we start talking about an idea in teacher education and the time it is generally implemented in the public schools. In the past we have been able to afford this time lag, but this crisis in our environment will not allow us this luxury. If we are to have any influence on this societal problem, then it will have to come soon. We will be most influential as models. There are some other, more conventional ways, such as magazine articles, speeches, workshops, etc., but these will be largely ineffective unless we ourselves change and exhibit this change.

And so, what are we to do? There have been many and numerous suggestions as to what individuals can do to improve the environment. Let me just list a few that may be more uniquely appropriate to us in industrial arts teacher education.

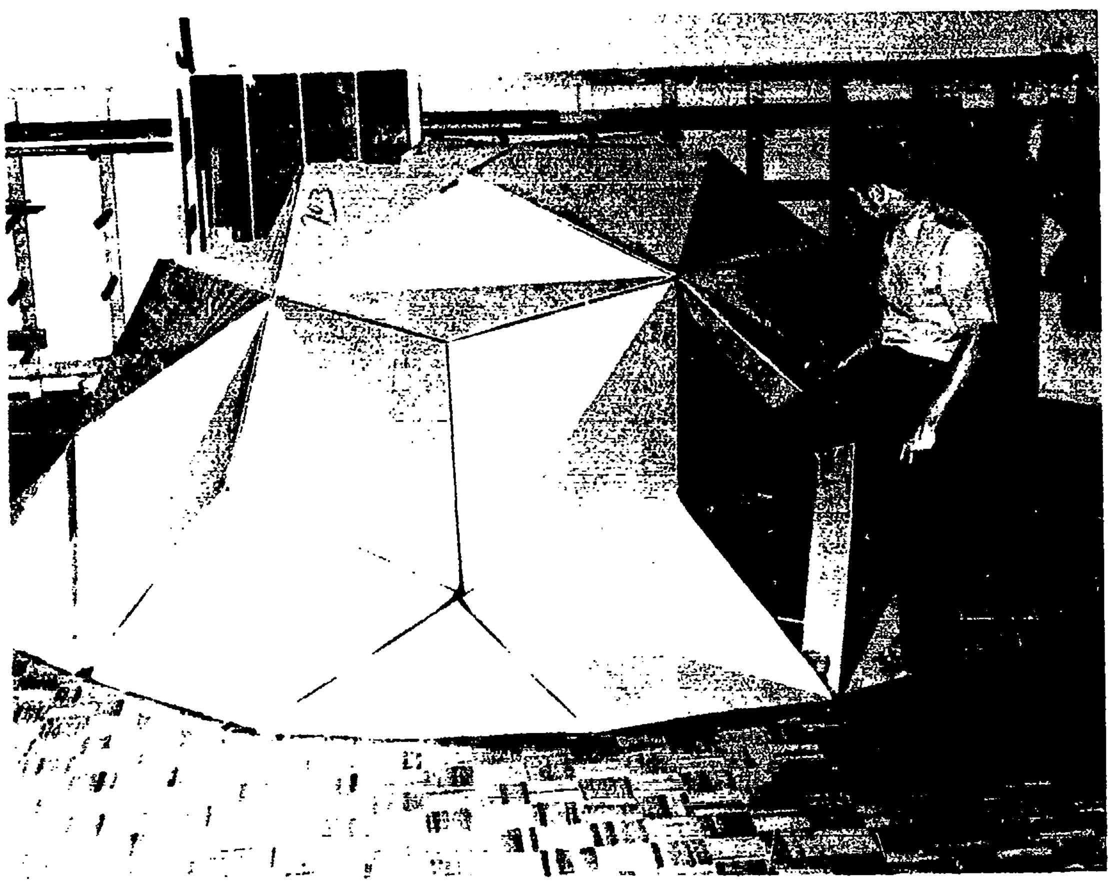

Figure 1. Recycled corregated boxes provide an ecological playhouse for pre-school children.

- Develop measuring instruments for air and water pollution.
- Experiment on mufflers and acoustical material to retard noise pollution.
- Build displays of how materials can be recycled.
- Redesign consumer products for more efficiency and safety.
- Study and report on the effect of industrial practices, or of technological changes.
- Consult with city officials on a proposed model city or urban redevelopment.
- Work with the science department on building equipment for experiments they would perform in this area.

- Build models of steel mills, sewage systems, paper mills, and nuclear power plants to show how they contribute to air, water, and thermal pollution.
- Test different devices on a car engine to "clean" it up.
- Build models of proposed alternatives to the internal combustion engine.
- Make a notebook of articles from magazines and newspapers on both positive and negative aspects of industry and technology.
- Test consumer products for adverse effects on humans or animals.
- Recycle paper used in school.
- Research methods to reuse sawdust.
- Check the school environment as to ecological practices.

There are many other things that we can do, but the important point is—we have to do them.

Education again has an opportunity to become relevant to the society within which it operates. How the teachers, administrators, and school boards respond will indicate the quality of the education our children are receiving. Interest and concern for the quality of our environment has increased in the last year to where there is hardly a magazine, a newspaper, or a TV news broadcast that does not make some reference to this concern. Once the population is alerted to the problem through the mass media, it is the job of teachers to teach so that their students may make intelligent judgments. Politicians are also "hot" on this issue, but the mass media and the government will move to other "hot" areas. Teachers must incorporate this into their teaching so as to sustain the interest and reverse the trend we are now in. Industrial arts teacher educators can provide needed examples and leadership to others who do not so clearly see the crisis in our environment.

Toynbee also observed that in each thriving civilization a "creative minority" was active in having the will, the vision, and the energy to carry out necessary programs to keep the society viable. Can industrial arts teacher educators be this creative minority to keep a part of our educational system contemporary, relevant, and viable? How many more chances are we going to get? Time may be running out for marginal courses that seem to have more to do with the history of how things used to be than with a contemporary and future look at the kind of environment we are going to be living in.

Kenneth Clark, in that tremendous series, Civilization, ended the series with the program called "Heroic Materialism." As he was looking to the future, he said, "We can look to the future and be optimistic, but we cannot be joyful." Can we help change the world enough so that we can look to the future and be joyful? I hope so.

Dr. Smalley is a professor of Industrial Teacher Education at Stout State University, Menomonie, Wisc.

Educational Psychology

Human Behavior in Teaching Industrial Arts in the Space Age

Richard Warner

One becomes astounded at what the nation's educational system in this country has accomplished since its inception as a mass educational program in Massachusetts in 1852. Technological progress has advanced beyond even the highest expectation of the leaders of the nation, and it is no secret that our educational system has much to be proud of in helping to make such advances possible. No area of our society has progressed more than the medical and physical sciences, as seen by the human footprints in the shade of the American flag on the surface of the moon or the substituting of one human heart for another in man's attempt to prolong the life of less healthy individuals. Certainly our educational institutions at all levels have contributed greatly to these endeavors.

Silberman tells us in Crisis in Education (Ref. 1) that 85% of the students entering school will graduate from high school by the middle 1970's. He also states that the other countries of the world are astounded at the ability the United States possesses to educate vast numbers of people at the higher educational levels and that they use our higher educational system as models for their own programs.

We have a great educational system in this country—great in many ways. It is absolutely unbelievable the content that is interwoven throughout the educational system and the knowledge that our youth gain from living in such an environment. Just compare the high school student and his bank of knowledge with his compadre of ten years ago. Junior high school students are doing things relating to educational subjects and practices that I didn't study until I went to college.

Before we pat ourselves on the back too vigorously, there is another factor that hasn't been mentioned. What about the individual, as we review all of our accomplishments in this country? Has the individual been able to cope with all of this showering of educational enlightenment? Materially speaking, the individual's life has been made easier through the efforts of our technological society. The variety of products that industry has placed in the store windows is incomprehensible. However, we all are concerned about the plight of the citizens of this country when considering the numerous challenges with which we are faced. These challenges will be referred to in this paper as human behavior problems of society.

HUMAN BEHAVIOR PROBLEMS OF SOCIETY

The incidence of delinquency and various crimes in the U.S. has increased at a phenomenal rate this last decade, mostly in the teen-ager and young adult brackets. It was estimated in 1967 that approximately 3 3/4 million serious crimes were reported to law agencies. About half a million of these crimes involved violence—murder, rape, robbery, and aggravated assault, most of the criminals being young males. If present trends continue, it can be assumed that approximately 40% of today's male children will be arrested for crimes during their lifetime, excluding traffic violations (Ref. 2).

Alcoholism ranks as the fourth most prevalent disease in the country, with some 6.25 million alcoholics and about 200,000 joining their ranks yearly (Ref. 3).

Did you know that 2/3 of all murders each year involve persons who know one another, and that marriage quarrels result in the largest group of murders (Ref. 4)?

Over one-half million people are behind bars, with approximately one million on probation or parole as a result of crimes committed (Ref. 5).

Mental illness is the number one health problem in the U.S. It has been estimated that one college student out of ten will need help because of serious personality difficulties. Three out of ten persons who are hospitalized for surgery have had mental disorders of one type or another (Ref. 6). The cost of keeping mental patients is well over a billion dollars yearly, with New York alloting 38% and California 25% of their annual budgets for that purpose. Young people are more susceptible to mental disorders than older persons, with the more educated having a much higher rate than non- or less-educated people (Ref. 7).

Much attention has been focused upon the suicide problem, which ranks third among causes of all deaths for those of college age. Each year more than 200,000 suicide attempts are made, with some 25,000 succeeding. These cases encompass all socio-economic and occupational classes. Suicidal people are not usually mentally ill, but they are extremely unhappy. They don't attempt the act on an impulse; a suicidal attempt usually is a cry for help to save the person's life, and suicide is not inherited (Ref. 8).

A good estimate would indicate that 90% of all police calls are from people who have problems within their own families or with their neighbors (Ref. 9).

And so the list of undesirable facts and parasitic statistics grows. In spite of the material and scientific changes that have transpired before our eyes in this generation, man still appears to feel lost and alienated, almost as if he is moved about by unknown forces. We seem to have solved the problem of meeting man's lower needs such as food, clothing, and other materialistic necessities but man still is faced with the problems of feeling, of belonging, of being worthwhile, and of satisfaction that he has reached his potential. Hersey and Lugo say it well with these words (Ref. 10):

> When the history of man in the twentieth century is written, it may be said that our greatest tragedies were not the terrible earthquakes, the series of wars, or even the dropping of the atomic bomb on Hiroshima, but that so many millions of persons lived and died without even realizing the tremendous human potential that lay undeveloped within themselves.

Lest we forget, all of the persons who are statistics in the problems just mentioned were educated in our schools under our jurisdiction.

I believe that studying and researching the human behavior functions of man which are the very foundations of a person's life and then applying the data acquired to all aspects of learning from the cradle to the grave will greatly reduce most of the problems discussed and many other psychological problems. Much of the information already acquired which can be validated is not being utilized to its fullest extent, as seen in the family setting and in all institutions of learning.

GOOD LEARNING CLIMATES

The field of human behavior and the process of learning is so extensive that no attempt will be made in this paper to touch all bases. Learning climate here refers to the physical and psychological surroundings that constitutes that area where learning takes place. This must take into account the learner and the teacher, the two main actors. As we know, learning can be acquired in practically all facets of our lives, but we are concerned at this moment with the school and its classrooms. A school where fear, anxiety, frustration, anger, conflict, and a threatening atmosphere prevails may constitute a breeding ground for many of the problems of our society today. Therefore, it is imperative that anything that blocks learning in the classroom be removed so as to help prevent the failure in any sense of the word of a person's life.

What are good learning climates? To attempt to lay the ground work for an understanding of the elements of learning climates, we must familiarize ourselves with feeling and emotions.

Feelings and Emotions

Emotions are defined as an experience or mental state characterized by a strong degree of feeling and usually accompanied by motor expression, often quite intense. While feelings are our perceptions of ourselves, of the situations in which we are involved, and the interrelationship of these two, they are also the faculties by which one perceives sensations of pain, pressure, heat, etc.

Feelings somewhat depend upon what life brings to the individual, with some people having a predominance of positive feelings despite great adversities. Others are constantly fearful, angry, and resentful, even when they seem to be living in a favorable environment.

It makes no difference what the situation might be; everyone tends to have feelings and emotions of some kind whenever an action or thought is concerned. Emotional reactions involve conscious feelings and also physiological changes which, if given an opportunity to become chronic, may lead to some type of psychosomatic disorder. Everyone should encourage positive emotions and discourage negative emotions. Emotionally competent persons usually manage to keep the balance on the positive side.

Emotional competence is dependent upon an accurate frame of reference within an over-all maturity. How a person perceives a situation will determine what emotions he will arouse. If he sees no threat, he feels no fear, regardless of the real danger. If he sees his performance as superior, he will feel elated. If he sees himself as unfairly treated, he feels angry, whether or not his perception is accurate. If he sees himself as inadequate and unloved, he may feel perpetually anxious and discouraged, whether his reasoning is just or not. How important it is for a teacher to recognize these behavioral traits in students (Ref. 11)!

Man is as consistent and predictable in his emotional responses as in his perceptual habits and thought patterns. Those events which arouse the emotions in him, the emotions that they arouse, and the methods he uses to control and express his feelings are important to the over-all pattern of strategies which make up his life style.

It is easy for us to assume that other people feel and react to situations the same way that we do. However, there is evidence that such is not the case. We do differ in the depths and ranges of our feelings, in our moods, and in the proportion of our positive and negative feelings (Ref. 12).

The events which can lead to pleasant and unpleasant emotions for us are as varied as our individual strivings and interests. Naturally, the more self-involved we are in a situation or activity, the greater its emotion-arousing potential for us.

The inability to develop a complete repertoire of emotions with appropriate intensity and depth may result from faulty attitudes, personal immaturity, or defenses against emotional involvement. Such failures, as in a case of one who lacks a sense of humor or is incapable of love for someone else, may seriously limit the richness and meaningfulness of a person's life.

When an individual experiences a general lack of confidence in himself and starts to perceive himself as nadequate, he becomes highly prone to the effects that stress, anxiety, and frustration have on mental health. He has a tendency to break down and become unable to tolerate situations which occur in real life such as delay in the fulfillment of need, frustration in achieving goals, competition, failure, and meeting the demands of society, parents, and friends (Ref. 13).

Students must remain free from crippling, short-circuiting anxiety, fear, and guilt. They need not assume such defensive postures as denial or repression, which impede learning processes. The teacher is the key variable in learning climates. All children will benefit from learning climates that free and maintain the freedom of the central nervous system to learn.

Feelings and Emotions of Students

Students need to be themselves, to live with other children and with grownups, to learn from their environment to enjoy the present, to get ready for the future, to create and to love, to learn to face adversity, to behave responsibly; in a word, to be human beings. To accomplish this, they need to have teachers who in some way meet the variety of emotions that students bring with them to school daily. All of a student's emotions influence his attitudes toward himself, other students, his teacher, his family, and the other persons with whom he associates. Emotions affect his ability to learn to read, to spell, to develop skills, and to think.

Most feelings and attitudes are learned at an early age, with students bringing to class a variety and intensity of emotions which may include fear; anxiety; failure to acquire self-confidence, self-reliance, and success; feelings of rejection and insecurity; attitudes of prejudice and intolerance to accept and respect differences.

Some of these feelings and emotions are situational or temporary, while others are persistent and chronic. Some are submerged, some are superficial, and others are natural and spontaneous.

In a school setting, the threat to the person's psychological safety is increased by being forced to bahave in certain ways. The individual will probably attack or withdraw in the interest of safety. This may cause the alarm systems of anxiety, fear, and guilt to disorganize or inhibit mental behavior. Defense postures like negativism, denial, and repression can curtail an individual's learning.

Traumatic experiences in the school setting are remembered by individuals long after the situation happened. They tend to remember vividly the teacher's emotional responses, even the teacher himself, long after they have forgotten the school, the skills, and the lessons that were taught.

One traumatic experience that happened to some industrial arts students who were in woodworking classes of a teacher friend of mine most certainly must be embedded in their temporal cortex. It seems that every now and then a student would bring his project to the instructor for some sort of evaluation, regardless of its stage of development. The instructor would give the project the "once-over" and woe be unto those that were considered less than desirable. In this case, the instructor would go to his office, grab a long-handled ax that lay in the corner, and then proceed to utilize that well-sharpened instrument to its fullest upon the products of these astonished students. Perhaps you might say that he was releasing his feelings in a very dramatic and external manner. I would concur, but the poor students and their emotions were somewhat unable to appreciate a mad-man and his ax.

Dr. Wilder Penfield, a neurosurgeon, experimented with patients and their brains by using a weak electric current which was transmitted through a galvanic probe placed at different spots on the temporal cortex. The patients were given local anesthetics and were consequently fully conscious during the exploration and therefore able to talk with Penfield. The results indicate that everything which has been in the conscious awareness is recorded in detail and stored in the brain. This process can be compared with a high-fidelity tape recorder capable of being played back in the present.

Penfield concluded that the probing only evoked a single recollection at a time, not a mixture of memories. The responses appeared in the patients' consciousness whether they desired them to or not; in other words, they were involuntary. It wasn't just the past events recorded in detail, but also the feelings and emotions associated with them. The evoking of memory sequences makes it seem understandable that memories that are recalled have a separate neurone pathway to travel upon. It may therefore be stated that the past influences the present by the observation that the temporal cortex is obviously utilized in the interpretation of current experiences (Ref. 14).

It is imperative that the experiences of an individual must be as positive as possible, inasmuch as his future behavior will depend upon what has already transpired, so that the positive experiences may be imprinted upon his brain.

It is interesting to note what Glasser has to say about emotions (Ref. 15):

> People who fail fall back upon emotion to direct their behavior; people who succeed rely upon reason and logic. Of course, the result of any behavior is emotion, with successful behavior producing pleasant emotions in contrast to the suffering of unsuccessful people. In addition, therefore, to develop a warm, positive, personal involvement with students and working with them in the present, we must deal with their behavior because only their behavior can be changed. One cannot change emotion directly. Emotion is the result of behavior, but it is behavior and the behavior alone that can be improved. When behavior is improved, it leads to good feelings that in turn snowballs toward better behavior. Although our involvement must not ignore feelings, when we are trying to change behavior we must always relate feelings to behavior. When a person changes his behavior and feels better, our involvement with him deepens. Too often in the past, when people responded to his feelings and ignored his behavior in an attempt to help him feel better, he continued to fail and in the end suffered more.

When speaking of feelings and emotions, it is only natural that punishment should be included. The punishment exerted by man on man is quite a familiar pattern to all of us. Should a man not behave as we feel he should, we knock him down. If a child misbehaves, he gets spanked. Perhaps the peoples of nations take upon themselves to misbehave—our retaliation many times takes the form of a bomb. The law has various ways and means of punishing its malefactors, as do religious and other organizations. Each individual, as he faces his fellowmen, has ways of punishing such as censure, snubbing, disapproval, or even banishment. The actions taken are all administered with the intention of reducing tendencies to behave in certain ways.

Psychological investigations and studies have raised doubts that punishment really accomplishes what it is supposed to achieve, especially when concerned with emotions. These works indicate that (1) punishment may cause emotional arousals which are not conducive to the changing of behavior; (2) punishment may produce hostility in the person who is being disciplined, and hostility has no place in learning institutions; (3) punishment sometimes produces poor attitudes toward the punisher and/or all authority figures in general; (4) punishment may lead to a reliance on external restraints rather than on more desirable internal controls (Ref. 16).

Information which has been collected on the subject of punishment should force us to be cautious in its use. However, punishment of some sort may be unavoidable at times.

I observed an unfortunate case where an industrial arts teacher punished a high school student. It seems that the teacher had a policy that anyone who had three demerits would be "kicked out" of the class. Whether a student's actions warranted a demerit or not was the sole decision of the teacher. One of the boys did some small, incidental action and was promptly given a demerit, his third. He was expelled from the industrial arts laboratory. The next day this student dropped out of school, never to return.

I wonder what criteria is valid when we use punishment in ways that impede the normal behavior and growth of youth. It is hard to believe that the use of punishment in the very strict sense of the word is beneficial to anyone when utilized in situations like the case just mentioned.

Many parents are extremely troubled over the independence that youth has developed. It is difficult for them to think of letting up on parental pressures. Rather, they apply more and harder pressures even to the point of extreme punishments without realizing the possible consequences. All of this may point to the differences in values as seen by the different generations. Perhaps neither the parents nor the youth can build an impressive case for their own values on matters such as length of hair, type of clothing, and methods of protesting.

Feelings and Emotions of Teachers

All too often the emotions of the teacher have had to take a back seat to all of the activities that take place under the roof of a school building. No one will argue that the school system of this country was set up for the children and not for the teachers. This is not to imply that the teacher and his feelings are unimportant in the classroom. It is inhuman to expect teachers not to feel angry or shaken, joyful or helpless when working with students. But they have been schooled to appear calm and confident at all times rather than being typically human and expressing natural feelings when the occasion arises. Teachers must be free to express their feelings and show their emotions. However, they must be tempered and tactful when dealing with students. It isn't wrong to display displeasure with a student for the breaking of a safety rule, but the words and actions of some teachers need to be reviewed.

There is a myth that the teacher's feelings have no place in the classroom or laboratory. Teachers who continually follow this myth are more than likely wrapped up in stress and internal struggles and are usually susceptible to psychosomatic disorders which medical treatment cannot successfully cure.

Have you ever heard of the teacher who says, "I love all of my students the same?" It is impossible to love all the students the same, having no dislikes for certain ones or for specific behaviors in others. The claim of love for all in the classroom is truly unrealistic, just as it is to state that "there are no favorites in my classroom." The attempt of a teacher to deny his true feelings is a clear path into the hidden feelings game, with all of the adversities which develop.

When a teacher states that he treats all students alike, he is denying special feelings for individuals. He rejects normal favoritisms, inevitable dislike for some students, and many other special feelings that he must have for each one in the classroom. All situations and all students cannot be handled in the same manner. Do you believe that students who are hyperactive in the IA laboratory should get the same treatment as those who are on the right track as judged by the teacher? Do you feel that the student who accomplishes little, although he would seem to have average ability, should be treated the same as one who produces a great deal in the laboratory?

Mature teachers, and I'm not talking about age, must learn to cope with their stresses, their anxieties, and their conflicts because they are ever present. They must find outlets for these feelings or suffer the consequences, as they must work with many deviations from the so-called normal in their contacts with children.

Studies in industry have recognized individual problems by showing that a personal crisis usually corresponds with a drop in production figures. School systems should recognize the effects that teachers' personal crises, many times emotional, have on their teaching ability and performance. It is inevitable that their production is also reduced. By providing professional support and understanding for teachers who are in need of help, school administrations could be greatly rewarded.

It is extremely essential for every teacher in the American system of education to have in his or her possession an organized and systematic conceptualization of human behavior. Teachers must establish learning climates in their respective classrooms which stimulate and reinforce the learning and acceptable behavior of students. This is not only important in the classroom but in every part of a person's life, regardless of that person's activities. Forces that are operating within and without the body create the type of person that he will be, and it behooves us as teachers to extend to the utmost every known factor that establishes a person as a person. Too often we leave that learning to hit-and-miss or trial-and-error approaches at the expense of the student and of society as a whole.

Teacher education programs at the college and university levels have failed to educate their graduates with the knowledge and sophistication needed to teach in schools where the change process is involved in educating students and achieving the goals of society. Too much of a teacher's training has been in the subject-matter and instructional methods area at the expense of the knowledge of mental structures and functions of the human body so important to the normal and well-rounded human being. Teachers must possess and implement a rationale that explains how a person learns and what is required in the development of effective learning climates.

One method of achieving the goal, acquainting teachers with the human side of the individual, is an attempt to "turn them on" at conferences and conventions such as this one. It is my hope that many of you will be stimulated to do what is necessary in acquiring knowledge that will guide and direct you in your relationship with students and other persons as well. There are methods which can greatly help such as selected workshops dealing with the issue, specific college evening or Saturday classes, or thumbing through and studying the considerable bank of relevant books and periodicals on the subject which are readily available and then discussing your findings with others.

Teacher-Student Emotional Relationships

What we need in all classrooms is an atmosphere where there is no fear, and free communication is not only possible but is present. Living in fear is one of the most devastating demands we place on students. Fear of the principal, fear of the teachers (to different degrees, depending upon the teacher), fear of tests, fear of assignments, fear of grades and the various other evaluations, and fear of the requirements and policies of the school. Despite our knowledge of fear and its effects on students' learning, school systems continually create fear with little success at eliminating those elements that produce fear.

Teachers who can respond seriously and non-judgmentally to the students will free them from their fear of censure or ridicule, thus relieving them from pressures and stresses that act adversely on and within the individual. Teachers who can create the conditions under which vast amounts of learning can be acquired are persons who can best help the students out of many of their emotional dilemmas. These conditions are more inclusive than the four walls, the benches, and the machines of the IA laboratories.

Psychologists tell us that some persons are extremely healthy psychologically. Persons with the characteristics necessary for this healthiness are more accepting of others; they are able to express warm and intense feelings toward other persons; they judge others more realistically and can maintain relative calm during crises; they are more creative and live democratically by relating well with others. These necessary and essential characteristics all apply to teacher-student relationships.

People can become more psychologically healthy if they choose so to live. Self-understanding grows as we relate intensely to more and more people, and specifically to more and more students in our classrooms. We can be the architects of our own personalities—as we build healthy bodies, we can also build desirable personalities. We as teachers are required to construct ourselves in this direction as well as helping the students to construct their personalities (Ref. 17).

The following are some relevant statements concerning feelings and emotions as they would apply to the teacher-student relationship (Ref. 18).

1. All students should relate to the teacher as a person, not an authority figure. The teacher's attitudes toward them, though perhaps only subtly expressed, are conveyed to students and influence their behavior.

2. Teachers who delve deeply into the emotional experiences of their students find the going difficult at times, confusing and stressful, but their contribution to the students' total life and their own growth are rewarding experiences. A free atmosphere which permits open expression of feelings is essential.

3. Teachers must work out for themselves the kind of relationship that will help the student as well as the teacher to be more honest and more genuine.

4. Once students know they have the right to express themselves, the negative feelings which may be present at the beginning will often be lessened.

5. Through expression there is the possibility for change in both the student's feelings and behavior. Suppressing these feelings does not eliminate them.

6. Sometimes the teacher is forced to reject the behavior of the child and therefore to reject the child. This rejection may be less severe if the teacher focuses on the behavior itself and not on the student.

7. To lower the dignity of a student is serious. The real tragedy is the teacher's lack of sensitivity and awareness, his failure to recognize the student as a person. The adult that undermines an adolescent's respect for himself is assuming a greater responsibility than he has the right or wisdom to do, and he may stunt the growth of a personality.

8. When the teacher loses sight of the students as humans, when he fails to exhibit himself in the students' presence as a person, there is no reality, relationship, or mutuality between them.

9. Students are often reprimanded for, or forced to inhibit, an expression of their real feelings associated with such negative emotions as anger, hostility, hatred, and envy. However, if these emotions are turned inward without outlets, they are likely to grow until the student is unable to think or act free from their influence.

10. Perhaps one of the most valuable experiences the school can provide for many students is an acceptable, yet effective, means of expressing their feelings. Healthy emotional patterns tend to perpetuate themselves just as unhealthy ones do.

11. Cognitive functioning may be reduced by such physical factors as defective senses, alcohol, drugs, fatigue, loss of sleep, pain, undisciplined senses, temperature extremes, hunger, and thirst. But it may also be reduced by such psychological factors as excessive anxiety, fear, rage, anger, hate, love, prejudice, tradition, taboos, conformity, pressures, and defense mechanisms.

In gaining the students' respect of teacher authority, teachers must show interest, competency, and wisdom in matters which directly concern them. Teachers cannot hope for genuine respect from students whose interests and behavior they deplore or from those whose wishes are ignored.

Challenges to Industrial Arts Teachers

Our Executive Secretary, Edward Kabakjian, stated in the last Journal (Ref. 19):

> We must teach the young the skills of a technology whose goal is ever-improving production of things, and most importantly, we must instill in them the wisdom to apply their technological skills for humane and peaceful purposes. ...The first task, the teaching of skills, is not new to industrial arts. It has always been our central mission. We should, however, never lose sight of our real goal—the students. They want to learn the new technology, the new knowledge, and they must learn these things.

The teaching of skills and the wisdom of utilizing these skills for "humane and peaceful purposes" are extremely essential, but I feel that there is a task far more important than either of these. Industrial arts teachers, although perhaps not as guilty as some of our colleagues in the various curriculum areas, have put more emphasis upon skills and knowledge than on the individual and his affective domain. Too often we are so anxious for imparting content to the students that their normal growth in the area of human behavior is stifled or disarranged. Without a pattern of normal behavior, all the skills and knowledge and the wisdom to utilize them may be lost.

CONCLUSION

The human behavior factors cannot be overlooked by those involved in the roles of teacher or administrator. To completely cover the whole realm of human behavior is impossible in a paper like this. Few people have the expertise to operationalize all of the ramifications that are faced by persons working with students. There are too many variables that must be considered when speaking not only of the students but of their teachers as well. However, there is no excuse for those who are employed to help educate our nation's youth to fail to recognize that there is much more to teaching than the memorization and recall of a discipline's content. These people must make a consciencious effort to continually update themselves with the new and valid concepts of human behavior and the effect it has on the learning process. The space age is important to all of us, but we must have normal behavior patterns if we hope to survive in it.

FOOTNOTES

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Dr. Warner, Associate Professor at The University of New Mexico, will take the position of Associate Professor at Ferris State College in Fall 1971.

Educational Technology

The Potential of Compressed Speech in Advancing Industrial Arts Education

Gary D. Oakley

It has been said that if all the knowledge mankind possessed was placed in books in 1900, that number of books would have doubled by 1930. It would have doubled again in 1940, again in 1947, and thereafter approximately every seven years to the present time. Yet, schools have no more time to present this body of information than they had in 1947. If the role of the school is to provide an amount of information necessary to enable its populace to cope with their surroundings, then it follows that more efficient means of conveying this information must be developed. The schools have assumed responsiblity for teaching that geometrically expanding body of knowledge.

The lecture method of instruction has been and will continue to be a very important part of the learning process. We utilize it in classroom instruction in the traditional sense, and in the more innovative approaches (such as slide-tape presentations, "canned" lectures, and the like) we also use the human voice at its normal speed to transmit the word pictures that we desire.

Research has shown that the speed at which the average (or even above average) person speaks is far below the listening capabilities of the students who are hearing these lectures. The average person speaks at only 150-175 words per minute (Ref. 1) while the average high school senior reads at approximately 250 words per minute (Ref. 2). Furthermore, persons such as the late John F. Kennedy are reputed to be able to read beyond 1000 words per minute with a remarkable degree of comprehension. It appears that we are wasting the potential learning power of the student when we obligate him to listen to any type of conventionally recorded speech. Evidence also exists that many persons are bored when they are asked to listen to most conventional tape recordings. The person is, in many cases, ahead of the speaker, anticipating the words he expects the speaker to say. If this is true, then the person is anticipating wrongly a great deal of the time and is forced to "unlearn" one idea he has anticipated and replace that idea with the one the speaker finally did say. One of the laws of learning contends that the first impression is the one most apt to remain in the student's mind. Therefore, to say the least, confusion would exist in the student's mind as to what the speaker actually wanted him to remember.

But, until around 1953, there was no acceptable way of accelerating the rate of recorded speech. True, a record could be played at a faster rate, increasing the rate of speech, but along with that shift in speech rate went a shift in the pitch, thereby creating a "Donald Duck" effect on the recording. Of course, this made for a drastic reduction in comprehension level on the part of the student. In 1953, Professor Grant Fairbanks and a group of his associates at the University of Illinois unveiled an electromechanical device known as a speech compressor (Ref. 3). This machine actually deleted certain portions of each syllable from every word recorded into it and then "compressed" the remaining portions into a smaller period of time than the original recording had required.

From this original machine, a number of research studies were fostered. There were studies that compared the comprehension of compressed speech with speeded recordings (Ref. 4,5,6), the comparison of various speech rates to determine the optimum rate (Ref. 7,8,9), and the desirability of listening to one presentation at the conventional rate vs. hearing the presentation twice at double the normal rate (Ref. 10,11). Studies were also done to determine the relationship between I.Q. and comprehension level (Ref. 12,13), between age and comprehension level (Ref. 14), and between reading rate and effective listening rate (Ref. 15), as well as studies to determine the effect that practice has on intelligibility and comprehension.

When all of these studies had been analyzed, three general findings concerning the use of compressed speech could be seen. One, there was no significant difference in comprehension level until a word rate of beyond 275 to 300 words per minute. Two, there was no significant difference between the retention levels of information presented by compressed speech and that of conventionally recorded speech. And three, there was no significant difference in retention levels between information received by compressed speech and by conventional recording.

What is compressed speech, and how does a "speech compressor" work? Compressed speech is speech that has minute portions of each word deleted but continues to be intelligible. One way it can be done is by mechanically and painstakingly clipping portions from conventional tape recordings. We go from there to an ultra-elaborate means by which one utilizes a computer to omit these parts. A more conventional way to do this, however, is through a machine using the Fairbanks method of sampling spoken of previously. One of these machines is the Tempo-Regulator, manufactured by Telefonbau und Normalzeit, Frankfurt-am-Main, Germany.

The Tempo-Regulator samples recorded tape in the following manner. The tape passes over the curved surface of a cylinder and wraps around the cylinder enough to make contact with one quarter of its circumference. Four tape-reproducing heads are spaced equally around the circumference of the cylinder. When this cylinder is stationary and the tape is moving at the same speed at which it moves during recording (15 inches per second), it makes contact with one of the reproducing heads and the signal is reproduced as recorded. When the Tempo-Regulator is adjusted for some amount of compression, the speed of the tape increases and the cylinder begins to rotate in the direction of of tape motion. As the speed of the tape is increased, the rotational speed of the cylinder is increased so that the speed of the tape relative to the surface of the cylinder is held constant at 15 inches per second (ips). Under these conditions, each of the four heads in turn makes and then loses contact with the tape. Each head reproduces, as recorded, the material on the portion of the tape with which it makes contact. When the cylinder is so positioned that one head is just losing contact with the tape as the preceding head makes contact, the segment of tape that is wrapped around the cylinder between these two heads never makes contact with a reproducing head and is therefore not reproduced. The segment of the tape that is eliminated from the reproduction in this manner is always the same length, one quarter of the circumference of the cylinder. The amount of speech compression depends upon the number of such eliminations per unit time, and this in turn depends upon the tape and cylinder speed. Speech may be expanded by reversing the direction of rotation of the cylinder and by moving the tape across the cylinder at a speed slower than that used during recording.

What percentage of compression are we talking about when we use compressed speech? Are we talking in terms of minor acceleration in speed or in terms of doubling our conventional speech rate? To answer this, remember that conventional rates are 150-175 words per minute. Research shows that comprehension and retention levels do not drop a significant amount until a word rate of approximately 275 to 300 words per minute is reached. So, in effect, we are almost doubling the word rate (or, conversely, cutting the presentation time in half) with no significant decrease in comprehension and retention levels.

Is compressed speech destined to take over all forms of recorded material? No, I would think one would have a difficult time in compressing Beethoven's Fifth Symphony, and I would imagine that information of a highly technical nature presented to students for the first time would have disastrous results. But it would be suitable for compressing almost any type of recorded lecture in our field. Taped presentations by leaders in the field of industrial education, "canned" programs placed in the learning resources center, dial access systems which provide off-campus listening stations via Alexander Graham Bell, "Talking Books for the Blind," recorded lectures speeded up for student review; the list is almost endless. The speech compressor can be utilized in almost any situation where a conventional recording is now used.

But we have, up to now, been talking about the speech compressor in a very narrow sense. In addition to compressing speech, it will perform many operations on the recorded word. By using the concept of speech compression in reverse, one can also stretch out the words without affecting pitch for language study. Conversely, one can change the pitch without changing the word rate for a study of music.

Think of possibilities. This process will almost double the normal speech rates (to 300 words per minute). This is even higher than most high school seniors read. Might this be practicable for slow readers as a temporary measure until they can obtain remedial assistance? If they are now reading below 250-300 words per minute, then it most certainly would. Remember, I said that it was a temporary measure.

How much time might be saved on information presented over dial-access systems? Almost double the information could be effectively presented in the same period of time that a given amount of information can be presented by conventional recording. So, in effect, we save almost one-half the student's time by utilizing this medium.

In summary, it appears that we can utilize compressed speech wherever we now use recorded speech except in a very few situations. Highly technical information might not be readily understood by the listeners. Sound tracks that accompany movies would seem to be inappropriate for compression. Other uses seem almost unlimited. Compressed speech needs to be carefully evaluated by persons in our field and the entire field of education. The process is still in the experimental stage in our area, although it is out of the experimental stage in many others. If we are in education, and particularly industrial education, to find better and more efficient means of promoting knowledge at all levels of intelligence, then this method should at least be given a chance and carefully evaluated. If research in our field shows this to be as promising as it is in other fields, then it is one that we cannot afford to overlook.

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The Utilization of Video Tape Recorders for the Teaching of Concepts and Techniques

Glenn M. Thatcher

Video tape recording has been recognized as having a potential for the stimulation of learning since the early 1950's. However, it has just recently emerged in the area of industrial education. The use of television and video tape recording equipment has been economically unattainable for many educational institutions in the past. With the development of improved circuitry and production processes, sound and picture recording and immediate playback equipment are financially within the reach of many secondary schools and colleges. As a result of this accessibility, television and video tape recording equipment are being utilized in increasingly new and varied ways.

An intensive review of the literature has shown that immediate playback equipment is being utilized successfully in industrial education. There are also strong indications that the marked improvement of instruction is due to the immediate playback properties of video tape equipment. Thus, other educational aids could not provide the same degree of improvement in like situations. Many of the applications are not unique to industrial education; however, it is intended that an awareness of existing utilizations of video tape recordings in various educational situations will provide a foundation for the creation of new and more productive uses of video tape recordings in the industrial education classroom.

LARGE-GROUP INSTRUCTION

Without question, the most publicized use of video tape equipment has been in large-group instruction where a large number of persons can be reached by one instructor. The receiver of the disseminated information, while physically distant from the instructor, feels as if he were sitting in the first row. One question often rises with respect to live instruction vs. video tape or electronically reproduced instruction. While video taped instruction is more expedient in large-group situations, is it as effective as small-group instruction?

The majority of research conducted in this area has indicated that there is no significant difference between the two methods of instruction. C. R. Anderson compared the effectiveness of television vs. live instruction in teaching the use of the slide rule. He found that there was no significant difference between the gains made within the two groups (Ref. 1).

Another area of consideration is the low-aptitude and high-aptitude student using video taped instruction. In 1967, John Nazarian conducted a study to measure the achievement of college students of different mathematical aptitude, using closed-circuit television and a recitation method of instruction. The results of his study gave evidence that both high-aptitude and low-aptitude students achieved as well in mathematics from closed-circuit television as from ordinary classroom methods of instruction (Ref. 2).

Occupational education has utilized video taped instruction in large-group situations for orientation courses and courses common to more than one occupational area, such as industrial mathematics and technical English.

MICRO INSTRUCTION

Outstanding attributes of video tape assistance are its ability to:

1. Enlarge minute objects.
2. Present small objects or mechanisms physically crowded in a maze of wires or other matter as a single unit which can be viewed easily by the student.

Industrial education has often called upon video tape recorders to make small objects more visible to a class. This use of the video tape is not restricted to electronic components and the like. To the contrary, this application can be found in dental technology programs and even in mortuary science classrooms.

TECHNIQUE TEACHING

In industrial education, an instructor often gives a technique demonstration which only one-half of the class can see. This situation can vanish forever with the emerging of video tape equipment. The solution for this problem calls for a few minutes of pre-class set-up work by the instructor. It necessitates the focusing of the camera on the area of demonstration, such as the instrument panel on a piece of electronic test equipment, and the placement of the monitor in a position close to the demonstration where it can be easily viewed by all. The result is that the demonstration is seen by the total class, and at the same time the monitor is located so that the sounds associated with the technique are in sequence with the visual perceptions. Once again, the video tape possesses the potential to solve a long-standing problem in occupational education.

OBSERVATION

There are situations in industrial education where observation is needed and yet it is advantageous for the observer to be unseen.

For example, the nursing faculty at Bronx Community College in New York City have utilized closed-circuit television in the training of nurses. Fifteen television cameras were placed in patients' rooms and were fed into a teaching center. From this center, a nurse instructor could figuratively move electronically and instantly from one student to another. She could easily observe nursing skills and, when required, give instruction to students by a wireless receiver worn in the ear of each student (Ref. 3).

This observation technique could also be used in role-playing situations where students are simulating job interviews. Utilization of the observation technique via video tape recordings is limited only by the imagination.

FOLLOW-UP

Many of the educational situations which have been described could well have been satisfied by the use of closed-circuit television. However, the closed-circuit television system is restricted to one presentation. With the aid of video tape equipment, the presentations and/or demonstrations can be represented at will. Video taped instruction provides the student with opportunities for review. It also permits the absent student to experience the next best thing to the real teaching situation. In the case of the low-aptitude but highly motivated student, video taped instruction allows for repeated replay until the information and/or material is understood.

While still an infant in the educational arena, video tape equipment has contributed greatly to the increased effectiveness of industrial educators across our land. There is a great deal of evidence to support the idea that the future of video tapes as an educational tool is bright in terms of improving instruction and truly becoming the teaching aid for the space age.

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The Student Film Makers

John J. Sladicka

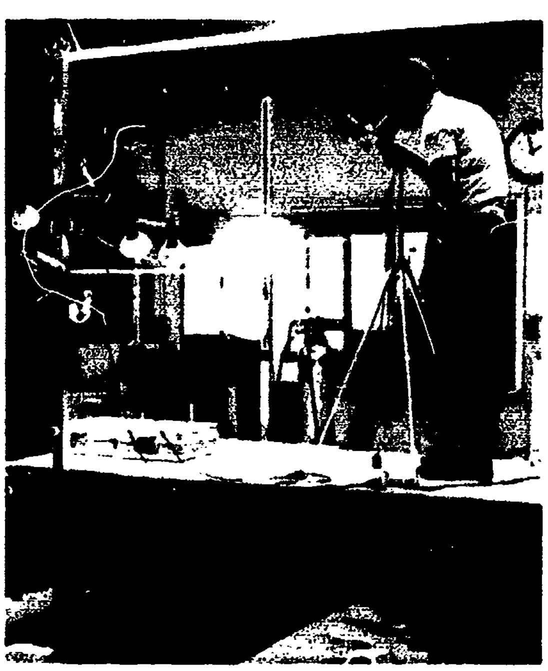
Super 8 single-concept commercial cartridge films have made significant inroads into various fields of education. The single-concept cartridge film has a great deal to offer the educational process. A cartridge can be inserted into a projector easily by a first grade student. The film is to the point, presenting only the basics of a particular concept and staying well within the attention span of even the most restless individual. The film is a continuous loop. A slow learner need not be apprehensive about continually asking questions; he can simply view the film over and over until he has mastered its content.

Super 8 films can be implemented in a manner which was troublesome and expensive when using the 16-mm films. Libraries of Super 8 cartridge film can be established for single classrooms or made part of more comprehensive media centers utilizing dial access media retrieval systems. In a system such as this, students have access to carrels and film indexes located strategically within an institution, which can be dialed for and subsequently projected on a closed-circuit television providing for independent study.

In the classroom, discussion can be expanded and made more meaningful through this concise film which can be stopped at any point and studied more closely. In short, the Super 8 single-concept cartridge film has proven to be a fine educational tool. However, commercially produced films are not always compatible with out methods of teaching or with equipment and materials with which we expect our students to learn. Super 8 film makes it possible for the classroom teacher to produce tailor-made films compatible with his methods of teaching and the equipment and materials the student will be expected to use.

Film making is fun, not very difficult, and well within the budget of most industrial arts departments. Home movie cameras are suitable for producing teaching films, provided they are equipped with an automatic light meter and a zoom lens which permits the type of close-ups necessary in many manipulative skill oriented demonstrations. A tripod will provide the camera with stability and control during shooting.

A good script is extremely important and should be quite detailed. Its content should reflect titles, length of shots, sequence of performance, materials needed, types of shots (high angle, low angle, straight on), photographic techniques such as close-ups, panning, fade, etc.



Good lighting is indispensable. Flood lights should be positioned so as to eliminate shadows. If it is possible, shooting can more easily be done outside where lighting is not as big a problem.

Titles can be produced using a variety of techniques, depending upon the situation and the degree of professionalism desired, starting with a typewriter or tapewriter and photographed close-up. A more professional title can be made up from three-dimensional plaster letters—this, however, is quite time-consuming. Still another technique is shooting through an acetate sheet on which block varitype letters have been placed.

Titles can be placed and shot in sequence exactly as they appear in the script. This practice reduces the time spent in editing. However, it requires a great deal of practice before one can edit effectively through the camera.

The novice would be better advised to shoot all titles at one time and subsequently splice them appropriately into the film during editing. Titles should be kept at a minimum. Editors sell from $30 and up.

Dry splices are easier to use and appear to hold up more effectively than wet splices. If it is desirable to eliminate splices or to produce a number of copies, duplication of films can be acquired at a nominal cost. Audio tracks can also be applied to Super 8 film.

The impact of Super 8 films has been very dramatic and promises to generate further study and new ideas. Courses in film making are currently being taught in teacher training institutions. On a more informal basis, students can enroll in an independent study and develop materials for future use in teaching. Some universities, such as Rutgers, maintain curriculum laboratories where students and in-service teachers can develop teaching materials like the single concept film.

Software such as this can be reproduced for the department in which they were developed, providing custom-produced film at nominal cost. It is feasible that this software could also be made available for dissemination to all school districts within a state at a nominal cost, similar to the practice of the Rutgers Curriculum Laboratory in Vocational-Technical Education.

Another innovative approach to learning and film making is the practice of including students in the development of the script, with the understanding that they would be included as actors in the film. The object in this case would not necessarily be the development of an outstanding teaching film, but a tool in the teaching of a particular concept. This practice should promote a number of positive side effects. In some cases, students would have an opportunity to observe themselves on film for the first time and see themselves as others see them. In the development of a script, students would have an opportunity to develop critical and logical thinking. The results of such close study should provide a profound understanding of the film content. Teaching films which reflect student participation will hopefully promote keen interest and acceptance. This approach may have desirable effects in the teaching of the disadvantaged.

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Guidance

Oceanography

Harris B. Stewart, Jr.

What is oceanography? I'm often criticized for this, but I claim that oceanography is not a science. Oceanography is nothing other than the application of earth, physical, and life sciences to the ocean.

It's comparable, in a way, to our all being creatures who live in the ocean. Suppose we were just beginning to explore the land a little bit; we might call the people who explored the land terrographers. Terrography would then entail biologists, geologists, chemists, physicists, and a little of every science capable of learning what the land was like.

A relatively small chunk of the earth we live on, only 29%, is land; we're just making halting steps toward finding out what the other 71% of the earth is like. Therefore, the term that has been used for any scientist who applies his scientific talents to the ocean is oceanography.

The really intriguing thing about oceanography is that it isn't a single science but rather a mixture, a mélange of all of the sciences. To me, oceanography epitomizes the interdisciplinary approach.

Let me give you one example: Assume that you are out on a research vessel somewhere in the mid-Atlantic—no land within sight at all. You lower a large chained bag to dredge, and the dredge comes back up from maybe two or three miles down. A crew member aboard the ship would say, "Yuck! Just another bag full of dirty mud." You dump it out on the deck and you pick up a handful; it would be mud. You look at it under a microscope and find that it is made up predominantly of the shells of one-celled organisms. These would probably be of the foraminifers, little one-celled organisms that live mostly in the lighted parts of the sea. When they die, their shells drift down—a perpetual snowstorm—accumulating on the bottom.

You're looking then at a biological sediment composed of the shells of organisms. The biologists are immediately involved. If you look a little more carefully at these, you realize that some of them have been pitted, dissolved, and you realize that these are calcium carbonate shells. Calcium carbonate tends to dissolve in cold water; hence coral reefs, for example, are all limited to warm water areas. As these shells come down, there is a physical/chemical reaction with the water, and the shells begin to dissolve. Calcium and carbonate go back into the system, and the calcium carbonate system or the carbonate system in the sea is extremely complex. So you're involved in marine chemistry.

You're involved in physics, in that these organisms as they drift down tend to reflect the current distribution. Some of them are warm water organisms, and some are cold water organisms. Their distribution on the bottom reflects not only water temperature, but the distribution of the currents that spread them around. Physical oceanography is involved. You've also got geology involved, because these little forams that make up the marine sediment are very keen indicator organisms in establishing the environment of deposition. Oil company geologists are very interested in these forams. As they are drilling they take samples, and they can tell from the bio-assemblage of the organisms what the environment was where these particular sediments were deposited.

What originally looked like a glob of dirty old mud has implications for biology, geology, physics, and chemistry. To me, that one handful of mud epitomizes the interdisciplinary aspects of oceanography.

Oceanography is the science of the things that go on in the sea; not only the water itself, but its contained life, its sediments, the basins in which the oceans are lying and, interestingly enough, the atmosphere above.

One problem traditionally has been that oceanographers study the sea up to the surface and stop, meteorologists study the atmosphere down to the surface of the sea and stop, and there was a lot more interaction between the atmosphere and the ocean than there ever was between the meteorologists and oceanographers. At present, the two sciences are working toward cooperation. This has to be.

The oceans are the great heat engines that supply our atmospheric circulation. Very strange things begin to happen when you start playing around with the distribution of temperature in the ocean. This affects the overlying atmosphere, which in turn affects the wind pattern, which in turn affects the surface current, which in turn affects the distribution of hot and cold water, which in turn affects the atmosphere.

This intricate feedback mechanism between the ocean and the atmosphere is fascinating scientifically but hard to study. How, for example, do you measure fluxes of heat or fluxes of water vapor or momentum between the ocean and the atmosphere when the interface between these two is doing this in twenty or thirty degree waves, and you're trying to hang on in a boat and make measurements in this wildly vibrating interface? It is a very intriguing problem, not only scientifically but oceanographically.

Oceanography is the study of the ocean; of its life, its chemistry, its geology, its physics, its interrelation and reaction with the overlying atmosphere and the underlying earth.

One of the reasons I think it is so interesting is that it's still quite poorly explored. People who are interested in making a scientific name for themselves can find more challenges in the oceans than they can on the land, because almost every ship that goes out doing oceanographic work comes back with something nobody knew before. This is where the real push in science comes in.

Why is it popular? What has come about? People in the mid-continent area, for example, who have never even seen the ocean have an interest in oceanography. What's happened to bring this about? One of the things, certainly, was Rachel Carson's magnificent book, The Sea Around Us. It should be in every school library. She had a real knack for making things exciting and living and pertinent and relevant. Rachel Carson probably did as much as anyone else to make oceanography popular.

The other person, I think, that probably did a lot for it was Jacques Costeau. He invented the aqualung, which suddenly opened up great areas of the ocean. Now the common man can strap his gear on and go take a look to see what is down there. Not just the searcher in his diving bell or in his research submarine, but anyone interested in swimming can buy the equipment or rent it for a few dollars a day, take a few lessons, and go down to see what's there.

One of the dangerous things, incidentally, about the aqualung is that it is so easy to use. You can walk into a store and rent an aqualung, a regulator, and a face plate. You can get foot fins and a weight belt, and then rent a skiff. Go out into a few feet of water, roll off the side, and it works; you can swim underwater with absolutely no training at all. That's the dangerous part. Everything is fine until something goes wrong, and things do go wrong. The person you're swimming with—and you should always be with somebody—could turn around in a hurry. His swim fins could wipe your face plate off or could pull it out enough so that it suddenly begins to fill with water and you're at 60 feet. What do you do? If you have had no training, what you do is panic. That, of course, is what kills.

Or you begin to run out of air and you find that you are sucking harder and harder on your machine. You are so intrigued by what you are doing that it is a while before you realize you are running out of air, and then you panic. If you are at 60 or 80 feet, headed for the surface, and you think you don't have any air, the natural thing to do is hold your breath. If you have gotten air at the pressure at 80 feet, hold your breath, and rocket to the surface, you're going to rupture your lungs and have all sorts of problems.

Another thing that made oceanography popular, in addition to Rachel Carson, was a popular revolt in the federal government and academia. It started about 1958 or 1959 with the appointment of a Committee on Oceanography at the National Academy of Sciences. In the classic tradition, the committee came out with a 12-volume report saying how important the oceans were and that the federal government should begin to do a lot more to investigate the oceans. A series of reasons was offered, including military defense, mineral chemistry, weather forecasting, and beach erosion. I think that pollution was brought in, but it hadn't yet become terribly popular.

A charisma has gradually developed about the importance of the ocean. For a while the Madison Avenue boys took over, and there were phrases about feeding the world's starving millions from the sea, phrases such as "tapping the untapped treasure trove of the continental shelves." People got quite carried away with all those things.

Then it developed that we really need more than marine science to feed the world's starving millions. It is partly a food from the sea problem, a scientific problem, a technological problem, an institutional problem, an economic problem, and a part of it is strictly a judicial/legislative problem. For example, there is a 1791 law that says that any fishing vessel over 50 tons used in the United States fishing industry must be built in the United States. If you wanted to build a nice, relatively inexpensive, good fishing vessel in Scandinavia or Japan, you couldn't use it in the United States fishing trade. It helps the ship yards, but it certainly doesn't help the fishing very much.

There are a lot of laws that should be changed. In Chesapeake Bay, for example, if you want to go for oysters or clams, you have to do your dredging under sail. It's very colorful when they have their annual races, but if you are t[illegible] to be efficient in the recovery of mollusks on the floor of the Chesapeake Bay [illegible]n't do it on a sailing vessel. But this is a law, and it's on the books.

The great problems that we're having today with the large fishing fleets that are working off the U.S. coast and the problems of U.S. fishing vessels being impounded down around South America are international. Some of these are also scientific problems. For example, off the west coast of the United States, big tuna live along what we call the thermoclime, an area where the temperature changes fairly rapidly with depth. If the fish get too warm they can go down just a little way into cooler water, or if they get too cold they can go up just a little way into warmer water. Oceanographic work in the mid-Pacific established that this temperature change with depth reached considerably deeper, below the level where they did their tuna fishing.

Tuna fishing procedure in the Pacific has always been to see where the tuna are, pull out the poles, and haul them in over your shoulder. By the time you get a 60- to 80-pound tuna coming in on a pole over your shoulder, it feels like 600 pounds. Someone suggested that if the thermoclime is this much deeper, they should take a look. So they devised nylon nets and went down 200 to 250 feet. They came back with the biggest haul of tuna on record. Here was a scientific work that modified much of the tuna fishing on the west coast.

It's been a real economic problem, particularly in the New England area where the young men have seen their fathers get old fast on fishing vessels, being away days at a time and leading a pretty rough life. They can go to a local factory and make twice as much money as their fathers without ever going to sea.

It's partly a technological problem. The development of a power block, for example, made a great improvement in our fishing technology. Some of the things that oceanographers, marine scientists, and marine technicians are working on today may pay off in the future. I'm thinking of such things as the development of scents that can be injected into the water to attract fish, electronic sensors that tend to herd fish toward the bottom of a ship which has a big vacuum cleaner and just sucks the fish up into it, and the training of porpoises to herd fish. These are all possibilities that are, in fact, being worked on.

But what do you do with the boy who comes to you in the 10th or 11th grade or as a freshman in college and says that he has read a lot of this material and is fascinated by the ocean? How does he get into it, what does he do, how should he tailor his high school and college course work in order to lead to a degree in oceanography? I think this is worth answering for you.

In the first place, I think oceanography should be taught in the high school and as a general course in college, not with a view toward training professional oceanographers, but with a view toward teaching something about the real challenges and the role that the ocean plays in our daily life. I would like to see a course in oceanography in the high schools and colleges much the way history is taught. The people who take courses in history don't plan to be historians any more than people who take courses in English literature plan to be Englishmen. It would be a very good idea to have courses in oceanography just so that the kids growing up today would be aware of this interdisciplinary business of the ocean and have some feel for the ocean and the role it plays in our daily lives.

What of those who hope to go on and become oceanographers? The general feeling is that if anyone wishes to become a scientist in the field of oceanography, he should look around the first year in college and sample everything that the university has to offer. Universities, without exception, have doors that have not been open during high school. They may come to college with preconceptions of what they want to be and, because of those preconceptions, never give themselves the opportunity to sample some of the things the university has to offer.

So my suggestion is that for the first term, for the first year, and perhaps for the first term of their sophomore year, they just investigate everything; the whole range, the whole gambit of courses, even sitting in and monitoring things just to see what the subject is about. It may be that something will catch their fancy that they hadn't thought of before.

If, on the other hand, they do decide they want to go on and be a marine scientist, having allowed themselves to be exposed to some of these other things, then they should major in their undergraduate years in one of the sciences which are used in the ocean. In other words, major in geology, physics, chemistry, or biology. Those who are intrigued by physics and chemistry usually are less intrigued by the more descriptive sciences like biology and geology. Those, on the other hand, who just can't stand math very often gravitate toward biology and geology, although both of these have become incredibly quantitative in the last 10 to 15 years.

I would also say here that if is not necessary to get a BS degree. The AB degree, I think, is a great one. We're turning out an awful lot of highly specialized people who have never heard of Chaucer, who can't get up in front of an audience and talk, who can't write a coherent sentence. I now insist that my researchers, before any paper is submitted for publication, show it to me. The original intent was so that I could keep up to date and see what their science was. But I found, having taught English in a boys' boarding school for a couple of years, that I would have to break out the red pencil and fix up the singular subjects and the plural verbs. The number of highly capable scientists who are incapable of conveying their ideas is just staggering. The AB degree develops not highly skilled technologists but well-educated people who love the scientific end of the business.

Once a student has his AB or BS degree in biology, geology, chemistry, physics, or whatever, then he can decide where he wants to go to graduate school. And that's where the real nitty-gritty, as they say, of the oceanography business takes place. This is very good. The area in which he wishes to specialize will partly determine which graduate school he wants. The Lamont-Doroughty Geological Observatory at Columbia University, for example, is one of the best places to go for graduate work in marine geophysics and marine geology. Many universities are just crackerjack in the fields of marine biology; the University of Miami is one—there are many others.

If his particular field is the physics and chemistry of the sea, he will prefer places like the Scripps Institution of Oceanography in California—one more tentacle of the great octopus, the University of California. Or he can go to the new combined MIT/Woods Hole Oceanographic Institution complex; they are soon to grant graduate degrees at the Woods Hole Oceanographic Institution in Cape Cod on a joint program with MIT.

So this then is the advice; work hard in high school and come out with good grades so that he can get into a good college. Once he's in the good college, major in one of the basic sciences involved in the ocean, but make the decision on that major only after looking at the other things that the university has to offer. And finally, to do his specialization in oceanography in one of the many graduate schools. That, briefly, is how he can get involved in the field of oceanography.

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Occupational Versatility—The Role of the Student in an Industrial Arts Environment

John Lavender

Many experimental approaches toward improving industrial arts programs are being tested throughout the country. Most of these are centered or designed around a certain body of knowledges and skills considered essential for life in our world. Social implications of our industrial and technological nature, and industrial organization and operation seem to be the focal points of the curriculum design.

Occupational versatility is an innovative approach toward the teaching of industrial arts. It is centered or designed around the learning methods the students employ in the industrial arts environment. Its focal point is the student—the individual and how he functions in a shop setting.

The major objective established for the student is for him to find his identity in an industrial arts environment and to have the opportunity to develop his abilities to be self-sufficient, productive, and adaptable.

A student exhibiting these abilities will be able to select a problem from a wide range of areas, develop a plan and procedure for solving that problem, draw from resources and instruct himself in the processes and operations required, produce a product, and evaluate the product against his design standards. He will do this independently, utilizing a mode of operation designed by him to fit his needs and his rate of performance.

The development of these characteristics should prepare him for confronting future problem-solving situations in his life, whether they be vocational or avocational. He would be occupationally versatile and could approach a problem able to say, "I know I am capable and I'm willing to try."

These needs were the basis for a proposal designed by the Metropolitan Area of Seattle Industrial Arts Consultants and titled "Project Occupational Versatility." It was submitted under Title III, "Innovative and Exemplary Approaches to Education" E.S.E.A., Public Law 89-10. It was funded for planning and operation commenced in the fall of 1969.

Four counties with 46 school districts comprise the Project area. The population is two million, or about two-thirds the state of Washington. One hundred and seventeen junior highs and/or middle schools benefit from the two pilot schools' operation. One pilot school is Chinook Junior High in the Highline School District, a large suburban district bordering Seattle on the south. The other pilot school is McKnight Middle School (6-7-8) in Renton, a small city of about 25,000 and the home of the commercial division of the Boeing Airplane Company.

To meet the objectives designed for operational testing, the following general procedures were adopted. The program will be:

- personalized. The student will elect the activity areas he desires, select the problem he wishes to solve, and perform at a rate established by his abilities.
- student directed and managed. The instructors will guide and counsel the students as required.
- nongraded and ungraded. All class and experience levels will work together and will record their performances for reporting purposes.
- team-taught in a large single general shop facility.
- self-instructional. Media of all types will provide the necessary instructions.

The 1969-70 school year was the planning year for the program. The Project staff consisting of a director and an assistant director, the five pilot school teachers, and the Metropolitan Area Industrial Arts Consultants designed the methods and the particulars to be used to meet the general objectives and procedures. Facilities were remodeled in the summer of 1970. In the fall of 1970, the pilot schools went into operation.

The facilities at Chinook Junior High and McKnight Middle School have an area of 6500 square feet. There are three teacher stations and limitations are set at 90 students. They are often described as a supermarket of activities, as they are one large room with activity areas around their perimeter. The finish room and teacher offices are the only separated areas.

The activity areas are: woods, both hand and machines; plastics; power, primarily small gas engines; electricity/electronics; graphics; metals, including gas and arc welding, forge, foundry, bench, sheet and art metal; crafts, including leather, jewelry, and carving; general industries, including masonry, glass, tile, roofing, laminates, drywall, etc.; drawing, both freehand and instrument; and career guidance.

Each area is self-contained and color coded. All materials are open and housed within. Open tool panels and project displays are on the walls and the necessary instructional media and machines are on the specially-designed work stations. Planning stations are also provided in each area. No chairs or stools are provided, as all stations are designed for stand-up activities. Machine areas are compatably located and removed from natural traffic flow. Machines are color coded, and the area is entered only by those students wishing to operate.

Both schools operate on a regular scheduling basis. New students come to the shop every hour. The class structure is not part of the shop program, as each student is considered as an individual. When entering the shop, they take a colored, numbered notebook from the record case. The color indicates the period, and the number the student. They proceed immediately to the elected activity area and go to work. Roll is taken by the office girls and an absent student is indicated by his notebook still being in the case.

The notebook serves two major purposes. First, it provides housing for the student's records. Secondly, it provides the basis or the medium for the student/teacher relationship. The teacher's role is to provide guidance and assistance in helping the student solve his problems. The notebook reflects the student's progress, and teacher-student conferences are enhanced through this record.

Operational guidance material is provided for students in their notebook as well as the following record-keeping forms:

- Attendance and Time Utilization Record—The student maintains his attendance record as well as indicating start and completion dates of his projects.
- Materials Cost Record—The student may cut material as he needs it; he computes the cost and enters it on this form. He also enters his payments and keeps a current balance.
- Student Performance Record—The student records his activities and operations as well as stating opinions on the activities. This form is used for reporting to parents.
- Machine Operation Check List—The student prepares himself for machine operation and then asks the instructor to check him. This form records this information.
- Planning Records—The student records and files his plans and procedures in this section.

In an activity area, a student has three options. He may elect to work on one of the projects and experiences designed by the staff, with a model displayed and a plan and procedure available. He may wish to work with an idea in one of the many reference books, or he may wish to design his own project or experiment. He is encouraged to progress to the design stage, but it is not a requirement.

As he progresses toward the solution of his elected problem, many instructions are necessary. The objective of the program is for the student to seek out the type of instruction that will serve him best. Many avenues are available for the student in this aspect. He may elect to use one of the 300 loop films available or perhaps, where video is not necessary, one of the casette tapes. He could use one of many instruction sheets, charts, programmed texts, or other printed materials. Quite commonly though, he prefers to ask an experienced classmate to teach him how. The teacher is also available if requested and, through his communications, helps the student evaluate the effectiveness of the procedures he is using.

If a machine is needed, the student is to prepare himself for operation and should feel, "I am ready to operate this machine." The analysis procedure is utilized, and the student takes a specially-prepared manual and studies the machine. He also may call upon films, texts, and other students to assist him. When he feels he is prepared for

Figure 1. A student teaches herself a basic operation.

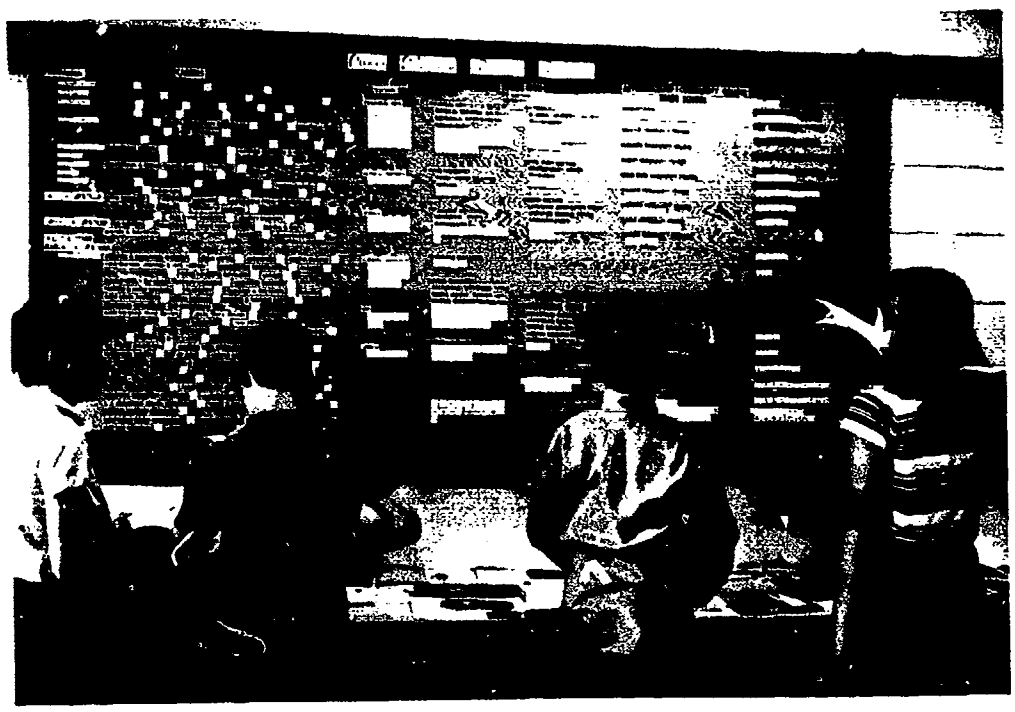

Figure 2. Students seek career information through self-instructional system.

operation, he asks a teacher to check him out. A satisfactory performance demonstration by the student is the key to safe and efficient machine operation.

The career guidance system operates in the same manner as the activity areas. A prerequisite, the need of the student, is hopefully established as the student works in the areas. His curiosity as to what the future may be in a career related to areas that interest him may lead him to the "Career Guidance Program Directory." This directory is two 4 x 8 boards that list over 300 careers. The Occupational Outlook Handbook, a government publication, provided the selection of these careers. The board's function is to direct the student to films, tapes, college catalogs, apprenticeship programs, vocational schools, and any other material that the student can utilize for analyzing the careers that interest him. A selection for the future is not promoted for this age student, but the ability to analyze will give him a basis to operate with when applicable.

The results of the first year have been very positive. Students can and will accept the responsibility of managing their activities. They can and will instruct themselves with a high degree of efficiency. And, perhaps most important, they like to be independent and direct their learning experiences.

The pilot school teachers are very positive in their acclaim of the program. Visiting teachers and administrators also are pleased with what they see. Many districts are making plans to adopt this learning method.

Next year, the Project plans to add voluntary group activities to the program. Plans are also being developed to improve the planning procedures of the students and to increase the reward factors. Evaluations are also to be conducted to assess if what looks good is really educationally sound. Results of these studies will be available in summer, 1972.

A manual is also to be developed to assist teachers in implementing facets of the program or the total program. This and other materials are not presently available outside the Project area, but hopefully these problems can be overcome.

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Career Development at the Elementary School Level

Larry J. Bailey

Growing unemployment among better-educated segments of American society and the growing cry of young people for education that has personal relevance has caused many people to re-examine the role of education and the universal worth of a college degree. Charles Silberman, in his best-selling book Crisis in the Classroom (Ref. 1), seems to sum up the feelings of many young people: "What these students understand, far better than their parents, is that the choice of a career involves far more than a choice of how to earn a livelihood; they understand... that the question 'What shall I do?' really means 'What shall I do with myself?' "

In response to the need to assist youth in career planning and decision-making, a research project was begun in March 1970 at Southern Illinois University in cooperation with the Illinois State Board of Vocational Education and Rehabilitation. Entitled the Career Development for Children Project, the goal of the project is to develop an exemplary career guidance program for elementary and junior high school students. This will be accomplished through a series of carefully articulated developmental experiences beginning in grade one.

WHAT IS CAREER DEVELOPMENT?

The term career development is used to describe an individual's behavior related to work, both before and after entry into a formal occupation. For example, the young child playing at fantasy occupations; the adolescent boy simulating the work role of a production foreman during a group manufacturing unit in the industrial arts laboratory; a girl working at a hospital during the summer as a "candy striper;" all are engaged in stages of career development. The unfolding of an individual's career development begins in early childhood and is characterized by identifiable developmental stages, with characteristic behaviors at different age levels. Career development is considered to be one aspect of an individual's total development and occurs over time through processes of growth and learning.

PROJECT GOALS

Career Development for Children Project is designed to involve children, beginning in elementary school, in experiences which will facilitate the broad goal of "vocational maturity." Vocational maturity is used to denote something different than traditional vocational education, which is usually geared to specific skill training or, in the elementary grades, to a study of specific occupations. This curriculum is not aimed at teaching manipulative skills or presenting stereotyped pictures of the work community. Under the basic hypothesis that a realistic career choice is the result of a developmental process beginning in early childhood, CDCP aims at providing direct decision-making experiences. Attention is focused on the child in relation to broad interest areas and worker roles. The over-all goal of the project is to allow the student to gain adequate knowledge about himself and the world of work, and adequate experience in relating the two to make more intelligent career-related decisions.

Since it is not desirable to have children make specific occupational choices, the intermediate goal for the project, at approximately the grade eight level, is to have students formulate a tentative occupational preference which will aid them in making decisions about their choice of high school curriculum. The term "occupational preference" is used here rather than "occupational choice" to symbolize a number of occupationally-related activities for which liking is indicated. The tentativeness of the preference is the indication that it is not a specific preference of the type which may prevail at a later stage. Occupational choice is used to indicate an individual's positive intent to enter a specific occupation.

ASSUMPTIONS

The assumptions involved in the development of educational objectives for the project are as follows:

1. Career development is one aspect of the continuing process of growth and learning.
2. Career development is closely related to attempts to implement a self-concept. The specification of an occupational preference is an expression of one's idea of the kind of person he thinks he is.
3. The quality of a decision concerning career or occupation is determined by the type, amount, and correctness of the information used in making the decision. According to Kroll (Ref. 2), other things being equal, the more accurate the information a person has about himself and the world of work, the more valid will be his career decisions.
4. The final assumption has important implications for education. It states that the information, skills, self-knowledge, and attitudes needed for career decision-making can be developed. Presented simply, career development can and should be systematically influenced.

PROCEDURE

The purpose, assumption, and project goals for the Career Development for Children Project resulted from a synthesis and application of career development theory and research. A curriculum framework was then developed which outlines three developmental stages: the Awareness Stage (Grades 1-3), Accommodation Stage (Grades 4-6), and the Exploration Stage (Grades 7-8). Within each stage there are several levels, each with a specific emphasis and theme. Following are the levels within the three stages, which correspond approximately to grade levels.

Awareness Stage

I. Activity. As a starting point for learning about self and the broad world of work, the child needs to be aware that day-to-day activities are purposeful and should be able to identify some of the reasons for human activity. Specific objectives will be concerned with having students identify and compare their activities throughout the day, develop broad definitions of work and play, and discuss activities of self and others in terms of broad work-play classifications.

II. Interests and "Fantasy" Preferences. Unit II builds on Unit I by moving from awareness of human activity, from broadening understanding of work and play, from classification of activities to identifying relationships between what a person likes to do and possible future occupational roles. Here we are attempting to use the natural tendencies of children to fantasize about occupations, as a base of knowledge to develop more realistic attitudes and understandings.

III. Occupational Roles. In Unit III, the child will be introduced to the classification of work activity in terms of goods and services production. An examination of the necessity for both goods and services will lead to an understanding of the interdependence of occupational roles. A consideration of various worker roles involved in the production of a service or good is designed to show the range of possible occupations within student's areas of interest.

Accommodation Stage

IV. Self Appraisal. At this level, self appraisal becomes more meaningful as students examine their interests and abilities for changes as a result of maturity and education. Opportunities are provided for individuals to express interests, exercise talents, and explore areas in which to develop new interests and abilities. The focus on self understanding is intended to be a further step in assisting the process of self-concept formation.

V. Occupational Families. In Unit V, students become more familiar with occupational classifications and a wide range of possible occupational roles. An understanding of goods and services classification is extended to include a familiarity with "occupational families" which are contained within the goods and services classifications. An important aspect of this level is that students will, in a laboratory situation, "try on" occupational roles representing each of several specific job families.

VI. Understanding Career Development. The purpose of this level is to make students aware of the need to formulate preferences and make decisions, and to introduce the fact that individuals do have some control over their future career by careful planning and decision-making. Students will also become acquainted with the multiplicity of factors that influence vocational behavior and development. Experiences will be structured which relate the importance of attitudes toward education and planning one's own future to orderly and successful career development.

Exploration Stage

VII. Economics and Career Planning. At this level, concepts and principles related to economics and manpower will be introduced. An understanding of the changing nature of manpower supply and demand will provide students with an over-all view of employment trends in the 1970's and 1980's. The importance of education and training for effective participation in economic life will be emphasized. Finally, the study of relationships among the economic, social, and psychological aspects of work is designed to help students better understand the reasons why people work and to identify those factors of work which are of primary importance to them.

VIII. Exploration and Decision-Making. The formulation of a generalized occupational preference and the preparation of an educational plan begins by helping students to become aware ot the need to decide on a future occupational goal. This awareness will hopefully increase the motivation for students to study and accumulate information about the many occupations that will be available to them. A unit on self-understanding will be introduced in which the students relate knowledge discovered about themselves to the occupational roles they have studied. The culmination of this unit will be the planning of a projected high school program that is compatible with self characteristics and occupational goals.

APPROACH FOR IMPLEMENTATION

As has been mentioned earlier, the Career Development for Children Project is not limited to the traditional study of "community helpers" that characterizes many occupational information programs. In terms of a developmental model aimed at broadening a child's view of work, it simply does not seem legitimate to take such an approach. As Charles Silberman says in Crisis in the Classroom, "For children who may still be in the labor force in 2030, nothing could be more wildly impractical than an education designed to prepare them for specific vocations or professions...." Consistent with career development theory which specifies development from general to specific, the CDCP curriculum focuses on job families and broad interest areas instead of specific job titles. For example, rather than acquaint elementary age students with the occupation of licensed practical nurse, children are shown how the physician, nurse, inhalation therapist, x-ray technician, nurse aide, and dietitian interact as part of the health care team.

From a teaching standpoint, CDCP has tried to build into the curriculum experiences that will require concrete activities in addition to vicarious ones. Techniques such as role playing, gaming and simulation, and problem solving will receive high priority in conjunction with personal guidance experiences. Rather than have children only study about production lines, for example, they will have an opportunity to engage in manufacturing activities in the classroom; to see first-hand the inter-relatedness of workers; to simulate the role of different workers. In addition to goods-producing occupations, students will participate in group activities representing personal and public service occupations.

Teacher-led discussion sessions will, of course, continue to be of great importance in allowing children to express the meaning that these different kinds of experiences have. The sophistication and comprehensiveness of these direct experiences will vary greatly between the first and sixth grades. The important thing for the teacher to keep in mind is that the curriculum is designed to allow the children to participate in various experiences so they will have, on a personal level, an idea of what certain kinds of work are like and will be able to see how these kinds of work "fit" with their emerging concepts of themselves.

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Welcome to the World of Work

Franklin D. Arbaugh

Doctor
Lawyer
Indian Chief
Be a spaceman
Dig a ditch
Work in an office
Work in a store
Live a life of leisure forever more!

Look around you - see the people work all kinds of jobs!
In the factories
Deliver the mail
Build a building
Progress
Make room for the children to play.

Big towns
Small towns
All around
Take a rocket to the moon

Where would you live?
On a farm?
In a city?
Or here!

Draftsman
Carpenter
Back yard chef
Load a truck
Run a machine
Be a "hippy"
Be an engineer
Where do we go from here?

We have handbooks
Textbooks
Magazines galore
I challenge you - Open the door!

How many times have you asked a child, "What do you want to be?"
The role of the elementary school in preparing all pupils for the "world of work" is described as follows:

"What is needed now is a developmental system of education. Such a system introduces in the elementary grades awareness of the relationships which exist between schooling and work (Ref. 1)." The role of industrial arts is to provide and coordinate activities to show the relationship between schooling and work.

A child using scissors in an elementary class is being prepared with the concept of cutting. The boy using the squaring shears or the man in industry working with a lathe is but a part of the relationship which exists between school and the "world of work." The little boy carefully shaping each letter and the mechanical or architectural drawing student doing the same task with quickness and precision are preparing for entry into the work world as a designer. The little boy assembling blocks today may be the automotive mechanic of tomorrow. The same little boy may be the telephone lineman or the machine operator.

Both boys and girls must be given the opportunity to become a part of this school-work relationship. Many of these relationships are in progress in our schools today.

"In the main, the elementary school role is diagnostic and prescriptive. It provides whatever experiences a child may need to make learning real through a continuing examination of how man uses work for self-support, how major occupations employ knowledge, and how productivity is related to a variety of abilities. A major objective of elementary education is to discover the talents of each child and demonstrate their relationship to the work world (Ref. 2)."

Another major objective of the elementary school should be to instill an attitude of respect for the "world of work."

It is widely accepted that learning takes place by experiences that go through the central nervous system; therefore, opportunities for the child to visit the world of work and for a moment become a part of it by seeing, hearing, smelling, feeling, and tasting must be provided. Many activities can be provided by the school to help furnish these experiences, such as role playing, audio-visual media, field trips, doing.

With suitably equipped classrooms, properly trained and resourceful teachers, and carefully chosen instructional activities integrated with other school subjects, industrial arts will greatly enrich learning for this awareness to the "world of work" (see Figure 1).

How many times have you asked a young boy or girl, "What do you want to be?"

The industrial arts exploratory program at the junior high or middle school level can be one of the most significant aspects of the school program and presently represents a substantial portion of the total industrial arts function. It can also be the key to the Exploring Occupations program to be discussed, an important and significant part of the curriculum for this age student.

The industrial arts program must be broad enough to allow for exploration and advanced study, but specific enough for those students who will not take any more industrial arts. Unfortunately for many students, the industrial arts experiences will end with grade nine.

How do we go about developing a program that will be a continuation of the elementary program and also give the boy or girl the necessary background to make a wise career choice?

Industrial arts is the study of industry, the technology of tools, materials, processes, and occupations.

Each child should be given the opportunity to explore the fields of electricity, graphic communications, including drafting, graphics, and photography, materials and processes, including metals, plastics, and woods, and power mechanics. All of these should stress safety, the "hands-on" approach, organizational systems, and occupational requirements.

Presently it is also in the ninth grade that most students are asked to make a choice of a career for a lifetime. Along with the role played by industrial arts, providing an exploratory approach to the study of industry, is a guidance-oriented program of occupational exploration. This program, Exploring Occupations, provides the student with occupational awareness through a "cycled" approach. As designed, the 8th grade student would, in the course of the year, be "cycled" for a period of time through several experience areas. These might include such areas as: industrial arts, home economics, social studies (economics of industry and personal economics), science, business education, and agriculture. The "cycling" method uses the team teaching approach. Many occupations would be included in occupational clusters. Occupational cluster awareness can be developed by role playing, audio-visual media, field trips, and guest speakers. Neither time nor space permit the author to explain the program in detail. All students could profit by these experiences.

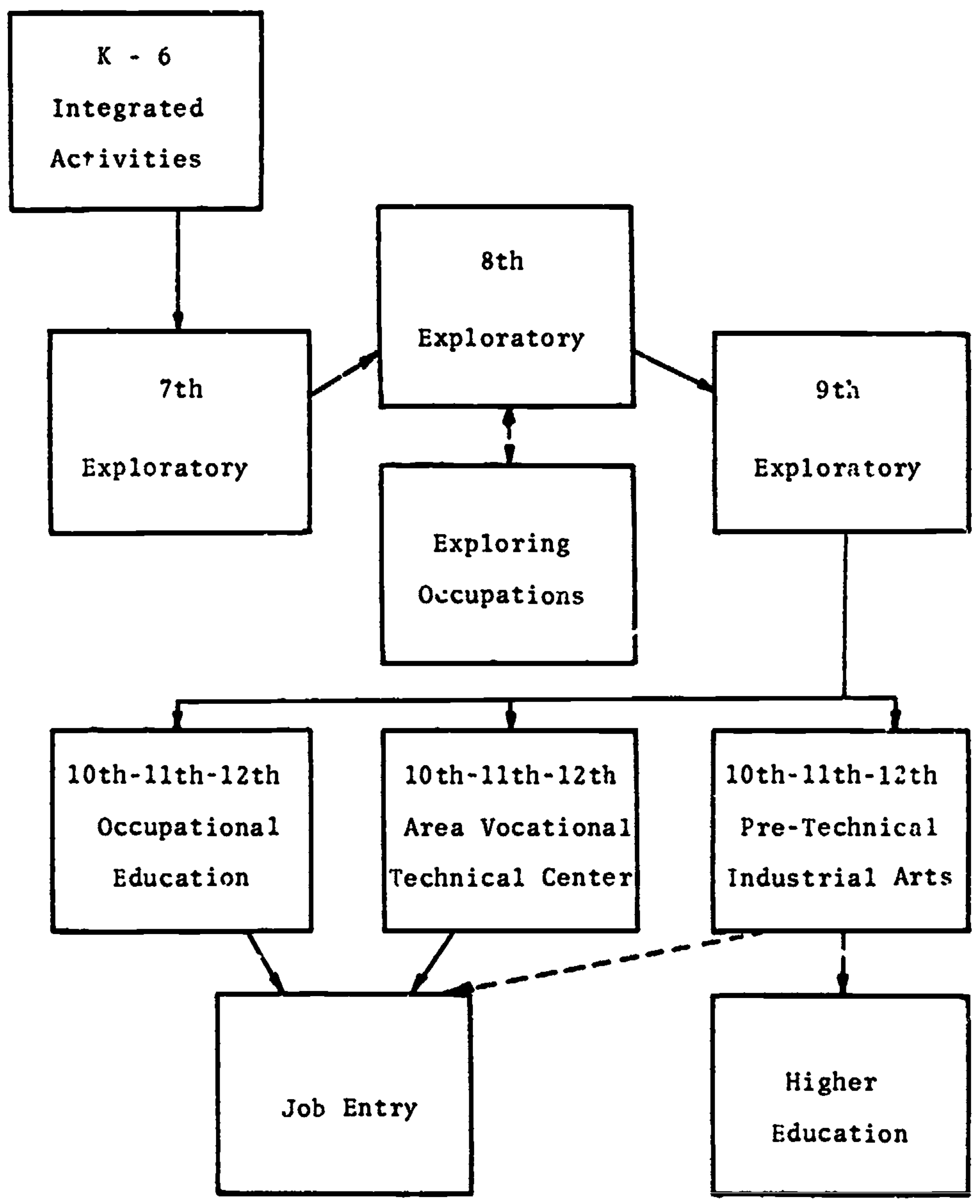

Figure 1. Industrial arts, K-12

The moment of decision has arrived in the ninth grade when the student must make a choice as to the path he will follow in the high school.

How many times have you asked a high school boy or girl, "What do you want to be?"

Have you made provisions for students to develop a salable occupational skill?

One approach being explored is that of utilizing an occupations mall to provide occupational training in the areas of auto services, food services, hospitality, general contracting, ornamental horticulture, and factory employment. The program is designed primarily for the 40% of the students of Milford Senior High School in Milford, Delaware, who are classified as "general" students. This does not mean that students in other courses cannot participate, but the school is concerned with the large percentage of students who graduate with no salable skills.

The "hands-on" practical experiences ready the students for entry into the "world of work." Students learn the occupation of their choice in the mall with a cooperative occupational education program culminating their experiences in their senior year.

Prior to the implementation of the program in September, 1970, a survey was made to assess the occupational needs of the Milford area.

The auto service occupation area gives the students basic non-technical training in the work encountered in a service station. These experiences include the pumping of gas, salesmanship, oil changes and lubrication, maintenance of a station, and minor repairs to an automobile.

The hospitality area, or hotel/motel services, provides experiences in an occupation very prevalent in seashore resorts near the Milford area. Students study the work associated with the front lobby, maid service, house detective work, maintenance, and other phases of the industry.

Small restaurant type services are studied in the food service area. The instruction is not concerned with preparing employees for formal dining establishments, but rather the short order establishment. Simple food preparation, service as a waitress, waiter, clean-up, personal appearance, and organization are stressed in this area.

The role of the landscape gardener is explored in the ornamental horticulture area. This includes hands-on experiences in growing and using plants to landscape various types of areas and properties.

Masonry, carpentry, electrical systems, and plumbing systems are studied in the general contracting area. Students work on practical projects in and around the school district to gain experiences as to the general laborer's role in the industry.

This program is not an end in itself, but one means of providing students with a salable skill as they enter the "world of work."

As a student is followed through an educational sequence, an appreciation can be gained for the increasingly difficult task ahead for educators in the preparation of the child to fit into his rightful place in the "world of work," and to advance in this "world of work" as he gains knowledge, skills, and experience.

The kindergarten boy or girl is being prepared to take a place in the "world of work" 12 to 18 years from now. The junior high boy or girl—six to 12 years, and the high school student—six years or tomorrow.

With this thought in mind, I suggest that we should be working with the research divisions of industry to develop our curriculum, and not follow the present trends or, as exists in many places, yesterday's trends.

How many times have you asked yourself, "What do I want to do?"

Dig a ditch?
Explore the moon?
This is our earth—do something soon!

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Occupational Information for Eighth Grade Boys

George Samson, Jr.

PHILOSOPHY OF THE PROGRAM

Those of us in education who are familiar with industry and technology are usually surprised at how little our students know about occupations in these fields. The greatest lack of knowledge seems to be about the skilled trades and technical jobs. Teaching in affluent communities, we are aware of a tremendous pressure existing to have students attend college. This is sometimes called the "college syndrome." Part of the myth revolves around the idea that the only means of achieving economic success is with the help of a college degree. Parental pressure causes intense competition between students for grades. Many students succumb under this pressure and become apathetic about their future.

Those students who do not attend college feel insufficient among their peers. Much of this pressure is a result of the materialism within our society. Each of us should be teaching in such a way that we develop social values. Materialistic values have been the paramount concern of teachers and the society they are part of for too long. Few students realize that there are a variety of skilled jobs which pay high wages and offer the satisfaction that comes from working with one's hands. College degrees are a means to an end, not an end themselves. Happiness, self-satisfaction, and worth should be the end we strive for. Most people think a college degree will automatically provide this. They are very far from reality. As a result, their children and our students are unaware of the many skilled jobs that do not require a college degree and can provide happiness, self-satisfaction, etc.

Teaching in depressed or ghetto areas, we see the same lack of knowledge. The ghetto student's life is further compounded with daily personal problems. The need for job knowledge is especially prevalent here due to the environment, which forces many of these students into a labor market at an early age. The dropout rate in schools certainly indicates this. Students are unable to ascertain what might be a good occupation for them, an occupation that is "open-ended" with avenues for advancement and social acceptance.

The important point is that all students, particularly boys, need occupational information early in life. Students are asked to make decisions about their future occupations as early as the ninth grade. They do not possess adequate occupational knowledge. Decisions regarding curriculum and course study may well affect their lives for years to come —perhaps a lifetime.

The eighth grade is a most opportune time in terms of student need as well as a time when rapid increases in student maturity take place. Students should have a knowledge of many occupations in professional, technical, and skilled categories. By providing the student with occupational information as well as instruction in how to interpolate this data, the student will be better able to analyze what type of occupation is both practical and right for him as an individual.

Many industrial arts teachers wonder if occupational information is not the province of vocational education. At the eighth grade level, vocational education is seldom available. Then too, vocational education is only one of the areas discussed in occupational information. Skill development is not an objective of the program. A general education and knowledge of many careers is. As such, the program should definitely be considered a part of general education. Ideally, the program should include girls as well as boys. The traditional value of the man being the provider is still prevalent in our society. The tenure of employment for married women, although increasing, is still short compared to that of men. As a starting point, a program for boys seems of greater urgency.

Industrial arts teachers generally have held jobs in industry, technical fields, trades, and some professions. Unlike most guidance counselors who have little experience in any of these fields, the industrial arts teacher is in a unique position to provide first-hand career information. A discussion of careers in industry fits in naturally with the students' study of industry in industrial arts classes.

A PROGRAM TO CORRECT THE DEFICIENCY

The initial program was scheduled to last 12 class periods of 50 minutes' duration, the main means of presentation being lecture by various individuals employed in a skilled occupation. Ample time was allowed after each presentation for questions and discussion. Those lecturing were instructed well in advance to talk about specific categories. These included type of work performed, salary, opportunities for advancement, education or training required, advantages and disadvantages of the occupation, and the main reason why he went into that field. Class interest remained high because each class session had a lecturer with his own unique personality. The teacher's role, rather than that of the traditional instructor, became that of producer and director.

As an added innovation, each lecturer was video taped. A video tape file of good lectures was an invaluable aid in future programs. The possibility always existed that a speaker might not be able to appear for each class meeting that day or might be unexpectedly called away on business. The video tape equipment could be set up quickly to fill in with an appropriate lesson. Each lecture could be repeated as many times as necessary. Each occupational information class now had the opportunity of viewing and listening to a lecturer, even though his class was held at a different time than the actual lecture.

Initial lectures were scheduled at many different times. Each class would have some live and some recorded presentations. The immediate and future benefits derived from a video tape file more than compensated for the additional work involved.

My experience in recruiting guest lecturers from the community was truly heartening. A list of names, addresses, and telephone numbers of lecturers willing to help students was compiled. A student particularly interested in a field could easily speak with one or more of these individuals. Often, a student could arrange to visit him on the job, receiving "on the spot" information and consultation. In this manner, the program took on a personal touch and actively involved the student and the resource person. This community resource was one of the most valuable aspects of the program. Several students who are now in tenth grade have returned to find out who they may contact for information about a considered occupation. Students were promised help in securing employment when they enter the labor market. This empathy between student and adult surprises many people who are frustrated by the generation gap. The adults were generally flattered by the interested enthusiastic students. The students were motivated by the knowledge that they would soon be working at an occupation themselves.

PROGRAM FORMAT

The term assignment for each student was to research an occupation that was of interest to him and then report his findings to the class. The report was to contain the following information: occupational outlook, type of work performed, education or training required, local schools and training programs offered in the field, salary, working conditions, advancement possibilities, social recognition, personal attraction, and best source of information.

Much of the information was in the library, and many students requested information from local vocational schools and industry training programs. There are also several well known resource publications on the subject of occupations. The assignment allowed the students to familiarize themselves with the various resource materials available. This information will be helpful during the later high school years. Oral reports before the class provided each class member with additional exposure to many varied occupations. Especially informative reports could be video taped.

The guidance department was invaluable in providing a follow-up campaign to the Occupational Information Program. They were in a qualified position to advise students on an academic course of study that would prepare them for a number of occupations in line with their ability and interests. After talking with the student, the counselor filled out a card listing the student's occupational choice area at the time. A follow-up campaign will again be conducted in the twelfth grade.

Hopefully, these campaigns will provide information that can constantly improve the program. One early outcome of the Occupational Information Program was to awaken the guidance department to the severe lack of knowledge available on occupational information. It showed a need for additional choices, and that local industrial and technical programs had been sadly neglected. The guidance department began to think of revamping its structure to include more emphasis on occupational information. Parents would also be informed of the advantages and variety of choices open to their children. The initial 12-day program is outlined below. It can be easily structured to meet the needs of a particular group and extended in such areas as field trips and speakers. It can be lengthened so that all students have a chance to fully cover their topic in the area of oral reports or modified by having students with similar interest areas work in committee groups.

OUTLINE OF THE DAILY PROGRAM

Each class will follow the same sequence as their scheduled class periods meet.

Period #1 - Orientation of the students to the new program. Assign research project, explain oral reports, give out a list containing many varied occupations, including those that are frequently unknown to students.

Period #2 - The teacher presents a lecture and then conducts a discussion about those qualities that distinguish a good job from a bad one. The students are encouraged to think critically about various occupations.

Period #3 - A speech by a successful auto mechanic followed by student questions.

Period #4 - The students visit a local construction site and are taken on a tour of the project by the union foreman. The foreman points out what several of the various tradesmen do.

Period #5 - A local union leader speaks to the class on the benefits of union membership. He also discusses the means by which an individual may obtain membership.

Period #6 - The class is presented a two-pronged lesson by a fire safety technician. One prong deals with fire safety, the other with his occupation.

Period #7 - The director of guidance of the local vocational school discusses the training programs that are open to them as future high school students. (All the classes were combined for this presentation.) In addition, a vocational student explained his course of study at the school and what occupation he is training for. He further explained why he chose this type of training for himself.

Period #8 - Each student presents the occupation he investigated to the entire class. Some are video taped.

Period #9 - (Extended according to need)

Period #10- A lecture by the teacher that helps a student establish values for himself in terms of the occupation he wants.

Period #11- A state employment agent speaks on how an employer evaluates a perspective job applicant.

Period #12- Overview and summary of the past 11 sessions. Discuss how the student may pursue an area of interest and formulate questions about academic preparation that can be answered by the guidance department.

SUMMARY

The success or failure of such a program appears to be directly connected with the degree of cooperation the community gives the school and teachers developing it. As is often the case, hard work is necessary to bring about this spirit of community helpfulness. We each hope that our students will govern their lives by rational thinking. To perform this rational thinking, they need information. Occupational information is one of the most practical and necessary kinds of information our students will ever need. A small beginning becomes a catalyst of the future for boys who will one day take their place in a working man's society. We need to help them meet this challenge, head on, with an adequate knowledge of many occupational fields which are as diverse as they are as individuals.

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International Relations

Peace Corps' New Directions in Relation to Industrial Arts and Vocational Education

Arden Lampel

The tenth anniversary of the Peace Corps celebrated last month coincides with the end of the U.N.'s "First Development Decade." It was during the sixties that most of the "new nations" emerged as sovereign states, shedding the yoke of colonial rule. Having gained political independence, the new nations sought as rapidly as possible to achieve economic independence in order to provide improved conditions of life for their citizens. These concerns are shared by neighboring countries which managed to maintain their traditional monarchies but as little nations were also thwarted in their development by the big powers.

The first order of concern was to achieve political consolidation of what were in so many cases artificially designated territories grouped for colonial administration. Tribes of people with common language, culture, and territory had, under colonial rule, been divided; their separated parts were regrouped with people of other tribes in order to facilitate administrative order. Characteristic of the first development decade is the establishment of administrative organization, a tax system, and increasing the proportions of revenues from the extraction of their natural resources.

In order to secure these accomplishments, massive programs of education were conducted to provide themselves with the civil servants needed and to ready their peoples for next steps in development. It was at the beginning of this period that President Kennedy and the Congress provided an innovative technical assistance program, the Peace Corps. It would consist of young people who would help to locate levers for progress, levers for social change, and levers for the much-needed improvement in understanding between peoples.

Principal among the early forms of involvement were programs of village or community development. Volunteers were sent to remote towns and villages to assist in the organization of programs of public health and sanitation and the improvisation of schools. For the most part the volunteers were, in Peace Corps jargon, "B.A. Generalists," young men and women with degrees in liberal arts. The skills accumulated in the process of their development and education as individuals in a technically sophisticated society, coupled with a deep desire to bridge the barriers to world peace, well equipped the early volunteers for the achievement of their tasks. They were largely free to do the things that the villagers and they decided needed to be done. They played a major part in defining their roles, and they played them well.

Having accomplished many of the early goals, the developing nations have come to emphasize economic development so that their peoples may enjoy all of the material and social benefits that are available in the more developed societies. We find then among the aims of "The Second Development Decade" a determination to greatly improve methods of land utilization and to stimulate the growth of industries. The developing nations and institutions such as the World Bank, UNDP, and bilateral aid programs came to realize that the preparation of a trained labor force was requisite to accomplishing these aims. Funding for expansion of education facilities would now require that programs relevant to development goals would have to be substantially provided for in order to justify the allocation of the limited resources available.

Since development goals more directly emphasize the economic sectors of society, education would likewise be expected to share in this emphasis. First Development Decade educational programs sought to aid in the consolidation of political systems by providing civil servants and developing towns and villages as centers of service.

The programs of the seventies seek to aid in bringing masses of people, heretofore relegated to subsistence and often sub-subsistence level farming, into the money economy. People tilling the soil using implements and methods thousands of years old, subject to success or failure by the amount of rainfall or the degree of drought, extremes of variation resulting in starvation or disease or both, would now have available to them information that will help them to improve their efficiency and thereby be a step ahead of the elements.

Improved methods result in surplus crops which enable the farmer to purchase commodities from the local traditional artisan whose iron work can be used to fashion a blade for a plow. His skill reaches markets which lie beyond the radius of the surface mining availability of ore. His activity and those of other traditional craftsmen stand as beacons to the world that hordes of untapped natural resources lie awaiting exploitation: bauxite in Jamaica and Guinea, timber in Honduras and Malaysia, iron in Liberia and Iran, and oil throughout the Middle East. Some of these and the many other countries of the third world have begun the process of extraction, but inestimable quantities remain yet untouched.

Efficient extraction requires infrastructure and equipment. Many countries are finding the money for such facilities through large loans to their governments as well as from local and expatriate investors. The money can buy materials and equipment and even the advisors to tell how it should be spent; but it does not work nearly so well with regard to aid in transforming peasant peoples into road and railroad builders, equipment operators, and the people to maintain them. Expatriate labor is costly to the extractor as well as to the nations in which they work. Transportation and bonus salaries for imported labor plus the loss of taxable wages to the country place limits on the attractiveness of investment, no matter who the investor. In some countries, more than half of salaries earned go to expatriate labor. Hence, the only realistic means to rapidly increase production is to provide the skills needed within the country. The economic desirability is evident, the means a bit more difficult.

Those of us in the various branches of industrial education call upon a rather extensive apperceptive base in order to help the learner to knowledge, be it in terms of skills training or related information. The American student lives and learns in a highly charged technological environment. Television, radio, automobiles, not to speak of our self-conscious conquest of the moon, surround him. At home there is frequently a rather extensively equipped shop, in some cases better equipped than the ones he finds in school. He brings all of this background to the classroom so that we can help him to put it in order. Try to picture your presentation to a group of students who may never have seen a modern hammer or a pair of pliers. Does the challenge sound inviting?

The changes in priorities in the developing world have had a direct effect on all programs of foreign technical assistance. Requests for assistance have become more technical and the needs greater. In Peace Corps, we have called our response to these changes "New Directions." In order to maximize the ability to identify and to serve the needs of the 60 countries to which the Peace Corps sends volunteers, the policy of bi-nationalism was established and is being widely implemented. Nationals of the countries in which we serve have been employed as staff members to participate fully in the policy-making and administration of the programs.

An extension of this idea which aims at an efficient use of resources within the countries is that of multi-nationalism. Peace Corps seeks to join efforts with technical assistance programs of other nations and the agencies of the U.N. working in the developing countries. We have had volunteers participate in programs of the International Labor Organization, The Food and Agricultural Organization, and recent discussions with representatives of UNESCO may result in the placement of volunteers in its vocational and agricultural education programs. We have supported the advent of the U.N. Volunteer Service and will recruit U.S. volunteers for its initial and succeeding programs.

Most dramatic of the "New Directions" is that of adding emphasis to the participation of people with professional and highly skilled backgrounds in Peace Corps programs. There is no doubt that the B.A. Generalist will continue to be an important if not major part of Peace Corps programs. We are finding ways to program and train for his employment in the new needs as was done in response to earlier needs. Clearly though, the countries we serve have requested and do require increasing numbers of people with higher levels of skill.

The responses to the New Directions are encouraging. We have announced to the countries we serve that we can provide people with the skill levels they require who will also bring the "people to people" understanding of the earlier volunteer. The requests from the countries indicate that this combination of qualities is needed more and more. The response to our call for volunteers with skills is likewise increasing.

Americans more than others usually acquire other valuable assets at the same time they are developing skills. Hence, our program efforts now must provide for the placement of married couples as well as those with children.

The number of requests for volunteers with backgrounds of traning and experience in the areas of industrial arts and vocational education is rapidly increasing. The school year of most of the countries we serve coincides closely with that of the United States.

For the last school year, 33 people with industrial arts and vocational education backgrounds were requested; for this coming year, more than 100. There is every reason to believe that with the increase of investment in providing shop facilities as indicated by the rise in World Bank funding, the requests for the following year will rise sharply again.

I would like now to describe some of the procedures and conditions for Peace Corps service. Any United States citizen above the age of 18 may apply; good health is the only upper limit. The placement of volunteers is done by matching the skills requested by countries to the background experience of applicants, and so the very youngest applicants with only limited experience find too few opportunities to serve.

Prospective volunteers are brought together in groups of those who have expressed interest in participating in a specific project for two or three days at Peace Corps' expense in what is referred to as a pre-invitational staging. Having received a letter describing in some detail the nature of the program, the staging allows for a more careful discussion between Peace Corps representatives and the prospective volunteers, together with their wives and children. Pictures, literature, artifacts, country staff members, and nationals of the program's host country bring descriptions of the culture and the structure of the society which contains it. Frank and detailed discussions afford the opportunity to match continued interest in the program with the necessary qualifications for participating.

Having mutually agreed as to the desirability of volunteer service, the participants are brought together once again for pre-training medical staging and are shipped by air to their training sites. The largest bulk of volunteers are placed into training programs during June and July so that the training period will end in time for the start of the school year. Other groups of volunteers are processed at other times during the year.

Training of volunteers is increasingly accomplished in the countries in which they will serve. This is done with the expectation that cross-cultural and language instruction will be most effective in the environment of their practice. Even in those countries where the language of instruction in the schools is English, the tribal languages are important to comprehension of the cultural background of the students as well as to enable the volunteer to integrate into the life of the community he serves.

We occasionally hear warm stories of an ex-volunteer returning for a visit to "his village" and the festive joy with which he is received. It is invariably this sort of human contact which the volunteers cherish most dearly from among their experiences.

Technical training is tailored to the special requirements of the programs in which volunteers are placed. It is hoped, of course, that the required technical skills will reside in the individual as he enters volunteer service and that all that remains to be done is to provide an orientation to the program in which he will work. It may include, in the case of a teacher, the structure of the school system, the methods of instruction employed, and an understanding of the accepted relationship of teacher and learner.

In most foreign school systems, the teacher's role is authoritarian, and rote instructional methods are widely practiced. While many officials in ministries of education are interested in changing to inductive methods, as evidenced by invitations to Peace Corps to introduce new math and coordinated math-science curricula, most teachers have been trained to old methods, and diplomacy must be employed to win acceptance to reform. Students themselves must learn to respond to questions as a method of learning. The teacher is looked upon as the master and dispenser of knowledge, and the encouragement of students to inquiry takes some prodding and patience. The results, though, are rewarding.

Being thus far unable to provide all of the trained and experienced teachers which have been requested of us, we have sought, as many stateside school systems have, to seek and to provide acceptable alternatives. Industrial arts and vocational education programs will include many professionally prepared teachers available for volunteer service, and group with them skilled tradesmen and other blue collar workers who are willing to teach.

The result of the combination has been to utilize the advar[illegible] preparation of the teachers in training the skilled workers in pedagogic methods [illegible]ng the two- to three-month pre-volunteer service training period. Professional teachers also lend field support to their less experienced colleagues. In several training programs, we have employed returned teacher volunteers and faculty members of industrial arts teacher education institutions as volunteer training staff. Programs in Malaysia, Iran, and Eastern Caribbean Islands, and this summer training programs in Ethiopia, Malaysia, and Iran have been supported by professional industrial arts people. It is our expectation that this relationship will continue and will widen as our programs do.

A model of this type of experience will be the training of a group of 55 volunteers in Ethiopia this summer by New York University in the areas of industrial arts, home economics, and business education for comprehensive secondary schools in that country. The university will offer six credits applicable at the senior undergraduate or the graduate level for the technical training component they will provide.

At the completion of training, the final decision is made as to whether in fact the individual still desires to spend the next 21 to 24 months in the program of the country. If so, his volunteer service begins. Having paid all transportation costs thus far, return air fare is also provided for transportation home at the end of the 24- to 26-month period of service. From the time the volunteer enters training, a living allowance is provided that will be adequate to provide modest housing by western standards and a well-balanced diet, plus a vacation allowance which will allow limited travel within the country and in some cases to neighboring countries. The dollar amount varies from country to country and is based on the cost of living in each country. In addition, the Peace Corps will set aside $75 per month as a readjustment allowance, which is provided in a lump sum with the return fare home. Many returning volunteers use their air ticket to stop off for visits to countries enroute home.

While there is no pretense that Peace Corps service is anything but voluntary, a single volunteer does receive $1800 at the termination of his service. A married couple receives $3600, since each in fact is a volunteer. A family regardless of size receives $4800, with the total brood rated at two-thirds of a volunteer. Living allowances are proportional to family size as well. While such matters are important with regard to being able to live during the period of service, the things of enduring value that a volunteer takes away with him are also the things he leaves behind: the richness of having experienced deep and lasting friendships, an appreciation of different cultures, and the knowledge that some desired contribution to development has been made.

Where can you fit, my colleagues, in this rich experience? In what ways may your life, the lives of your students, and those in the developing world be enriched in the spirit of sharing? Peace Corps offers several of the many ways that such satisfaction can be gained.

The School Partnership Program operated from our Washington office seeks to encourage American schools to raise funds for school and clinic construction in countries with limited resources for such purposes. One thousand dollar units go to provide the materials needed for construction, with labor provided by the receiving communities. Volunteer architects and construction men assist in the planning and completion of such projects, and frequently a volunteer teacher or health program person will man the operation after completion.

The same office receives requests from countries in which we have programs to provide much needed equipment for school shop industrial arts and vocational education programs. If your school or district can provide either the money, used equipment, or both, the School Partnership Program would gladly arrange the receipt of such contributions to a specific recipient who will acknowledge the "Partnership."

Volunteers in occupational programs abroad receive requests to locate institutions in the United States in which their counterparts can receive training which can enable them to assume a greater professional responsibility upon their return to their country. The effect of linking a scholarship program to the placement of volunteers can mean that the volunteer will be replaced by a teacher of the country at the end of his service rather than another expatriate. Teacher education institutions interested in offering such scholarships can arrange this through the School Partnership Office as well. In as much as I receive requests for people to participate in training programs of volunteers, I would appreciate hearing from those interested, most particularly those who have had professional experiences abroad. I can best be reached by writing me at Peace Corps, c/o United States Embassy, Tehran, Iran.

This convention's committee on resolutions might consider encouraging the members of the profession by urging school systems to allow teachers to extend sabbaticals with leaves of absence to allow for a two-year period of Peace Corps service without loss of seniority, pension rights, and salary increment credits for continued professional experience. Some school systems already practice such a policy.

The finest of all contributions and the one which will be best received is yourself. I will cite some of the new and replacement programs which will be filled this summer.

They are by no means the only Peace Corps programs; there will certainly be others and in larger numbers during the coming year. In this hemisphere, the Eastern Caribbean Islands have volunteers in an industrial arts program and are expecting some 15 more for a vocational education program to work with Canadian volunteers and islanders in a string of Polytechnic Institutes built with British funding which will be completed for September. Jamaica is expecting new volunteers to work in programs of industrial arts in the junior secondary school system who will, after teaching one year, function as supervisors of interns who are in their third year of teacher education. Some will be employed in eight- to ten-month trade training courses, and others will teach skills to young early school leavers in youth camps.

In Peru, a program of training villagers in house construction in areas affected by last year's earthquake disaster will begin. In Bolivia, short courses to upgrade the skills of construction workers are taught by volunteers. A request has been received from the Ministry of Education of Honduras to provide people to do industrial arts and business education teacher education at the Escuela Superior now under construction. We presently have a volunteer teaching related technology to automotive students in that Central American country.

Moving east to Africa, there is a program of industrial arts requiring 10 people to start teaching this fall in Kenya. I mentioned earlier the program in Ethiopia which will include 25 in industrial arts, two in vocational education, 10 in home economics, and 18 in business education, most of which will be done in the comprehensive school system of that country. Nine people will go to the Gambia to teach industrial arts, wood and metals, and home economics. The two most qualified in the group will teach industrial arts and home economics as part of a teacher education program at the Yundum College there. Having started a math-science program there with volunteers last year, there is interest in extending the coordination of curriculum to include industrial arts and home economics. Vocational schools are building much of the needed equipment for this program.

Three industrial arts majors from Cal-Poly are serving their fifth year in a project of industrial arts in Botswana. Two of them are married. Appropriate volunteer jobs will be found for them that will utilize their respective skills. Liberia has an industrial arts volunteer doing curriculum development at the Booker Washington Institute, and discussions with an International Labor Organization mission for the development of a project of rural vocational schools may result in a volunteer placement. My visit to that country last summer was greatly enhanced by having read a report by Dr. Alvin Thomas of Prairie View A & M on Liberian vocational education which was published by Epsilon Pi Tau.

Continuing eastward, Iran, which is my new home, is expanding its involvement in the vocational education project. With eight volunteers presently employed in schools, I am to meet with a group of 29 more in various skill areas next week in Philadelphia for a pre-invitational staging. At least 10 of the group are industrial arts people with some in-depth skill training and background and a willingness to teach salable skills. It is expected that Iran will request our participation in a new program of guidance schools which are in some ways similar to our junior high schools.

Peace Corps has a program of construction skills training in India. A program in Malaysia of industrial arts which was ably supported by Professor Keith Gummere of Los Angeles State has recently been phased out, since Malaysia now has filled its classrooms with trained Malaysian teachers. In its place, a new Peace Corps program will start this year to provide teachers for a post-secondary technical program while Malaysia prepares to train replacements to be ready at the end of the volunteers' tour. A most important objective of Peace Corps programming is to work ourselves out of a job.

Discussions are taking place in Thailand for a Peace Corps in-service teacher education program in which volunteers will tour with Thai counterparts to give instruction in the use of equipment new to the teachers of that country. South Korea is also exploring the use of volunteers in vocational programs aimed at the development of manpower for developing industry. A study of the Technical Assistance Division of the International Organization for Rehabilitation Training of the vocational education needs of that country may provide the basis for a substantial investment in building vocational schools. The Trust Territory of the Pacific, Micronesia, will start an industrial arts program this fall with volunteer teachers who will train counterparts to replace them at the same time as they will be teaching classes. The island kingdom of Tonga is discussing with the Peace Corps the advent of an industrial arts program for that nation.

Clearly, my colleagues, the opportunity for a broadly based international dimension for our profession is increasing rapidly. Not only are the demands for salable skills imminent and pressing for the new nations, but it has become clear that relevance for general education must include a knowledge of tools, materials, and processes. The developing countries are at a point where our nation was some years ago when the predecessor of industrial arts, practical arts, came into being. The wealth of experience of these transitions resides in the industrial arts profession of the United States and Canada. In order to find the resources with which the new nations can build such programs, they look to this continent.

Our students are looking abroad to the cultures of other peoples. For some it is a search for their identity; for others it is the quest for enrichment and world peace. Students abroad are seeking new applications of their art and their culture through technology. Human and professional links can bring them together.

What are you doing on your next sabbatical?

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The NEA Teach Corps Action Program in Ethiopia

Sam R. Porter

In my estimation, one must accept an overseas educational assignment with the humble realization that his expertise is limited in his own country and even more so when applied to the problems of others. This is especially true when one's stay in a foreign country is too brief to allow an in-depth understanding of that country's society and culture. So, without apologizing, I must admit that I went to Ethiopia with the NEA Teach Corp knowing that my visit would not result in vast improvements in the educational system of that country, aware that my contribution must be within the framework of the educational system of that country, and cognizant of the fact that any deficiencies I noted in the educational system of Ethiopia were perceptible only because I recognized them as deficiencies prevalent at home.

Industrial arts has an unusual and unique contribution to make to many overseas situations because of the active and concrete nature of this discipline. Many parts of the world have inherited bits and pieces of educational systems and practices from England, America, Russia, and other so-called developed countries, yet when these practices are installed in their new host nation, they take on a rather curious blend which does not necessarily reflect the best practices of any of its origins. I think it is safe and fair to say that Ethiopia, for example, has inherited the lecture/assignment/homework/examination syndrome of England—a system which some consider adequate for the upper class and wealthy of England but which is not necessarily relevant to a developing nation. Industrial arts educators from the United States disagree on many things, but they do enjoy consensus regarding the practical application and approach to be taken in shop course work. Moreover, industrial arts educators would probably agree that the purpose of education is not to develop a massive leisure class, a giant civil service, or an impressive government bureaucracy. For this reason, it is my opinion that industrial arts does have a substantial contribution to make to the educational systems of many developing nations.

It seems appropriate that this presentation on the 1970 Action in Jimma, Ethiopia, should be prefaced by several major generalizations which came out of that experience.

Because industrial arts is action-oriented and does involve manual work, the industrial arts educator should not approach an overseas assignment with the idea that he is a consultant or a lecturer but rather a fellow worker. If there is anything uniquely American worth demonstrating to developing nations, it would be, in my opinion, the innovative, energetic, and active approach that industrial arts teachers take in their work. The idea of a visiting American educator rewiring a wasp-infested attic under a hot corrugated roof is most astonishing to the teachers of developing nations, yet it is this spirit which has characterized the American approach—especially in industrial arts teaching.

It is presumptuous to think that industrial arts should be taught primarily for the purpose of imparting handcraft skills. This is a questionable goal in the United States and even more questionable abroad. When one examines the beautiful carvings, the practical architecture, and the traditional arts of African nations, he realizes that this work cannot be surpassed in the industrial arts laboratory. Rather, the purposes of industrial arts must be more humanitarian in nature and must dwell upon such things as an approach to a problem, the satisfactions and dignity of manual work, the importance of cooperative and well managed efforts, and the quest for discovery of rew methods and applications of scientific knowledge. While the handcraft-oriented shops of America may provide avocational interests for the copious leisure that Americans expect to enjoy, this purpose cannot be transplanted to a country which sees handcrafts as a necessity and which has developed them to a point far beyond anything to be expected from the hobbyists.

Most of the problems and deficiencies I perceived in Ethiopian society and the educational system and practice parallel exactly those perceived in my own country. Irrelevant and rigid educational practices, unequal educational opportunity, a cumbersome hierarchy and bureaucracy, and the lack of dignity accorded to teachers are all seen abroad, but are also seen at home. One cannot be hasty in condemning these factors knowing full well that his own house is not in order.

Another generalization I would make concerns community relations. In Ethiopia, and I would suspect in many other African nations, education has been a national government function and as such has been installed on the local scene without a great deal of local consensus or understanding. In order for schools to be properly supported and utilized, they must establish a liaison relationship with the local community. I feel that industrial arts is one of the disciplines uniquely suited to this task. Because of the applied and manual nature of industrial arts, it has a great deal in common with the vast majority of local citizens and, properly interpreted, can escape the lofty, distant status often accorded to the more academic fields.

The Action Program in Jimma, Ethiopia, was conceived by officials of the Ministry of Education and their USAID advisors. The approach was examined, endorsed, funded, and staffed through the efforts of Dr. Bouey-Yates with USAID support.

Seventeen outstanding industrial arts teachers from each of the provinces of Ethiopia were selected as participants. All were experienced teachers; many had outstanding credentials of preparation; some had studied in Germany and Russia in technical institutes. All came to the program, however, with the feeling that teaching—especially industrial arts teaching—enjoyed low prestige in their communities and that they were hampered by lack of supplies, equipment, and ability to carry on an active industrial arts program. All seemed to rely on teaching methods which included mostly theory, lectures, memorization, and examinations.

The idea of the Action Program was to demonstrate to teachers that their classes could become active agents in community relations and their method of teaching content could be best presented through active classroom participation in school improvement projects. Each morning for one or two hours the class spent time discussing the principles of shop planning, analyzing the space provided in the secondary school in Jimma, redesigning the laboratories, and acquiring any necessary background information. The rest of the day, however, was spent in vigorous activity. In the five weeks, working six days a week, the class accomplished the following: (1) welded, painted, and provided new tops for 100 school desks; (2) repaired frames and reglazed 88 broken windows; (3) completely renovated two laboratories, including new cabinets, windows, doors, wiring, and paint; (4) installed power equipment and practiced its use; (5) constructed tool displays and accounting systems for laboratories; and (6) took field trips in the community and hosted the many visitors through the school. The Action Program in industrial arts, which was supervised by Mr. Ray Baldwin of Batavia, New York, and myself, was paralleled by a similar action program in Home Economics under the direction of Miss Ruth Potts of Jamesville, Wisconsin.

In the opinion of the Teach Corp volunteers, the Action Program did generate an enthusiasm which had carry-over value for the teachers involved. It demonstrated, too, that the school officials in the community were willing to support education of a demonstrable and constructive nature and that there were learning resources in the schools and the community.

Dr. Porter is the Chairman of the Department of Technology at Western Washington State College, Bellingham, Washington.

With the NEA Overseas Teach Corps in Ethiopia

Loyd C. Gass

We industrial arts teachers complain endlessly that the ever-changing needs of youth cannot be served due to lack of material, equipment, and facilities. For many of us, it is hard to realize that people in other parts of the world have a similar problem, often magnified many times.

In order for the nation of Ethiopia to progress from one dependent primarily on an agricultural economy to one with industrial opportunities, the Ethiopian Ministry of Education recognizes a need for technical training of its people and believes industrial arts to be one of the more worthy programs in preparing youth for productive work and advanced technical training.

The National Education Association's Committee on International Relations sought to find a way to help. They recruited five American industrial arts teachers to work as volunteers in Ethiopia during the summer of 1970 in two different teach corps projects. I count it an honor to have served as one of these volunteers.

To spend six weeks living and working in Ethiopia was an educational experience for each of the volunteers as well as the Ethiopian students.

Ethiopia is a constitutional monarchy. Her ruler is His Imperial Majesty Haile Selassie I, Emperor of Ethiopia, King of Kings, Elect of God, Conquering Lion of Judah. His Imperial Majesty commenced his reign as Regent in 1916 and was crowned Emperor in 1930.

Ethiopia is called the land with "13 months of sunshine." This slogan is based upon the use of the Julian calendar and emphasizes one of the country's most pleasant assets. There really is sunshine nearly every day of the year, although it may be interspersed with heavy showers during the "big rains" from June to September and the "small rains" which occur any time between February and April. The Teach Corps volunteers were in Ethiopia during the "big rains." Spirits were not dampened, however, and everyone set to work with a real determination to make the six weeks as meaningful as possible.

We who were assigned to the teaching center in Addis Ababa found the capital to be a city embracing both the traditional and the modern. Today, Addis, the birthplace of the organization of African unity, has 58 embassies and is the home of the United Nations Economic Commission for Africa.

Headquarters of the United Nations Economic Commission for Africa was built in 1961 by His Imperial Majesty Haile Selassie I. Africa Hall is a graceful and modern seven-story building. It stands as a monument to the African unity it represents and to the beauty of Addis Ababa.

Addis Ababa, at the same time, is a city possessing all the charm of traditional Ethiopian life. The hubub of a thriving business community and the exciting atmosphere of international diplomacy merge with the tranquility of farmers and herdsmen. Together they become a city of progress and tradition.

Ethiopians are deeply religious. Although Christianity is the official religion, there is complete religious tolerance. Moslems and other minorities worship in their own mosques or churches.

Most of the Teach Corps volunteers found time to visit Harrar, the birthplace of His Imperial Majesty. Harrar is a unique combination of ancient walled city, with casbah-like alleys and quarters, blended with wide, tree-lined avenues and buildings of the 20th century.

The markets at Harrar proved to be a fascinating place to the Teach Corps volunteers. Marketing is largely done in traditional fashion, with most of the merchants being women. Each merchant utilizes perhaps four square meters of ground to display her wares. Bargaining is the order of the day, and any customer willing to pay the first price asked for something has violated the code and spoiled the enjoyment of the occasion.

Hyenas are a feature of Harrar. They may be seen after dark, loping across the streets. There is a place along the wall of the Old City where at night you may find a "hyena man," who has his pets among these scavengers and will call them forth to be fed by hand.

These two cities exemplify the changes taking place in Ethiopia. Mountains and deserts, camel caravans and jet liners, traditional and western dress, contrast and progress, the past and the present blend to make Ethiopia one of the most scenic and enjoyable places in all of Africa.

The Teach Corps volunteers found Ethiopia truly a world between worlds, a land of "thirteen months of sunshine," and a land whose people possess a desire for economic improvement. The success of our efforts could not be measured at the end of the six weeks. Time will be the final judge. One thing each volunteer could say was that it had truly been a rewarding and worthwhile experience for each one personally.

Mr. Gass is a member of the faculty at Davis High School, Trenton, Georgia.

Education in Ethiopia

Anderson A. Taylor

The Committee on International Relations of the National Education Association was authorized by the U.S. Agency for International Development to conduct an NEA Overseas Teach Aid program in Ethiopia for the summer of 1970, from July 6 through August 30. This was the third year of the Teach Aid program in Ethiopia.

This program involved in-service education for teachers and headmasters at the elementary and secondary level and specialized activities in several different areas.

Six American educators in the field of industrial arts were recruited to serve as instructors in a special program for industrial arts teachers for the secondary schools, to help set up an industrial arts section in a new secondary school, and to develop community action programs in industrial arts with the Ethiopian teachers.

The secondary school program was designed to upgrade teachers through instruction in content, methods and techniques, and the preparation of teaching aids and materials in specific subject areas. Instructors in the area of industrial arts provided a practical program of instruction, with concentration on metal-working, wood-working, electricity, and mechanical drawing. We (Aids) gave direction and help to Ethiopian teachers in finding meaningful solutions to some of the problems prevalent in the secondary schools and generally inspired, influenced, and gave direction to the program.

We (Aids) worked together with Ethiopian teachers in planning and setting up industrial arts facilities for new secondary schools, in working out course outlines, and in developing community action programs involving the three areas of concentration.

The NEA Overseas Teach Aid program is a volunteer program. There was no salary; however, all expenses necessary for program participation were provided by the NEA through its contractual arrangements with the USAID.

The NEA 1970 team consisted of 33 volunteers in the instructional program who worked in several programs and in many different parts of the country.

The team leader worked closely with AID, the Ministry of University Personnel, and assumed responsibility for the coordination of the entire program, with major emphasis in the organizational academic area. The administrative assistant was primarily concerned with logistics. Both parties, however, worked cooperatively and shared responsibilities as the situation demanded.

Provisions were made in the contract for the team leader and assistant to arrive in Addis 1-2 weeks before the team arrived and to remain for 1-2 days after the completion of the program to finalize all details.

Areas of NEA participation included primary (elementary) teachers, secondary teacher training, and university training program for school directors. Personnel consisted of 1 program coordinator or team leader, 1 administrative assistant, 12 volunteers - primary program, 12 volunteers - secondary program, and 9 volunteers - school directors program. Twelve volunteers taught in the secondary program in the following areas:

Courses	Volunteers	Location	Course Center
Business Education	2	Addis	Technical TTI-University
Home Economics (Instructors)	2	Addis	Secondary School-Addis
Home Economics (Special Program Community Development)	1	Nazareth	Secondary School-Nazareth
Industrial Arts (Instructors)	3	Addis	Technical TTI-University
Industrial Arts (Special Program Community Development)	2	Nazareth	Secondary School-Nazareth
Agriculture Education	2	Jimma	Jimma

ORGANIZATION OF THE PROGRAM

We found the facilities and supplies of teaching materials available at the Center adequate.

Some of the weaknesses I observed in the program were lack of communication between the teachers (students) and the Ministry of Education and discontentment of teachers (students) over salary problems.

For improvements for such future programs, I feel the Ministry of Education should design a well-planned 3-year sequence program necessary to eliminate repetition and insure adequate coverage of all industrial arts areas. Professional techniques and new methods of teaching industrial arts should be applied to all areas of classes of Industrial Arts. A long-range program should be designed to inform students of the courses available and the preparation necessary before enrolling.

Prior arrangements should be made to facilitate the operation of the program in the future. The teaching staff (NEA) should be informed of the exact nature of subjects they are to teach several weeks in advance, to allow them adequate time for the preparation of their assignments. If possible, all students should be registered prior to the beginning of classes. Transportation should be provided for field trips at no extra cost to participants enrolled in the program. A better atmosphere between the Ministry of Education and the participants is needed.

PARTICIPANTS, PROS AND CONS

I feel that the participants possessed sufficient academic knowledge to follow the instruction. However, I feel that more professional training is needed to strengthen them in their profession.

I did not have any problems involving the participants in class discussions. In fact, the motivation appeared very high.

The participants were very resourceful in outside assignments, new and different ideals, group and individual discussions.

Participants showed sufficient knowledge and appeared to be very concerned about solutions to such problems as a need for more industries and limited job opportunities in Ethiopia, as well as how they could be rectified.

SUGGESTIONS AND RECOMMENDATIONS

A follow-up is advisable on previous evaluations; re-evaluate them and their procedures to see just how valid they were; if changes need to be made, start making them as early as feasible. Make sure that the goals and objectives are obtainable in Ethiopia and that when reached, they meet the needs of the people concerned.

CONCLUSION

In the final analysis, I concluded that my participation in the NEA Overseas Teach Aid program contributed as much to my professional and educational growth as I contributed as an educator to the program in Ethiopia. I personally feel that in order to be a professional and successful educator, one must possess primarily three qualities: professional dedication, understanding and willingness to work with people, and competence in his field of concentration. I feel that participating in overseas programs of this sort strengthens and widens one's outlook and that I am able to deal more effectively now with problems which occur in average situations, or in some situations that are above average, and have a better understanding of how to deal with and work with individuals at large. Therefore, I would personally encourage others to take advantage of such opportunities when they present themselves.

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Metals and Materials

The Glass Industry and Instructions for Industrial Arts Programs

Milton K. Berlye

According to mythology, Prometheus, who stole fire from the realm of the gods, fashioned... with earth and with his tears... the body of the first man. With a touch of poetic license, it can be said that glass and man were formed from the same substance—minerals of the earth. The history of glass has paralleled the history of the progress of humanity. Each new application, the primitive hunter's spearhead, the first beads of adornment, vials and bottles and vases and goblets, represented great advances in utility and beauty over materials previously used. Today, glass has reached a new zenith in service to human society.

O.K., you say, so it serves human society, but what does it mean to the student who comes to my class day after day? ... Well, let's take a close look at him. The alarm goes off, shaking Johnny back into the world. He yawns, stretches, then turns on the glass bulb, puts on his glasses, and peers through the glass face of the clock to verify the time. In another moment he looks out the glass window to check the weather, then moves to the bathroom—a room literally filled with objects made of glass or glazed with glass. He uses the glass for a drink, takes up the glass bottle of Vitalis, looks in the mirror, and proceeds to comb his hair (if and when he does it). Down to breakfast, where he eats out of glass and glazed recepticles of all kinds, then onto the school bus, which is literally a box of glass and steel. Slowly the bus worms its way toward school, passing through canyons of glass windows in homes and stores where glass objects are displayed in hundreds of different forms and shapes. Finally, Johnny arrives at school—which, if it is a modern one, may very well be constructed of from 50 to 80% glass.

Johnny's day has just begun; he has been awake less than an hour and has already used and observed more than a thousand items of glass. Wouldn't you say glass was important to Johnny?

Before getting into our discussion of glass, let me play the typical teacher and start this class with a quiz. You may write down your answers or keep them in your mind.

(Hold up blue dish)

This dish was made by a student in our Monticello Schools. Notice the nice even shape and the lovely lace work around the edge.

Question One; what was the student's grade level? Two, how old was he or she? Three, how long did it take to be completed? Four, how much did the material cost?

While you are preparing your answers, I would like to take the time to tell you a little bit about glass.

Man has made glass for over 50 centuries, yet only within the past 75 years has he begun to understand and utilize the versatility of this material. Even today, there are questions still to be answered.

Most of us think of glass as we use it. To the glassmaker, it is the material he obtains by heating such things as sand, lime, and soda until they fuse into a liquid which can be worked to form useful or decorative objects. To the housewife, it is a heat-resistant pie plate or a sparkling tumbler. To the chemist, it is a reagent bottle or a chemical flask. To the young girl, it is a shining mirror.

The large number of different glasses melted by a modern glass factory prevents us from easily defining the material from a viewpoint of its properties. Today we have glass products which are light as cork or almost as heavy as iron; strong as steel or fragile as eggshells; soft as cotton or hard as precious stones.

The variety of possible properties points to the great advantage of modern glass. That is, through engineering skill and scientific knowledge, the properties of glass can be controlled to a remarkable degree. Over 100,000 different variations of glass have been developed. More than 800 of these compositions are manufactured commercially to make more than 35,000 different products.

All glass, however, begins with one simple definition. It is the substance obtained from mixing inorganic materials (matter which is not animal or vegetable) and melting them together at a high temperature. The resulting hot liquid, when cooled, becomes rigid without crystallizing—that is, its molecules never arrange themselves into a tight crystalline pattern. The thousands of different glasses are produced by changing the formulas for the original mixture and by varying the way the glass is made.

I wish there was time to go into the very fascinating history of glass, which actually starts with the beginning of time. You see, the first glass furnaces were volcanoes. And the first man to use glass took it from the ground already fused and cooled. The most common form is a black and translucent glass called obsidian. Man probably began to use this natural material to make tools as long ago as 75,000 B.C.

Another form of natural glass is a glassy stone caused by lightning that struck a field of grain and fused the ashes. Lightning also accounts for the formation of fulgurites, long slender tubes of fused sand.

It is not known when glass was first manufactured. Some authorities set the date as early as 4000 B.C. The first use of manmade glass was as a pottery glaze. Later glass beads and jewels were formed, and small containers were made by dipping a sand core into molten glass.

One of the most remarkable things about the history of glass is that until modern times there has been little basic change in the constituents which are fused to make it.

It was the invention of the blowpipe shortly before the beginning of the Christian era that rapidly extended the use of glass and emphasized the desirability of transparency. For the next 1700 years, glass makers contented themselves with developing decorative techniques and, especially in Rome and Venice, attempted to limit the impurities in their glass.

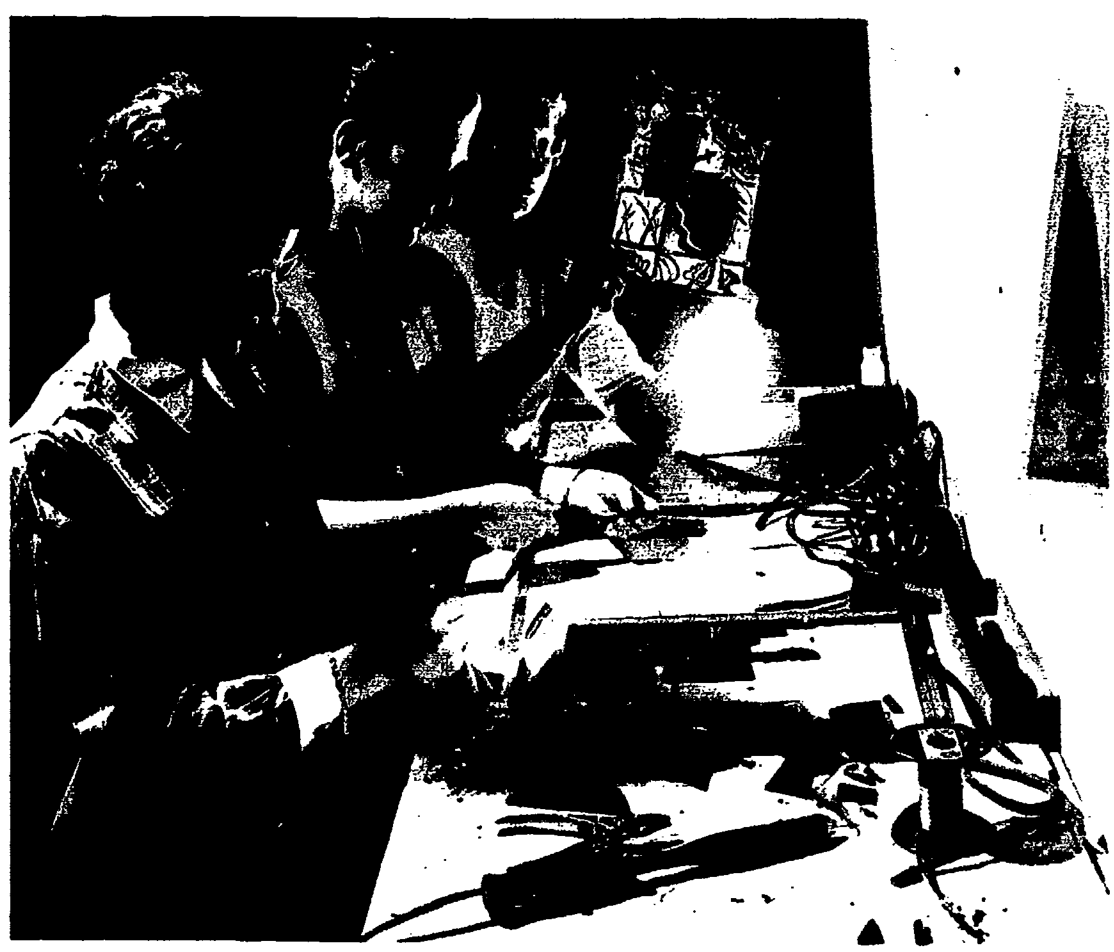


Figure 1. Students lead up modern stained glass panels.

The next giant step came in 1676 when George Ravenscroft, an Englishman, developed lead, or flint-type glass. It was more than a century before the next major improvement appeared when a French glassmaker developed a method of producing optical glass with few physical imperfections. The search for glasses with improved optical properties in the 19th century became the key and guide to modern glass making.

As I said, the history of glass is a long and exciting one and I wish there was time to present it in detail. I would strongly recommend it for your leisurely reading.

The thing I find most interesting about the history of glass is the human interest stories that permeate the subject. For example, how many here know that man's first flight to the moon was, to a very large extent, made possible by a train accident that happened in 1901? It was a dark, rainy winter night when an express train hurtled down the track. A signal man stepped from his station to warn of a freight ahead. He began to swing his lantern, his only means of "talking" to the express engineer. Then cold rain hit the hot lantern globe and it shattered. As the flame guttered out, the express roared by the helpless signal man. Minutes later came the sound of a rending crash.

Out of this disaster came the need to find a glass that could withstand temperature changes. Finally, in 1912 a successful borax glass called Nonex was developed, and the problem of railroad lantern breakage was solved.

The new glass aroused the curiosity of a young physicist. Because glass transmits heat well, he reasoned, it should make a good baking vessel. He brought the bottom of a Nonex jar to his wife, and that night she baked a cake in it. From this successful experiment came Pyrex ovenware in 1915. From Pyrex it was only a small step to Vycor brand glass, which can withstand an instantaneous temperature change of 900° and is used for nose domes of missiles of all kinds.

It is difficult to imagine a world without glass.

As a basic engineering material, glass is used today in thousands of products in science, in industry, in electronics, and in the home. Several hundred different commercial glasses are melted each year, each carefully produced for the proper combination of specific optical, thermal, mechanical, electrical, and chemical characteristics.

Optical glasses help us to investigate the stars and study bacteria. Heat-resistant glasses enable us to bake a cherry pie and to transport hot sulphuric acid. Other glasses are used to harness heat, electricity, and light.

Indeed, there are few modern activities in which glass does not play a substantial role. From the dairy barn to the dress shop, from the living room to the laboratory, glass serves in some useful fashion.

We have only begun to recognize the infinite variety and fundamental usefulness of glass. To improve our health, our pleasure, and our comfort, new glasses and new uses for glass are developed each year through continuing research.

Industrial applications demand glasses with diverse combinations of properties. Different compositions and manufacturing methods make it possible to produce glasses equipped to solve many specific industrial problems, such as corrosion, heat, mechanical and thermal shock, abrasion, and the need to maintain high sanitation standards.

Specially-treated glass windows shield steel mill workers against heat, molten metal, and flying slag. Tubular and panel heaters of glass are used in industrial drying, baking, and curing, providing an efficiently controlled, even source of radiant heat.

Other manufacturing applications of glass range from godet wheels, which are used to pull threads from acid baths in the manufacture of synthetic fibers, to gauges, mercury switch enclosures, jewel bearings, blueprint cylinders—even protective tubes for thermocouples used to measure temperatures inside steel furnaces.

The inherent resistance of glass to chemical attack, combined with its mechanical strength, thermal properties, and transparency, makes it an ideal material for piping and accessories used in the chemical and food processing industries. Miles and miles of glass pipe are used to transport everything from fresh milk to hot acids. Entire processing units of glass are used in industries that require extreme product purity.

Glass is used in heat exchangers to heat or cool liquids or acids. Drainlines of glass are increasing in use because of their resistance to corrosion and ease of installation.

Glass and ceramic researchers continue to find new materials for the world of industry. A pure magnesia ceramic, capable of long-term high-temperature operation, has been developed for use in crucibles for melting metals. Light-weight honeycomb ceramic structures have applications in gaseous heat exchangers, as catalyst supports and as structural materials. Low-expansion ceramics in varied shapes are applicable as furnace linings and kiln furniture. Mechanically strong, corrosion-proof porous materials are used for gas diffusion, purification, and chemical filtration.

American glassmakers annually produce some eight million tons of glass worth approximately two billion dollars. This growing industry is divided into four major areas: specialty glass, container glass, flat glass, and fibrous glass.

Figure 2. Chemicals are applied to achieve special effects.

Corning Glass Works is the leader in the field of specialty glass. For over 100 years, the company has been developing new materials and glassmaking methods. It is the largest producer of specialty glassware, manufacturing thousands of products with specific—and often unique—properties.

The manufacturers of glass containers produce more than 25 billion glass items annually on automatic machines. The two largest companies in this field are Owens-Illinois Glass Company and Anchor Hocking Glass Corporation.

Plate and window glass producers serve the residential, industrial, and institutional building industries. In recent years, over 50% of the industry's total output has been for automobiles. The two largest producers of flat glass are Pittsburgh Plate Glass Company and Libbey-Owens-Ford Glass Company.

A rapidly growing section of the industry is in fibrous glass. Commercial manufacture of glass fibers began in the 1930's, and today they are used as structural, textile, and plastic reinforcement materials. The leader in sales and research in this field is Owens-Corning Fiberglas Corporation, which was formed jointly by Corning Glass Works and Owens-Illinois Glass Company.

So much for an understanding of glass. Now let's get down to the "nitty-gritty" and try to answer some of the questions that must be forming in your minds:

Just where does glass fit into the industrial arts picture?

Who can teach it?

What does it cost to offer glasswork in terms of equipment and materials?

I'm sure there are dozens of questions you have in mind, but these three should hold us for a while. Where does glass fit into the industrial arts picture? From a philosophical point of view, glass should be a positive part of industrial arts. For years we have been claiming that our responsibility as industrial arts teachers is to develop an understanding of the arts of industry. If we are to substitute fact for lip service, then we can no longer ignore glass, which is one of the major materials of our society. If we agree that we are now living in the atomic age, we must accept the fact that glass made it possible.

From a practical point of view, glass could be organized as a shop by itself or as part of any other shop. Incidentally, those of you who have become high-class and now refer to your places as laboratories, forgive me if I use the word shop. When we're in the family this way, I don't feel we have to watch our p's and q's. There are sufficient industrial glass processes that can be duplicated in a school shop to justify a course by itself. However, if you would not care to make such a large commitment to glass but would prefer to work into it in a more gradual way, then you will find that glass is an excellent mixer and can be included as a part of almost any other shop.

Glass being the most popular ceramic in our society, it most certainly belongs in the ceramic shop. Incidentally, how many here know of ceramic shops that include glass experiences—other than glazing—in their offerings?

Do you know that if you have a modestly equipped ceramics shop you can add a dozen or more meaningful and fascinating glass activities to this shop for pennies? I'll say more about this when I comment on our third question concerned with costs.

Glass mixes well with metal, plastic, wood, other ceramics, and could—no, should—be a part of these shops. If you question this, all I ask you to do is take a walk through the gift, novelty, and houseware departments of any decent size department store and notice how many items are made up of a combination of these materials.

Frankly, I cannot imagine an industrial arts woodworking shop existing today without fiber glass being included as part of its offering. They are so completely compatible it is just silly not to combine them.

The fact is, there are so many different activities that can be conducted with glass that if you have a series of shops, glass could be included as part of each with very little duplication.

Now let's get to the second question, concerned with who can teach glass work.

It's a crying shame that our industrial arts teacher training institutions do not include any glass work experience, or so very little as to be insignificant. The saving grace is that any conscientious industrial arts man can master the skills involved in glasswork with a little time and attention.

From my experience, I have found that there are two detrimental images that industrial arts teachers retain in their mind concerning glass that must be overcome. Once they are eliminated, the teacher finds the work both easy and fascinating.

The first image is that of breaking. Say glass to the inexperienced teacher and he visualizes a shattered window pane or drinking glass on a bathroom floor, blood running from cuts, and all the rest of the gory details. Glass is not really that fragile; it can be cut, drilled, shaped, formed, sagged, and decorated with about as much ease as the other materials we ordinarily use in shop. With a minimum of safety precautions, it is not one bit more dangerous.

The second image they retain is that of the poor results they had when they tried to cut glass. These poor results are due to a silly practice on the part of most industrial arts men. The ordinary industrial arts man will think nothing of replacing a tool each year that might cost from $5 to $100 or more. And yet, this same teacher will buy one glass cutter for 50¢ or 75¢ and try to go on using it for the next ten years.

In the next few minutes I am going to tell you how to make expert glass cutters of all your teachers. First, go through your shops. Find all the glass cutters you can and throw them away. Unless your situation is unusual, you will find the wheels on these cutters will not turn, have flat spots on them, or are impossibly dull. Now, secondly, buy a few new cutters. They cost a lot less than a dollar and will last much longer than many things in your shop that cost a great deal more. Thirdly, get yourself some small spice jars. Put about 1/2 inch of absorbent cotton in the bottom of the jar; then fill it with about an inch of a half-and-half mixture of light oil and kerosene. Store the glass cutters in the spice jar whenever they are not in use. This will keep them in good operating condition for a long time. Next, place the glass to be cut on a wad of newspaper or a thin rug. Hold the cutter firmly against the glass. Draw it across the cut just once—do not go back over it. Separate the glass immediately. Do not let the cut get "cold."

Over the past few years I have made good glass cutters out of dozens of industrial arts teachers in the space of one industrial arts club meeting with no more instructions than I just gave you.

Let me talk a moment about drilling glass.

Ask an industrial arts man about drilling glass and he will invariably start by telling

Figure 3. The spiral was cut from a light bulb with a sand blast gun.

you to make the drill by taking a triangle file and breaking it in half, etc., etc., etc. If your industrial arts men want to drill glass, tell them to get a glass drill. Just as there are wood drills, metal drills, and masonry drills, there are also glass drills; they are comparable in price to any good quality drill, and will enable you to drill holes in glass almost as easily as in any other material.

Just before coming to this conference, I stopped in a middle school shop where I noticed a boy drilling glass. This 7th grader had drilled 14 quarter-inch holes in a piece of plate glass about 3 inches wide by about 10 inches long, and every hole was as true and clean as it could be.

I am not going to try to explain all the different glass work operations and procedures a teacher can incorporate into his shop. Even if I had the time to do so, you wouldn't remember them. But this I do wish you would remember. Most of the procedures and operations in glasswork are such that almost any industrial arts teacher can master them with a little time and dedication.

When I first became interested in bringing glasswork into my shop, I looked about for some help. Much to my surprise, there was little if any to be had. There were a few articles that, on rare occasions, appeared in the technical magazines. Some companies had booklets available, but these were very limited in scope and content. That is why I wrote "The Encyclopedia of Working With Glass." I felt that industrial arts men will never have a source of information they can readily understand and apply.

Incidentally, "The Encyclopedia of Working With Glass" is divided into two distinct parts. Book 1, which is the front half, is concerned with all the processes, such as cutting, drilling, bending, sagging, laminating, decorating, frosting, chipping, engraving, blowing, mending, sandblasting, etc. The back half, referred to as Book 2, includes suggested things that can be made by applying the processes covered in one, and also fiberglass work, the making of stained glass panels, slabglass work, mirror making, enameling, glazing, etc. There are large sections devoted to sources of supply, inasmuch as most industrial arts men do not know where to go for the unusual supplies and materials.

Talking about supplies and materials brings me to the third question. What does it cost to offer glass work as an industrial arts activity in terms of materials and equipment? The answer depends on how great a commitment to glass work you wish to make in your program. If you have a power drill and kiln already available in your shops, you can incorporate a substantial offering in glass work for less than a hundred dollars in equipment. The fact is, if you have fairly well equipped shops, you can probably do it for a lot less than a hundred. Of course, if you want to offer a unit shop in glass work, then your equipment costs can be comparable to that required to furnish a ceramic shop.

As for supplies, here again, costs can vary a great deal. For most activities, costs are minimal. The fact is, you can offer quite a few glass activities at no material cost whatsoever. How is it possible? In every community there is one or more glass or glazing stores. A call to this store telling them you are going to do glass work in the school and would like their scrap glass will bring you tons of usable pieces.

Let us get back to our quiz. (Hold up dish once again.) How much did you estimate that the material in this dish cost? If you said nothing, you were correct. Those who take an occasional physic should recognize the glass because this dish was made from two Phillips Milk of Magnesia bottles.

Incidentally, this dish was made by a seventh grade girl in our Middle School ceramic shop, and it took her four periods to complete it.

Bottles are an excellent source of free material from which hundreds of different items can be made. And incidentally, you will be doing your community a big favor ecologically by putting the bottles to good use and keeping them out of the trash.

As I said before, there are probably dozens of additional questions that could be answered, but time will not permit.

In closing, please try to remember this. The American glass industry annually produces some eight million tons of glass worth approximately two billion dollars. It employs millions of people who form and shape this glass into thousands of different products that touch the lives of your students every moment they are awake for as long as they live. How long can we go on claiming that we teach the arts of industry and avoid teaching about such a material and product?

We are failing to recognize that we have a problem. For too long and in too many places, we are doing the same old thing in the same old way, failing to take cognizance of the changing world that is engulfing us. Unless we open our eyes, open our minds, open our shops, and open our curriculums to expansion and change, we will find ourselves without an honest cause or purpose, or even a justification for our existence.

Mr. Berlye is assistant superintendent of schools for the Monticello Central Schools in Monticello, N.

A New Look at Metals

Marie T. Parker

Seeing is believing, the old saying goes. And through the ages, men in their quest for knowledge have searched for better ways to look at things. They have traveled long distances, gone on arduous journeys, risked fortune and life itself to see things close up. They have developed telescopes and microscopes to bring the stars, the minute insect world, and even molecules into better visual range. They have also developed various tools to reveal the chemical, physical, electrical, and metallurgical nature of things—all to better see and understand this magnificent world, this stupendous universe we live in.

DISCUSSION OF INSTRUMENTS

General

There are a number of excellent instruments on the market and in our laboratory that contribute regularly to our understanding of metals. The emission spectrograph, the mass spectrograph, the electron microprobe, X-ray diffraction equipment, and others give chemical information such as the elemental and molecular makeup of a metal. The metallograph, hardness tester, tensile tester, and others give metallurgical details. The light and electron microscopes give information about the appearance of the surface. Such instruments are continually improving, and each makes its unique contribution in improved ways.

Scanning Electron Microscope (SEM)

Recently, another instrument has come on the market—not to replace the others, but to add a particularly useful new dimension. Because it does this quickly, easily, and with little or no sample preparation, it has won almost immediate interest and popularity. It is called the scanning electron microscope (SEM). Briefly, I would like to describe some of the things that make it unique, and then show you some of the ways it has helped us to understand metals better.

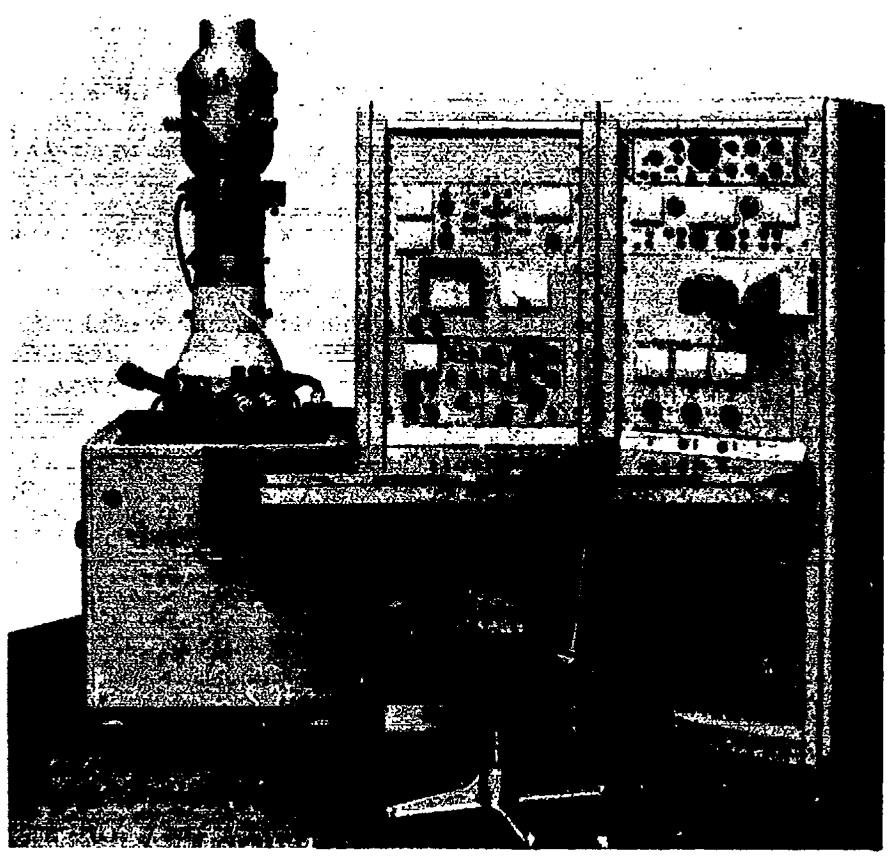


Figure 1. Scanning electron microscope.

Operation of SEM

The principal function of the SEM and of other microscopes is to magnify. But just making things larger does not necessarily help us to understand them better. We must also have (a) sufficient resolution, or ability to distinguish two adjacent points as two instead of one, (b) an enlarged image rich in information content, and (c) a three-dimensional image since, as three-dimensional people in a three-dimensional world, we find it much easier to understand and interpret a three-dimensional image that resembles what we are used to instead of a two-dimensional one. Dr. T. L. Hayes has explained these problems and how the SEM solves them (Ref. 1).

The light microscope, versatile, inexpensive, and reliable has made and continues to make invaluable contributions to our understanding. It gives an image rich in useful information: color, chemical, physical, etc., because it uses the same light we are used to, to react with the specimen to form a magnified image. And at lower magnifications, this image is also three-dimensional. However, because it uses this light, the resolution, dependent upon the wavelength of this light, is limited, which gives a rather low limit of useful magnification (1000 to 2000X).

The strong desire to see things at ever higher magnifications led to the development of the electron microscope. This instrument has also made remarkable contributions to our understanding of the nature of things. By imaging with a beam of electrons instead of visible light, the resolving power has been improved to such an extent that useful magnifications of more than 350,000X are possible. At the same time, the depth of focus has been greatly increased. But the same electrons react with the specimen to give us unfamiliar, primarily atomic information, which is two-dimensional, on a photographic plate or fluorescent screen.

The light microscope images poorly (poor resolution, poor depth of field) but it gives readily understood three-dimensional information. The electron microscope images very much better (great depth of field, high resolution) but it gives hard-to-understand, limited, two-dimensional information. What we would like is to see or image with the high resolution and depth of field of electron optics and also to read out with the three-dimensional and high-information qualities of light optics. This calls for uncoupling the functions of imaging and readout.

The magic of the scanning electron microscope comes partly from such an uncoupling. In doing so, it combines the best of the light and of the electron microscopes into a whole new approach. It does this by imaging with electrons, thus giving superb resolution, depth of focus, and high magnification, and by reading out bits of the magnified image with light, giving images with a high information content and a remarkable three-dimensional quality. It accomplishes this by using two synchronized sets of scanning beams of electrons to "see" and some other radiation to transfer exceedingly small bits of the subject at a time, faithfully following the three-dimensional subject. The electrons carrying each bit of information are converted in a light pipe, and the bits eventually appear one by one on a display screen similar to your television screed for bit-by-bit viewing and photographic recording. In addition to this, by using relatively slow electrons which can "see" around corners and into holes, the 3-D quality is enhanced. Viewing stereo pairs of pictures (that is, pictures taken at slightly different angles, to imitate our eyes) in a stereo viewer, gives us a truly 3-D effect. Now we can see into a magnified world with our everyday type of vision and find remarkable new understanding. The SEM can give us similar views of images showing specimen current, cathodoluminescence, and elemental distribution.

In addition to providing a magnified view of the subject that is relatively easy to understand, the SEM provides a relatively fast, simple, and direct view of the subject. Samples do not have to be exceedingly thin, only small enough to fit in the specimen stage. No time-consuming replica techniques are required; however, simplified versions can be used to give surface information on a sample in the field, or one that cannot be cut to size for direct viewing if desirable. We can transfer any desired area from the viewing screen to a somewhat more sensitive photographic screen and take a polaroid photograph which is ready to look at in less than two minutes. By eliminating lengthy specimen preparation and darkroom procedures, we can spend virtually all of our time looking at samples and interpreting what we see.

Electron Fractography

And what are some of these things that we look at? Our laboratory was established to provide on-the-spot failure analysis and evaluation of materials including recommended corrective measures, especially on space hardware. My principal responsibility is in the area of electron fractography. When something breaks—or fractures—the fracture surface usually has features that point to both the origin and the cause. While examining the fracture surface is not new, examining it with the SEM provides a rapid, direct evaluation, often with better understanding of the real cause, since the area of origin can be examined directly, with greater precision and with excellent resolution at relatively high magnification.

There are a number of causes of fracture of metals: tensile overload, shear, torque, stress corrosion cracking, and hydrogen embrittlement, for example. Many of you are no doubt familiar with the necking down of an unnotched tensile specimen of ductile material and the typical cup and cone fractures. The fine surface features on the flat surfaces, revealed by electron fractography, are called "dimples." When these are equiaxed, indicating equal stresses, we attribute them to tensile overload. An early worker in this field, Harry Rogers, of General Electric, checked the theory that the tensile failure really started at the center of the specimen (Ref. 2). He pulled some tensile specimens part way and discovered that cracks developed in the center of the specimens before final failure. Early workers envisioned the formation of voids which gradually grew together to form such a crack. This led to the now-common term, "failure by microvoid coalescence" (Figure 2).

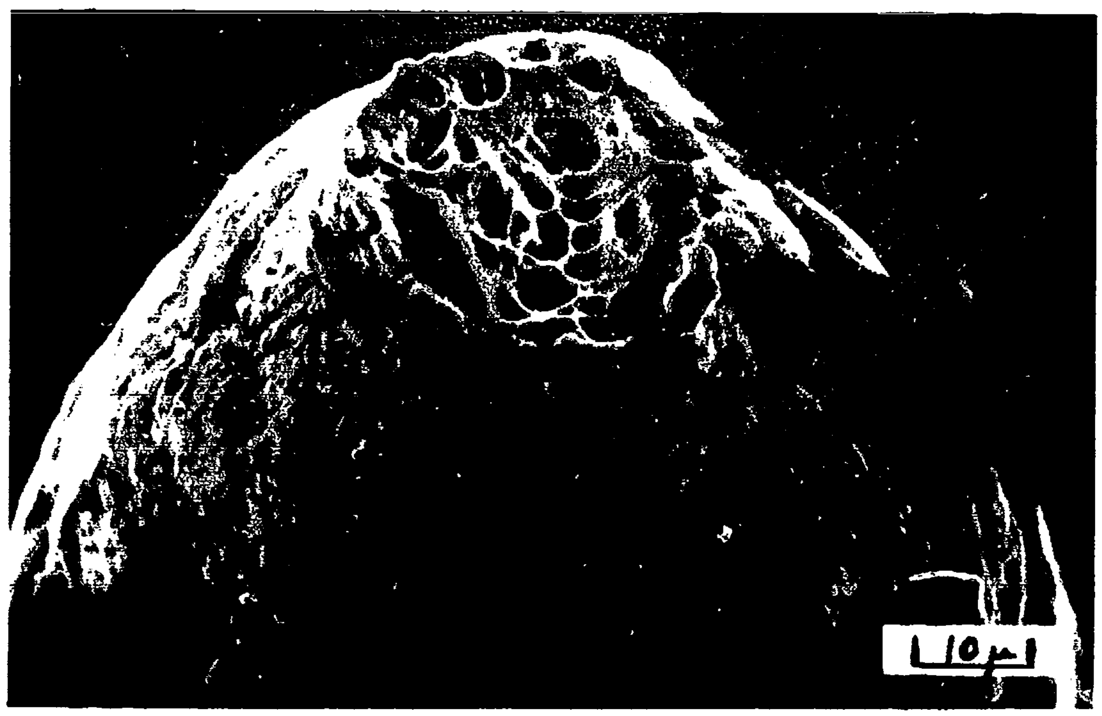


Figure 2. Failure of wire by microvoid coalescence indicating tensile overload. (Picture taken at 45° tilt angle.)

In similar manner, shear failure of a ductile specimen shows one-sided, open features called "shear dimples." These dimples point to the origin of the shear failure which is at an edge of the shear area (Figure 3). Failure by torque also begins at an edge—as a matter of fact, at many points along the edge—and causes shear dimples that are at an acute angle to the surface, rather than approximately normal to it.

One other type of fracture mode we often see is stress corrosion cracking. While the experts still do not agree on just how these failures occur, we do know that high stress, plus corrosion, can lead to sudden and catastrophic failures. These failures happen with the speed of sound and are accompanied by a loud noise. They do not usually give helpful warning signals. The material acts in a brittle manner. The characteristic features are blocking, corrosion products at least near the origin, and secondary cracking. The secondary cracking is essentially perpendicular to the original crack.

Chemical and metallurgical information tell us if the wrong material was used in a broken part—another cause of failure. But if the right material was used, it is imperative to know, for instance, if a screw failed because it was overtorqued, if a rod failed because the load was too heavy for it, or if materials subject to corrosion led to stress corrosion cracking.

While many of these answers seem obvious with the bare eye or the light microscope, the SEM can often reveal an area closer to the origin itself and show that, while a large portion of the fracture may have failed by one fracture mode, quite another may have been the primary cause. In such cases, our new look at metals can give us a more complete answer, calling for a remedy to the problem which can be more accurate because of the additional information provided by the SEM. The SEM has broadened our capabilities and provided advantages heretofore not realized. It cannot nor does it want to replace

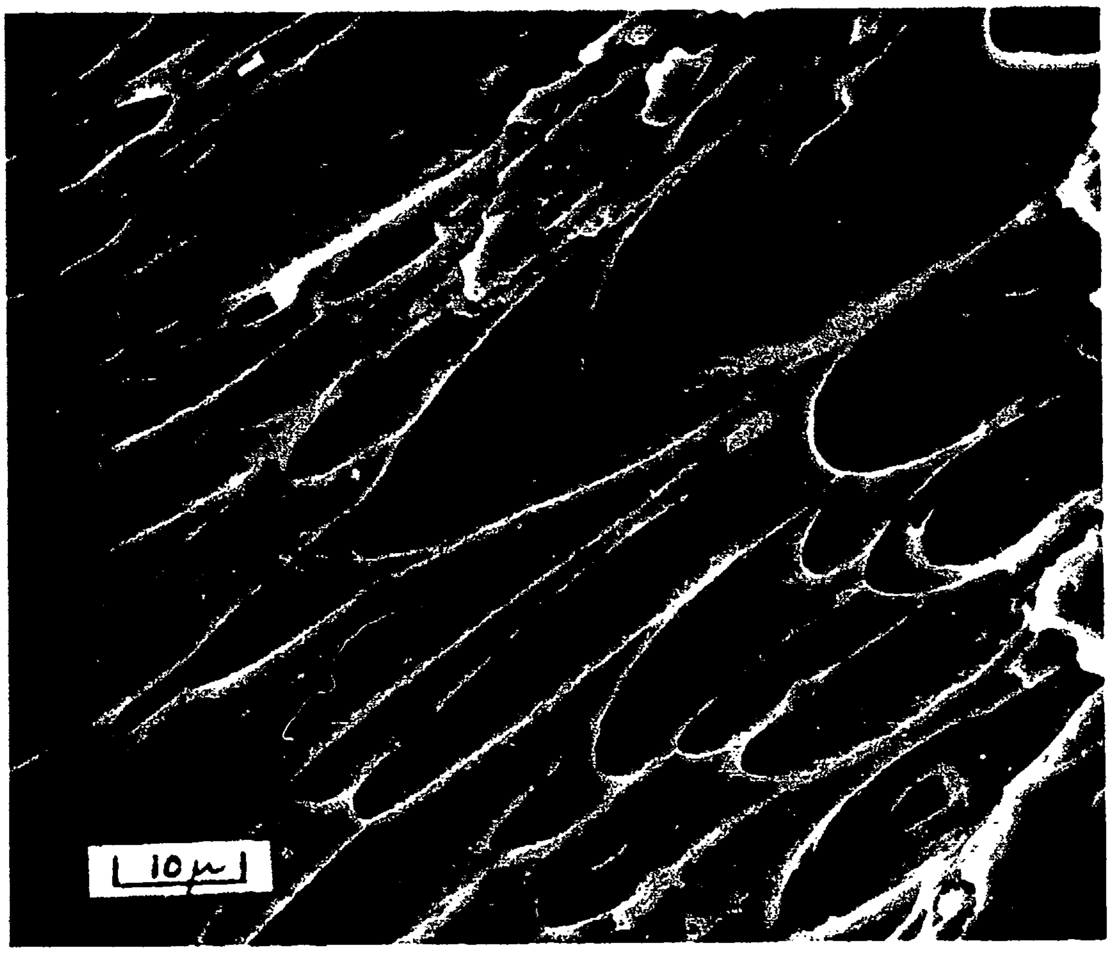


Figure 3. Shear area on a screw alignment pin showing "shear dimples" which point to the origin of the shear failure.

the traditional methods or instruments. But it can provide a new look and work with the others to provide, in many cases, a better answer than was possible before.

REPRESENTATIVE PROJECTS

Comparison of Transmission and Scanning Electron Microscopy

Background

Basic work in electron fractography was done using the TEM and replica methods. I was familiar with these when we got our SEM and wondered if our new instrument would provide compatible or contradictory information. To compare the methods, we looked directly at samples of AISI 4340 steel that we had studied in detail in the TEM. The comparison became one of our first long-term projects.

Test Program

For several years we had heard exotic reports about the spectacular capabilities of the SEM for electron fractography and its speed; we had also heard warnings about the inadequacies, even misrepresentations, of the TEM and of replica methods for this kind of work. The purpose of this study was to explore for ourselves to determine ways in which the SEM could be useful in our laboratory, to find the best methods for electron fratography, and to document observations made on the samples that helped us determine how to approach such a problem. It was a study of methods rather than a complete analysis of the samples involved.

Specimens of AISI 4340 steel had been prepared in various ways, then tensile-tested at room temperature to produce different types of fracture surfaces for a corrosion study. One of the specimens, tempered at 450°F, broke abnormally in the thread area because of a quench crack. It provided us with an unexpected failure-analysis-type specimen we called the quench crack fracture (QCF), which promised to be especially useful.

Using the TEM, we had already explored three areas of interest: the initiation area, the transition area from quench crack to tensile, and the tensile area. We chose this sample to compare TEM and SEM methods because of its special interest and variety of features. Using the SEM, we examined the original fracture surface which had been kept in a dessicator, a TEM replica (plastic-carbon, platinum-palladium-shadowed), and an SEM replica (aluminum-rotary-shadowed) of it, and the mating half which had been kept for about two years in a moist atmosphere to develop corrosion on the fracture surface.

TEM and SEM Evaluations of the Dry Quench Crack Fracture

Transmission electron microscopy using replicas had revealed some interesting and unexpected features about the QCF. The quench crack itself showed the characteristic mixture of intergranular fracture (blocking) with quasi-cleavage (Ref. 4). The ratios of these features across the quench crack may have significance, but determining these involved more time than was available. Two other things were indicated: there were several types of corrosion, and corrosion was heaviest in the initiation area, then seemed to taper off. Time was not available for good statistics on this feature, either. There was a sharp transition between the quench crack and the tensile part of the fracture. The tensile region near the transition point had characteristic dimples. There and further out there were gigantic structures, really towering peaks when observed in a stereo viewer, indicating large deep holes in the original surface. While distortion of these peaks was presumed because of the replica method, this was not thought to be a hindrance in understanding the nature of the fracture. The principal drawback was the time involved preparing suitable replicas and waiting for photographic prints. The same amount of basic information could be obtained directly with the SEM in three or four hours.

Pictures of areas of the QCF from near the presumed initiation area to final shear were taken with the SEM. They show blocking and quasi-cleavage, features typical of a quench crack; a transition area with a rather sharp demarcation line between the quench crack and tensile areas; a multiple hole which could produce a gigantic structure by the replica method; more of the tensile area; and finally shear.

Of course it is possible to spend considerably more time because there, readily available, is a large fracture surface that can be studied to give statistical results, more complete details, and a better understanding of the material as well. In this case, the SEM quite quickly revealed some additional information: It showed a very narrow ductile region ($< 10\mu$ thick) at the outer edge of the quench crack thought to be softer because of decarburization. It also showed the transition from quench crack to tensile areas in much fuller detail, and gave a somewhat different picture. The transition is really not a smooth line. Areas from which the "river patterns" seem to arise appear to reach out and hold on to the quench crack area. On the tensile side, these "arms" appear to have extensive shear areas. It is presumed that the material was changing from austenite to martensite as the quench crack progressed. As it was terminating, it may be that "fingers" of relatively ductile material held areas of the specimen together while around them, in the more brittle regions, the quench crack advanced a little further. The intergranular cracking, along with signs of corrosion in the quench crack area, raise the question not answered here: Is this really a special type of stress corrosion cracking? Then on the tensile side of the fracture, the sizes, shapes, and population of holes can be observed along with the mixture of dimple and quasi-cleavage type features. It would take time, but here again a statistical approach of any desired thoroughness could be applied to gain a better understanding of the material.

SEM of Replicas of the Dry Quench Crack Fracture

While it certainly seems preferable to look at the fracture surface directly if possible, it may be necessary at times to preserve a sample whole or get information on one that cannot be brought into the laboratory. In such a case, a replica might provide the required information. Some early work has indicated that at least sometimes it is impossible to do adequate or valid electron fractography using replica methods. Certainly there are limitations: the replicating material cannot be stripped away from some areas without tearing or gross distortion; it cannot be used to distinguish between a featureless depression and a hole, etc. But we wondered if replicas could contribute worthwhile information within such limitations.

First, a conventional TEM plastic-carbon replica, shadowed with platinum-palladium, was observed (without removing the plastic) in the SEM. A picture taken near the initiation area showed mixed intergranular fracture and quasi-cleavage along with some apparent but not confusing distortions. However, there is some doubt about the tiny surface particles. They may be particles of corrosion or they may have come from a faulty shadowing technique.

But simpler replicas can be made for the SEM. The plastic replica can just be rotary-shadowed with aluminum (or gold-palladium) and viewed directly. This would cut down on time as well as distortions due to heat in the metal evaporation process. There are both problems and possibilities with this approach. Bits of torn plastic could be seen at some of the edges but there was also quite good representation of the basic features. However, corrosion products were not observed; they were probably removed with earlier plastic replicas.

Two of the problems with replicas actually provided valuable and enlightening information: Because the replica reverses the surface topography, it showed small holes as more readily observable small peaks. Because the resolution was not as good, shear areas could be seen as a continuous piece of material which we readily recognized as a shear area instead of as the lacy network seen on the material itself. While the lacy network is more accurate, the other representation helps us to bridge the gap in understanding how the fracture progressed. It would seem from this that replicas can sometimes be useful not only as a substitute for the material when necessary, but they also can enhance our understanding of it.

SEM of the Corroded Quench Crack Fracture

Unfortunately, many of the samples that come to us for failure analysis have not been carefully protected or kept in a dessicator, and we have to work with corroded surfaces. We have to recognize corrosion or some variation of it, such as stress corrosion cracking, as a cause of fracture and distinguish it from post-fracture corrosion. The apparent initiation area of this particular specimen, determined from light microscopy of the dry part and verified using the SEM, was at a thread root, an area of high stress, and developed a very deep pit in moist atmosphere. According to corrosion expert Lloyd Gilbert, corrosion attacks a point of high stress, forming a pit; the bulky corrosion products create more stress and then a deeper pit (Ref. 5). Although stress was certainly relieved by this fracture, the appearance of the deep corrosion pit would tend to verify the residual high stress of the area. While this does not exactly pinpoint the initiation, it draws attention to the area. This type of action, if consistent, could be useful in locating initiating areas and possible initiation points. Several types of corrosion seem to have formed within the pit. The remains of a gelatinous mass were at the edge, but the adjacent areas appeared quite clean. In another area, where corrosion appeared on the fracture surface, the product appeared very light and feathery—much too wispy and delicate to replicate successfully, yet easily seen in the SEM. In a transition area, preliminary work indicated that corrosion attack was spotty, perhaps indicating stress points; we hope to find significant relationships in future work. With the SEM, we hope to learn more about where and how corrosion forms, what the various types look like, and to possibly identify them with the help of electron or X-ray diffraction. We discovered that corroded samples can be useful for several reasons: They may be all we have to determine fracture modes and cause of failure. The corrosion itself indicates areas of high residual stress and may direct our attention to the initiation area (or point). The types of corrosion, many of which would be impossible to replicate adequately, may help us to understand corrosion processes and the sample better, particularly if we can identify them and draw relationships.

Some General SEM Observations

We learned in this early study that the SEM is a very flexible instrument. It is quite possible to turn a dial or two and get worse results instead of better ones. It may take an hour or two to return to an even mediocre combination of settings. For this reason, it was a temptation at first to leave a reasonably good arrangement alone. This may be a satisfactory operation for very routine work where samples are practically identical. However, we have learned that, while a quick answer may be possible, a much better one may be available and is often well worth the extra time it takes to explore the instrument's flexibility. Several times, after long fruitless searching, we found the answer quickly and easily after making a change or two. On one occasion, we couldn't seem to locate the initiation point on a fracture surface. We tried two different tilt angles; then at a third angle, the initiation point seemed obvious, as I will show you later. Changing tilt and azimuth revealed a whole new view and enhanced our understanding of this point and the early fracture modes. Since notches often reflect too much, we usually look at the near side of a fracture surface. However, this proved fruitless with one sample. Changing the azimuth so that the area of interest was as near the collector as possible revealed pertinent features of the fracture surface which contributed significantly or our understanding of that initiation area. Changing the kV can help even with samples for electron fractography because some are bright, some are dark, and some have various types of bulky corrosion products on the surface. Changing the scanning speed on the record raster has proved helpful in at least two ways. It saves time, if it doesn't give a picture that is too noisy; it also gives a better picture at very low magnifications because the increased noise appears to give additional desirable contrast. Most of these things were emphasized during installation and in training sessions. But the value of one variation came as a startling surprise. A different aperture can be used to increase depth of field, of course, but it can also be used to decrease depth of field advantageously to see a small region more clearly. The time involved in using this flexibility can be much greater, but the rewards are much greater, too. It may be enough to pinpoint an initiation area and determine fracture mode on a particular sample, but it may be helpful and, in the long run, it is often better to take time to understand the material better.

Conclusions

In addition to proving known and previously mentioned capabilities beyond the scope of the TEM, the use of the SEM in this study provided some unexpected benefits. With its marvelous flexibility, it can reveal much more about a sample and greatly enhance our understanding of it and of the material involved. Sample preparation—even preparation of suitable replicas—and photographic processes are relatively easy and rapid. This means that most of the time can be used to actually study the sample rather than in laborious and time-consuming preliminaries and darkroom work. As far as we have discovered, the SEM can provide more complete but not basically different information. We feel that it can add to, rather than nullify, conclusions drawn from good transmission electron microscopy and replica methods. For these reasons, we recommend using the flexibility of the instrument, observing related samples such as replicas if warranted, observing samples before as well as after cleaning, and using TEM and replica-generated theories and macrofractography for more complete electron fractography and a chance to realize more of the remarkable potential of the SEM.

Comparison of Post-Fracture Corrosion and Stress Corrosion Cracking

Background

Another long-term project was work that we did to try to determine the difference between post-fracture corrosion and stress corrosion cracking (Ref. 6). Distinguishing between the two can be vitally important in the failure analysis of fractured parts. Yet in the past, evidence from the best available methods sometimes had given conflicting or inconclusive results. To clarify this problem, a program was started to study corrosion as it develops on fracture surfaces and to compare it with stress corrosion cracking.

Test Program

A series of specimens of AISI 4340 steel prepared in various ways were tensile-tested at room temperature to produce different types of fracture surfaces for post-fracture corrosion. After preliminary observations, half of each sample was kept in a dessicator, while the other half was kept in a humid atmosphere for about two years. An additional sample, prepared out of AISI 4340, was bend-tested in the presence of water to produce a stress corrosion crack (SCC). One-half of this sample was stripped repeatedly with replicating tape to clean the surface; the other half was merely rinsed and dried. Then both were stored in a dry atmosphere for about two years, after which all of these fracture surfaces were examined using scanning electron microscopy.

The samples discussed here include the stripped and unstripped SCC fracture surfaces and the "wet" and "dry" fracture surfaces of three tensile specimens: a normal cup and cone fracture, a similar fracture with a different strength level and heat treatment (ratchet type), and another of strength comparable to the cup and cone fracture but notched. Pertinent test data is shown in Table I. Some visual observations are shown in Table II.

TABLE I

Sample	Geometry	Hardness	Strength (psi)	Temper Temperature
2 *	Smooth	$R_c \sim 50$	uts 284,000 ys 205,000	450°F
4 *	Smooth	$R_c \sim 34$	uts 150,000	
5 *	Notched		279,000	
SCC	Irregular	$R_c \sim 45$		450°F

* Quenched as 5" round, tempered to R_c 34, machined out of bar for series of tensile test specimens.

TABLE II

Sample	Relative Brightness of Dry Surface	Type Fracture	Macrofractography	Type Corrosion[1] on Wet or Unstripped Half
2	Medium	Cup/cone with necking	Flat smooth cup. Very smooth initiation region with fine radial lines extending to somewhat coarser ones, then to shear	Large masses,[2] especially in initiation area, secondary cracks radiating out from a point near the center.
4	Darkest	Very rough ratchet type with considerable necking	Small rough fibrous center extending to somewhat torqued large shear "teeth"	Limited corrosion found in shear pits and on shear edges
5	Brightest	Quite flat	Radial lines from initiation area to shear	Polkadot: heavy in initiation area, otherwise quite free in adjacent crescent. Several secondary cracks, one outlining crescent. Corrosion outside crescent seems to follow valleys
SCC	Darkest in initiation area	Sharp notch at center of initiation edge	Smooth textured shear initiation near center of edge extending to mixed radial and fibrous to shear	Very dark (blackish) discoloration especially in initiation and adjacent areas

[1]Location and types possibly due to gravity and/or surface tension in some cases.
[2]Rust-colored gelatinous masses.

Scanning Electron Microscopy

Each of the samples was examined in the SEM with the basic question in mind: What's the difference between simple corrosion and stress corrosion cracking?

This question could have been answered quite quickly by looking first at the SCC samples. The results seem startlingly simple and obvious. Both the stripped and the unstripped samples quickly and clearly showed the features that are associated with this fracture mode. The unstripped sample provided a bonus, however. In the systematic exploration of transition areas and unusual features, a long worm-like structure was revealed in the fibrous region. Then others were observed. These are believed to be stringers, possibly of manganese sulfide, which would probably have been removed by vigorous cleaning of the surface. None were later observed on the stripped half. The impact of this is a little overwhelming. Not only is observation of the uncleaned surface quicker (a very important factor in our laboratory) but it also reveals at least some of the features more fully and gives a better understanding of the material itself as well as of the fracture. This suggests that samples should be observed before as well as after cleaning.

Exploration of the wet and dry surfaces of the tensile fractures provided more background for evaluating the SCC samples quickly. While nothing like the SCC features were observed that could be related to the original fractures, many interesting features were revealed and questions raised about the materials, the fractures, and how corrosion affects the different types of surfaces.

Cup and Cone Fracture. Scanning electron microscopy revealed that the very fine textured initiation area had very fine features resembling equiaxed dimples observed in replica work, indicating transgranular fracture by microvoid coalescence. But nearby and still within the fine-textured area, both fibrous- and radial-type lines were observed. The radial ones seem to resemble "river patterns" associated with cleavage (Ref. 4). The fibrous ones resemble strongly oriented X-ray diffraction patterns and are centered around the presumed iniation area in the long direction. They suggest incremental yielding of the material in this direction, while the river patterns suggest cleavage steps in the perpendicular direction. Farther out, fibrous lines were observed in other directions as well, but radial lines predominated, indicating a somewhat brittle fracture of this ductile sample.

Heavy gelatinous masses of corrosion appeared on the wet sample, especially in the initiation area. Some of it could easily produce features interpreted as "mud cracks," sometimes associated with SCC. There was also a more fluffy type of corrosion. The corrosion product was not stripped off, but high magnification of a directly adjacent area showed no signs of original SCC. However, fine as well as clearly visible secondary cracks appeared during storage in the moist environment. Such cracks might be incorrectly interpreted as stress corrosion cracking of the original fracture by replica methods.

This sample provided a bonus by developing secondary cracks believed due to environment and residual stresses (even though this would not be a typical service failure). If this theory is correct, the secondary crack surfaces should show SCC features. The sample actually broke completely apart during preparation for the SEM and two secondary crack surfaces (perpendicular to the original) were eventually explored. They both showed widespread SCC features in spite of additional corrosion on the surface.

Ratchet-Type Sample. The second sample, similar but with a different strength and heat treatment, was more ductile, as indicated by such gross features as elongation and fibrous initiation area. The SEM revealed several interesting features. At what appeared to be the initiation "point" was a castle-like structure with smooth, possibly cleaved, pointed rods extending out of the top. These might have been carbides, a likely possibility, since the sample was originally heat-treated around 900°F. Further examination revealed many similar rods, some apparently broken off. In the sharp shear areas, some appeared to come out of the knife edges; others formed a bridge between teeth.

Corrosion on the wet fracture surface was scanty but tended to occur as rust-colored gelatinous masses in shear pits and on steep shear faces. It would not be likely to confuse the areas observed with SCC features.

Notched Sample. The third tensile specimen examined here was comparable to the cup and cone fracture in strength, but it was notched. The precise initiation area of the fracture surface was not as clearly indicated as in the other two, since there were many initiation areas along the notch edge. After considerable somewhat fruitless searching at what seemed like the best angle, other angles were finally tried. Exploration of several areas at the three angles (0°, 20°, and 45°) indicated that the main fracture emanated from an area where the predominant feature was a pointed twin with a crack between two peaks. The surrounding area and even the sides of the twin had features resembling dimples. The crack itself resembled the classic sketch used to illustrate plastic fracture (now commonly called transgranular fracture by microvoid coalescence) shown by R. Pelloux. Pelloux explains that the several modes of fracture illustrated for grains are also "true for smaller crystallographic units such as the twins, or the martensite needles or the second-phase crystals" (Ref. 7). If this comparison is correct, then the iniation occurred in a ductile manner. But since it happened with a relatively large coherent particle, a rather large area was rapidly affected. Strong radial lines appeared almost immediately and predominated across the fracture, indicating a rapid break (Ref. 8). There were also fibrous lines throughout, especially in the adjacent crescent area. The SEM revealed many dimpled areas and stretched zones (as well as quasi-cleavage) across the fracture, indicating that while the fracture was fast, giving the gross appearance of a rather brittle break, the material itself was really more ductile.

This sample also developed secondary cracks in the moist atmosphere. But the surface corrosion, while occasionally in gelatinous masses, was more often of a fluffy nature. There was also a spider web type of developing corrosion in the crescent near the initiation point and other features we hope to investigate further. But here again, it seems that scanning electron microscopy can distinguish between corrosion and stress corrosion cracking.

Discussion

The basic problems of distinguishing between corrosion and stress corrosion cracking as a cause of fracture in AISI 4340 steels seemed to be solved by looking directly at the sample with a SEM. It is taken for granted that both stress and corrosive environment are required for the latter. And it is recognized that simple corrosion can form a pit that causes sufficient stress to produce stress corrosion cracking and perhaps is often ultimately responsible. However, the term stress corrosion cracking refers to the process described by Brown, "in which a crack propagates by the stress-induced corrosion of metal at the advancing tip of the crack" (Ref. 9). The resulting surface looks as if the small "building blocks" had been jolted loose from each other.

As the fracture surfaces corroded in the moist atmosphere in quite different ways visually, it was hoped that relationships could be made between the type of corrosion and the type and position of minute features attacked. Work has started in this direction, and many questions have been raised but not enough answered. We hope to continue with this study.

Conclusions

Unexpected exciting things happened during the course of this study: The excellent work that had been done previously by C. C. Beacham et al. at the Naval Research Laboratory (NRL), Washington, D.C., and many others using the TEM can be of advantage in interpreting features seen in the SEM. Their work and their great insight has produced a remarkable fund of useful information. The SEM is not only relatively fast but it can produce information impossible to get by replica methods or other known means.

Investigation of Whisker Growth on Relay Metal Surfaces

Background

Still another long-term project was work on whisker growth. Whiskers that grow from metal surfaces have often short-circuited electrical equipment and caused failures. To better understand how and why whiskers grow and how to stop them, we studied in detail whisker formation on various metal parts of a relay (Ref. 10).

Test Specimens

Relays (two-multiple contact, armature type, 6 VDC/Res. 39 ohms) which had been hermetically sealed had a number of whiskers on the contact arms and other metal surfaces after use. These contact arms had been prepared by electroplating a copper flash, then a layer of tin on the steel basis material, then evidently adding a conformal coating such as an epoxy or a urethane. They were sent to our laboratory by Mr. Lloyd Gilbert, chemist and corrosion consultant, of Army Weapons Command, Rock Island, Illinois. He had already solved the problem of whisker growth in this particular case by changing the potting compound from a phenolic type to an epoxy type. He theorized that corrosion pits on the surface exerted pressure which forced out some of the material in the form of whiskers (Ref. 5) in a manner similar to the "squeeze" whiskers described by Arnold (Ref. 11). This indicated an environmental, chemical, and corrosion problem similar to ones which have come into our laboratory. We hoped that study of the large population of whiskers on the contact arms would reveal the mechanism by which they grew and provide a more general solution to controlling their growth. Test specimens were prepared by carefully removing the whisker-covered retaining plate and contact arms from the assembly, cutting to suitable size, if necessary, and mounting the contact ends on stubs for microscopic examination.

Scanning Electron Microscopy

The samples were examined in the SEM with several questions in mind: Was the whisker growth stimulated by pressure exerted due to corrosion on the nearby surface? Could it be due to compressive stresses in the contact arm from electroplating or other manufacturing processes? Could it be a purely chemical reaction of contact arm materials with the environment, or a combination of mechanisms?

Topographical Observations. Observations in the SEM showed at least three distinctly different types of whiskers: thick, curly structures that appeared to form without a regular pattern; long, thin, needle-like rods; and short, stubby rods with somewhat flat faces. The number and ratio of these types varied from contact arm to contact arm. It would be necessary to observe many assemblies before forming quantitative conculsions. However, the variations might be related to variation in temperature, pressure, etc., during use, as well as to variations in materials due to the manufacturing process (Ref. 11).

Further examination of the different types of whiskers revealed the following:

The short, stubby type appeared to ram through from beneath, cutting the outer surface sharply on the way and carrying a portion of it on top as it advanced. Closer examination of the top where some of the surface material was missing suggests that this type is columnar, made up of a number of rigid, long, thin rods which give the column a fluted effect. This particular one came right through the center of a surface feature. However, others came through between surface features. Probably these features had little or no part in forming or shaping this type of whisker.

Many thick, curly, irregular structures grew randomly on the contact arm surface and broke the surface layer, occasionally carrying some as they grew from an internal region. Closer examination of one revealed a subsurface grain with a number of small whiskers growing out of it. Many thick, curly, irregular structures also appeared to grow exclusively next to the area where the contact button was pressed into the contact arm. The large sizes, the irregular shapes, and the irregular surface striations are striking features of this type.

The third type, long, thin, and needle-like, often grew from an edge. While it might appear to be a variation of the first type, we distinguish it on the basis of chemical analysis as well as appearance.

Another type of whisker, observed on the retaining plate, grew out of what appeared to be an amorphous pool. Closer examination revealed a number of whiskers on the irregular tip. An older whisker, though rigid, had a broken point, conchoidal in nature, which is typical of noncrystalline material (Ref. 5). This type may have grown in part from reaction material formed from the surface layer and the environment. It was not evaluated chemically.

A wide variety of whiskers formed on the retaining plate near a screw hole. The edge of the screw made a depressed area which was essentially whisker-free. But in other areas, both under the screw and beyond it, whiskers grew profusely. One of them was a very long, very thin one, seen at higher magnification.

Nondispersive X-ray Analysis. The first three types of whiskers described above were actually different chemically. Nondispersive X-ray analysis, an attachment which identifies chemical constituents, revealed that a large irregular structure was at least predominantly tin, in agreement with earlier chemical analysis of this type. A thin, needle-like whisker contained copper, iron, tin, and aluminum, the latter probably from the tin plating bath. A short, stubby one contained possible trace metals but was judged to be predominantly organic. The background showed no metals at all, indicating that a conformal coating had been put on the surface (Ref. 5). Since this part of the work was done during an equipment demonstration, we have not been able to confirm or continue it, as yet. However, the fact that different types of whiskers grew stimulated a search for the reason why—and an effort to discover where each type originated.

Fracture Surface Studies. We also mechanically separated one contact arm and examined the fracture surfaces, particularly along the edges where the coating layers could be seen. One area showed the basis metal at the bottom, layers of coating material, a whisker growing out of the surface, and nearby, the sides of a hole from which a whisker grew. The sides of this hole showed striations similar to those seen on some of the whiskers. While the void seen underneath could have occurred from grain fallout during the tearing process, it does suggest a source of whisker material. And the striated walls suggest that they either marked or were marked by the whisker as it grew. Since this was the tin layer, easily deformed, it may well have been marked by the growing whisker.

Another area showed the basis material at the top, small grains of copper, much larger grains of tin covered on the outside with the surface coating, and part of a very large irregular structure. It was interesting to see whiskers from one of the tin grains apparently growing toward the large structure, and others which were perhaps broken during the tearing process. Other much smaller whiskers were growing from tin grains, from a copper-tin grain boundary, and possibly from copper grains. This suggests that whisker growth can originate deep within the material and even on chemically different grains. If this is true, then it is not surprising to find a variety of whiskers growing on nonhomogeneous material.

Discussion

The evidence here indicates that we have at least three distinctly different types of whiskers: different morphologically, different chemically, and different in origin. There seem to be different mechanisms involved as well.

Large structures seen on the contact arm all around the contact button seem to have been forced out by pressure from the button, like the "squeeze" whiskers described by Arnold (Ref. 11). The button, cold-head-riveted, could actually exert considerable pressure, deforming the surrounding area. The whiskers and their strange shapes could well be the result of attempts to relieve local stresses.

The electroplating process could give intrinsic compressive stresses (Ref. 12). Corrosion pits could also provide subsurface stresses (Ref. 5). Perhaps neither one could induce whisker growth alone, but a combination of mechanisms may be involved.

It is worth noting that lack of whiskers on the inside of relay cases where tin was hot-dipped, relieving stress, led to the current use of reflowed tin on printed circuit boards. This process gives apparent immunity to whisker growth. But even if pressure or pressure and temperature variations played a part, whisker growth in this type of relay was controlled, essentially eliminated, by changing the potting compound from a phenolic to an epoxy type. This changed the environment in the hermetically sealed relay. It would seem that, in this case, at least some of the whiskers were initiated or propagated by a chemical reaction mechanism.

It is possible that stresses caused nucleation sites and perhaps the growth of some whiskers. These, in turn, may have caused the surface layer to crack. In addition, this layer may not have been completely continuous in the first place. Any open areas would make a path available for chemical attack in a corrosive environment.

Whatever prompted their growth, there seem to be cases where young whiskers joined to form some of the large structures. We think such activity is the cause of the striations on several types. Deformation of the large irregular structures during growth could have deformed outer individual whiskers at random, giving the irregular striations we observe. The short, stubby rods, which show little or no deformation and have quite even striations, may actually be bundles of whiskers emerging from neighboring nucleation sites. This would explain both the striations and the top of the stubby rod where individual thin rods are exposed. Close examination of the fourth type of whisker referred to above confirms the presence of a number of young whiskers apparently ready to emerge together. The much longer, much thinner type, possibly single whiskers, are more likely to reach out and short-circuit electrical equipment, perhaps, but as the spacing of components decreases, understanding the nature, growth, and control of whiskers becomes more and more important.

No one mechanism or combination of mechanisms seems to fit the observations at this point. It does seem like a challenging and worthwhile field for further study.

Conclusions

This investigation revealed that there are several types of whiskers—different in appearance, different in chemical composition, different in origin. It showed evidence that some types of whiskers are actually made up of a number of whiskers growing together to form a single unit. It explained longitudinal striations on some whiskers as outer surfaces of individual whiskers which have grown side by side to form a larger unit. And it explained the irregularity of the striations on the large tin structures as deformation during growth. While this investigation provided more questions than answers as far as mechanism is concerned, we hope it will be a useful springboard for further study.

Miscellaneous Short-Term Projects

Such long-term projects make our day-by-day work easier. I would like now to describe to you a few short-term projects that illustrate some of the problems that have come to us.

Accutron Timing Wheels

A series of samples came to us to check on wear and cleaning procedures. These were tiny timing wheels (Figure 4A) like the ones used in accutron watches, some of which were destined to go to the moon. Since they would be expected to function successfully for two years or more, it was important to have them clean and functioning properly before installation in an instrument package.

Improper wear, producing debris, or even a chunky particle on one of the teeth could ruin the whole experiment package. The light microscope could provide sufficient magnification, but with its limited depth of field, examination of the 360 teeth of each wheel would be hopelessly long and difficult. But it was an easy job for the SEM. We were able to see the whole wheel at 20X, and the teeth at 600X. First, we examined wheels of various materials for signs of wear. Some showed extensive wear and large amounts of debris (Figure 4B); others were much better. When the most satisfactory material was chosen, we examined candidates for the trip to the moon on Apollo 11 to check on cleaning methods. Occasionally we found particles, but cleaning techniques improved. Eventually we found wear-resistant, clean wheels ready for such a trip (Figure 4C). Countless hours must have been spent in developing satisfactory materials and cleaning methods, but the SEM quickly, easily, and accurately inspected the wheels and all of the teeth and monitored the progress.

Sheared Cable Wires

Cables are sometimes cut accidently or pulled apart. It is often hard to tell which, using the light microscope, because wires of both types have tapered ends. We examined one group of four wires from a stainless steel cable in the SEM. Even at 20X, the ends seemed to be sheared but we couldn't be positive. We looked again at 100X; finally, at 2000X, we found shear (one-sided) dimples, conclusive evidence that these wires had been cut or had failed to shear.

Wire from Corroded Cable Assembly

Another wire presented a similar problem and gave us an interesting view of grains elongated in the drawing process. The first area we looked at revealed many long, apparently separate grains. There seemed to be gross evidence of shear, but few grains seemed to have necked down in a manner resembling tensile overload. We next looked at the tip end, head on, and found an area of final failure where the individual grains had evidently become so thin that the final wispy strands bent over after separation. This is in line with a view some people hold that final failure is always by tensile overload because at some point before final failure, the cross-section is reduced to such a point that the material can't hold together any longer.

Wires from Short-Circuited Cable

Sometimes cables arc, melt, and fuse together in such a way that we can readily determine the cause of failure. However, sometimes we need to determine if there is

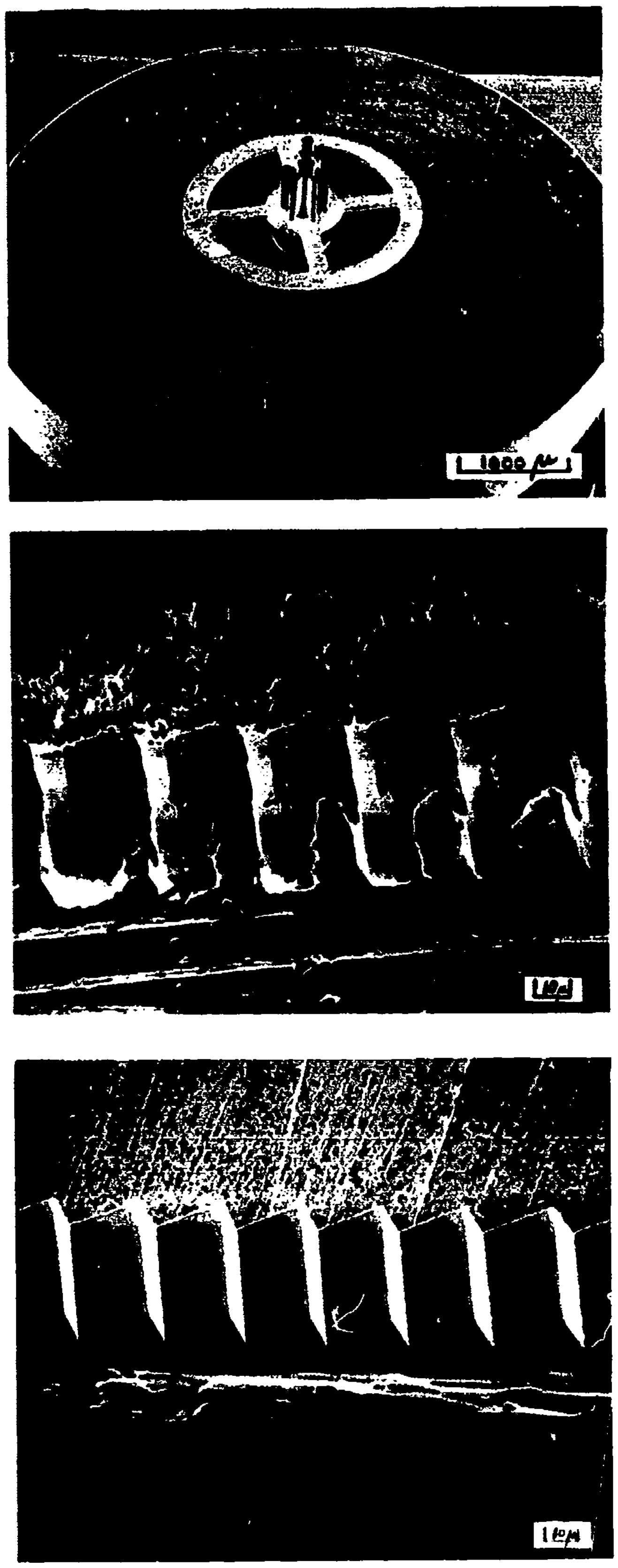
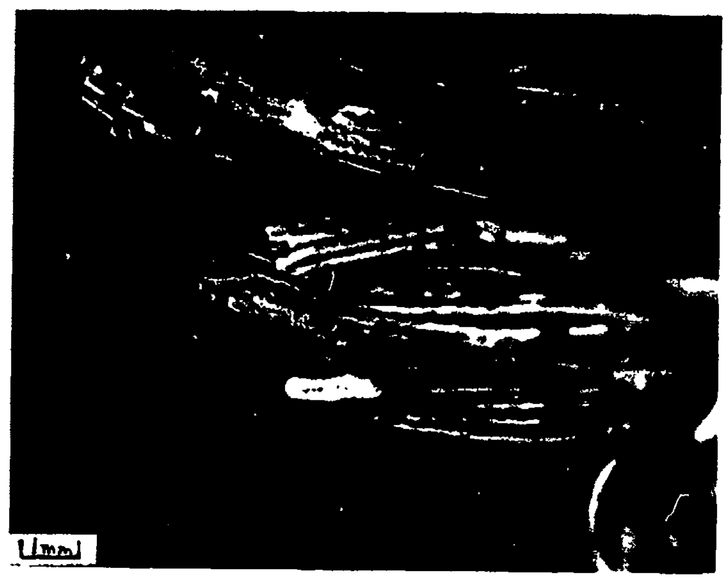


Figure 4. (A) Arrow points to accutron wheel in the center of a specimen stub. (b) Accutron wheel with large amount of debris. Arrow points to area showing excessive wear. (c) Clean, wear-resistant accurton wheel suitable for sending to the moon.



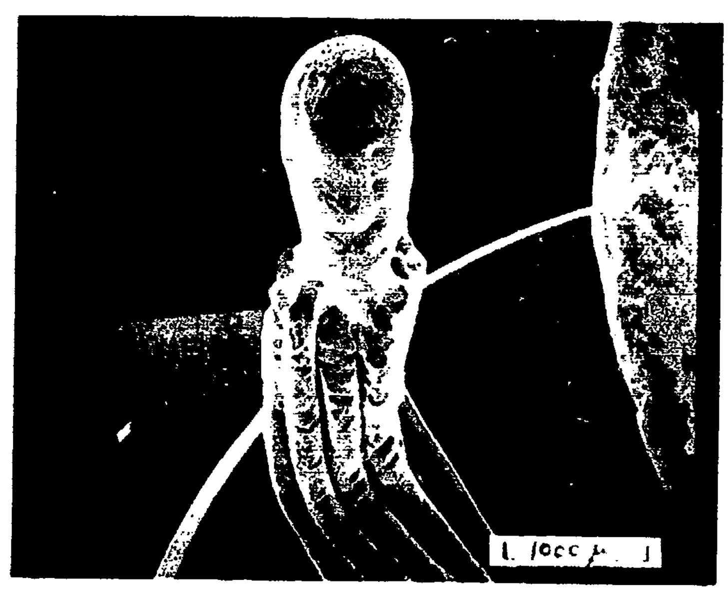


Figure 5. (A) Light microscope picture of wires from short-circuited cable showing bundles of wires, some ends fused, some with separate wires. (b) Bundle of wires from short-circuited cable showing fused end.

also another cause such as tensile overload or an accidental cut. Low magnification of wires from a traveling cable suggested a combination of all three (Figure 5A). The SEM revealed that one group of wires fused (Figure 5B); one broke in a brittle fashion with secondary cracking. Fine surface detail at 6000X actually suggests depletion of material, perhaps not an unlikely step as melting temperatures come close. In this particular sample, we only found causes related to the arcing and overheating.

Probe of an Inlet Transducer

Helping the investigator find the cause of failure sometimes goes beyond examining the fracture surface. One sample, the probe of an inlet transducer, was a round tube with three indentations spaced equally around the circumference. These were crimp marks formed during manufacture. The edge of one crimp mark appeared to be at the origin of fracture. We explored this area in the usual fashion, but also wondered about contamination on the inside of the tube as a possible contributing factor. One of the unique things the SEM can do is look inside a small tube like this. We discovered that there were a number of crystal-like particles on the inside. While these particles probably did not contribute to the failure, the SEM provided a way to take a close look at them and the surrounding surface.

Gold-Plated Electrical Contacts

Sometimes the SEM reveals a surprising view of an exposed surface. Since gold-plated electrical contacts were failing in use, an attempt was made to find a protective coating material. In support of this work, we looked at new contacts in the SEM and discovered that even the new ones had numerous perforations or voids in the gold, as expected. However, whiskers were already growing from the nickel and brass subsurfaces. Treatment with a protective coating can provide limited service, but a complete redesign was recommended for extended use.

Unexpected Appearances

Quite often unexpected things happen, even on familiar types of materials. Just a few weeks ago, after four years of studying corrosion and stress corrosion cracking, I observed surface corrosion pits for the first time, with some of the corrosion material intact and the surrounding area eaten away by the corrosive action. The sample showed evidence of stress corrosion cracking as the crack progressed, but here we saw some of the many pits that acted like small notches and the effects of simple corrosion on the material. Because of such unexpected views, scanning is always an adventure—occasionally even an exotic one. One day, in the routine procedure of taking pictures at various magnifications, a delightful scene appeared: a "bird" on a "rock" (Figure 6). You might think it was only a piece of distorted thin metal that charged in the beam more than the rest of sample and looked like a bird, but I could almost hear it sing as it brightened my day!

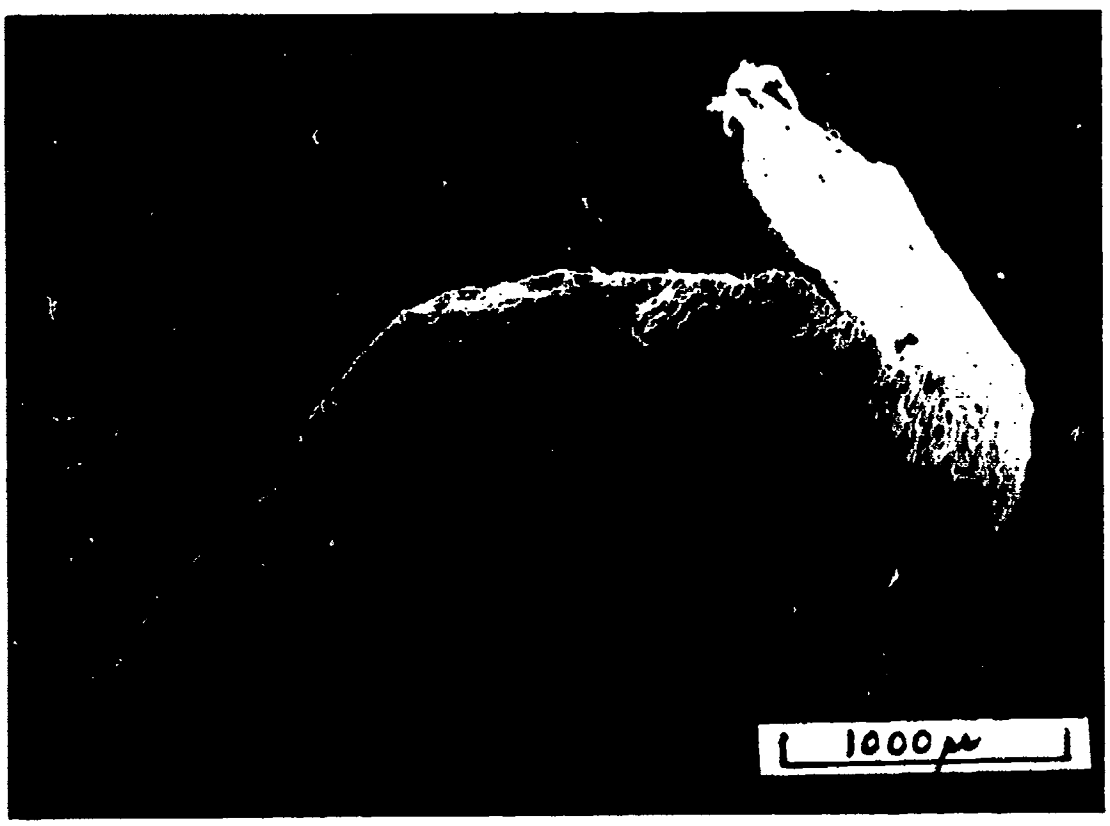


Figure 6. "Bird on a rock" or, if you wish, a piece of distorted thin metal, part of which charged in the beam.

CONCLUSIONS

We could go on with many more examples, but these few, perhaps, give you an idea of what the SEM can do to provide quicker, more direct answers to some of our problems. But, important as saving time on a particular project may be, two things are even more important: A more accurate view and a more complete view help us to better understand the nature of these things. Our samples are of a few specific types, but the SEM is used now all over the world to give a better view of practically any material of suitable size that can withstand the vacuum. If you want to see metals or other materials with better depth of field, greater resolution, and better understanding, you, too, might find helpful answers with the scanning electron microscope.

ACKNOWLEDGMENT

I wish to thank Mr. Joseph D. Morrison, metallurgist in our division, and Mr. Lloyd O. Gilbert, Army Weapons Command, Rock Island, Illinois, for considerable amounts of background information, encouragement, and help with interpretations in some phases of this work.

NOTE

Reprints of References 3, 6, and 10 are illustrated and are available from the author.

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Teaching About Space Age Materials

S. K. Lee

Materials research scientists are dedicated to the task of developing new and better materials to provide for a higher standard of performance and dependability. The driving force behind this research has come primarily from the industries associated with the development and construction of aircraft, rockets and space vehicles, nuclear-powered devices, computers, and electronic equipment.

The demands imposed upon materials used for these applications are severe: the high temperatures and stresses associated with supersonic flight, rocket engines, and space vehicle re-entry, the cryogenic temperatures associated with liquid rocket-fuel storage, and the high-vacuum conditions of space in which mechanical components must function reliably without liquid film protection.

SOME RECENT DEVELOPMENTS

Graphite "Whiskers"

Imagine a material that has an ultimate tensile strength of 3,000,000 pounds per square inch! Just ten years ago, a material with this ultra-high strength was only in the minds of science fiction writers or was the distant objective for a few materials research scientists.

Today, graphite "whisker" crystals are being grown experimentally that possess not only this remarkable strength, but a rigidity that is over four times that of the strongest alloy steel. It has been reported that the ultimate tensile strength of sapphire "whiskers" exceeds 6,000,000 psi.

As a reinforcing material, these whiskers will greatly increase the mechanical properties of plastics such as the epoxies and polyimides, as well as metals, thereby enabling structural designers to use thinner sections. The saving in weight will make this composite material most desirable to the aircraft and space vehicle industries.

Flexible Glass

Picture a sheet of glass only 0.085 inch thick that can be bent to a 30-inch radius and then fully recover its original shape upon removal of the load! This remarkable glass is so tough that it can withstand impact blows that would shatter thermally-tempered safety glass of over twice its thickness.

A unique chemical-tempering process substitutes large ions for small ones on the glass surface; upon cooling, the surface is "packed," thus creating a strong compression layer. Typical applications include: the Airstream travel trailer windows that must bend to conform to the shape of the vehicle, the windows in the high-speed turbine trains, and the replacement windows in the New York City schools.

Engineering Plastics

New developments in plastics formulations and molding processes have enabled the plastics industry to enter competitively into materials markets that were traditionally held by the metals and glass industries. For example, the front grilles in the Caprice and Torino, as well as in other automobiles, are being made from an injection-molded and chrome-plated plastic called acrylonitrile-butadiene-styrene (ABS). The traditional material was a chrome-plated diecast zinc alloy or a plated pressed steel. Not only is the ABS grille lower in cost and lighter than a diecast one, but it is more ductile and therefore is more likely to spring back relatively undamaged if involved in a low-speed parking collision.

Nylon, polyimide, and ABS plastics that contain glass fibers are being injection molded to form structural parts that possess new highs in strength and toughness. The trend is towards plastics that are tailor-made to meet a customer's needs in respect to mechanical properties, resistance to heat and damaging ultraviolet light, resistance to moisture absorption, color, and cost.

The engineering materials grouping that up until recently had been held largely by metals and alloys has a newcomer—plastics!

MATERIALS STUDY IN THE SECONDARY SCHOOL

These are but a few examples of the space age materials that today's secondary school student comes into contact with, either directly or indirectly through reading the daily newspaper, a hot-rod magazine, or technical literature.

The secondary school would appear to be the most logical place for the student to gain a degree of familiarity with the scientific and practical aspects of materials. The industrial arts student, in particular, should possess at least a basic knowledge of the structures, properties, and applications of the materials he is working with in the school shops; he would also benefit from an examination of the processes used to form materials into their finished shapes.

OBJECTIVES IN TEACHING MATERIALS

This writer sees the study of materials as having three main objectives.

Familiarity with Materials

The student should become familiar with the more common materials in each of the following groupings:

metals and alloys	surface coatings
woods and wood products	petroleum products
plastics	cement mortars and concretes
rubbers	glasses
adhesives	ceramics

The depth and breadth of study will be determined by the students' interests and abilities, and the availability of equipment, materials, and time.

The Relationship Between Structure and Properties

The student should be made aware of the relationship that exists between a material's structure and its properties. Experimentation that will enable the student to change a material's structure and to measure this change will work towards achieving this objective.

A selection of destructive and nondestructive tests can be performed to make meaningful to the student properties such as yield and ultimate strengths, ductility, modulus of elasticity (stiffness), impact strengths, hardness, etc.

Familiarity with Forming Processes

The student should be introduced to the forming and shaping processes that transform materials into useful products. The selection of processes will be based on the criteria above.

There will always be some students who will experience considerable difficulty in understanding principles and concepts; these difficulties can often be overcome if the instructor supports his teaching with illustrations, schematic representations, and practical experimentation. Regardless of a student's ability, the study of materials demands laboratory experimentation.

A SEPARATE COURSE IN MATERIALS?

A question often asked is, "Should materials study be offered as a separate course or should it be taught where needed in existing courses, such as wood, metal, and plastics technologies?" There is no clear-cut answer to this question as there are many factors to consider, such as:

- the philosophy of the I.A. department and school
- the availability of a suitable instructor(s)
- the availability of space and testing equipment
- the number of students involved
- the timetable flexibility

From the standpoint of content, there should be no difficulty in developing a materials course of at least 100 hours of theory and experimentation.

In the British Columbia secondary schools, there is a course called Industrial Science offered within the industrial arts departments. Considerable time is allotted to the study of materials testing and processes, and where the approach has been descriptive and practical, the course has met with much success in terms of student interest and satisfied objectives.

A CHALLENGING AND REWARDING EXPERIENCE

The teaching of materials testing and processes can be as challenging as the instructor wishes to make it; the diversity of materials and the frequent introduction of new materials and processes will require that the instructor keeps up to date through the reading of technical literature and by maintaining a close contact with industry.

For many instructors, there is a thrill associated with teaching in an area that is new to the secondary schools. The reward can come in part from seeing your students become enthusiastic about their study of materials—materials that are taken for granted by so many people.

The second part of this paper consists of a listing of experiments and testing equipment in each of the materials groupings which this writer believes appropriate for the secondary school. Due to its length, it will not be included in the convention proceedings; anyone desiring a copy can write to the author at this address: Division of Industrial Education, Faculty of Education, University of British Columbia, 3750 Willingdon Ave., Burnaby 2, B.C., Canada.

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Materials Testing

John C. Duggan

Industrial arts is the study of tools, processes, materials, manufacturing methods; the study of industrial technology as the means of producing a better man-made world through the transformation of materials and energy; those phases of general education which deal with industry—its organization, materials, occupations, processes, and products. As one reads and hears definitions of industrial arts education, the words tools, processes, materials, manufacturing, and so forth tumble through one's mind, and we line these things up with our own experiences, what we do in our shops or labs, what we see in colleges, and what we see in other shops or labs as we visit schools in our own geographical area.

If we accept these various definitions of industrial arts, then we ought to live up to them. Without picking an exact definition from a particular man, college, state, or what have you, let's take a look at some words that are included in most definitions and see how we have approached them in shops or labs.

One can hardly visualize an industrial arts shop without tools, and in most cases tools are given a high priority. Some tools we cannot obtain for actual use in our shops; we can at least study their operation and uses with films and field trips.

Manufacturing is being stressed in many programs. Students plan a product, organize for production, build jigs and fixtures, and fabricate a product.

Processes are studied in some depth. I would be hard pressed to find a metal working shop where the instructor does not spend a period of time discussing the process of making steel.

The materials of industry are usually approached from the standpoint of identification. This is hot-rolled steel, this cold-rolled steel, this is a hard wood, this is a soft wood, this is a thermo-plastic, this is a thermo-set plastic, and so on.

Information on tools is easy to come by. Any manufacturer is more than happy to send a salesman to you because of the possibility of a sale. Information on manufacturing can be found in books, plant visits, your own experience, etc. Most industrial arts text books cover processes in some depth. But what about materials? Most resources available to industrial arts teachers merely list materials, their properties, uses, appearance, and so forth. But is this what we want students to know about materials? Is this all the engineer, the designer, the welder, the builder, the machinist, the steel maker, the polymer chemist should know about the materials used in manufacturing a product in his plant? The students coming through our programs today are coming in contact with all sorts of materials and products manufactured here in the U.S. and abroad. Although we cannot make engineers, metallurgists, and polymer chemists out of our students, we can at least teach them about the structure of various materials, how their properties can be altered to suit our needs, how we may test for various properties, and how to make a selection of products based on the materials used for the manufacture of the product and thereby give them one more tool for coping with the world of work and the technological society in which we live.

My presentation this afternoon is comprised of how we in the Greece Central School District went about gathering information, teaching techniques, and equipment for teaching about materials and materials testing in our labs, and to show you, through a slide and transparency presentation, how we are accomplishing our goal in our schools.

The key to the study of materials and materials testing is the utilization of outside resources. Many people and institutions are more than willing to assist you in your endeavors, but it is up to you to make the contacts.

At this point, let me elaborate for a moment on the town of Greece, New York. Greece is a community of 75,000, a suburb located directly adjacent to Rochester, New York. Rochester, in addition to the Kodak and Xerox Corporations, contains many other industrial complexes including the Gleason Works, Rochester Products, Delco, Riter-Phaudler, Sybron Corp., Case Hoyt Printers, clothing manufacturers, and many other smaller industries. The University of Rochester, Monroe Community College, and the Rochester Institute of Technology are all within easy access from the town. The Rochester Institute of Technology houses world-renowned schools of printing and photography and the School for American Craftsman. Buffalo, New York, is 70 miles from Greece and boasts much heavy industry, the State University College at Buffalo, which contains the Industrial Arts Division, and Erie County Technical Institute, a two-year college with a fine metallurgical technology department.

With all of these resources within your grasp, how do you take advantage of them? The S.U.N.Y. College at Buffalo with its large Industrial Arts Division was a good place to start. The plastics course and other courses offer units in materials and materials testing. Several of our teachers sought out these various courses for graduate credit. In April 1970, Erie County Technical Institute offered a seminar in cooperation with the S.U.N.Y. College at Buffalo on materials and casting. The seminar lasted one week and covered such areas as metallographic sample preparation and heat treating, nondestructive and destructive materials testing, casting, and emission spectroscopy. Teachers were allowed to use all equipment and were encouraged to bring castings and welded parts. Materials testing covered was X-raying of welds and castings, magnafluxing, high frequency sound inspection, X-rays using a nuclear source, spot check, tensile testing, impact testing, hardness testing, and sand testing.

This seminar was followed up the following February by holding a seminar for Greece industrial arts teachers. The seminar was held on a Saturday, and 15 of 22 teachers attended. We were also invited to an American Foundrymen's Association meeting the night preceding the seminar and saw an excellent presentation on the die casting of the Vega engine.

The Rochester Institute of Technology offers several courses in their evening school of continuing education. These courses are taught by people from the institute as well as engineers from local industry.

The American Society for Metals and the Society for Plastics Engineers has been most helpful in assisting us with technical help and teaching materials. Industrial arts teachers are encouraged to join the various societies. I am a member of the American Society for Metals and a member of the Student Affairs Committee, Rochester Chapter. The American Society for Metals offers a course for teachers entitled "Solid State Structures and Reactions" at R.I.T. This is a program in which high school teachers are given a course dealing with materials. Topics include crystal structure, metals, alloys, glasses, and plastics. The entire program is underwritten by the sponsors.

The American Society for Metals is also offering a "Mini Course in Metallurgical and Engineering Materials" at Greece Arcadia High School. This course is a pilot program which will be expanded into other high schools in Monroe County next year. The mini course covers an introduction by Mr. Winston Beers, metallurgical engineer, Kodak;

ferrous metals, Kenneth G. Budinski, metallurgical engineer, Kodak; non-ferrous metals, Richard Eisenberg, Associate Professor of Metallurgy, University of Rochester; polymers, Edward Morrison, chemical engineer, Kodak; ceramics and glasses, Dr. Robert Snyder, professor at Rochester Institute of Technology; corrosion, Arlin L. McKin, metallurgical engineer.

As I stated previously, the key to the area of materials and materials testing is outside resources. More than likely, there are people in your community who would be more than willing to help you get started in defining a unit of instruction on materials and materials testing.

At this point, I would like to explain our industrial arts program in Greece, New York, and show you where materials testing may be utilized in a course. Refer to Chart A.

The Level I courses are 20 weeks in length. A host of areas must be covered during this time, but a unit on materials and materials testing is advisable. As I am a metalworking teacher, I will elaborate on the metals area. In Level I Metals, students are given instruction and experiences in foundry, lost wax and centrifugal casting, drill press, bandsaw, milling machine, and lathe operations, sheetmetal, forging, heat treating, and welding. Of these areas, welding seems to best fill our needs for materials testing. Approaching welding from the point of thermal fabrication, each student arc welds, gas welds, spot welds, brazes, and solders several test specimens. He then is instructed on the operation of the tensile test machine and performs a tensile test on each specimen. Depending on how well the samples have been prepared, several things happen. Bandiron or sheetmetal samples that could easily be bent by hand are now virtually unbendable. The reason is work hardening, and a class discussion is in order. In most cases, the metal will have necked down and broken, not the weld; this backs up the welding lessons, where you stated that the weld is stronger than the base metal. When explaining the electrode numbering system, the first and second digit indicate the minimum tensile strength of the wire used to make the electrode. A group of students may perform tensile tests on various electrodes to see if they meet minimum standards.

"Modern Welding" by Althause, Turnquist, and Bowditch has an excellent section on inspecting and testing welds. For those without elaborate testing equipment, there are timely suggestions for the use of liquid penetrants and bend tests.

Activities of this type may be carried on in other labs also. The wood lab can do tests on different types of glues, nails vs. screws for holding power. The plastics lab may be doing burning tests and specific gravity tests for identification purposes. The Modern Plastics Encyclopedia is a source for information on plastics testing.

The Level II activities are more sophisticated, as more time is available for student investigation. Students are encouraged to attend lectures in the "Mini Course on Materials," to obtain literature on materials by plant visitations and writing letters, and to read articles and books on materials and materials testing. These activities along with classroom lessons and demonstrations provide a good background in materials for the high school student.

It was my good fortune to attend an institute at Texas A & M University on Engineering Influences on the Industrial Arts. At Texas A & M, we developed several areas of materials testing to be utilized in the high school lab.

Hardness testing is a good place to start, as it will be utilized later in other types of testing. The Rockwell type of testing is explained, using transparencies. A demonstration is given showing how to operate the Rockwell Hardness Tester and how to check the tester with the proper test block. The student then selects several specimens of materials found in the shop, such as copper, cold-rolled steel, brass, aluminum, etc. He then selects the proper penetrator and scale and performs a hardness test on each specimen, recording the type of material, scale, three readings, and the average of the three readings on the data sheet. He then constructs a graph which shows the variation in hardness among the specimens. He is then required to answer questions drawn from his testing results. If at all possible, a plant trip is taken to allow the student to observe different types of hardness testers in use and to compare the operation and use of these testers to the ones in the school lab.

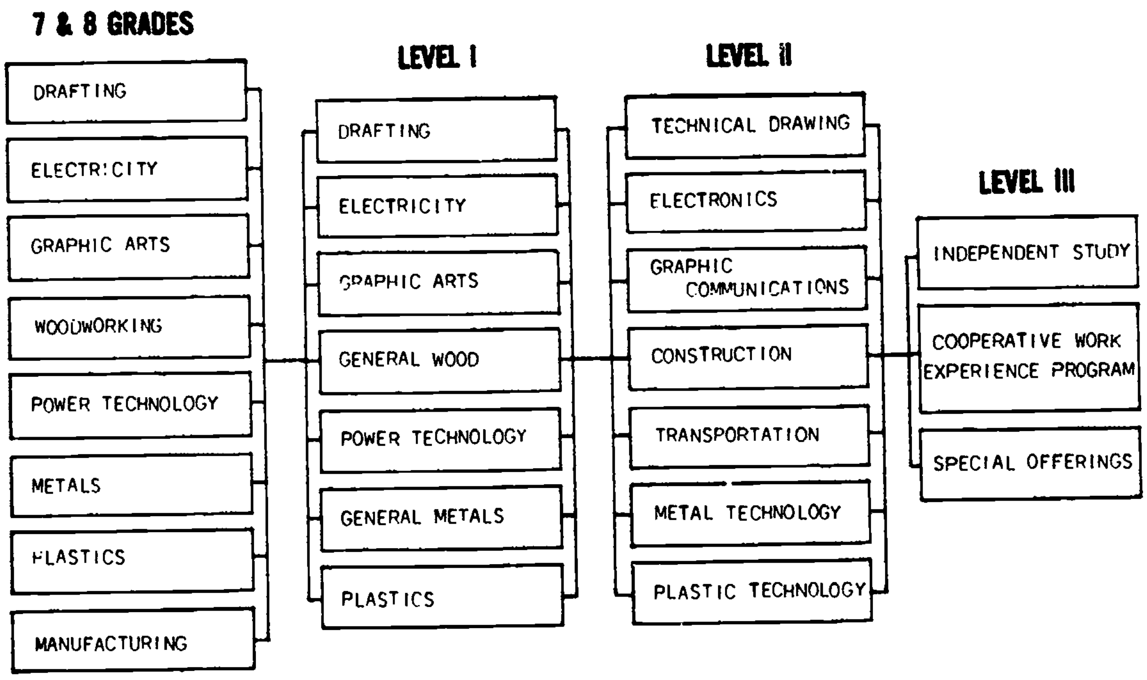
"Ferrous Metallurgy" by Joseph Umowski has an excellent section on Rockwell hardness testing. The American Chain and Cable Company, makers of the Rockwell Hardness Tester, has available a book, "Hardness Testing Handbook" by Vincent Lysaght and Anthony De Bellis.

Students in Level II are also required to do tensile testing. Here the machine skills are put to the task by having students make their own test bars to standard specifications.

Chart A. Industrial Arts Technology, Greece Central School District No. 1

Every student, both boys and girls should have the opportunity to enroll in courses devoted to the study of the tools, materials, processes and products of our American industries.

Opportunities should be provided for students to assist them in securing the skills, information, attitudes and understandings that will enable them to enter employment in a given occupation or field of work.



JUNIOR HIGH PROGRAM

The junior high school industrial arts curriculum is designed to provide the broadest possible exposure to industrial concepts for the greatest number of students. Instructional units in the eight selected technologies of plastics, drafting, woodworking, metals, power technology, graphic arts, electricity and manufacturing are designed to provide meaningful activities that enable each student to develop basic conceptual understandings related to the tools, materials, processes and products most commonly associated with our current technologies.

HIGH SCHOOL LEVEL I PROGRAM

Semester courses are offered on an elective basis in the areas of woodworking, drafting, electricity, metals, power technology, graphic arts and plastics. These courses are open to all students grades 9-12. The major goals of this level are to provide a broad general survey in each of the selected technologies centered around manipulative activities, provide an opportunity to investigate the tools, materials and basic processes that are unique and common to each technology in relationship to our contemporary society, and assist students in exploration of likes and dislikes and discovery of aptitudes which should help with educational, avocational and occupational guidance.

HIGH SCHOOL LEVEL II PROGRAM

The Level II courses are designed to help the student broaden his knowledge in a selected technology from the superficial introductory level to the more concentrated in-depth studies that will point out relationships on the inter-disciplinary level that will further assist him in realistic preparation and selection of a satisfying career. Emphasis is placed on inter-disciplinary activities and total student involvement centered around an identified area of study.

LEVEL III HIGH SCHOOL

The Level III program is designed for those students who have an avocational or vocational goal that cannot be reached through the established Level II or B.O.C.E.S. offerings.

Programs at this level are primarily for students who have completed Level I and Level II courses, but is not necessarily limited to such prequisites.

Programs are flexible enough to enable a student to make maximum use of specialized equipment, facilities, instructional staff, district support facilities, work experience programs and in-service co-op programs.

A student has three options at this level: Independent study, cooperative work experience program, or a choice of special offerings.

Students are required to perform a tensile test as outlined in "Ferrous Metallurgy" by Joseph Umowski. In this test, many learning situations take place. The student must machine specimens to specification, perform the test on a Dillon Tensile Test Machine, make hardness tests, record information, make several mathematical calculations, draw graphs, and draw conclusions from his findings. The opportunity for class discussion is unlimited. Work hardening of specimens may be discussed along with work hardening of machined parts and welding parts from the Level I work. The review and strengthening of mathematical procedures are reinforced. Properties of cast materials as compared to extruded materials may be discussed, etc.

Interaction between two different labs is another advantage to having this type of exposure given to students. The metals lab machines molds for injection molding specimens for hardness tests in the plastics lab. Students refer to the Modern Plastic Encyclopedia for standards and specifications and follow much the same procedure as outlined for metals. Molds are also machined for tensile test specimens and tensile tests performed.

Materials testing is an excellent tool for use when teaching heat treating. For example, tempering is a difficult area for students to understand. "If it's hard, it's strong." This might be a typical reaction from a student. Specimens of tool steel are machined to specification. Hardness readings are taken; the steels are heated to the required temperature and quenched out in the required media. Hardness readings are taken and recorded. The specimens are then tempered at different temperatures and time intervals. Hardness readings are recorded and tensile tests made on each specimen. A discussion of the constant battle between hardness and toughness follows this test.

Level III is an opportunity for a student to follow up on his area of interest. An example of materials testing just completed by a Level III Power Technology student points out the possibilities at this level. The student was interested in the differences in horsepower and torque characteristics of different premium fuels. The student obtained 12 samples of premium fuels, ran dynamometer tests on all 12 fuels, calculated horsepower and torque characteristics for each fuel, and graphed results. Some fuels proved to have higher horsepower characteristics than torque and some higher torque characteristics than horsepower. One fuel proved higher in both categories. You know which fuel that student is using in his car now.

Another student using the dynamometer ran tests on fuel consumption. This student ran 25 milliliters of a fuel through an engine, timed how long it ran, converted milliliters to gallons per hour, calculated miles per gallon, and graphed his findings. He also did this with 12 different samples.

In conclusion, I would like to reinforce the following points. Seek outside help when placing units for materials and materials testing in your labs. You may be pleasantly surprised at the results in terms of information, equipment, and supplies. Join organizations outside the teaching profession as well as those inside and become involved in their activities. Finally, become involved in teaching materials and materials testing in your lab. The results in student learning and the personal challenge are well worth the effort.

Mr. Duggan is Curriculum Chairman for the Industrial Arts Department at Greece Arcadia High School, Greece, New York.

Is the Establishment Really Plastic?

Robert S. Krolick

The names of materials have a special place in our language. The older, natural, traditional, tried and true materials generally convey the feeling of warmth, durability, and value. New materials are often reflected in a negative sense. The intent of this paper will be to examine the implications of material use as it relates to personal attitudes.

Because of the way we have come in contact with materials, we automatically assign certain physical properties to them. We have in our minds certain ideas about materials so firmly imbedded that these impressions are expressed by our figures of speech. Some common examples of this phenomenon include proper names. Names such as Joseph

Stalin; if he became the dictator of an English-speaking country, his name would be Joe Steel. Joe Steel would be a significant name for a leader to have since we associate strength with steel. We speak of iron men in wooden ships when referring to the old days of the Navy. You may hear someone referred to as a cream puff, because of the physical properties of cream puffs. Some other examples that may be familiar include a reference to nerves of steel, or a will of iron; we say a person has feet of clay, or she is a woman of straw. The Chinese have a figure of speech that uses a double notion of properties. They say a country is a paper tiger, meaning that it is outwardly ferocious but actually vulnerable. You may describe an iron fist in a velvet glove; something might be crystal clear or slow as molasses; a person perhaps uses salty language, or he has a stone face, a heart of gold; he may be steady as a rock or smooth as silk.

Now we have a new figure of speech to contend with. Some of the new generation are calling the establishment plastic. They are implying that it is fake, phony. In a recent movie, The Graduate, the rejection of a suggested career in the plastics industry was selected to dramatize the hero's reluctance to assume his role in society. This rejection typified a current image of plastic as a cheap substitute, glossy, and not really deep down worthwhile.

The negative attitude toward plastics and other new materials that are justifiably credited with increased comfort and utility has been the result of what might be called carry-over symbolism from older, natural materials. The most obvious example of carry-over symbolism is the use of gold on consumer articles. Not real gold, the handsome, expensive, and durable metal, but imitation gold is found on everything from fountain pens to cosmetic cases. In the public's eye, gold represents luxury, expense, and high status.

Another material with a rather curious symbolism is wood. Inexpensive or utility items such as low-cost furniture and serving utensils consistently use wood as a finish. Conversely, all types of simulated wood finishes are added to such expensive items as station wagons, automobile instrument panels, and metal filing cabinets. Leather is another material with symbolism attached to it. Genuine leather, highly regarded as a soft and elegant finish, is practically non-existent in mass-produced items, with the exception of certain clothing articles. Yet there is hardly a camera, a set of binoculars, or an automobile interior that does not use at least some simulated grain leather texture.

All of us have an opinion concerning the reputation of plastic. It is easy to examine this by considering your own thoughts about plastics vs. other material. The Rolls Royce automobile company advertises that the inside door panels are made of walnut. Most people reading that advertisement will be impressed by the use of wood. Meanwhile, the entire dashboard is molded out of ABS plastic. ABS happens to be the best material to use when manufacturing the complicated shape of a dashboard. ABS is non-conductive so the circuits can be bonded directly to it. Rolls Royce does not make a point of describing their use of plastic because of consumer attitudes. Perhaps the biggest single problem that has warped our perspective on the acceptance of plastic materials has been poor communication which has resulted in a lack of understanding.

What do we expect from plastic? It is commonly accepted that wood burns, steel rusts, and glass breaks, but what is plastic supposed to do? If the younger generation is demanding honesty, then maybe plastic articles should not look like wood, or stone, or glass. Maybe all plastic articles should look just like plastic. But what does plastic look like? Anyone with even the slightest exposure to plastic materials soon discovers that one plastic material may appear as a liquid, a powder, a pellet, an adhesive, a coating, a foam, a structural shape, a fiber, an elastomer, or a paste.

Plastic articles are the only type that get blamed for failing in an application when the user is at fault. If you receive some very expensive whiskey in a glass bottle and you drop the bottle on a concrete floor, regardless of how angry you become it never occurs to you to be critical of the fragility of glass. However, if your wife drops a polyethylene bleach bottle on a tile floor and the impact splits the seam, she would just automatically criticize plastic as being a pretty lousy material to make a bottle of. Recently, there has been an acute concern about the use of some plastics in the home because of their flammability. There was a rumor that ABS pipe would spread fire from one floor to another. This of course is not true; the same people who started the rumor failed to recognize the fact that ABS pipe is in a wooden wall. People have been living in wooden houses for centuries, and wood is very combustible stuff.

The examples cited may be slightly exaggerated, but typically they illustrate how readily we accept older well-established materials and processes. We educators cannot continue to let ourselves be hindered by the kind of imagery, carry-over symbolism, and misunderstanding that has plagued the development of new technical programs. The study of plastics should be taken from the arts and crafts areas of our schools and developed with the proper consideration and support. The Society of the Plastics Industry has predicted that by 1983 the use of plastic by volume will exceed the use of metal, and that by the year 2000 we will have entered the Plastics Age; at that time there will be more plastic material used by volume than all other materials combined.

I suggest that our advanced industrial society needs plastic technology programs at all levels of education. Instruction should begin in elementary school and continue through college. Engineering, vocational education, industrial arts, and consumer education courses can all be justified and must be made more meaningful. Programs that claim to reflect current industrial trends must include the study of plastics—the principal material of the year 2001.

Mr. Krolick is the Plastics Technology instructor in the Design and Industry Department at San Francisco State College.

Modern Metalcasting in Your Program

Ralph E. Betterley

Many industrial arts metals teachers are faced with teaching cast metals as an area of a general metal shop or as a unit shop. The latter may be especially true if the program is in a technical high school or vocational program.

The expression above, "faced with teaching," was deliberately used because many metals teachers are inexperienced or untrained in foundry operations and may naturally raise the question: Why teach foundry—or metalcasting? Inexperience and lack of understanding of this basic industry not only created the question but leaves this important area out of many industrial arts and vocational programs.

A BASIC METAL-FORMING INDUSTRY

Casting is one of our oldest arts and is now rapidly becoming a science. With crude beginnings around 4000 B.C., it has mushroomed into our sixth largest basic industry, an industrial giant employing more than 400,000 people and producing an annual 22-million-ton product valued at about $12 billion.

Castings are everywhere. They are involved either directly or indirectly with every man-made product used in society today. The modern automobile, which uses 26% of the annual tonnage, would be an impractical luxury if it were not for castings. We all use castings from morning to night. Our industrial society, as we know it today, would eventually grind to a halt without this basic metal process.

IN KEEPING WITH OBJECTIVES

Therefore, if the interpretation of industry, its machines, materials, technology, and processes is a primary objective of industrial arts, there is no justification for omitting metalcasting from our curriculum. Again, it goes back to the teacher, his experience and background, and above all, his interest and that of his school administration.

Fear resulting from inadequate teacher background, training, or experience then becomes a gigantic detriment to active foundry operations in industrial arts programs.

THE BASIC CASTING PROCESS COMES FIRST

School shop programs with casting capability do not have to be production giants, producing large castings. These programs must be based on basic processes—simple two-part molds (flask), largely hand bench-molding operations, crucible gas melting, and small-to-medium nonferrous castings (aluminum and brass).

However, the sky is the limit in challenging possibilities. It is up to the teacher—his interests, abilities, equipment, and administrative cooperation. To modernize with new methods, materials, and techniques, the teacher merely has to upgrade himself and utilize the numerous in-service training opportunities which are available.

Molding and casting can utilize the CO_2 and shell molding and core-making processes with simple equipment. Investment casting for intricate forms can be developed for special applications. Vaporization of a polystyrene pattern called the "full mold" process holds unlimited challenge for the imaginative teacher. This material can be carved, burned with an electric wire, or machined to any desired shape and cast into good castings without removing the pattern. The metal vaporizes the plastic, and the pattern, because it is not "drawn", can have any amount of negative draft.

NEW CORE-MAKING METHODS

Core-making methods have literally been a revolution in the past 10 years. Many of them, using CO_2 gas, air-setting, and chemically-setting "no-bake" binders, give the industrial arts teacher a new dimension in casting operations. More complicated castings can be achieved by using cores, and new methods do not require the long tedious core oven baking required in conventional cores. The CO_2 core-making process is ideal for school shops. It is fast, clean, and economical, producing good results.

Teachers can use short cuts in making core boxes to produce the cores. Wood positives (the shape of the core required) can be fabricated easily from wood and then boxed in a frame to be filled with plaster and sand mixtures. When set, the wood positive is stripped, leaving the plaster cavity for core production.

With new methods, study, and special training in specific operations, the metals teacher can bring into his casting activities modern ways for making castings. They can motivate the teacher and update his program for a better realization of basic objectives.

MODERN SAND TECHNOLOGY SIMPLIFIES THE JOB

Three basic types of sand are presently used for conventional molding operations:

1. Natural bonded sand—silica sand taken from natural deposits and containing varying amounts of natural clays and organic materials. Moisture is used to "temper."
2. Synthetic sands—blended silica sands, with selected grain fineness distribution, bentonite clay bonding materials, and other additives as selected for specific molding and sand properties. Moisture is used.
3. Oil-bonded sands—selected silica synthetic sand mixtures, bonded with clay derivatives and selected oils. No moisture is used.

Since it is most common that school industrial arts foundry facilities do not have a sand muller or mixer, the synthetic sand above is not often used. Natural bonded sand has, therefore, been the most frequently used molding material. There is nothing wrong with this. However, it does take careful attention, conditioning, and control, especially as to amount of water used. Too frequently, teachers are plagued with the problem of poor moisture control, producing rough casting surfaces, pinhole porosity, or large depressions from gas, called "blows."

The use of the new oil-bonded sand mixtures eliminates many of these basic problems. Constant tempering is not required. And, since moisture is not used, this basic problem-producer is out of the picture. It is necessary, however, to have these sand mixtures properly prepared and mulled. Many local foundries will do this free or at low cost for a school operation.

The sand can be stored and used as prepared for considerable time, in some cases for several months. It can be stored through the summer with little or no deterioration in moldability. The material is easy to use and mold. It gives good results, and surface finish and detail are excellent. Many teachers, having a casting area in a general metals shop, are using oil-bonded sand.

Improvements in all facets of foundry operations and teaching have made gigantic strides in recent years. Many other typical problem areas of foundry teaching in the past have been greatly alleviated with equipment, technology, methods, and especially the in-service development of teachers through special courses.

The safety aspects of melting, pouring, and handling foundry operations have made significant improvement through newly designed equipment and recommended safe practices. Teachers who are motivated to learn these new developments and correct procedures to solve basic problems can make metalcasting one of the most rewarding activities in their shops. Basic fundamentals and techniques are the keys. Motivation of students is significant.

The proper—and attainable—practices for metal selection, melting, gating, risering, pouring, sand practice, molding, and core practice can produce attractive castings and projects. With improved methods, castings can become more complicated and serve as basic components of over-all integrated projects which combine patternmaking, casting, welding, machining, and finishing. Many such operations can be incorporated into production teaching methods.

HELP FOR TEACHERS AVAILABLE

The American Foundrymen's Society Training and Research Institute has a broad and comprehensive education program. Considerable emphasis in these activities is directed to the "grass-roots" level—the industrial arts and vocational teachers, their students, and career interests. As the technical society of the castings industry, American Foundrymen's Society and its chapters are devoting considerable time, effort, and money to your areas. Why? These educational programs and services exist to help technical casting education at all levels. They are needed to meet the rapidly changing personnel requirements which parallel the technology explosion existing in industry today and in the future.

Specific help for the teacher can be obtained in many ways from the AFS Training and Research Institute, Golf & Wolf Roads, Des Plaines, Illinois 60016. These services are geared to help the teacher of patternmaking or metalcasting as well as the one who is contemplating incorporating these activities in the school program. Inquiries can be directed to the above address; one may also contact local foundry managers who have affiliation with one of the 50 AFS chapters located throughout the U.S., Mexico, and Canada.

Technical casting assistance and/or participation may include:

- --"Teach the Teachers" courses conducted by local AFS chapters and organized for inservice credit, often including college credit. Teacher and lecture guide texts are used. The course: "Basic Concepts of the Metalcasting Process."
- --Consultation with teachers and administrators regarding course planning and laboratory layout.
- --Publications list, including textbook recommendations, i.e., "Metalcasting—Instructors Guide." Programmed basic courses on five subjects.
- --Metalcasting career guidance booklets and free loan of 35mm color/sound filmstrip package.
- --Technical talks for industrial education conferences, seminars, and workshops by AFS Training & Research Institute staff.
- --Metalcasting Instructors Seminars, held bi-annually in June. A free three-day technical program for qualified instructors and supervisors involved with cast metals programs. Next seminar is in 1972.
- --Intensive technical courses conducted by AFS Training and Research Institute in Des Plaines, Ill., and other cities. Primarily for foundry operators, these courses carry a tuition fee and deal with the technology of a specific subject.
- --Free-loan AFS casting films. Contact AFS film librarian.
- --AFS membership in local chapters provides unlimited help and gives the teacher a chance to communicate better with local foundrymen.
- --Local help is available from area foundries and AFS personnel affiliated with them.

In addition to the above, teachers should not overlook the assistance available from the foundry suppliers and equipment manufacturers. An inquiry to AFS-T&RI can help the teacher locate these contacts.

This paper has not intended to give the teacher a technical "how-to" approach on teaching metalcasting. The main objective has been to alert teachers regarding new developments and to help them and school administrators to see the importance of having this basic industry in their programs.

Mr. Betterley is Director of Education of Training and Research Institute of American Foundrymen's Society, Golf & Wolf Roads, Des Plaines, Illinois 60016.

Making Iron Useful—How Does Carbon Do It?

Edgar Chambers

Iron is the fourth most plentiful element in the earth's crust. Implements of iron have been discovered that can be dated back to about 1000 B.C. The strengthening effects of carbon in iron were known perhaps as early as 500 B.C.

However, it was not until about 1100 A.D. that progress in the development of strengthening steels by the addition of carbon to iron began to be made in a systematic fashion. As short a time as 100 years ago, little was understood about how this strengthening actually took place.

Many of the men responsible for the remarkable developments in metallurgy, who have made possible the understanding of this fascinating mystery and the recent fantastic developments of steel making with its impact on our civilization, are alive and going strong today.

Because of the somewhat recent birth of the science of metallurgy and the great amount of work being done in the field, as well as many far-reaching industrial developments based on metallurgical know-how, confusion exists regarding many of the terms and expressions used in the metals-working field.

Alloy. An alloy is a combination of elements, one of which must be a metal. We are discussing iron, so it will be our base element. These elements are combined in mixtures, solid solutions, and often in chemical compounds. A basic knowledge of chemistry and physics, at least up to the college level, is needed for a person to go very far in metallurgical pursuits.

Iron. A metallic element which, in its pure state, is very soft and has little use.

Steel. An alloy of iron with carbon and sometimes other elements.

Ductility. Ability of a material to deform permanently prior to fracture.

Elasticity. Ability of a material to deform and return to its original dimensions without permanent deformation.

Heat Treating. Controlled heating and/or cooling of a metal which is intended to improve its properties.

Annealing. A softening heat treatment to improve machinability and formability. For steel, it consists of heating to approximately 1400°-1600°F, holding at that temperature long enough for the metal to heat through, and cooling slowly.

Normalizing. A homogenizing heat treatment consisting of heating the steel to the range of 1600°-1800°F and cooling in air. It is used to refine the grain structure to make it more uniform, to improve its response to hardening, and to improve machinability. Sometimes it is used to harden an annealed structure, to improve its strength and usability.

Stress Relieving. Stress relief of steel is done prior to hardening to reduce residual stresses resulting from machining, grinding, forming, cold working, and welding. It can be accomplished by heating to the range of 1000°-1250°F and cooling in air for low-carbon steels and simple shapes. Higher-carbon steels and intricate shapes may require slow cooling (not more than 100°F loss of temperature for each 15 minutes of cooling) to temperatures below 500°F.

Tempering. Sometimes this process is called drawing. It consists of reheating hardened or normalized steel to a temperature well below the transformation temperature to toughen and soften it. As the temperature increases, the hardness decreases and the ductility increases. Time at temperature is also an important factor. Tempering may be said to be a function of temperature and time.

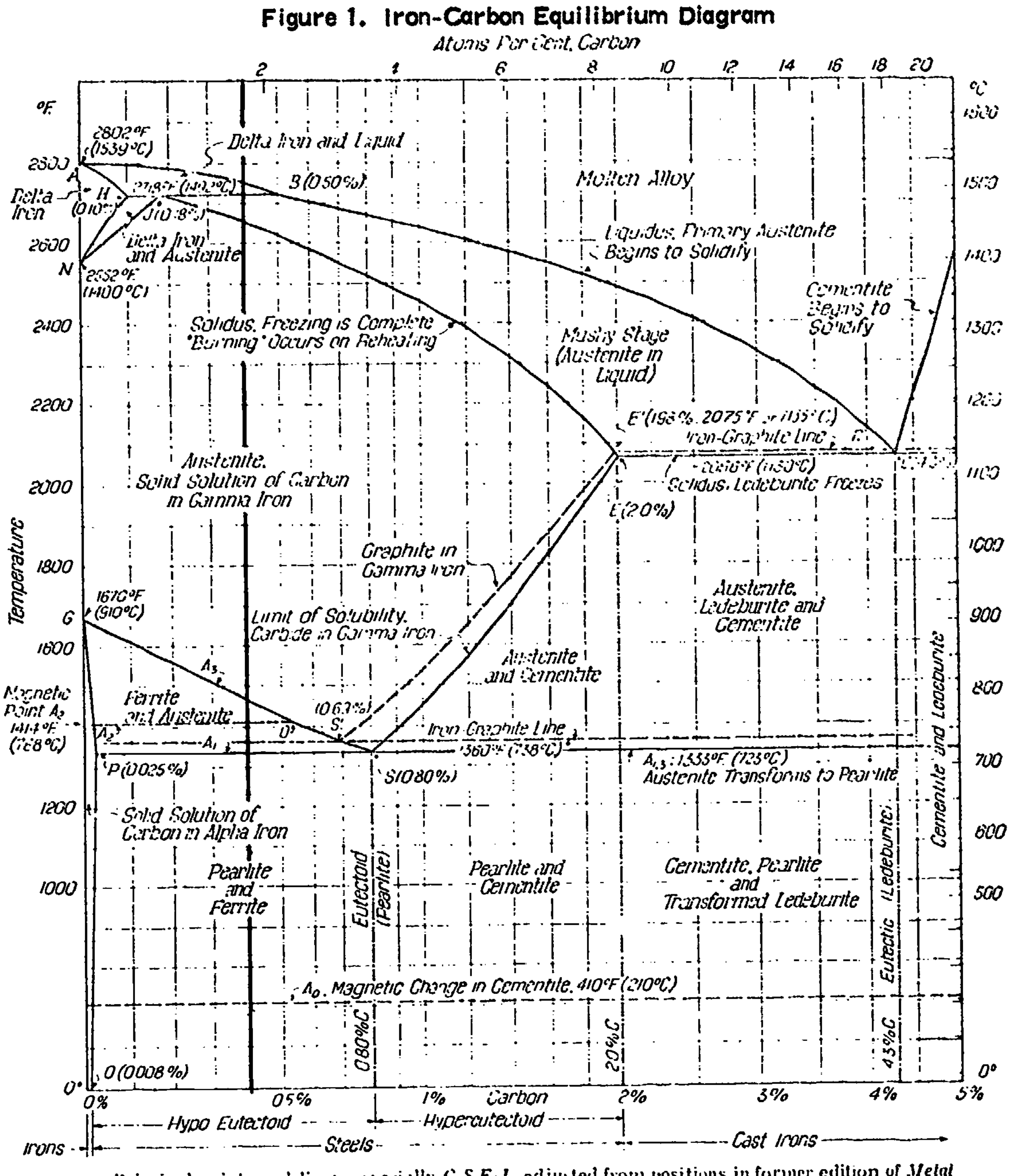
Transformation Hardening of Steel. Transformation hardening is accomplished by heating iron-carbon alloys to temperatures above their transformation temperatures and cooling them rapidly by quenching them in oil, water, brine, air, or with other metals.

The cooling of low-carbon steels must be done very quickly in order to form the desired microstructure. High-carbon and highly-alloyed steels may be cooled much more slowly.

The cooling rate of pure water at 65°F is considered the norm or 1.0. Solutions of 10% ordinary salt or caustic soda will have a value of about 2.0, removing the heat from the steel twice as fast as water.

The best quenching oils remove the heat at about 1/3 the rate of water and air at about 1/33rd the rate of water. Liquid air will remove the heat at about 1/25th the rate of water.

Figure 1. Iron-Carbon Equilibrium Diagram



Principal points and lines, especially *G-S-E-J*, adjusted from positions in former edition of *Metal Progress* data sheet, to agree with diagram prepared for the subcommittee on phase diagrams, Kent R. Van Horn, chairman, John S. Marsh and F. N. Rhines, for inclusion in the 1947 © Metals Handbook. Point *Q* according to J. H. Whiteley, *Journal* of the Iron and Steel Institute, 1936.

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Use is made, at this point, of the Iron-Cementite Phase Diagram taken from the publications of the American Society for Metals.

A line drawn vertically through the chart at 0.4% carbon will be followed as the cooling (quenching) process and the tempering process is described. For iron-carbon alloys of different compositions, other lines may be drawn. While the transformation temperatures for the other compositions may be different, the microstructural changes in them as they go through their transformation temperatures will generally be similar.

The chart has been developed by experimental work and the transformation temperatures shown on it reflect slow cooling. That is to say, the changes shown will only take place at the temperatures shown if the steel is permitted to remain at those temperatures until equilibrium is attained. Steel is a poor conductor of heat. For heavy sections, this could be a long time. Therefore, heating of sections for subsequent quenching usually takes place in a range of from 50° to 75°F above the transformation temperatures shown on the chart. Conversely, the transformations, on rapid cooling, are not completed until the steel has cooled to temperatures measurably below those shown on the chart.

A rule of thumb for heating sections to be quenched is to hold them at the desired temperature for 1/2 hour for each inch of thickness.

The microstructure of the steel at the elevated temperature, above the transformation temperature, is austenitic, a face-centered cubic crystalline structure of iron with carbon in solution. Austenite, gamma iron, can dissolve up to 2.0% of carbon at its eutectic temperature of 2066°F.

The 0.4% carbon in the steel we have chosen to examine will be completely dissolved in gamma iron above about 1470°F.

Face-Centered Cubic Microstructure. In the austenitic state, iron will ideally form cubic crystals with one atom at each of the eight corners of the crystal and one atom at the center of each of its six faces. Since these atoms are shared with adjacent crystals, there are four to each crystal. Carbon atoms, which are much smaller than iron atoms, fit between the atoms of the face-centered crystal; that is, in the interstices of the structure. The largest hole or interstice in this microstructure is about $1.04(10^{-8})$ cm. in diameter. The carbon atom has a diameter of about $1.40(10^{-8})$ cm.; therefore, a moderate number of the interstices can be filled without great distortion.

Body-Centered Cubic Structure. As the 0.4% iron-carbon alloy slowly cools through its transformation temperature, the iron crystals perform a slight change and ideally form body-centered cubic crystals with one atom positioned at each of the eight corners of the cube and one in the center. Since the eight corner atoms are shared with adjacent cubes and the center atom is not shared, the body-centered cubic crystal has two atoms. The time of formation of this arrangement of atoms during slow cooling is of sufficient length that the carbon atoms can be mostly ejected from the body-centered cubic ferrite lattice. This form is known as alpha iron. The largest holes in this lattice into which the carbon atoms would fit, if they were to remain in it during cooling, are approximately $0.72(10^{-8})$ cm. in diameter. As noted before, the diameter of the carbon atom is approximately $1.40(10^{-8})$cm.; therefore, only a very small number of carbon atoms remain in the body-centered cubic lattice of ferrite, about 0.025% at the eutectoid temperature of 1333°F and 0.008% at room temperature.

When the cooling from austenite proceeds at a rapid rate, the iron atoms attempt to form the body-centered cubic lattice. However, the time at temperature is not sufficient for the iron atoms to maneuver the carbon atoms from between them, and thus an entrapment of the carbon atoms takes place. The iron atoms are prevented from contracting to their natural cubic state and instead form a body-centered tetragonal lattice with one set of faces about 1.08 times as long on a side as the other or square set. This microstructure is known as martensite. If the cooling rate were fast enough, the iron-carbon alloy would reach the Ms (martensite starting) temperature before any of the upper transformation products had a chance to form. The transformed structure would be 100% martensite, an ideal situation that is never quite reached.

The upper transformation products will be discussed later in this presentation.

This highly-distorted lattice structure is primarily the reason for the high hardness of martensite. The iron atoms in the martensite are not as densely packed as they are in austenite so that an expansion occurs during the transformation from austenite to martensite, resulting in highly localized stresses and plastic deformation of the matrix.

Martensite in steel is very hard and strong. When an all-martensite structure is formed, it imparts maximum strength and hardness to the alloy.

Subsequent heating or tempering of the fully-martensitic steel at an intermediate temperature will increase the energy of the atoms. Some of the interstitially dissolved carbon atoms will be rejected and softer transformation products such as ferrite (body-centered cubic iron), bainite, pearlite, and precipitated cementite will form. The tempered martensite will be more stress-free, more ductile, and tougher than the as-quenched martensite, and if the tempering temperature has been properly selected, the alloy will possess optimum strength and ductility.

A one-inch bar of this 0.4% carbon steel has a tensile strength of 85,000 psi in its normalized condition. After quenching and tempering, it will have a strength of about 130,000 psi, an improvement of more than 50% due to transformation strengthening.

Under the microscope, martensite appears as an acicular or needle type formation. It develops its hardest and strongest values in a 0.65% iron-carbon alloy.

The hardness of a piece of hardened steel depends on the carbon in it. Other elements in the alloy will increase the depth to which it will harden, but carbon alone will increase that hardness.

There are two other methods of heat treating steel to strengthen it that have become quite popular in the last few years.

Martempering. This process is carried out by heating to the proper austenitizing temperature, then quenching in a molten salt bath to a temperature just above that at which the martensite begins to form, holding for a time, and then permitting the alloy to cool in air. During the holding time, the piece of material reaches the same temperature throughout. The subsequent cooling in air causes only a small temperature gradient between the outside and the center. Therefore, the martensite will form almost simultaneously throughout the piece, reducing residual stresses and the danger of distortion and cracking.

Steel hardened in this manner must be re-heated and tempered in the same manner as steel quenched in the conventional way.

Austempering. In this process, the part is heated to the correct austenitizing temperature and then quenched in a bath of molten salt to a temperature in the bainite range (400° to 800°F). The part remains in the salt bath, at this temperature, until the transformation to bainite has had time to be completed. After being withdrawn from the bath, it is air cooled.

The steel is never fully hardened to martensite. The temperature at which it is quenched and held is carefully chosen to give the steel the desired strength and hardness at which it is to be placed in service. Austempered parts are more ductile, tougher, and harder than parts tempered in the conventional manner. They also have a much higher impact strength. There is much less danger of cracking and distortion from quenching because the austempering quench is not nearly as severe as the conventional quench.

The austempering process is somewhat limited because of the effect of mass of the part. Parts of less than 1/2 inch thickness will respond rapidly enough to the cooling effect of the quench to avoid the formation of the soft, upper transformation products. Heavier parts, if properly alloyed with other elements as well as carbon, will respond to austempering methods but the time that it takes to do the job may be so long that it is not economically feasible to do them.

The upper transformation products, that is, those that first form on slow cooling from the austenitizing temperature, are bainite, pearlite, and cementite.

Pearlite is the first upper transformation product that forms on slow cooling of the iron-carbon alloy. It is composed of alternate layers of ferrite or body-centered cubic iron and cementite, the iron-carbon compound, Fe_3C, which is ejected from the austenite as it transforms from face-centered cubic gamma iron to the body-centered cubic alpha iron. Cementite is very hard and has a low tensile and a high compressive strength.

Bainite is somewhat of a transitional product of quenching, between pearlite and martensite. Upper bainite only faintly resembles the martensite structure and is sometimes called "feathery" bainite. As the temperature decreases toward the Ms (martensite starting point), the structure more strongly resembles martensite but is not as hard. This structure is usually called "lower bainite," and it is harder and stronger than "upper bainite."

On very slow cooling to room temperature, practically the entire structure formed from austenite is ferrite and cementite, called "pearlite."

On very fast cooling, very little pearlite is formed, most of the decomposition product of austenite being martensite.

As one might expect, tempering and intermediate rates of cooling from the transformation temperature produce mixtures of the decomposition products of austenite which are softer and more ductile than the all martensite structure produced on fast cooling.

It is the interstitial solution of carbon in the iron-carbon alloys that makes them useful.

Without the development of the understanding of this and of the mechanics involved, our civilization would not have the tools to do the jobs that we do today. Without carbon steels there would be no skyscrapers, no automobiles as we know them today. Literally hundreds of parts of our autos are heat treated to give them the strength that they must have. That is just a start. Manufacturing machinery and much more depends on this phenomenal job that carbon does in strengthening iron.

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Shop-Built EDM Simulator

Samuel E. White

Electrical discharge machining is a metal removal process whereby material is remov.d from the workpiece by intense heat, generated by a carefully controlled spark or a occurring in a dielectric medium between the tool and the workpiece.

Metal is actually melted or vaporized from the workpiece and is then recrystallized in the form of tiny spheres or globules of metal by the dielectric fluid.

Metal removal occurs in a small gap between the tool and the workpiece. Tool movement may be vertical, horizontal, or rotational, depending on the tool shape and the desired cavity. A mirror image of the tool shape is eroded in the workpiece, commensurate with the tool movement.

Since metal removal is accomplished by melting small amounts of the workpiece with each spark, there is little or no force generated between the tool and workpiece.

The metallurgical condition of the workpiece—that is, its state of hardness—is not a factor in EDM. The melting temperature of the material is the primary factor in the metal removal rate. Carbides machine almost as readily as mild steel.

Because this process takes place immersed in a fluid, there is no appreciable amount of heat generated in either the tool or the workpiece. As a consequence, a hardened and stabilized workpiece will remain so throughout the process.

POWER

Energy to create the necessary spark between the tool and the workpiece is generated electronically in the form of a pulsating direct current at the lower radio frequencies (5 to 100 Khz.).

Conventionally, this current may be supplied by a resistance-capacitance circuit, a rotary or static impulse generator, or a solid state isopulse circuit.

The solid state circuit has some advantages and is being incorporated in most new equipment.

Auxiliary. In addition to the spark generator, electro-mechanical power is needed to provide servo action for the tool head and pumping action for the dielectric fluid.

CONTROL

Servo. Since the generated electrical spark occurs in a dielectric medium between the tool and the workpiece, a precise gap or distance must be maintained in order that a continuous sparking action may occur.

The gap voltage or potential between the tool and the workpiece is usually used as a reference. As material is eroded and removed, the gap spacing will increase, resulting in an increase in gap voltage. If the gap spacing becomes too narrow or becomes clogged with "chips", the gap voltage will decrease, resulting in a zero potential when a shorting condition occurs.

Servo units are designed so as to sense and maintain a preset optimum voltage by either opening or closing the gap spacing as required.

The desired voltage plus the sensitivity and response of this action varies with different machining conditions and therefore must be controlable. Gap spacing may be in the neighbornood of 0.005 to 0.0005 of an inch; consequently, a very precise action is required.

Current and Frequency. The amount of current required for any one operation may vary considerably, depending on such factors as the size of the tool and the desired surface finish.

The spark generator should be regulated to produce desired currents up to capacity at a wide range of frequencies.

The frequency of the occurring spark will in effect determine the ultimate surface finish of the workpiece. Higher frequencies are naturally associated with lower currents, and the more sparks that occur in a given area per unit of time with a lesser current that produces smaller craters, the finer the surface finish will be. Finishes of 30 to 60 rms are possible.

The matte nature of the surface finished with EDM is excellent for retaining a lubricant and very desirable for stamping dies.

Capacitance. With RC and static impulse or rotary power supplies, the energy at the machining gap is obtained by discharging a capacitor. For more effective machining, this capacitance should be vairable in order that it may be matched with frequency and machining gap width for optimum current flow.

Fluid Pressure. Another controlable factor in the EDM process is the fluid pressure. When machining takes place, the metal of the workpiece is melted or vaporized and then immediately recrystallized in the form of tiny spheres or globules of metal. If this debris or "chips" were allowed to remain in the machining gap, it would eventually provide a conductive path for the current and a shorting condition would occur.

The "chip" problem may be overcome by

(a) making the tool hollow and forcing the dielectric fluid under pressure through the machining gap.
(b) drilling a hole in the workpiece and forcing fluid up through the machining gap.
(c) applying a vacuum to the hole in the workpiece and drawing fluid down through the machining gap.
(d) applying a vibratory motion to the tool or workpiece which produces a pumping action in the machining gap.

Pressures required to circulate the dielectric fluid are usually light (3-5 lbs psi) and can best be determined by the optimum machining conditions obtained in any given situation.

PERFORMANCE

Accuracy. Accuracy obtainable with EDM depends upon a number of factors. The accuracy of the tracking of the quill throughout its full length and the amount of side play are mechanical limiting factors. Lead screw accuracy for a movable table must also be considered in accurate machining.

The primary electrical factor is the machining gap, which becomes the overcut or electronic envelope as the cavity depth increases.

For any given combination of dielectric material, current, voltage, and frequency, electrical breakdown of the fluid will occur at a precise distance between the tool and the workpiece. This distance becomes the machining gap and consequently the overcut, or difference in size between the cavity formed in the workpiece and the size of the tool.

Since the primary factor in determining the overcut is the voltage at which the dielectric breakdown occurs, the ability to control the voltage by servo action becomes the determining factor in electronic accuracy.

Commercial machines are equipped with graphs that depict the predicted overcut for certain fluid, current, capacitance, and voltage conditions.

MATERIALS

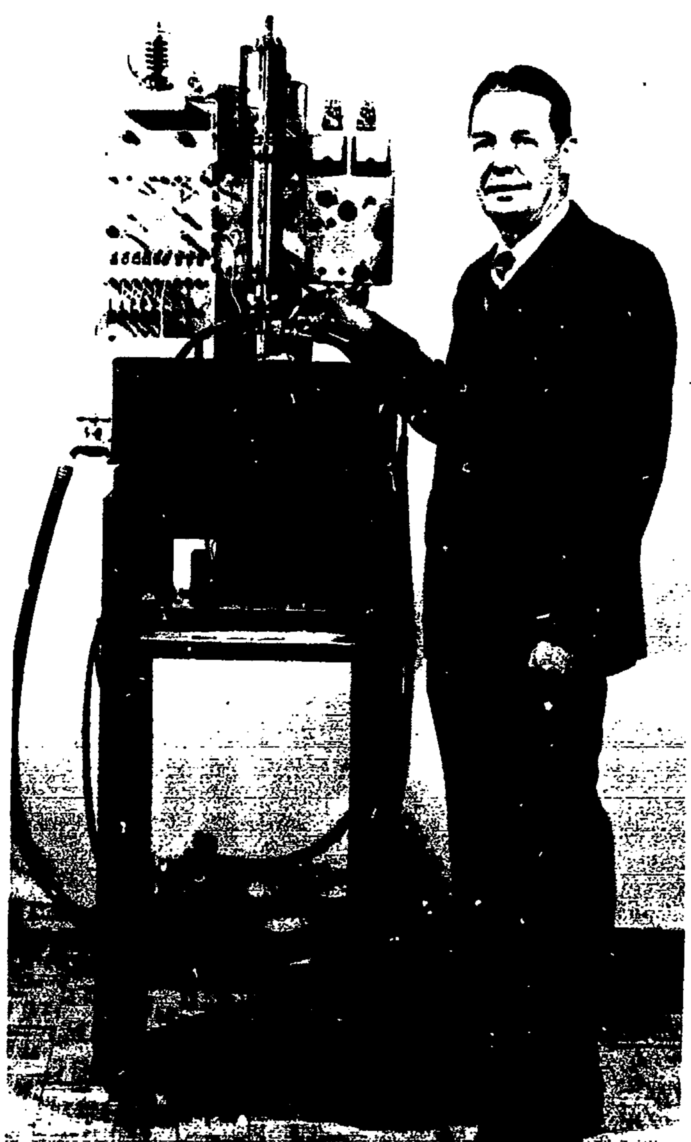
The prime criteria for tool and workpiece materials is that they be conductors of electricity; however, all combinations of materials do not function equally well nor are they always desirable.

Tool. Tool material, in addition to being conductive, must also have the quality of being formable, either by being machined or molded. It must also have a high enough density to exhibit a surface finish comparable to that desired in the workpiece. Graphite is one of the more common materials used with steels. A high-density grade is easily machinable and is a good conductor. Brass, tungsten copper, beryllium copper, tin, and zinc have also been used for certain applications. Brass seems to work well when machining carbides, but the wear ratio between the tool and workpiece is rather high.

Constant research is occurring in this area and better electrode materials may be expected.

Workpiece. Workpiece material is less critical than tool material. Aside from being a conductor, it may be in any form—i.e., hardened or annealed—and may consist of some of the more complex alloys that are difficult or impossible to machine by other methods.

Dielectric Fluid. Hydrocarbons are the most commonly used dielectric fluids. Kerosene or 10-weight motor oil work very nicely, especially after they become dirty or slightly contaminated with microscopic particles. Much research has been done with water-miscible fluids such as triethylene glycol. They seem to produce a good constant machining rate; however, they are not as solvent as hydrocarbons and do not remove the machining residue as readily, especially when machining high-carbon steels.



SUMMARY

EDM is a relatively new metal removal process. It is now finding wide acceptance in industry, especially in the tool and die field.

The advantage of being able to machine almost any shape cavity, even a compound curve, in a hardened and stabilized workpiece often outweighs the disadvantage of a slow machining rate.

Local construction of an EDM demonstrator is feasible. The criteria for the process as set forth herein should help as a guideline for construction requirements. The amount of sophistication desired would be an individual choice. More information on construction of an EDM may be obtained from Mr. Samuel White, Assistant Professor, Western Carolina University, Cullowhee, N.C. 28723.

Mr. White is a member of the faculty, Department of Industrial Education and Technology, Western Carolina University, Cullowhee, N.C.

Man/Society/Technology Forum

Man/Society/Technology: An Invitational Forum

C. Dale Lemons

Man has evolved from the status of a hunter of food with survival existence to the present affluent and physically comfortable individual primarily because of his technology. The constant striving of man to make his life easier and more comfortable, to provide himself with the pleasures of life, to gain mastery over the elements of nature that assailed him, to feed and clothe himself with better products, and to find answers for the many questions confronting him has resulted in a spiraling of technological developments. This technology that enables you and me to be here in this fine structure, enjoying controlled atmosphere and partaking of food and drink from a variety of locations in the world has, as you know, created many undesirable side effects.

Man, through his misuse of technology, has polluted the air and despoiled the earth and streams to the extent that many people fear that the point of no return has been reached in the ecological imbalance. Although the ecology problem has received much publicity in recent years, it is not the only major concern related to technology. Alvin Toeffler in his book, "Future Shock," relates other problems. Among these are the following phenomena:

1. The mobility of our population creates a rapidly increasing "through-put" of people through our lives. This has resulted in a decrease of personal bonds between individuals and a lessening of concern for local civic matters.
2. The rapid increase in data processing results in the demand for an accelerating burden of decisions to be made. Man can make decisions up to a point that varies from individual to individual, after which the number of decisions to be made frustrates him and results in physical and mental fatigue.
3. Accelerating technological development has made man more free to make choices than ever before in history. The availability of occupations, consumer products, recreational pursuits, food, etc., is so great that man becomes confused yet still protests of enslavement by technology.

The inability of man to use the technology he has created wisely and to change his society to be consistent with the possibilities of the products of this technology results in what Toeffler calls future shock.

The challenge facing educators today is not that of knowing the cultural patterns of the past nor of developing only the scientific and manipulative skills necessary for continual technological development, but developing understanding of the impact and potential of technology that will enable man to adapt to the changes in his society resulting from technology. The educator must develop the attitudes necessary for man to use technology for the benefit of man and his environment, both present and future.

An academic question is often posed: "Should we continue technological development?" To feed and clothe the population of today demands an acceleration of technology. The problem is to be far-sighted enough to use this technology in a manner that does not create other major social and ecological problems.

Industrial arts has been defined in many ways but almost all definitions include some of the implications of the definition given by Bonser and Mossman. "Industrial arts is a study of the changes made by man in the forms of materials to increase their values and of the problems of life related to these changes." Industrial arts programs have traditionally concentrated heavily on the first part of this definition and have sadly neglected the latter. A program of industrial arts relevant to the educational needs of youth today for living in a world of technological impact and social change must contribute more than fragmented bits of technical education unrelated to man and his society.

THE FORUM PROJECT

A concern for the relevance and direction of industrial arts was expressed at the Grove Park meeting of CONPASS, Consortium of Professional Associations. It was from this beginning that the Forum Project grew. In fact, several recommendations made at the Grove Park Institute were adopted as goals of the American Industrial Arts Association and are significant cornerstones of the Forum Project. These goals were:

1. Improve, update, and revise teacher education programs in industrial arts to reflect the latest findings and developments in industrial and educational technology.

2. Provide enrichment and in-service education courses at the graduate and undergraduate levels for industrial arts teachers in the public and private schools who are seeking to meet local certification requirements and/or continue their formal education.
3. Provide local and regional in-service education institutes and conferences to focus the attention of the classroom teacher on the latest technological developments in industry and education.

To achieve these goals as well as to resolve such problems as the school dropout, more relevant programs for minority and deprived groups, and environmental studies, the AIAA recognized that the unified effort of several organizations and agencies would be needed. Thus, the AIAA, through the Executive Secretary, Dr. Edward Kabakjian, drafted the proposal to focus the attention of governmental agencies, labor, industrial organizations, and educational agencies and associations on these common concerns.

The first step in this procedure was to obtain a small planning grant through CONPASS. This grant provided the opportunity of bringing 38 representatives of government, labor, industry, education, and industrial arts education together in a two-day conference. This conference was held in Washington, D.C., January 1970, and focused on an analysis of the social, environmental, economic, and political problems facing our society. Close attention was given to the changes occurring between man, society, and technology, with emphasis on the implications these changes have for teacher education in industrial arts. A full report on this pilot or Phase I conference may be read in the September-October 1970 issue of the MAN/SOCIETY/TECHNOLOGY Journal.

STRATEGY OF THE REGIONAL FORUMS

The Washington Conference served as a model for designing the regional forums through which representative groups from all states would participate. The strategy of the regional forums is to involve leadership personnel from the various segments of society with industrial arts educators to identify roles, relationships, resources, and responsibilities of these groups through which the problems caused by technological advance can be converted to benefits for mankind. More specifically, the objectives of the regional forums are to:

1. Initiate and further dialogue between industrial arts educators and others in education and with personnel from community organizations and agencies.
2. Examine the promises and problems of technology for implications pertaining to education.
3. Analyze critically the goals of industrial arts to better establish the relationship of industrial arts and technology.
4. Synthesize the promises and problems of technology with industrial arts education.

These objectives are included in the MAN/SOCIETY/TECHNOLOGY brochure that was sent to all AIAA members.

Phase II of the Forum Project was to conduct eight regional conferences in which leadership personnel from each state would be invited to participate. These leaders would serve as a core for developing further action within their respective states. The eight regions were defined to minimize travel and expense for the participants from each state. The number of states included in each region was held to a minimum to make each forum of efficient size.

The regions are as follows:

1. Southeast Region
   Alabama, Florida, Georgia, North Carolina, South Carolina, Tennessee, Puerto Rico, and the Virgin Islands.
2. South Central Region
   Arkansas, Kansas, Louisiana, Mississippi, Oklahoma, and Texas
3. West Coast Region
   Alaska, California, Hawaii, Idaho, Nevada, Oregon, and Washington
4. Rocky Mountain Region
   Arizona, Colorado, Montana, New Mexico, Utah, and Wyoming
5. Mid Central Region
   Illinois, Indiana, Kentucky, Michigan, Ohio, and West Virginia
6. North Central Region
   Iowa, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, and Wisconsin

7. North East Region
   Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont
8. Mid East Region
   Delaware, Maryland, New Jersey, Pennsylvania, Virginia, and Washington, D.C.

Representatives from Canadian provinces are invited to appropriate regional forums.

The location of the forum in each region is determined to some extent by the states to be included. The National Aeronautics and Space Administration, NASA, volunteered their support in this project through use of their facilities where appropriate. Five of the regional forums will be held on or adjacent to NASA centers. The support of Dr. Frederick Tuttle, NASA Director of Educational Programs, and the NASA Center Educational Program Officers have been tremendous and are due the gratitude of the industrial arts profession.

The greatest problem involved in conducting the regional forums is identifying the leadership personnel from each state to invite to the forum. Although many industrial arts educators from each state desire to be involved in the regional forum, this is not possible. The project is designed for a dialogue with other organized segments of our society and requires a balance of participants. To permit all those of the profession who are interested to participate would create an imbalance, and we would be talking to ourselves again. Therefore, the forum was designed as an invitational program.

An organizational pattern was designed to identify the leadership in each state. This organization consists of a regional coordinator and two state coordinators for each state included in the region. To identify individuals for these critically responsible positions, the American Council on Industrial Arts Teacher Education and the American Council of Industrial Arts Supervisors were asked to recommend one person each for each state. Through this method, the state coordinators were selected. Anyone interested in the project is urged to contact one of his state coordinators.

The state coordinators are truly the key persons in this forum effort. They have the responsibility of searching out the most valuable leadership personnel in their states and recommending these persons as participants. The success of this effort and the follow-up to secure the participation of those persons recommended determines the benefit to the respective state. These state coordinators also serve as discussion leaders in the forum to obtain maximum benefit from the knowledge and expertise of the participants. Further, they are the key individuals to develop action within their state after the regional forum is completed. In short, the state coordinators have the most responsible position in the forum design.

The regional coordinator also plays a very valuable role. He is responsible for all local arrangements, maintaining encouragement and communication with the state coordinators, securing sponsors for meal functions, advising and assisting in program arrangements, and generally operating his regional forum.

The program of each forum follows a basic format. This consists of four major blocks or segments, three of which are forum-oriented. These segments are:

1. Technology in Action—a tour or demonstration of technology as it is happening. NASA has provided this where the forum is at a center. The intent of this segment is to develop a tone or feel for the complexity and diversity of technology.
2. Technology/Society Relationships—an examination of the major thrusts of technology and its impact on man and his society. From this, implications for the education of youth are drawn.
3. An Analysis of Educational Responsibility—an examination of the content and methodology of industrial arts education to clarify the role of industrial arts in developing technological literacy.
4. Formulation of a Consortium—an investigation of the roles, responsibilities, relationships, and resources of organized segments of society in the educational partnership. Plans are formulated for developing educational partnerships in each state to improve industrial arts education.

Throughout the three segments of the forum, three techniques are used. A speaker presents a challenge to the participants to focus on the appropriate topic, usually followed by an open forum discussion to further stimulate thinking and clarify the subject. Then tasks are given to the participants in small groups. These tasks are related to the topic discussed, and the results of the small groups are reported back to the total forum. It is in the small group work that the most significant visible outcomes are produced.

STATUS OF THE FORUM PROJECT

Presently three of the regional forums have been completed. These are the Southeast at Cape Kennedy, Florida; South Central at the Manned Spacecraft Center in Houston, Texas; and the West Coast at the Ames Research Center, San Jose, California. In those three forums, 141 persons attended of the 275 invited. An analysis of those invited and participating shows the following:

	Invited	Participating
Government	56	23
Labor	23	6
Industry	68	27
Education	71	42
Industrial Arts	57	43

Although the total number of participants attending has been less and the number of industrial arts educators greater than that desired, the meetings have been stimulating and beneficial. Later in the presentation, I will relate to you some of the results from the forums.

The North East and Mid East Regional Forums are in the planning stages. The North East is scheduled for October 5 and 6 in Lebanon, Connecticut, and the Mid East is scheduled for November 1 and 2 at the Goddard Space Flight Center, Greenbelt, Maryland. The regional organization for each of those two forums is near completion. There are a few remaining coordinator slots to be filled.

SIGNIFICANCE OF THE FORUM PROJECT

Although the forum project is not yet completed, a significant impact has been made with those participants from outside our profession as well as industrial arts educators. Most outstanding has been the enthusiasm of participants when the purpose of industrial arts is clarified. This in itself is a significant result. That is, to discover how few people know what industrial arts is and how its programs can contribute to the education of youth. Mr. Boardman Moore of Chevron Research, who has been more than casually associated with education for many years, having served as President of the National School Board Association and presently Chairman of the California School Board, stated it in this manner. "Until asked to speak to this forum and being furnished much literature about industrial arts, I did not know what it was, and I have been actively associated with education for more than 15 years. You must inform the taxpayers about what you are attempting to do with their children. After being informed, I wish to go on record as fully supporting the programs of industrial arts."

If there has been a recurring emphasis throughout the complete forums, it has been that we must improve our public information efforts.

Great stress has also been placed on further developing cooperative efforts with other disciplines and community resources. But it has been equally stressed that we in industrial arts will have to initiate these cooperative efforts. As one participant put it, "When we (his company) wish to promote a major project, a concentrated public information effort is started years in advance. You (industrial arts educators) should have started 15 years ago with a planned program of information." This is the challenge to us today.

Other concerns that have been expressed in the forums are:

1. There is a lag from technology to education in implementing technological developments.
2. Less manipulative skills are required as work becomes more technical.
3. Young people are withdrawing from society, possibly because of an inability to identify themselves in this technological society.
4. Ecological and environmental imbalance are of great concern.
5. Somewhere in the educational system, a proper understanding of the value and need of technology as an integral part of our society must be developed.

Some challenges made to industrial arts education were:

1. A positive concentrated plan for program improvement must be made. The defensive attitude long held by our profession does nothing to improve our image or programs.
2. Industrial arts educators must become involved in civic and school affairs—in other words, emerge from the "shop" and engage in the community.
3. Define and interpret industrial arts programs to the community.
4. Develop and maintain programs that will aid youth in accepting the changes that technology will bring to their lives.
5. Seek out and involve advisory groups in program planning and operation.

Representatives from government, labor, and industry have expressed a keen interest in education, including industrial arts education. They have made commitments to support industrial arts through advisory services, human resources, financial contributions, instructional literature, and in many other ways. There has been only one string attached, and that is that they must be asked.

So how may you be involved in the forum project? Ask your state coordinators about what plans are being made for forums or conferences in your state. Seek their assistance in planning and operating a local forum with community leaders and industrial arts teachers. Remember, if you ask for help you must be willing to accept it. That is, few busy executives are able to give of their time to hear you talk. Make any program you plan truly a dialogue from which all involved will benefit; follow through so that recommendations are implemented and all that results is not rhetoric.

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Relevance of Industrial Arts

One Approach to Improving the Competitive Position of Industrial Arts

William R. Pollert

Many persons in industrial arts are working to revitalize the curriculum by increasing its relevancy to the real world of technology. Given the rapidly changing environment of education in general and industrial arts in particular, I believe these efforts are necessary if industrial arts is to continue to grow and, as a representative of business and industry, I view them with enthusiasm and hope.

In the past, education has flourished in a social, economic, and political environment which has almost unquestioningly accepted and supported it. Recently, however, this favorable environment has been changing. Government, business, and local communities who support education are increasingly questioning some basic and heretofore sacrosanct beliefs about education. For example, the belief that education is good and more education is better is no longer accepted without qualification. Government, business, and the local community are increasingly unwilling to leave education to the professional educator without also holding the professional accountable for the output of education—namely, student learning. Those supporting education are demanding empirical evidence that the benefits of an educational program to the student and the community justify the cost of that program. As a result, I believe that a new political, economic, and social environment for education in general and industrial arts in particular is evolving. As an outsider to education, I am in no position to give a value judgment as to whether these changes are good or bad. Rather, since these changes are occurring and are likely to continue to occur throughout the next decade, I would like to suggest one approach which might be used effectively to relate industrial arts to this new environment.

As with all change, it may be viewed either as a threat to be resisted or as an opportunity to be exploited. Because of the relatively weak political and financial base of industrial arts within both the educational establishment and society in general, it has the potential to benefit more from the changes which are currently taking place than most other educational groups. Whether it does so or not is a different story.

Despite the efforts of many in industrial arts to revitalize and modernize its curriculum, a large segment of the business and non-business community, as well as many educators, continues to perceive industrial arts as being directed at the same students for the same purposes as vocational and/or general education. Therefore, realistically, industrial arts must be considered in direct competition with vocational and general education for financial and non-financial support. Unfortunately, the relatively low-level funding of industrial arts as compared with vocational and general education indicates that industrial arts has not been able to compete as effectively as either of these groups for funds. A major problem facing industrial arts is to prove that industrial arts is offering a vital educational experience to the student not offered in either general or vocational education.

The solution to this complex problem will be a difficult one requiring, in some cases, painful change. The success of industrial arts educators in improving their competitive position vis-a-vis other educational groups will depend, at least partially, on the problem-solving approach used and the willingness of industrial arts teachers and administrators to adopt change.

The environment which currently faces industrial arts is not unlike that of a firm competing with other firms for a market. Therefore, one approach which might be used to improve the competitive position of industrial arts would be a problem-solving procedure similar to that used so successfully by many corporate management. Such an approach would first require industrial arts administrators to systematically identify and categorize elementary and secondary school students who could most benefit from industrial arts either because they have not been adequately served by vocational education and general education or because industrial arts can meet the special educational needs of these students better than other education programs. Many people in industrial arts argue that since technology effects every high school graduate, industrial arts is for all students. Although there may be considerable validity in this argument, it is not the most effective strategy when asking for increased public support to bring industrial arts to larger numbers of students, since it would be difficult, if not impossible, to prove empirically that all students would benefit equally from industrial arts. Yet the public is asking and will continue to ask for some supporting proof before widely endorsing industrial arts or any other educational program. For example, it is unlikely that the college-bound high school student, his parents, or his guidance counselor could be persuaded to financially support the inclusion of industrial arts into the academic curriculum, since there is little publicized empirical evidence that suggests industrial arts training will help a college-bound student gain admission to the college of his choice. Further, given the current biases of most parents of college-bound students and college professors, it is questionable whether it would be worthwhile to attempt to prove the worth of industrial arts to this group. On the other hand, no educational program has effectively met the special educational needs of the disadvantaged student who does not plan to attend college. Assuming that an industrial arts curriculum could be developed which could effectively satisfy the education needs of the disadvantaged student by helping him bridge the psychological gap between life in the ghetto and life as a useful employee in a technological world, increased financial and non-financial support from HEW and the community in general, including business and industry, would be assured.

Another area into which industrial arts can expand is elementary education. Since industrial arts is already concentrated at the seventh and eighth grade levels, curricula for elementary grades might also be developed. In light of recent studies which demonstrate the importance of early education in forming attitudes, a good agrument could be made for introducing children to the world of technology in elementary school.

A further advantage of developing an elementary school industrial arts program is that industry is on record in support of such efforts, as seen by the following excerpt from the recently passed National Association of Manufacturers policy position:

> All students' learning experiences should include general orientation to the world of work beginning with the elementary grades, and industrial arts programs at the intermediate levels should be kept up to date to reflect advancing technology.

Two examples of the type of the total support and close cooperation given by industry to the development of elementary school programs are the two pilot programs on technology in New Jersey and New York. Once again, assuming that effective industrial arts programs could be developed for grade school children, there is a good possibility for additional support.

To summarize, the effectiveness of the argument that industrial arts is for everyone is limited since many parents, businessmen, educators, and students do not perceive industrial arts as useful enough to receive increased funding. In order to be able to justify meeting the specific needs of students and society, industrial arts educators must carefully identify the type of student who is the major target for industrial arts. In defining a "market," industrial arts proponents should at least consider the following factors:

1. The socio-economic background of the student.
2. The unique educational and occupational needs of the student.
3. The grade level of the student.
4. The political and economic strength and legitimacy of other types of educational programs which are available to provide educational experiences to the student.
5. The needs of the high-technology sectors of the community—specifically, business and industry.

Once the target group(s) of students has been chosen, it is possible for industrial arts teachers to define the educational and occupational needs of this group(s) and to set specific goals and objectives in terms of satisfying these needs. This is necessary since officials, parents, businessmen, and even students are no longer willing to accept general or vague goals, but rather they want to know exactly what an educational program is attempting to accomplish so they can decide if they want to buy it. Both vocational and general educators are currently struggling to develop more specific and realistic objectives in order to continue to receive public support. Unless industrial arts can be succinctly defined in terms of student needs and objectives, it may find vocational and general education are better meeting the demands of the educational environment and further lose support to these programs. Using these objectives as a guide, industrial arts programs must be developed to meet the specific needs of the student groups toward which they are directed. The increasing demands of the community and the student for relevancy dictate that this be one of the prime considerations of industrial arts programs. Since industrial arts is closely tied to technology, there is no better source of relevant information about the world of technology than the high-technology sectors of the community—specifically, business and industry.

Therefore, a good place to start designing or enriching an industrial arts program is to determine which elements of the adult industrial world should be included in the student's learning experiences. The best approach is to survey knowledgeable representatives of the business community. By doing this, it may be necessary to develop educational skills and subject matter that are not typically provided by schools but that are of particular interest and value to the local community. In short, the educational and occupational needs of the student can be served better by incorporating "real world" experiences into the industrial arts program.

But setting succinct objectives and developing programs to meet these objectives is not enough. High taxes, relatively scarce financial resources, and soaring educational costs have created an environment in which the public is demanding that the outputs of all educational programs be systematically evaluated so that future resource allocation may be done more efficiently on the basis of program results. Therefore, if industrial arts is to receive increased support during the next decade, it is necessary to develop a meaningful system of evaluating whether the established objectives have been accomplished.

Unless industrial arts educators develop a realistic measure of the results of programs, they cannot hope to demonstrate to the public the value of the educational experiences being provided the student. The urgency and importance of developing an acceptable system of evaluating the outputs of industrial arts are so great that it must be given top priority.

Once industrial arts target students and their needs have been identified, succinct objectives set, relevant programs developed to accomplish these objectives, and the results of these programs evaluated, a plan must be developed for communicating the objectives and results of industrial arts to various publics—educators, students, and community leaders—so that they can justify their support.

In designing this plan, careful attention must be given to the special information needs of the many publics of industrial arts, as well as the legitimacy of industrial arts with these groups. Only by customizing your communications can industrial arts educators and administrators hope to communicate effectively. In other words, you must be able to talk the same language as your audience. To attempt to communicate the same information in the same way to businessmen as you would to fellow educators will only result in the alienation of both publics. Further, whatever communication strategy is developed and adopted, there must be some mechanism for two-way face-to-face communication, especially when a particular group views industrial arts as being of limited use or where cooperation is vital to the success of industrial arts, such as with business and the federal government. Without effective two-way communication with its primary publics, industrial arts educators cannot hope to be successful in changing the image of industrial arts and winning the full support of government and the local community, including business and industry.

To summarize, then, it is my opinion as an outsider that industrial arts is in an ideal position to reap the benefits of change. Recent attempts to revitalize and modernize industrial arts curricula are certainly steps in the right direction. By following a systematic problem-solving approach, such as the one outlined in this paper, the chances of winning increased public support for industrial arts so that a greater number of children can benefit from it will be greatly enhanced.

Mr. Pollert is executive assistant to the senior vice president of the National Association of Manufacturers, New York, New York.

A Warden's Opinion of Correctional Education and Training

J. J. Clark

After completing 27 years in the Federal Bureau of Prisons and most recently in my assignment as warden of one of the largest federal penitentiaries in the U.S., I have concluded that education and training is a very functional and important part of the rehabilitative process. It isn't easy to work 27 years with men and women who have dropped out of society for criminal reasons and not be concerned about their welfare after release.

We know that some 96% of the people who get involved in the criminal justice system and are sentenced have not completed high school. We also know that well over 80% of these people have worked in jobs which keep them below the poverty income level. We also are aware of the problems faced by many of these people after release because of their inability to work in upward career type positions or employment. These factors and the multitude of other problems which they face in their social background makes the rehabilitation of a prisoner a most difficult assignment.

But as a warden, today, I want to take a few minutes to explain to you my philosophy of education and training in a correctional setting. I take this assignment with a great deal of pleasure because over the past 27 years I've had a chance to reflect a great deal on what it is that has relevance in changing a man's behavior so that he can become a functioning part of society in a legal way.

The men and women who come to the federal prisons are sentenced because they have committed a federal crime. We know from the various tests we administer that these individuals differ very little in terms of intellectual ability and capability to accept and learn a trade from their counterparts in the free world; for example, according to our intelligence test, the average IQ for men and women in federal prisons is almost equal to, if not slightly higher than, men and women on the streets. If anything, the intelligence level tends to be skewed to the higher side because we have very few people in the prisons whom we could call mentally retarded.

We try to motivate these people in training and educational programs in order that they might be able to change their behavior in such a way as to be profitable for them to return to society upon release. We cannot use the excuse that the men and women in prison do not have the intelligence or the talent to successfully cope with the world of work in the free world. We also know that many of these people sincerely want to accept a new way of life. They volunteer to participate in many programs and are most hopeful when they are released from prison that they will be able to make a successful adjustment.

However, the problem of rehabilitation is not one of education and training alone—it is also educating society and people such as you who are attending this meeting today to the fact that no one can make it in our society unless he has the support of the community. With this in mind, I would like to talk to you as industrial arts educators about what can be done in this total process of rehabilitation of federal prisoners.

I noticed today when walking through your exhibits that some of you have put together what I would consider some very imaginative kinds of projects. I've seen the need for machine shop training, sheet metal forming, shop mathematics, blueprint reading, wood working, and a whole cluster of vocational skills that are used in the outside industries.

It would appear to me that industrial arts teachers have the know-how to develop a program which would be of great assistance in helping men and women learn a new skill or a new vocational endeavor for their future use after release. I cannot suggest that you as a group alone have the talent to solve the total problem. I do believe that if you as a group would take an active interest in the prison programs in your states, you will find a crying need for your talent and a willingness on the part of state and local officials to bring you into their fold in such a way that you will be in a position to make a positive contribution to their programs.

Education and industrial arts or vocational training, as we sometimes refer to it, have been involved in the rehabilitation of offenders throughout the history of corrections. At the beginning, there was considerable emphasis on the chaplain and religious contexts. I would remind you that it was a chaplain who first started the educational program in our prisons. Because he knew that people had to read in order to understand the Bible, he made a small beginning in teaching people a few things about the educational requirements for their survival.

Within the Federal Bureau of Prisons over the last 30 years, we have watched education and training grow from a very small start to what is now a major emphasis in the rehabilitation process. For example, we attempt to identify a man's needs upon admission through various tests which include intelligence tests, the GATB, entrance level tests, and psychological tests. These test scores are reviewed by professionals and recommendations are made to a committee as to what kind of program would best prepare the prisoner for release. I mentioned previously that these men come without an adequate background in education and training to equip them to successfully compete in the world of work. Throughout the prisons, we have a major emphasis on education and training as part of satisfying that need which is revealed by test results and case histories.

I cannot speak with authority of the total educational programs throughout the Bureau, but in my experience with the prison service I do know that there is strong emphasis placed on preparing a man to read. Being unable to read disqualifies a man for participating in many industrial arts or vocational training type programs. However, if a man is able to read at a sixth-grade level and can read manuals and technical journals or those materials which he will use in his world of work, we are in a better position to assume that he can successfully complete a vocational training program.

Our vocational programs vary from a blue-collar training program to computer program analyst. We are moving more and more to what we call the para-professional fields such as medical, social work, teaching aides, and other useful occupations that are emerging in the occupational outlook for '70's.

Our programs are mostly conducted by full-time staff members who are trained in their specialty. We recruit the best qualified people available as teachers in both the industrial arts/vocational training and education areas. In many of our vocational training areas, instructors are selected from journeyman who not only have the top qualifications in their technical skills but also have been given special teacher preparation. Out of this has come a very dedicated group of hard-working men and women who are sincerely concerned about assisting prisoners toward a successful release pattern. All of our teachers in the academic areas have college degrees; many of them have masters and some have doctorates. These, too, are people carefully screened and recruited because of the highly specialized skills needed to educate prisoners. We tend to select people with the backgrounds of special education, remedial reading, mathematics, and related trades specialists, especially those with backgrounds in blueprint reading, shop mathematics, and teachers who are willing to accept new innovative approaches to teaching.

Remember, the men we teach are school dropouts and have been exposed to a school system in which they failed. They do not see themselves as failures, but more that the system has failed them. The end result is that our school program must not reflect that which is found in the traditional public school setting. Therefore, we have attempted with some degree of success to build all our programs around the individual. This has caused us to make heavy use of programmed instructional material. Many instructional units are prepared by the teacher, although the teachers use any kind of prescription that can be put together which will enable a person to quickly and easily master the subject content.

For example, in prescription planning, the prescription may very well be the use of a magazine article, a page out of a mail order catalog, an auto parts book, or the use of a regular old-fashioned workbook. No material is overlooked nor is there any material not considered useful. In other words, everything which relates to the student's interests and needs is what the prescription will contain. As you can see, planning educational and learning experiences around the individual requires a staff which is talented, dedicated, and willing to try innovative ideas.

In the prison setting, we are forced to face the problem of what to do with a man 24 hours a day. One of the biggest concerns of any warden or prison staff is idleness. We know idleness breeds trouble, and unless we can keep a man usefully occupied, there is bound to be unrest. Therefore, we have built into the prisons a large industrial complex.

These industries produce everything from textile goods to instructional teaching machines. In each of these industrial settings, an effort is made to incorporate the training potential for the individual assigned to that industry. We know that in our industries there are many useful training activities. Even though some of our products may not be attractive—you have often heard the complaint about the making of license plates not being a good training area—I would remind you that in the making of license plates there is the need to learn to use a punch press, to service it, and also packaging, crating, and other activities which all have relevant employable relationships to the world of work.

I mentioned the Federal Prisons Industries because we have nearly one-fourth of our population involved in this kind of work. Where I am the warden, nearly 50% of the population at some time participates in an industrial assignment. Unless we put heavy insistence on the training activity and its value, we are not performing our duty as related to the rehabilitation of the offender. We also make heavy use of on-the-job training; work foremen have an active interest in rehabilitation. This may be in the plumbing shop, electrical shop, on the farm, in the food service, or in the hospital.

We are convinced that the sole success of any training program must be built around the motivation and interest of the teacher. Without the interest of the teacher and his serious dedication to assisting a man in improving himself, no amount of training and education will have value.

Mr. Clark is Associate Commissioner of Federal Prison Industries, Inc.

Pre-Employment Education Desired by Space Age Industry

Donald Ziebarth

When some of my associates heard that I was to address you, they asked, "Why do you want to address that group—what can you say to them?" My answer might be similar to that given by James E. Allen, former U.S. Commissioner of Education, when he was asked, "Why might anyone be interested in being a principal in these days of controversy and conflict over drugs, desegregation, teachers' strikes?" His answer was twofold: "First, an education is still one of the most important, if not the most important function of our society and one of the most satisfying and most productive ways of being of service. Second, despite current harrassments and turbulences, this is a time of tremendous hope for progress toward our educational goals." The real opportunity that now exists to change our schools adds excitement and promise to your role. No other persons determine the character and quality of life of the schools more than the teachers of these schools. As the English philosopher and mathematician Alfred North Whitehead said, "The first requisite for educational reform is the school as a unit, with its approved curriculum based on its own needs."

I would hope that you in the audience would be leaders in actively seeking change, open to new ideas attuned to the necessity for flexibility in all approaches, and cognizant of educational opportunities. This is a time when apple pie, flag, motherhood, and a college degree have become the American way of life. Our 18- to 22-year-old bright students have been encouraged, persuaded, badgered, ordered, and driven to colleges of their parents' choice. I think it is time for a change—a change re-evaluating the benefit of sending thousands off to college, only to have many of them return as "failures." I think it is time to state that college isn't all that great. It's great, yes, but not all that great. As one student said: "It's mainly just teachers who think that college is red, white, and blue, 180 trading stamps, and a partridge in a pear tree."

Actually, there are about 50 other ways to "make the scene" if you want to think about them. But you know something? It takes talent and guts to make the scene in a really big way. Without them, students will never make it big, no matter how many colleges they go to. With talent and guts, they'll make it whether they go to college or not. My objective here this afternoon is not to criticize the colleges; it is rather to urge you during this seminar, to give our students a freedom of choice the American way.

A recent editorial in Man/Society/Technology stated that the American system of education is beginning to find that the rapidly expanding world of technology is forcing the function and role of guidance counselors to become increasingly important. I would like to address myself for a moment to the role of the guidance counselor. By and large, public mood is such as to allow or accept the fact that a college education is not the prime prerequisite for success in today's environment. Colleges across the country are reporting a drop in enrollments for September. This is primarily due to the inability of families to pay for the high cost of education. But also, a secondary reason is that potential college students are taking a look at the educational opportunities and are asking, "Why college—why not vocational education?"

In a comprehensive program, the needs of a wide range of students can be met. A highly talented student can study a general education sequence leading to college entrance without ever taking a specific industrial vocational course. He may, however, study general industrial arts as an elective course throughout his program sequence. At the other extreme, there may be a special need which requires entry into a specific vocational training as early as the middle grades. All pupils should be encouraged to elect the industrial arts sequence until that grade level when guidance and performance indicate that he or she can more effectively profit from specific vocational courses.

I read with some amusement the article, "Beginning at the Beginning" by Edward Kabakjian, in the January issue of Man/Society/Technology. In it, he recommends starting industrial arts programs in the grade school, beginning with the first grade. He bases his recommendation on the fact that we are in the midst of a super-industrial revolution and must, therefore, train and educate as never before. Remembering back to my first grade, it seems to me that they were introducing us to vocational training even then. They had us build stores which required hammering, sawing, and painting. Although to this day I hate painting, it helped me decide that I didn't want to be a painter. Through junior high and high school, I was exposed to sheet metal, electricity, painting, woodworking, auto mechanics, and then to the machine shop. Although I liked many of the subjects, it wasn't until I had machine shop that I really knew what I wanted. At that point, more exposure would have been wasted. I knew what I wanted and, in my case, it was the right decision.

Why do I spend so much time in discussing subject matter for guidance counselors, rather than referring to specific requirements for some of the jobs at Honeywell?

First, I think it's important that you understand that subject matter should be organized so as to provide an opportunity to develop insights into broad aspects of industry; that these contents deal with the principles and concepts of industry. If your program is so organized, your contribution as industrial arts instructor will be of value not only to those who leave school early, but also those who continue on with their formal education. Among other things, it should enable all students, both college bound and non-college bound, to derive meaningful concrete experiences which will aid them in understanding abstract ideas. Secondly, as industrial arts teachers, you should have the highest level of competence, possess creativity and ingenuity, and enjoy working with people.

Last month, I attended a meeting of the Advisory Committee for Pinellas Vocational-Technical Institute. One of the subjects discussed was how to obtain more students. A suggestion was made that the Technical Institute be used for students who would normally be attending industrial arts classes in high school. Certainly we should make use of such a fine school, but not as a replacement for industrial arts classes in junior and senior high schools. Not until the student has reached the point of knowing what he or she wants should we start to specialize their training. When ready to specialize, a school such as the Vocational-Technical Institute is a good place to attend.

Employment for graduates of technical schools is still good. An article appeared in the St. Petersburg Times on Sunday, April 11, about the more than 100 June graduates from the Vocational-Technical Institute. All of the graduates had received firm job offers. When you compare the fact that there are 400-plus unskilled personnel and 60 engineers on layoff in Pinellas County from Honeywell alone and less than 10 skilled employees on layoff, you must conclude that opportunity still exists for trade school graduates.

Recently, I discussed with our manager of AGE/Instrumentation (a group that is responsible for the design, building, and repair of all test equipment) who we should send to a school for training in the repair of a special computer. I was pressing for a technician—he wanted to send an engineer. His reason for preferring to send an engineer was that the cost of the training would be lost to Honeywell if a technician went. He stated that his experience has been that as soon as technicians receive special training, they get job offers which are more attractive than ours and they leave the company, whereas the engineer will remain—another example of the need for skilled technicians.

In discussing the requirements for prospective employees with our personnel department, I found that they placed requirements in two basic categories: technical and non-technical. As you may be aware, Honeywell in Florida is concerned with aerospace engineering and production and, as such, our requirements are rather technical.

For the purpose of presentation, I will split the jobs at the Aerospace Division into five categories: unskilled, clerical, technical, skilled, and professional.

First, the unskilled: For the most part, employees in this category have a high school education, although this is not a requirement. The unskilled include our assemblers, who take a 20- or 40-hour soldering training course and a course in microminiaturization.

The next category is clerical employees. The educational requirement for this category is usually a high school diploma. There are many related subcategories under the broad category "Clerical", including typists, who have to have typing speed up to a minimum of 55 words per minute; stenographers, who must be able not only to type 55 words per minute, but take dictation at 80 words per minute; key punch operators; financial clerks; switchboard operators; and duplicating machine operators. Training on the job in this category is minimal.

The third category is the technical. This includes some hourly technicians and engineering support technicians. The educational requirements are high school plus approximately one to two years in a technical vocational school. It includes such categories as detail layout draftsmen, requiring one to two years training in drafting, and engineering technicians, requiring 600 to 1500 hours of electronic training. I might add that a good share of the employees in this category receive their electronic training in the services. Most recently, however, we have been employing a number of graduates from our local vocational school, which is a county-administered technical school.

In the fourth category is the skilled employee, for which educational requirements are a good high school plus an apprenticeship. In this category we have carpenters, machine repairmen, tool makers, machinists, electricians, millwrights, and utilities mechanics.

Then we have the professional employee, whose educational requirements include four years of college.

Very briefly, that covers the educational requirements from the hourly unskilled to the salaried professional employee.

Looking at some of the intangible requirements of the job, our employment people tell us that there are some attributes that the prospective employee typically lacks. These include initiative, dependability, willingness to put forth that extra effort, objectives, and in the clerical categories, the ability to spell and use proper grammar.

As instructors in industrial arts, I am sure that you are aware of the changing requirements in our society. We in industry look to you not only to change the educational environment, but also to prepare your students for the changes to which they will be subjected when they graduate.

Let me conclude this portion of my talk with a few statements regarding the industrial arts. There are thousands of different occupations and professions in the United States from which to select. The student today cannot study every type of employment. I have tried to give you a capsule form of the requirements of our company that are somewhat typical of our industry. The exploratory nature of the curriculum in industrial arts in the junior high schools provides an ideal setting for offering educational and occupational information. Students will be able to make wise career decisions if the occupational information provided them is meaningful and correlated with activities and other learning experiences provided in your industrial arts programs. As instructors in industrial arts, you are urged to have your students study about occupations collectively and in related lessons. It is to both our advantage and theirs to have the students relate the theoretical aspects of occupation with the practical situation in the outside world.

I would urge you, in presenting clearer information, first to give the students an opportunity to see and hear the industrial environment by touring industrial sites. By such actual visitation, the students are able to compare the courses that are encountered in industrial arts and those which are actually used in industry. Second, your class discussions should be centered around acquainting the students with the various sources of occupational information and related school courses which may be taken, for the increasing complexity of our technological society demands that we satisfy these two prerequisites. You as educators could, in fact, be accused of being derelict in your duty to society if you do not provide every youth with the information necessary for him to be able to make a wise choice of his life's work.

JOB ENRICHMENT

Saul W. Gellerman, a leading behavioral scientist, discusses management by motivation in his latest book. He states that money is not a motivator unless given in large amounts, and then only for a short time. In his opinion, job enrichment is the best motivator. Make the scope of the job large enough to give the person performing it a feeling of accomplishment, and you have the tools to provide for good motivation.

On the table is a chassis for our Inertial Digital Computer for the Minuteman III program. We are designing it as a possible replacement for the present computer. We are using the latest technologies, such as plated wire memories, multi-layer printed circuit boards with radiation shielding and plated-through holes, and large-scale integrated circuits. Weight is a major factor and, for this reason, all excess material must be removed. Designing and building such a device is a real motivator for a creative engineer—the professional man who feels that, unless he is creating or managing, he is not being used effectively.

There are many lesser engineering jobs in our business, and in order to provide motivation, we look for a less creative engineer. In this area, we find that the person who has not completed college, who took the route of an industrial arts trade school, on-the-job training, and added college courses is best suited.

IDCU CHASSIS

The IDCU chassis was designed to take advantage of advanced machining and joining techniques. The component parts were machined almost 100% on numerically-controlled equipment and joined with electron beam welding.

The chassis is composed of two main sections—upper and lower—with a coolant cover for each section and 16 small bosses. The upper section and the two coolant covers are machined on a 2-axis N/C machine. The lower section is machined using a 2-axis, a 3-axis, and a 4-axis N/C machine. The parts are joined using electron beam welding. This method of welding requires the parts to fit one another with clearances of .000" to .005" loose. This calls for very close machining tolerances on each part.

All the N/C programs were written at Honeywell by three programmers. Their backgrounds are varied, but they have one thing in common—they all attended some type of trade school.

One man graduated from a trade high school, taking pattern making. He worked as a pattern maker for four years and then attended night school, first taking drafting and then a course in tool engineering at a junior college. This led to a job as a tool designer, which he held for eight years. Three courses in manual N/C programming and two courses in computer assist programming have carried him through the last six years as an N/C programmer.

The second man graduated from high school, followed by a four-year apprenticeship as a tool and die maker. He worked as a tool and die maker and then as a model maker. This led to promotion to the position of group leader and, subsequently, assistant foreman. The next promotion was to an engineering aide and then to manufacturing engineer. Two courses in manual programming and two in computer assist programming have put him in his present position as manufacturing engineer and N/C programmer.

The third man graduated from high school with a good math background and some mechanical drawing. He spent two semesters at a technical institute, taking advanced math and chemistry. The next schooling was in a vocational-technical school, taking a tool design technician course. His employment started as a tool design technician, and then he became a tool designer. Additional schooling was undertaken while working. First, he took a course in the use of APT in programming and then data processing. Next came a design course at a vocational-technical school which led to his promotion to a tool designer and N/C machine tool programmer. He is presently working as a senior manufacturing engineering aide.

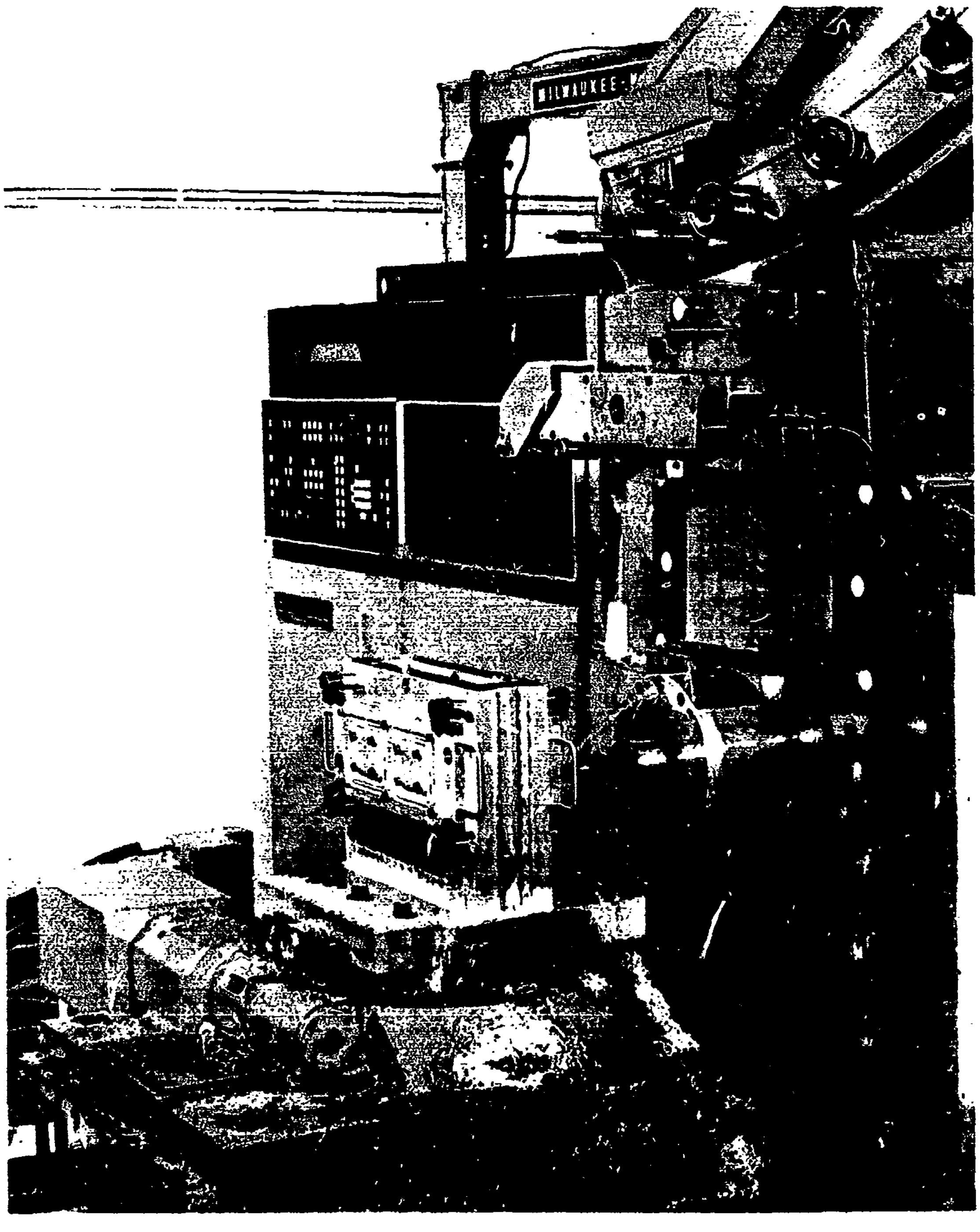

Figure 1. The numerically-controlled, 4-axis Milwaukee-Matic, used for some of the machining on the Minuteman III IDCU chassis.

The N/C programming and final machining of this complex assembly by these three men are accomplishments to be proud of. This came about because of the knowledge available in our vocational and technical schools.

In closing, I am sure each of you will agree with me, after viewing the computer chasis, that a person who can create the manufacturing processes which will produce these results must achieve great self-satisfaction and is of real value to any company. The people performing this work were once students of yours. Their pay is good, their morale is high, and we need them.

I would like to ask each of you to help us by training more, and by letting all have an opportunity for exposure to the different industrial arts until such time as they decide

Figure 2. Robert St. Andre, a numerical control programmer at Honeywell, Aerospace Division, who got his education through industrial arts schools.

what they would like to do. Whatever their choice, if made through understanding, it will be a good one.

For any counselors who may be in the audience, I have this word: Don't make the students feel that the only reason you would suggest they take industrial arts courses is that he or she is not intelligent enough to go to college. I can assure you that being a skilled craftsman does not have to be second best. It is a rich, rewarding career and can lead you as far as you have the desire to go.

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Research

So You Want a Funded Study?

Donald L. Clark

In our modern society, the demands being placed upon the educational community are at an unprecedented peak. There is at least a four-fold numbers game that contributes to one segment of this demand.

1. Population—the simple (or complex!) variable of population is significant; there are simply more students.
2. Tenure—youth start formal schooling at an earlier age and continue their education longer than any previous generation.
3. Adult Education—formal education is no longer restricted to youth.
4. Education for All—education is no longer restricted to the socially elite. Both ends of the continuum seek education.

In addition to more in terms of numbers, there is also the element of better and of greater variety.

To meet the demands of society for more and better education, the economic input into this important societal endeavor has been increasing at an alarming rate. A review of a polygram of the gross national product (GNP) and the expenditure for education would not reveal parallel lines. The incline of the educational line would in fact be rather steep when compared to the GNP line.

The simple economic factor of limited funds and the logistics of the number of students participating in formal education create a need for extensive research; however, in addition to these factors, there is also the variable of the knowledge explosion and the need not only for communicative and computational literacy but also for technical literacy that would prepare man to live in his complex world.

Research is supposed to be the answer to the ills of any institution. Yet, many knowledgeable individuals have questioned the value of much of the educational research that has been conducted to date. As one author has stated:

> If the research during the last three years were to be wiped out in the fields of medicine, agriculture, physics, or chemistry, our lives would be materially changed. If research in the area of teacher personnel during the last three years should vanish, education and educators would continue much as usual. There are relatively few studies among some 500 reported here which will, or should, widely effect educational practice (Lamke).

It is evident that not only do we need more and better education, but we also need more and better research. A relevant question that emerges relates to the factors that contribute to the lack of research and/or quality of research in education. Several variables could be considered, and one of them would relate to the training or education of research personnel at all levels. This variable could include not only the training of the researcher but also the professional preparation of the consumer of the research, which in educational circles is ultimately the classroom teacher.

A second variable, and of all those that could be considered the last one that will be discussed in this writing, is the lack of funds. Industry utilizes from 5 to 15% of its resources in research and development efforts; as evidenced by the standard of living enjoyed in industrial nations, they have been successful. Education, on the other hand, utilizes less than 0.05% of its resources for R&D activities. This very restrictive funding variable, however, should not be used to rationalize that research cannot be accomplished, because as one noted researcher states, "Money, in any amount, can be found if a research program of sufficient significance can be developed. We should not trim our dream to fit our purses . . . (Griffiths)."

The challenge is to identify the truly significant researchable problem and then develop a method of attack for that problem. As indicated in Figure I, we need to be mission-oriented and first identify the problem. For every problem, there is a method. The method then dictates the budget or money. Significant research will not materialize if we are method- or money-oriented as opposed to problem-oriented. The broken-line arrows in Figure I indicate that there is a feedback loop from Steps 2 and 3, but the critical line must follow the solid arrows from Step 1 through Step 2 to Step 3.

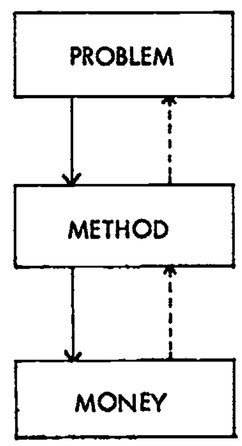

Figure I. Problem Approach to Funding

One evident obstacle to designing and completing significant research and development activities in the field of education is the ever-pressing factor of time. In our economic society, time is synonymous with money. Thus, assuming that there is a desire to pursue research and development activities, two logical questions emerge relative to money.

1. Where do I apply?
2. What procedure do I follow?

In the past, funds for R&D activities and the U.S. Office of Education have been almost synonymous terms. The U.S. Office is certainly one pipeline; however, educators are not restricted to only the Office of Education in Washington, nor are they restricted to only federal funds. It is not possible in this short report to enumerate all the various potential funding sources. Thus, only examples from which ideas can be generated will be pursued.

Where Do I Apply?

Industrial arts personnel would have to look long and hard to find a funding source that would actually have the word industrial arts listed in the type of activities funded, and we often bemoan the fact that I. A. is not identified by name in potential funding source information. Taking the positive approach, however, because of the interdisciplinary nature of industrial arts, the fact that industrial arts is not specifically designated in a few potential funding sources actually could be beneficial in allowing the industrial arts researcher the opportunity to draw upon a broader range of funding sources.

FEDERAL AGENCIES

In educational circles, the would-be researcher tends to restrict his concept of federal assistance to the U.S. Office of Education. This is certainly one important source; however, for the imaginative researcher, there are also other potential sources.

Examples of USOE Assistance

Three examples of U.S. Office of Education assistance will be delineated, from which the researcher may expand his ideas.

Basic Research Program. The basic research program of the Office of Education supports research that has a strong theoretical orientation requiring in excess of $10,000 of federal support and two or more years of continuation funding. Projects are selected on a national base but are contracted and monitored out of regional offices. The average annual budget for such projects has been approximately $50,000, with continuation funding being determined at the regional level on an annual review of project accomplishments.

November 7, 1970, and February 13, 1971, were the submission deadlines for research proposals under this program for FY 71 funds. Guidelines for proposal preparation and submission are the standard NCERD guidelines and may be obtained from:

Research Analysis and Allocation Staff
National Center for Educational Research and Development
U. S. Office of Education
Washington, D.C. 20202

Targeted Research Program. Based upon identified needs, the U.S. Office of Education periodically puts out a RFP (request for proposal). In this program, the problem area is identified and the researcher is limited to a work plan that will meet the specifications of the RFP.

Whenever an RFP is sent out, it is advertised in the Commerce Business Daily. An institution may also be placed on a bidders' list by making contact with the U.S. Office of Education.

Regional Project Research (Small Grants). To provide for more efficient and localized handling of proposals and to assist in establishing a research base in colleges in all states, the U.S. Office of Education has established the Regional Project Research Program. Each of the ten U.S. Department of Health, Education, and Welfare regions has a regional office to which the would-be researcher can make direct application. Proposals submitted under this program are reviewed on a regional basis.

Two limitations are imposed on the proposals submitted under this program:
1) The total USOE funds committed to the project cannot exceed $10,000.
2) The project duration must not exceed 18 months.
Guidelines for this program are available at each of the ten regional offices.

Examples of U.S. Department of Labor Assistance

There are at least two programs administered by the U.S. Department of Labor under which the industrial education researcher could apply.

MDTA Research Project Grant. Grants are made under the MDTA of 1962 as amended for research problems related to manpower. Under this division, the grant is limited to $15,000 in direct costs per year. Projects may be as long as three years in duration.

Doctoral Dissertation Grants. Graduate research support for activity related to manpower problems is available under the MDTA. In this program, the amount of the grant, for direct costs, for one year is $10,000. Projects may be renewed for a second year. Information concerning MDTA grants can be obtained from:

Office of Research and Development
Manpower Administration
U. S. Department of Labor
Washington, D.C. 20210

Other Federal Agencies

A review of current legislation and publications related thereto will reveal additional avenues within the U.S. Office of Education, the Department of Labor, as well as other potential avenues of support. For example, the U.S. Government document No. 91-33, Federal and State Student Support Aid Programs, June 1970, is an 82-page document that delineates and describes many programs under which the student researcher might apply.

STATE AND LOCAL RESOURCES

Just as there are various sources at the federal level, a great number of potential funding sources exist at the state and local level. As at the federal level, the State Office of Education is one good source; however, just as at the federal level, there are also a great number of other sources that the would-be researcher must become acquainted with at the state and local level.

FOUNDATION SUPPORT

Assistance has already been forthcoming from selected foundations for R&D activity in the area of industrial arts. Most libraries have various publications that list and describe the major foundations in the United States. This is another source of funding that the would-be researcher should not overlook.

BUSINESS AND/OR INDUSTRY

The establishment of local advisory committees for industrial arts and requests to local business and industrial concerns for research and development activities would not only serve the purpose of obtaining funds for potential research, but it would also assist in informing the local business and industrial community of the role and purpose of industrial arts.

PROFESSIONAL ASSOCIATIONS AND ORGANIZATIONS

Various professional associations and organizations make awards for R&D activities. Three exemplary organizations are listed here to stimulate additional thought.

1) American Iron and Steel Institute
2) Phi Delta Kappa
3) AAUW (American Association of University Women)

What Procedures Do I Follow?

In the 1966 ACIATE yearbook, Status of Research in Industrial Arts, Professor John Rowlett did an excellent job of discussing both the sources of funding and the procedures for securing funds. His chapter in that book, "Securing Funds for Research," is highly recommended as both supplementary material and reinforcement to this writing.

Most funding sources have both guidelines that must be followed in applying for funds and priorities that they will consider. It is imperative that the researcher be knowledgeable of his funding source and address his proposal to established priorities. In any proposal there are really three basic questions that need to be answered:

1) What—Identification of the problem
2) Why—Significance of the problem
3) How—Plan of operation

In answering these three basic questions, the researcher must communicate to his reader that the proposed project is a problem with educational significance and that if solved, the knowledge will have general applicability and thus, ultimately, have the potential of improving educational practice. The researcher must also indicate that he comprehends the problem and has developed a research design and operational plan that are appropriate to the problem.

Many funding sources are receptive to reviewing a brief of the proposed project prior to the submission of a full proposal. This brief is required by some funding sources. This process is generally very beneficial in that if the proposed project is not within the priorities of the funding agency, the researcher learns this at an early hour. If the funding agency is receptive to receiving the full proposal, it also allows for feedback from the agency that can be incorporated in the final proposal.

As stated earlier, "for every worthwhile proposal, there should be a legitimate home." However, it takes a good "hunter" to find the place to make the request and a good researcher to prepare and properly conduct the research activity.

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Teacher Aides

EPDA/COP Training of Teacher Aides for Industrial Arts

Chester W. Freed

The mere mention of Teacher Aide brings about a variety of responses from the listeners. To some, a paraprofessional is envisioned—one who is there to assist the teacher—while to others the entire arena of differentiated staffing being sprung upon the school is imagined.

Last year, at our Louisville Convention, Dr. Dwane C. Gilbert spoke on the topic "Industrial Arts in Federal Teacher Training Programs: A Statute Report on EPDA." Dr. Gilbert's presentation was comprehensive and, consequently, I will not review what he has so aptly presented, but rather I will further develop a portion of his presentation. The portion which this paper will concern itself with is the training of auxiliary personnel for education, particularly for industrial arts.

As a preface to the industrial arts aspect of this presentation, our experience with the Career Opportunity Program for training elementary school instructional aides must be reviewed. The Curriculum Improvement Center is a regional ESEA Title III supplemental center for eight school systems in Eastern West Virginia, jointly planned with Shepherd College, state and local education agencies, a teacher aide training program under Part D of the Education Professions Development Act. This program started during the summer of 1969 with 40 students and now enrolls 70 students, 10 of whom are veterans.

Mention was made of the fact that the Shepherd College Program was a joint effort between that college and the eight local education agencies. This joint effort is the key to success in training auxiliary personnel for education.

Since Career Opportunity Projects give education auxiliaries supervised classroom work in the schools combined with academic study at a cooperating college or university, it is essential that the project be jointly planned.

The role of the college is to provide the off-the-job training, course work, seminars throughout the school year and summer, and the administration/supervision of the project. Since the career ladder is a mandatory component of a Career Opportunity Program, 4-year colleges are most able to develop these projects; however, 2-year colleges with clearly spelled-out collaboration with a 4-year college may also be eligible. It is recommended that 27 to 32 credits be the yearly load of a Career Opportunity Program auxiliary. Not all of the credits are accumulated through course work; work experience and weekly practicums (supervised seminars) can account for three or four credits per semester.

The role of the local education agency is to provide space for the instructional aide and in most cases pay them (ESEA Title I supports many of the teacher aides.) The on-the-job supervisor is provided at the building level by the teacher and the principal. The college supervisor visits the classrooms in a program similar to most student teaching programs.

The proposal that I have to advance is for the development of a program to train instructional aides for industrial arts and, in the process, to start these aides on a career ladder which can lead to a BA degree and certification. The proposed program would revolve around the training of Viet Nam veterans. Why veterans? If the veterans are working one-half time in the schools, they are eligible for support from both the GI Bill and the Career Opportunity Program. This amounts to approximately $475/month for a full-time student carrying 12 credit hours ($175/month GI Bill and $300/month stipend from Career Opportunity Program.) As you will no doubt agree, the economics of the situation are very attractive for returning veterans. While the veteran as aide is emphasized, it is not intended to convey that other than veterans should not be prepared as industrial arts aides with the same opportunities as outlined for the veterans.

The following is an illustration of Shepherd College's COP career ladder. A similar ladder could be developed for industrial arts auxiliary personnel.

ASSOCIATE TEACHER - 96 credits.
Course training - theory oriented.

INSTRUCTIONAL AIDE TECHNICIAN - 64 credits.
Specialized course training - both practice and theory.

ASSOCIATE INSTRUCTIONAL AIDE TECHNICIAN - 30 credits.
Specialized preservice and inservice and on-the-job training oriented towards practice.

GENERAL SCHOOL AIDE - Short inservice sessions and on-the-job training.

Job descriptions for the four levels preceding full certification could be as follows:

Level I GENERAL SCHOOL AIDE

Performs tasks of a general noninstructional nature.

Level II ASSOCIATE INSTRUCTIONAL AIDE TECHNICIAN

Performs tasks in the child's environment involving learning-enabling activities under the supervision of certified personnel.

Level III INSTRUCTIONAL AIDE TECHNICIAN

Performs direct enabler of learning activities in the child's environment under the supervision of certified personnel.

Level IV ASSOCIATE TEACHER

Performs direct full-time instructional activities, including diagnosis and evaluation procedures, under supervision of certified personnel.

Since my intent is to propose that our teacher training colleges look at the possibilities of developing Career Opportunity Programs to recruit and train teacher aides for industrial arts, I will not dwell on the mechanics of how the Shepherd College Program was developed, but rather I will extend proposals for those who may wish to pursue this topic.

1. Low income receivers, as defined by the Department of Labor and/or the Office of Economic Opportunity, are eligible for this program.
2. Aides should come from the community they serve.
3. Urban/suburban setting with industrial arts training program seems to hold the most potential for a cooperative program.
4. Advisory committee should be composed of representatives from LEA's college and community and employment services.

5. Develop definite (not necessarily academic) criteria for admission to the program with interviews conducted by advisory committee.
6. Develop programs to train the instructor with whom the aide works (critic teacher)—teamwork is thus facilitated.
7. The summer "on campus" experience is of great value. Bring the supervising teacher along if possible.
8. The career ladder should be obvious to all concerned.
9. Establish linkages with as many projects as possible, such as ESEA I, ESEA VI, and vocational programs.
10. Some arrangement should be made so that when an aide gets to the point of his student teaching experience, the aide experience should suffice for fulfilling this requirement.
11. Aide's experience should be varied so that he can explore many areas of industrial arts.

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Seasoned Service—The Senior Citizen Teacher Aide Program in Dade County, Florida

Hal N. Black

Increasing concern by the federal government for the psychological and sociological well-being of those older Americans designated as "Senior Citizens" together with an increasing interest on the part of public schools to utilize the skills and experiences of lay citizens in the school community led to an experimental program in the Dade County schools in 1967.

In September of 1967, the Administration on Aging, a division of the Department of Health, Education and Welfare under provision of Title IV Public Law 89-73, "The Older Americans Act of 1965," made a grant of approximately $42,000 to the Dade County School system. The funds from the grant were to be used to conduct a pilot program in the public schools of the county, a program in which senior citizens would be employed to work as teacher aides at the junior and senior high level. To the federal grant, Dade County added approximately $8,000 as their share of the cost.

The pilot program, known as the "Senior Citizens Teacher Aide Program," went into operation in October 1967. The program had two broad objectives:

1. To determine the psychological and sociological effects on older Americans as a result of their involvement in such a program.
2. To determine the effectiveness of the aides as a supplement to the educational program in the classroom through the use of the skills and experiences which they had acquired in their regular working career.

The program in its inception presented a number of problems:

1. How would qualified senior citizens be located to serve as aides?
2. What kind of person were we looking for to serve as aides?
3. What kind of pre-job training should be given to the aides prior to their beginning work?
4. How would the aide be accepted by the students, teachers, and administrators?

We first looked to the local senior citizen centers in our quest for suitable aides. We did not find them here. Our experience in the senior centers was that the people there were too aged, lacking in the desire and enthusiasm we felt to be so necessary for the success of the program. We finally found our most effective means of locating the people we were seeking was through newspaper publicity and from publicity within the personnel of our own school system. Now we find our best source of contact is the aides we have working in the program. They are so enthusiastic about it that they want to bring their friends in. Although skill and success in past work experience was important in our applicants, we were equally concerned with the health, the alertness, the personality, and the enthusiasm they displayed.

Because our program did not begin until approximately a month after the opening of school and also because we did not locate all our prospective aides at once, we found it impractical to set up any kind of pre-job training. We decided instead to provide a local orientation program in each school in which an aide or aides were placed. We soon found this type of training to be most effective. The schools varied so much in their programs and in the utilization of the aides that any orientation almost had to be done at the local school level.

By the end of November 1967, we had placed 21 aides in 12 junior and senior high schools. Ten of the aides were used in industrial arts programs, 11 in language arts programs. One of the provisions of the federal grant required that Dade County make an evaluation of the program and submit a report of our findings to the Administration On Aging in Washington. The information necessary for such an evaluation was secured in two ways. Evaluation forms were devised and sent to teachers, administrators and aides who were involved in the program in January and again in May of the school year. On-the-spot observation teams visited the schools and observed the program in action. The information we obtained was tabulated, and a complete evaluation was submitted to the Administration on Aging in July 1968.

As we began planning for the 1968-69 school year, we were not sure as to whether the federal grant would be renewed or not. The local board and county administration felt that the program had been so successful that they wanted to see it continue, so funds from local tax sources were included in the budget to provide for 24 senior citizen aides to be used in the industrial arts program. These people were employed and were placed in 24 of our junior and senior high schools of the county.

Then in October 1968 we secured a grant of $48,000 from the Administration on Aging to continue our program. This money was used to finance a program of Senior Citizen aides at the elementary school level for the 1968-69 school year. Again we evaluated both programs and reported our findings to the Administration on Aging in Washington. A complete report of our findings for the two years has been published by the Administration on Aging. It is titled "Administrative Report No. I—Operation Seasoned Service. A Report on the Corps of Senior Citizens Teacher Aides."

Since 1968, our local school board has completely financed the program for the Senior Citizen Aides in the industrial arts program of the county. We have at present approximately 40 aides working in junior and senior high schools. Next year it is our hope to increase the number to at least 50.

We have outlined some of the history of the program. Now, what about the functioning of the program itself? What kind of people comprise the aides in the program? The aides range in age from 57 to 72. The average age is approximately 65. In education, they vary from one aide with a third grade level education to a graduate of M.I.T. with a Masters Degree in engineering. The average educational achievement of the aides is about one year of college. Two of our aides are graduate engineers. Three are former employees of Pan American Airlines; one a former traffic control manager. One of our aides in the graphic arts program of a school was shop foreman for Dow Jones Company for more than 20 years. Another operated his own print shop for many years. Only one is a former teacher.

Just what are the duties performed by the aides? The answer to this question depends to a large extent upon the past work experiences and skills of the individual aides. Most of the aides have had some background of work experience that involved mechanical or technical skills. However, some have had experience limited to office or clerical skills. The duties they perform are, for the most part, related to past work experience. Those aides who have a background of technical skills may perform such duties as maintenance of shop equipment, setting up class experiments, issuing and keeping track of hand tools, ordering supplies, and helping supervise work performed by students. Those more skilled in office or clerical procedures may perform such tasks as recording grades, making out report cards and other reports, grading objective tests, and performing the paper work for the entire department. They maintain stock room control and may order supplies. In some situations an aide works with one teacher, in others with more than one, and in some cases with the entire department. They may work a maximum of 30 hours a week and are paid $2.10 per hour.

In the beginning of the teacher aide program, we had some reservations about it. How would the aides be accepted by the teachers, the students, the administrators, the faculty? Because of the aides' age, would there be a problem of relating to young students? The past four years' experience has proven all these reservations to be without foundation. In our evaluations, 98% of the teachers and administrators have rated the program as outstanding. One hundred percent have said the program should be continued and expanded to other departments. The generation gap we feared might develop between students and aides has not materialized. Instead, many of the teachers report that their students will go to the senior aide and confide in him even more than in the teacher. The age of the aide has been a stabilizing influence in the classroom.

The one most vital element in the success of the Senior Citizen teacher aide program has been the caliber of the aides we have been fortunate enough to find. But Dade County is no more fortunate in this resource than many other communities. In almost every school community there is a wealth of resource waiting to be utilized. What we have done, you also can do in your community.

Our great satisfaction in the program has come from seeing the enthusiasm, the sense of pride of accomplishment, the relationship which has developed between aides and other members of the faculty. As one aide says, "Being able to make use of my past skills, occupy my leisure time, and share my knowledge and past experience with others—these are the things I like about the job." Another perhaps expresses it best of all when he says, "Doesn't everyone like the feeling of being constructive and active? I know I do."

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Technology

Technological Spin-Off Benefits

Lee DuGoff

History has recorded that man has landed on the moon. It is no longer fantasy or dream; it is fact. The date of the first landing, July 20, 1969, will be recited by school children for generations to come. They will learn of Armstrong, Collins, and Aldrin, followed by Conrad, Gordon, and Bean, followed by Sheperd, Roosa, and Mitchell. And they will learn of the scientific approach to collecting and gaining knowledge so that all mankind on this good planet earth can look ahead for those things that knowledge can and eventually will provide.

Our children can experience these wonderful accomplishments first-hand, through the news media, TV, and radio. Yet, I am sure they do not fully comprehend the meaning of space age events. It is little wonder because a great number of the adults do not understand. Perhaps with a little applied curiosity our youthful generation would be pleased, or surprised, to note that the establishment has something going here. The Space Age is now! Our children, and especially our children's children, will reap most of the benefits to be had, provided that we do not become content with what has been achieved and neglect the future. To understand this statement, let us review some of our history so that we may fully appreciate those things that we enjoy and take for granted today.

It would require a sample of 900 people to span the last 50,000 years of man's existence, a small enough group that all could gather in one moderate-sized meeting room, just to stand looking at one another, feeling the full impact of what God and man have wrought.

Looking at these 900, you would see that 650 would have spent their lives in caves or something worse.

Of these 900 people, only the last 70 had any effective means of communicating with one another.

Only the last six ever saw a printed word.
Only the last six could measure heat and cold.
Only the last four could measure time with any precision.
Only the last two used an electric motor.

Almost everything that makes up our material world has been developed within the life span of the 900th person.

Our way of life which offers opportunities leading to our present standard of living is the reward for acquiring new knowledge and applying that knowledge for the betterment of mankind.

TECHNOLOGY UTILIZATION PROGRAM

The National Aeronautics and Space Administration's (NASA) Technology Utilization Program was created to collect and share new and unique ideas discovered in the course of its space programs. This "sharing of new ideas" program has been experimental since its inception, experimental because NASA is continuously looking for new and better ways to get together with both aerospace and nonaerospace industry.

The NASA Technology Utilization Program has four basic purposes:

(1) To increase the return on the national investment in aerospace research by encouraging additional use of the results.

(2) To shorten the time gap between the discovery of new knowledge and its effective use in the market place.

(3) To aid the movement of new knowledge across industrial, disciplinary, and regional boundaries.

(4) To contribute to the development of better means of transferring knowledge from its points of origin to other points of potential use.

Reportable Items

New technology is defined in terms of "reportable items"—any invention, discovery, improvement, or innovation, whether or not patentable, that is conceived or first reduced to practice in the performance of work by NASA or NASA contractors. Items include, but are not limited to "...any new or improved technique, products, devices, materials, processes, compositions, systems, machines, apparatus, articles, fixtures, tools, methods, or scientific data." Scientific and technical computer programs, for example, are reportable items.

Publications

The most common medium for announcing the availability of new technology has been the Tech Brief. This one- or two-page brief describes the innovation and explains the concepts and principles underlying the innovation. Compilations of related technological advances such as Welding Technology, Cryogenics, Testing Methods and Techniques, and Measurement Technology are published. Special TU Reports and Surveys are made available where contributions on a broad front or quantum jumps in the state of a single art are achieved.

The response of industry, universities, the medical community, and others to Technology Utilization publications continues to increase. These publications are among the "best sellers" of all government publications.

Regional Dissemination Centers

Regional Dissemination Centers provide tailored problem-solving and educational services to industry by bringing to the attention of the client companies, for a small fee, new scientific and technical information of direct and immediate relevance to each client company's problems, objectives, and interests.

The Centers are located at universities or not-for-profit research institutions. NASA Regional Dissemination Centers can help you find new materials or methods, solve production problems, plan new products, stimulate new applications and ideas, keep abreast of competition, conduct feasibility studies, obtain "state-of-the-art" knowledge, and avoid duplicating work already done by others.

Biomedical Application Teams

The Biomedical Application Teams experiment, orginated in 1965, is located at various research institutes and staffed by professionals from a variety of disciplines. These teams provide an interface between biomedical investigators and potential solutions to their problems from aerospace technology. The Biomedical Application Team and the researchers, each from a quite different research area, get together to define the public sector problem and then try to locate a potential solution from NASA information sources.

The Biomedical Application Teams currently have 56 institutions, including leading medical schools and hospitals, actively participating in the program. The relatively short history of the NASA Application Teams has clearly demonstrated that traditional communications barriers can indeed be bridged when there are well-focused and directed efforts made to solve pressing problems of our society.

Technology Application Teams

The initial success of the Biomedical Application Teams and increased public interest in potential use of aerospace technology to solve other pressing social problems led to an expansion of the Applications Teams program. Other teams now focus on such public sector problem areas as air pollution, water pollution, criminalistics, law enforcement, urban construction, transportation, and mine safety.

Significantly, the economics of our way of life demands change, new things for new markets. The government-industry team responsible for our achievements in space is providing many of these new things.

From NASA's development of space-related equipment and methods, both for manned flight and unmanned flight, many spin-off benefits have been offered to the potential nonaerospace user. To date, more than 3700 such ideas have been announced with assurance of many more to come.

We feel that a technology transfer has occurred when an item is acquired by a potential user, further developed if necessary, and put to use in a context other than the one for which it was originally used in NASA's space programs.

Let us now consider some examples of transfer.

MEDICAL BENEFITS

The field of medicine is becoming a prime beneficiary of space research. An excellent example of the work being performed by the Biomedical Application Teams is noted in the area of diagnosis of infant hearing defects.

Infant Hearing Defect Research

A space helmet utilizing unique sponge electrodes, originally developed by NASA to obtain electroencephalographic (EEG) tracings from astronauts and test pilots under stress, has been adapted to detect hearing defects in infants.

Thousands of children classified as mentally retarded are believed to be suffering not from mental retardation, but rather from hearing impairments which have cut them off from auditory rapport with their environment. Investigators at the Scott-White Clinic and Hospital at Temple, Texas, feel that if hearing defects can be detected early in infancy and appropriate remedial measures initiated, this can serve as prevention against many youngsters becoming functional retardates. Instrumentation has been developed which will indicate whether or not a child reacts to an auditory stimulus. Because EEG electrodes attached to an infant's scalp by the present standard method are often yanked off by him, means of preventing this action was needed.

When this problem was presented to the Southwest Research Institute's Biomedical Application Team, they suggested the use of NASA's EEG helmet. It was successfully applied. The helmet not only provides for improved placement of the EEG electrodes on the infant's scalp, but also provides earphones for an auditory signal. This project is still in work toward further refinement of the instrument package for measuring the child's response to the auditory signal obtained by means of the helmet.

Clean Room Techniques

Clean room techniques have been employed by NASA to prevent contamination of spacecraft components. Information about these principles, particularly of the advanced design using laminar flow, has been requested by organizations such as the Washington University Department of Cardiothoracic Surgery. Other space-derived techniques have been made available such as sterilized filtration, positive pressure environments, and contamination-free clothing. The anticipated benefit from the adoption of aerospace clean room techniques is the marked improvement in contamination control, and therefore, the prevention of infections in surgical operating rooms.

Digital Image Enhancement

Digital computers have been widely used in the aerospace community to correct various response distortions in the images received from the television cameras of unmanned spacecraft. This image enhancement, or two-dimensional filtering, is particularly useful for bringing out fine detail that is often invisible in an unprocessed image. Nothing is added; the desired information to be viewed is highlighted. This process is being applied to facilitate the interpretation of x-rays and retinal images.

Bioinstrumentation

The need to accumulate biomedical information regarding man's ability to function in space has resulted in extensive revisions of monitoring equipment and monitoring philosophy. New measurement techniques which represent advances in biomedical data processing and analysis are available for clinical and research use.

Fabrication techniques developed for the space program have contributed to an improved state-of-the-art of clinical instrumentation in terms of size, quality, reliability, and safety.

The rewards from the teamwork between the biomedical and aerospace communities continue to flow. They become more self-evident, particularly if you or your loved ones are involved.

INDUSTRIAL BENEFITS

The process of technology transfer is at work with the nation's business and industrial firms. Many have acquired new technology from the contributions of space research through the channels briefly mentioned earlier. Many are clients of the Regional Dissemination Centers through which they obtain directed access for computerized search of NASA's scientific and technical data bank presently containing over 750,000 reports. A random sampling demonstrates the acquisition and utilization of space technology.

Shock Absorber

Research and development in experimental astronaut couches contributed to an advance in the state-of-the-art with technology which previously did not exist. An energy-absorbing device called an "O-ring shock absorber" was invented. NASA waived title to the invention so that the contractor could incorporate it in a highway barrier system which has been tested by the Bureau of Public Roads and installed by a number of states and localities. A major automobile manufacturer has purchased an interest in the company and is testing the invention as one of several proposals for reducing collision damage in the type of accidents responsible for 40% of the property losses underwritten by automobile insurance companies.

Electromagnetic Hammer

Often an item of new technology can be adapted to more than one other use. Such is the case of NASA's electromagnetic hammer. Designed and developed for use during the fabrication of large booster casings, it is now being used in a modified version in the production of wings for the 747 Jumbo Jet. Another company is using an adaptation in the fabrication of aircraft wing sections, and a third has applied for a patent on a modification for use in producing fuselage and wing sections for military aircraft. The electromagnetic hammer smooths and shapes metals without weakening them.

Honeycomb Construction

NASA's study of foam and honeycomb-core sandwich construction has led to an especially interesting innovation in truck bodies. By using plastic-faced foam sandwich panels, the over-all weight of a van can be reduced from 45 to 50%. This cuts operating costs. Since the panels are prefabricated and new ones can be quickly inserted to replace damaged panels, repair costs are also low. A prototype has been tested.

Honeycomb construction can be adapted to odd and irregular shapes without losing its strong, light-weight characteristics. It is also being used in prefabricated housing construction and packaging.

Fiber Reinforced Material

Composite materials have been found to be four times as strong as conventional alloys. Tungsten fibers enmeshed in a base can be used wherever higher strength or a greater strength-to-density ratio is needed. Examples of such applications include turbine components, such as buckets and vanes, and other parts of advanced electrical power systems.

Flat Conductor Cable

Flat conductor cable, under investigation for more than 10 years, has reached a highly successful stage of development. These cable forms offer advantages to electrical system designers by saving weight, space, cost, and lead time with excellent reliability and uniformity. A large family of tools, fixtures, and test equipment has evolved for flat-cable preparation, installation, and repair.

WEATHER INFORMATION BENEFITS

The meteorological satellite was one of the first direct applications of space technology to improving life on earth. NASA sent its first "metsat" into orbit in 1960 and has since conducted a continuing program of research toward perfecting the techniques of weather forecasting by space observation. Today a network of space observers under the Environmental Science Services Administration (ESSA) watches the world's cloud cover from a topside vantage point and daily advises men on the ground.

Weather satellites do more than photograph the clouds. With the new sensors, satellites take pictures not only in the visible light spectrum, but also in the infrared, showing cloud patterns by night as well as by day.

Probably the greatest boon to date is the ability to save human lives by forewarning of destructive storms. A notable example of the satellite's effectiveness is the tracking of Hurricane Camille (August 1969), the most intense storm to hit North America in modern times. When it was clear that Camille's 200-mile-per-hour winds would strike Louisiana and Mississippi, warnings were issued well in advance of the impact. Inhabitants had ample time to evacuate. Property damage ran to hundreds of millions; loss of life was minimal.

Information from weather satellites may soon permit accurate 2-week forecasting. Just think of the possible advantages to farmers, fishermen, construction, vacationers—the total savings could be billions of dollars each year.

EDUCATIONAL BENEFITS

The exploration of space has profound and continuing effects on American education. The results of this country's space programs and the needs of scientific and technological education have converged in the classrooms. NASA compiles relevant information into useful formats which are made available to the teacher. The teacher then makes the judgment on how and when to employ this new knowledge in the classroom.

In addition to the teacher-oriented educational program, NASA "Spacemobiles" offer lecture demonstrations directly to the students at all levels. This program reaches about 3 million students annually.

Examples of teaching tools which are currently available on the market resulting from space technology are:

Portable Planetarium

This novel educational device permits a student virtually at a glance to determine the relative positions of the planets on any given day between the years 1900 and 2000.

Oculometer

The oculometer, an electro-optical instrument, was designed by NASA to measure human eye-pointing direction, pupil position, pupil diameter, and blink occurrence. The potential applications of this instrument include reading analysis and psychological testing, studying early development of the eye system, training and evaluation of drivers and pilots. A Teaching Aid which permits students to realistically simulate the flight paths of space vehicles, investigate trajectories, and understand the effects of gravitational fields is now available. The Hubbard Scientific Company also sells a moderately-priced Planetary Celestial Globe which enables students to plot the orbits of Mercury, Venus, Earth, and Mars without the use of planetary tables.

In essence, the vast amount of information available from NASA's data bank is limited in its application to the educational field only by the users—teacher and student.

HOUSEHOLD BENEFITS

Consumer products for everyday use are becoming increasingly available from adaptations of space technology. Entrepreneurs, motivated by the availability of new ideas, are rapidly pursuing the directed research necessary to place new products on the market.

There have been remarkable strides in the general field of food technology. A housewife can serve a meal any day of the year, with very little effort, which may rightfully be referred to as gourmet fare. Some of the conveniences available to her have been expedited by companies providing for the needs of our astronauts.

Astronaut Food

In general, space provisions have consisted of freeze-dehydrated, rehydratable, and bite-sized foods. The menu has grown since the Mercury and Gemini days and provides quite a variety of items. In all cases, meals carried in flight have been carefully monitored and prepared so that the well-balanced nutritional content has provided the sustenance needed. Food as a morale booster is not new. Improved foods and packaging are new.

The very important life-support function of an advanced food technology program is but one area of space research which is reflecting benefits to the nonaerospace consumer.

The food industry, in support of the special nutritional requirements of the aerospace and military programs, has conducted much research which has resulted in the evolution of many different products.

Space Food Sticks

An example is a rod-shaped contingency food developed by the Pillsbury Company under a 1966 research contract. This effort resulted in the delivery of 12 different flavors of 4 different types of rod-shaped foods in the fruit, vegetable, meat analog, and confection area.

Today, three varieties of this rod-shaped food can be purchases at the local grocery store—chocolate, caramel, and peanut butter. This item is also marketed by the Pet Milk Company under the name "Space Energy Sticks."

The food stick is a nutritionally balanced snack which contains only 44 calories.

Think of the boon to campers. There are literally thousands who enjoy outdoor recreation and who will benefit from the easily carried, easily prepared foods which are becoming available to them.

Space Sportsman's Blanket

Speaking of camping, there is a lightweight sportsman's blanket now being sold throughout the United States. This inexpensive item is a derivative of superinsulation being used in NASA's Apollo program. It is 56" x 84" in size and weighs just 12 ounces. Its aluminized side reflects heat; in an emergency, when used in the field or on boats, it becomes a radar reflector.

Space Rescue Blanket

In another application which is handy to have around the house or in one's car, this aluminized mylar is sold as a rescue blanket. This 56" x 84" material, without backing as in the blanket, can be used as a stretcher. In this form the blanket weighs 3 ounces, and it can be folded and carried in a shirt pocket. An accident victim when wrapped in the rescue blanket is protected against shock. Eighty percent of the body heat is reflected back to the victim.

A sportswear manufacturer has reduced the bulk of outdoor wear by lining windbreakers, ski jackets, and parkas with this superinsulation.

During the past year, the technique of applying a thin coating of aluminum to fabrics has resulted in the marketing of unique drapery materials that are heat reflective yet porous and machine washable.

Thermal Magic — Heat Pipe

The space program has utilized the principles of heat transfer, dissipating heat by transporting it to unheated areas, in a number of applications. A unique method has been the heat pipe, which can transfer large quantities of heat without moving parts.

Using the principles of this development, Energy Conversion Systems, Inc., is marketing an application for cooking. They call it Thermal Magic.

Normally, cooking takes place from the outside in. The Thermal Magic-heat pipe spears the item to be cooked, transporting heat into the interior and permitting cooking from the inside out concurrent with cooking from the outside in. As a result, cooking time for roasts, for example, has been cut approximately in half.

EARTH RESOURCES SATELLITES

An area of broad potential is the use of satellites to make possible more efficient management of earth's natural resources. Information obtained can be put to use for earlier discovery of new resources and for identification of trouble zones for quick remedial action. Observation of earth resources is achieved by means of viewing devices operating in the infrared and ultraviolet portions of the spectrum in addition to regular cameras photographing in visible light.

The photographic returns from man's venture into space have already provided new images and concepts of this Earth on which we live. Controlled and programmed photography by our space-borne astronauts has unequivocally attracted the attention of specialists such as geographers, agricultural engineers, foresters, geologists, hydrologists, oceanographers, and cartographers. The "new look" underlines the potentialities of ecological surveys from space.

A crop-imaging sensor can be programmed to "see" one particular kind of vegetation, thus providing a basis for predicting the yield and planning the distribution. Diseased crops can be detected, initiating treatment to reduce losses. Terrain features associated with new oil and mineral deposits can be detected. Water pollution trends can be charted; fresh water reserves in underground streams and springs can be located. The potentials appear to be unlimited.

CONCLUSION

To date, scores of new technical developments designed to meet the needs of the space program have been transferred or adapted for use outside that program. It behooves us to remember that technology transfer is the process by which practical knowledge is acquired, developed, and put to use in a context other than the one in which it originated. Individuals, groups, and firms should and must identify the implications to be derived from the new technology being collected from the space program. The continuing and increasing returns from the space investment promise to increase economic growth, create new employment opportunities, help offset imbalances between sectors, aid competitive position of industry, improve the quality of life, enhance the national prestige, and assist in fulfilling human and community needs.

The extra dividends already achieved are but a small sample of the returns which will continue to pour forth to benefit all mankind on Earth.

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Technology and Related Technics of the Space Age

Walter J. Hall

Before discussing "Technology and Related Technics of the Space Age," we should take time to analyze it. What is involved?

According to Webster's Third New International Dictionary, technology has many meanings; for our purpose, technology is the science of the application of knowledge to practical purposes—a technical method of achieving a practical purpose.

What did the program planners have in mind when the combination of words "related technics" was selected? Related refers to having relationship, connected by reason of an established or discoverable relation. Technic is defined as having special practical knowledge of a mechanical or scientific subject; the way in which technical details are treated.

Therefore, it is evident that industrial arts comprise a sampling of the total structure of the title. We all agree that industrial arts is a study of tools, materials, processes, products, occupations, and related problems of America's industrial society.

It is obvious that the space program has developed new materials, new tools, new processes, as well as new occupations, unheard of five to ten years ago. This change is being brought about by man's interest in the heavens and underwater explorations. It is evident then that emphasis must be placed upon scientific and technical goals which are constantly changing our social environment and pattern of living.

As teachers, supervisors, administrators, and others involved in the transfer of societal developments, it is of vital importance that the following factors be considered: curriculum changes and improvements, sociology, self, administration, and school. Based upon the above factors, this presentation attempts to shed some light upon the "New Frontier Space Age Technology."

First let us consider our present subject areas, namely: crafts (emphasis in areas of plastics and ceramics), drafting, and design; electronics and electricity; graphic arts; metals; power mechanics; and woodworking. These subject areas are of vital importance to the aerospace industries. It is of vital importance that we transfer this industrial knowledge to students, parents, and other lay persons in order that they may be kept abreast of our ever-changing industrial society. As Dr. Grant Vann said in his book, Man, Education, and Manpower, "If we want an educational system designed to serve each individual and develop his creative potential in a self-directing way, then we have work to do and attitudes to change."

We have come a long way from 1910 to the present, from dull courses in dull buildings, from a time when a boy might observe the full range of his occupational expectations as working beside his father in a blacksmith shop, walking beside his father while plowing in the field, or even learning to drive a car; we are presently in the age when the boy is riding beside his father in a monoplane or a high-speed motor boat, or even driving his own souped-up auto. But how different things are today, and how grave and important our need to reshape our system of industrial arts to meet the demands of the ever-changing complex technological society we live in. We cannot afford to talk of the past. We must concentrate upon the capacity of our society to sustain and accelerate the pace of technological progress in America.

According to Sidney P. Marland, Jr., U.S. Commissioner of Education, Department of Health, Education, and Welfare, "Of those students currently in high school, only three out of ten will go on to academic college-level work. One-third of those will drop out before getting a baccalaureate degree. That means that eight out of ten present high school students should be getting occupational training of some sort. But only about two of those eight students are, in fact, getting such training. Consequently, half our high school students, a total of approximately 1,500,000 a year, are being offered what amounts to irrelevant, general educational pap!"

It is impossible to gauge the full extent of human values, of new horizons, and of new hope for a better world that have resulted from the space program. It has had a terrific impact on our educational systems. The space program has done much more than just change our technological structure; I believe it has brought the people of the world together as never before in history, thus creating international unity. This has been proven in the Apollo 13 flight to the moon which included modules Aquarius and Odyssey. It is significant that Webster defines Odyssey as "an adventurous journey marked by change of fortune." Prayers for a safe return of the crew were said around the world.

Senator Clinton P. Anderson has said that the space advances of the past decade, culminating in the Apollo 11 lunar landing, were "achievements that have moved the minds of men around the globe." Today we live in a different world because in 1958 America recognized the challenge of space and boldly made the required national investment to meet it. Because of the space program, our children will learn a new sociology, a new cosmology, and a new view of man and his destiny in the universe. The next generation will view the earth as a whole for the first time and be better prepared to deal with technology, with science, and with philosophy as a unified experience, common to all men of the blue planet earth. We can no more fully visualize the effect of this new technology on their lives 30 years hence than we could fully visualize today's technology back in 1940.

Jules Verne, a canny French fictioneer and prophet, foresaw with incredible accuracy man's most awesome reach, his quest for the moon. He wrote in 1865, "Can this wonderful journey ever lead to any practical result? Reflect a moment on the audacious go-aheadiveness of the Yankee...." Verne even called the shot, targeting his imaginary moon probe from a site not far from Cape Kennedy. He prophesied the use of a solid propellant in the mission, too. Gunpowder. As Verne wrote, "Can this wonderful journey ever lead to any practical result?" We have but to relate a few practical benefits already achieved from America's space efforts.

Dr. Denton Cooley, famed Houston heart surgeon, uses a device developed by NASA to monitor heart-transplant patients after surgery. Perfected at the Minnesota School of Medicine, the device can gauge externally the volume of blood being pumped by a human heart.

Small biosensors used to monitor the physical condition of astronauts during flight are now being used in hospitals throughout the nation. Pasted on the chest of heart patients, the biosensors broadcast heart data to a nurse at a central console, permitting her to monitor the condition of many patients at once.

The computer industry is an excellent example of space-stimulated technical progress. For example, according to the Manned Spacecraft Center, the Mercury computer program contained 40,000 "computer words." The Apollo computer program needs 1,500,000 words, 37 times more than Mercury. The computer technique used by the Jet Propulsion Laboratory to improve TV pictures of the moon and Mars is now being used to clarify medical X-ray photographs.

According to Dr. Richard L. Lesher, Chief of Technology Utilization of NASA, "It is still too early to expect many specific transfers of space technology to other sectors of the economy.... Since the economists tell us that the total innovative process requires somewhere between 10 and 20 years, it follows that the bulk of the commercially useful return from the first decade of investment in space research and development will be dramatically harvested in the 1970's."

Dr. Lesher's office can cite hundreds of items that have been developed already. A few of these are:

An electromagnetic hammer which makes metal flow like soft plastic, allowing the smoothing and shaping of metals without weakening them; the new tool is widely used now in shipbuilding and auto manufacture.

A badge-sized hydrogen gas leak detector, developed for rocket engine testing by North American Aviation, is now being marketed as a battery gas leak detector, for small boat owners among others.

An unusually tough coating developed for spacecraft is the basis for a new long-wearing paint now on sale in the nation's retail stores.

A six-legged vehicle proposed by a NASA contractor for unmanned exploration of the moon has been redesigned as "the wheel-less wheel chair" for crippled children. The powered walking chair, simple to operate, is being used in a number of children's hospitals. It can cross rough terrain, climb and descend stairs, and has been described by at least one satisfied user as "groovy."

Pyrolitic graphite, an insulating material for nuclear-powered rockets, is now being used to line the bowls of pipes for a cool smoke down to the last puff. What's more, graphite-lined pipes can be washed with soap and water.

A light switch developed for astronauts has been adapted to powered wheel chairs, enabling paralyzed people to control their movements by simple sidewise eye movements. In other applications, the same switch enables immobilized patients to signal a nurse or to turn appliances on and off.

Many industrial firms are constantly developing new products and services for the space program. Significant explorations now being examined are deep ocean technology, silver zinc and dry tape batteries, deep submergence vehicles, power generation systems, high-temperature ductile alloys, new welding techniques, oxidation-resistant coatings, compact batteries for hearing aids, supersonic aircraft, chemical processing, and a host of others.

Nobody foresaw three score and seven years ago when the Wright brothers climbed a few feet in a crude biplane at Kitty Hawk and flew 120 feet that man would so soon explore outer space. Our space program is but 12 years old; nevertheless, we plan to terminate manned moon flights by 1972. Preliminary design work is under way on basic space station modules, and a broad technology program is advancing the state-of-the-art of such key components as recycling life support systems, data handling, artificial gravity, and experimental modules. Skylab will employ astronauts in space for up to two months to learn more about effective operations during long-duration space flights. It is predicted that by 1980 the planned space transportation system will be completed, due to the shuttle program. We will then look beyond the solar system, thus creating additional stress upon our technological minds.

Industrial arts, too, has come a long way since 1910. I took manual training in a crude small shop in a basement next to the boiler room during the years 1931-32 and constructed only a foot stool and the standard book shelf. Since then, I have seen vast industrial arts laboratories emerge, complete with many innovations unheard of during the thirties. What about the future? Are we to remain the traditional "shop," or will we change with our ever-changing industrial society? Industrial arts can make a significant contribution to understanding the aerospace industry because it is concerned with areas such as drafting and design, ceramics, graphic arts, electronics, metals, plastic, power, and wood. Through industrial arts courses, the instructor can acquaint students with products and processes of the space age.

One need only tour the facilities of the Manned Spacecraft Center. The philosophy of industrial arts exists everywhere, in tools, materials, processes, products, operations, continuing through the total system.

One example is the "Technology Utilization Program" conducted by NASA. Here are a few accomplishments:

An effective electromagnetic hammer, utilizing extremely brief but intense electric charges, removes dents from large tank sections and other sheet-metal shapes in microseconds, without structurally weakening the piece involved and without leaving marks. NASA documents enable a manufacturer to bond metal to metal in a plant making computer tape reels. This process involves an adhesive cured at room temperature which can be efficiently applied to any surface.

Filament-would plastics developed to give rocket cases a high strength-to-weight ratio are finding experimental use on the highways as tank trailers.

These and thousands of other innovations have been developed by the space age program. According to NASA, this is a tremendous storehouse, growing bigger at a rapid rate. Currently it acquires around 6000 scientific or technical aerospace documents each month. There are now some 200,000 documents in the system, and approximately 75,000 more will be added in a single year's span. Since collection began in 1961, this material has been indexed in great depth for computerized searching and retrieval. But, in addition, printed abstracts and indexes have been brought out twice every month to allow individuals to make manual searches. Each document is also photographically reduced onto microfilm sheets. Duplicate film is distributed to 140 locations within the NASA family. These not only may be scanned locally on viewers but facsimile copies can be made from them in practically infinite number. Furthermore, they serve as reproducible masters, from which duplicate microfilm sheets can be made at will.

The system is extraordinarily compact. Microfilm copies of 1000 average-size reports can fit into a container no bigger than a shoebox. The same number of full-size documents will fill 14 feet of shelves. All recent available world-wide aerospace information on structural design and materials, reliability, life sciences, electronics, and instrumentation is compressed in this manner. There, besides, are the latest detailed investigations in such disciplines as astronomy and aerodynamics, communications and chemistry, mathematics and meteorology, plasma physics and radiation effects. Despite its remarkable compactness, all this material can swiftly proliferate, through the media of magnetic tape and sheet microfilm, to an almost unlimited degree.

What we have learned from the aerospace program will remain with us; scarcely a home, scarcely an individual will fail to feel the impact of the space program. We who are strong advocates of industrial arts should endeavor to acquaint our community as well as the students with our ever-changing industrial society.

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A Comparative Study of British Technology in Industry and Education

Eckhart A. Jacobsen

In the quest for possible solutions to the contemporary concerns of industrial arts, a somewhat anthropological approach was taken to studying the technology and cultural development of old world countries. Thus, an attempt was made to view education in its totality, including industrial education's implications for larger cultural problems with reference to philosophical, social, economic, political, ecological, and occupationally related needs.

PARAMETERS OF STUDY

The parameters of this study are condensed into the following characterizations.

1. The study provided four months of continuous interviews, meetings, many written reports, observations with industrialists, educators, scientists, governmental officials, labor and management consultants, and professional organizations as a selected population.

2. Each interview centered around the following concept—How does technology, its generation and its potential, interface with education and industry? How and to what degree is there conscious cultural evaluation,[1] control, and ultimate use made of technology?
3. Visitations (traveling over 6000 miles) to research laboratories, schools and universities, industries, numerous offices of officialdom, and many homes by chance invitation.
4. Countries visited: England, Denmark, Sweden, Norway, Germany, Austria, Switzerland, Netherlands, Belgium, and France.
5. This paper will confine its attention to England.

COMPARISON OF CULTURAL DEVELOPMENTS

Why make the effort to compare the cultural and consequently the educational efforts of one continent with another? Rather, would it not be better to analyze the cultural needs and resources of a single nation and record operational answers given by professionals? While having some merit, this inbred approach to cultural problem solving leaves much to be desired in terms of introspection, projected and innovative thinking, and planning. The operational phenomena for cultural problem solving too often is limited to isolated problem recognition and planning without the essential steps of implementation and action. Thus, how European countries solve problems and implement solutions may have relevance to our own needs in the United States (often the most imitated country on earth).

THE BRITISH

As others view them, the British have some difficulty in grasping the concept and the significance of technology, not only in the sense of machine tools or the technical devices of industry, but also as a philosophical concern in terms of the cultural make-up of their society. Apparently, it will be some time before their schools succeed in playing an influential role in today's industry. Some feel that traditional and historical educational concepts will persist in keeping the status quo. Reverence for the historical past often makes it difficult for the English to change their professional and technological practices. They have a facility for empathy with each other, having a tradition of mutual support. They often excel at scientific discovery, only to default to others for technological implementation. Monumental contributions by the British during the last century include Wilke's stored program computer, Parson's steam turbine, Farnesworth's video scanning system, Armstrong's F.M. circuit, Fleming's penicillin, Crick's structure of DNA, and numerous others.

OTHER COUNTRIES

This is not necessarily true of other nationalities, such as the Danish, Swedish, and Dutch. As expected, they also had some difficulty in viewing a concept which, while educational, also had cultural implications. While concerned about technology, they have difficulty in projecting beyond the "nuts and bolts" stage of thought in implementing technology and relating the technological concept to educational concern and cultural make-up.

TECHNOLOGY IN THE EDUCATIONAL SYSTEM

The level of technological involvement in Britain is primarily that of the industrial revolution, or machine and craft. More advanced thought remains at the scientific level, and there is some difficulty in relating research findings to development and to implementation at the production level in industry. How technology is to be brought into the educational system, providing both skillful technicians and culturally knowledgeable people, is a problem considered by many in Britain as a frontier concern. The success factors

[1]Cultural evaluation and control as:

a. Philosophical innovation in terms of national needs and resources.

b. Social interaction toward richer societal goals.

c. Political decision making and governmental choice.

d. Economic commitment and industrial implementation.

present in Britain may be deterrants to more innovative approaches. Their level of technological sophistication, in advance of some western mainland countries (France, Belgium, and Norway), may encourage satisfaction with their own progress, leading to a lesser sense of urgency for innovative approaches to technological implementation.

The British have a Ministry of Technology charged with governmental awareness and encouragement of developments in technology. They urge British industry, education in general, and the cultural aspect of British life to be sensitive to and to respond to the implications of technology. This ministry in the British government is unique, having no precise counterpart in other nations in Europe or the American continent.

BRITISH SCHOOL SYSTEM

The educational system in Britain essentially concludes at the 16th year. As the grade level increases, so also does the stature of content and the required intellectual involvement. Hence, children who are not scholars are culled out and no longer permitted to continue their formal education. This differs from the situation in the United States, where occasionally social promotion rather than intellectual achievement forms the basis for educational accomplishment and advancement.

When the student completes the 16-year level in general education, he has accomplished the equivalent of our first year of college. Therefore, their colleges and universities are normally of three year duration rather than four. Students must take examinations which evaluate their intellectual achievement and establish whether they will be permitted to enter universities or colleges. By and large, the universities and colleges in Britain are private in the sense that there is no guarantee or assurance that because a student graduates from high school, the state will see to it that he has a college or university education. He must, first of all, be intellectually and academically capable. He applies for higher education on the basis of his grades and examination scores; only then is further consideration given as to whether he will be permitted to continue the educational process. There are some cooperative programs at the college and university level for technology and engineering. This the minister of technology supports rather strongly in order that programs will provide technological personnel for the upper echelons of industry.

PROJECT TECHNOLOGY

The Ministry of Technology's "Project Technology" encourages the public schools to approach technology from a training as well as educational aspect. The determination of what projects and other educational experiences are to be used comes from the local schools. They have what might be termed "practical projects" in technology in an educational setting. Where there is a cooperative thr· st of the government and education to accomplish technological exposure, technical and trade schools are available beyond high school. These are at varying levels, and the intellectual involvement and training concerned with these programs vary greatly.

CHANGE IN INDUSTRY

Much of industry is essentially "old fashioned" in its concepts of manpower usage and the technological techniques available. The larger corporations are sensitive to technological developments and implement newer technological procedures and techniques into their investment planning and production set-up. It is estimated that 70% of the small or medium-sized companies, employing 5000 or less, are rather lethargic in their attitudes toward implementing newer technological procedures. Often the engineering and technological departments of the small companies are not aware of newer technological developments, or the management is not sufficiently in tune with these developments and thus unwilling to provide the necessary investment capital. Hence, they fail to improve their own competitive position in the European and world market place.

By and large, the academic and peer industrial research is mostly traditional. There appeared to be no urgency on the part of those responsible for the research to concern themselves about its development or implementation in industry. Likewise, those in industry demonstrate little interest in translating pure research into developmental techniques and practices suitable for improved production and the development of new products. An example of the application of pure research would be nylon, a successfully developed synthetic material. Once an intellectual curiosity in the laboratory, it is now a very common material throughout the world—used in products from women's hose to machine parts. One of the real problems is intellectual communication; cultural development is failing to take place. This should be one of the real concerns of educators, educational planners, and economic, governmental, and political thinkers. The applied technologies must play a more important role in relating to pure research. The work taking place must be not only pure research but also applied technology, where the developmental aspect needs researching with a great deal more seriousness.

TECHNICAL REPRESENTATIVES

The Ministry of Technology has technical representatives whose responsibility it is to relate technology to education, then to encourage a direct technological liaison between education and industry. Too often educators are primarily concerned about learning as education and show little or no concern about the instructional experience relating to how their product, the graduating student, is able to function culturally in society or industry.

Industry, while having a token interest in education, is primarily interested in prepared and trained workers for different kinds and levels of work. The technical representative here can play a very important role. One possible problem would be the acceptability and receptivity of such a government representative. The American concern for extricating oneself from governmental control and bureaucracy does not necessarily have its counterpart in Great Britain. Their tolerance for governmental involvement is probably higher.

TECHNOLOGY SCHOOL COUNCIL

A "Technology School Council" enables professional engineering and professional technology to relate to the educational establishment, providing education with resource materials and people. There appears to be no counterpart in the United States, and the idea has much to recommend it. The council provides for resource personnel, resource materials, and the kind of realistic liaison that the academic community is often incapable of providing. Central control is frowned upon in Great Britain, a concern similar to that in the United States against governmental domination so characteristic of much of our education during the past 30 years.

The British prefer governmental involvement on a confederation basis, a loose relationship between government and local initiative. The important factor here is initiative at the local level on the part of educators and industry in order to come to grips with the problem of relatedness. It is possible that at times a governmental intermediary could provide services which may not be too convenient for either the educator or the industrialist. Once we delve deeply into this concern for relatedness between education and industry, we discover a serious void in cultural communication.

It is one thing to identify industrial need and another to be able to relate it through governmental or professional channels to education. People in industry, education, and society in general must ultimately be more conversant with the newer technologies as the technologies relate to the population and their economic welfare. This concern for cultural communication is very difficult to solve. Informed opinion is not too informed! In bridging history and the traditions of many centuries, especially concerning the evolution of the mechanical and the technological (producing something as contrasted with just pure intellectual involvement), one is aware of the old status concern that goes back to the days of the Romans and Greeks. It is difficult for many people to acknowledge that there is an exponential rate of development on the part of technology with which they must come to grips if they are going to be effective participants on the cultural scene where the economic, political, and educational action is to be found.[2] How to bring this about is a serious concern to British leadership.

PUBLIC OPINION

An interesting observation expressed by some British was that public opinion makers in Great Britain are essentially 10 to 15% of the total population. This observation supports the relevancy of governmental involvement, which is likely to be more successful

2 I, as well as representatives of the Ministry of Technology, was characterized by a technical attache as being 20 or more years ahead of my time.

in Britain than the United States. In the States, lip service is given in behalf of individual citizen involvement, yet too often this involvement is not knowledgeable participation. There was the impression in Britain of greater commitment to involvement simply because the public opinion makers are a dedicated percentage.

WORLD WAR II AFTERMATH

World War II did much to influence technological development and industrial progress throughout the world. Japan and Germany were destroyed industrially either by bombs or occupation. This was not the case in England. While England did receive a severe drubbing by bombs and destruction was in many instances total, the industrial structure essentially maintained its old character and continuity. Hence, what existed before the war and during the war still exists today in England.

By virtue of their total destruction, Germany and Japan had no alternative course to be followed. They were obliged to start anew. It was not a matter of rehabilitation, but of rebuilding and restructuring industry in a total sense. By their industrial need and consequent technological thrust, they were obliged to recognize the exponential character of technological development and have engineered their industries on this newer basis.

Consequently, by comparison, Britain has had a difficult time competing in the world market with the newer productive technologies of Germany and Japan. Assuming, therefore, a more traditional posture in the choice of attitudes, management, equipment, research and development policies, and work force, all of these things have militated against a realistic comparative posture and a more positive and successful competitive role on the part of Britain. This dilemma is acknowledged by the "thinkers" in British government and its educational community, but it is one thing to recognize the situation and another to be willing to make a commitment and to take action where the apathetic anchorage to tradition plays such an important role. Therefore, government is seeking to share in the industrial enterprise—not for the purpose of control, but rather to play a more sympathetic and involved role.

Government's role (in terms of cultural development represented by industrial productivity and community welfare) would hopefully seek to provide the exposure of a more active, effective, and appreciative view of the industrial-economic-educational enterprise. They are encouraging the merger of small industrial units into larger confederations or units. This is not to suggest that they are seeking to set up monopolies. They are trying strenuously to avoid them, although they do recognize that size is important where research and development is the concern. Encouragement is given to developing some of the smaller industries, often craft in character, into larger groupings.

EDUCATIONAL TECHNOLOGY

The newer concept of educational technology, that is, educational equipment and facilities that assist the teacher in presenting material, is getting a substantial play in Great Britain as it has in the United States. There is often "much ado about nothing" in this area. Under the title of educational technology, there has been a substantial amount of almost worthless material being peddled by adventurers who have seen a financial opportunity in equipment and software that is often neither pedagogically sound nor adequate in terms of content. From now on, the educational establishment is taking a much more critical look at audiovisual materials (the more traditional name for educational technology) in terms of how adequate it is for the purposes indicated.

CULTURAL ASSISTANCE

Government-related agencies are assisting in developing improved educational technology. The British Association for the Advancement of Science, on a cooperative basis, promotes such regional and national efforts in science as science fairs and television programs, as well as providing lectures to schools and other interested groups, even a little theater group whose performances are guided by knowledgeable people from the B.A.A.S. As a result of this effort, there are "young scientists" groups developing. These groups are similar to the Junior Achievement and the Industrial Educational Exhibit movements that have taken place in the United States within the last four decades. It is likely that as a result of the cultural stature exhibited in England, these efforts may bear perhaps more substantial results than similar efforts might have in the United States.

Notwithstanding a similar lethargy toward the assimilation of newer technological developments, there appears to be at least a more sincere common commitment and understanding on the part of educational leadership toward this sort of thing than exists in the United States. An encouraging aspect of this whole program is that there is a forward movement on all fronts (government, education, industry) which is likely to result in cultural progress that can be truly significant. When the office of the minister of technology, industry, professional organizations such as the British Association for the Advancement of Science, the educational establishment, and the public open up their channels of communication (and listen to each other), there will be forward movement toward this innovative approach. This would make (it would seem) for a more mature assimilation and synthesis of the social-technological-economic idea—thus benefiting on an over-all cultural basis that which sometimes is only little understood by limited groups within the total society. This must happen if industrial education is to reestablish its cultural relevance.

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NASA Resources for Industrial Arts

William D. Nixon

The Space Act of 1958 charged the National Aeronautics and Space Administration with the responsibility to "Provide for the widest practical and appropriate dissemination of information concerning its activities and the results thereof." To carry out this responsibility, NASA has an agency-wide public affairs program. Within this program, an Educational Programs Division was established to disseminate knowledge to the educational community. At the Kennedy Space Center, we attempt to do this by establishing a number of programs to reach students and teachers with new developments, new discoveries, and scientific advancements in a usable form for the classroom. In the past, we have worked through science and math, but in the last few years at the Kennedy Space Center we have worked very successfully with the industrial arts teacher and student. We have resources at hand which will provide assistance to industrial arts educators, and this is basically what I would like to discuss today.

Industrial arts has been defined as the study of tools, materials processes, products, occupations, and related problems of America's industrial society. America's space program has developed new tools, new materials and processes, as well as new jobs unheard of 12 years ago.

We feel that space is the new frontier of science and technology, and if industrial arts teachers are to give students an insight into American industries, these teachers must concern themselves with space age technology. We are not interested in turning industrial arts curriculums into space technology courses, but we furnish materials and knowledge enabling the teacher to do a good job in interpreting the aerospace industry. To give a better idea of subject matter we are discussing, let's briefly discuss basic areas of industrial arts.

Power

We feel every course in power should include a study of rocketry. Students should be familiar with parts of rocket engines, what makes a rocket go, rocket fuels, future rocket engines, nonpropulsion nuclear power. In the KSC region, we like to bring in the crawler transporter. We utilize two of these devices at KSC every launch to transport the Saturn IV vehible and its mobile launcher, about 13 million pounds, as well as the service structure. It operates on electric diesel power, and this information is of great interest in power classes.

Graphic Arts

Graphic arts machines and processes play a leading role in the communication of the space industry. Aerospace applications that we attempt to provide for graphic arts classes are space photography, on-board cameras, how photographs are telemetered to earth, and infrared photography. It is possible to conduct ecological surveys from space. Photography can be utilized in this fashion for land use—hydrology, geology. NASA will launch an Earth Resources Satellite (ERTS) in 1972 which will enhance this area.

Design and Drafting

While working with design classes, we attempt to examine some of the kinds of problems associated with space. One of great interest is a true space vehicle—the lunar module. It is designed to fly only in space, never in an atmosphere. This, of course, affects its design. We like to use the problem-solving method, giving students definite information on future programs we are working with on the space shuttle or space station and let them create a design.

Electricity and Electronics

This area as applied to aerospace technology is almost limitless in its scope. Subject matter we discuss in this area is microminiaturization, solar cells, space batteries, and fuel cells.

Due to the success of the fuel cell in Gemini and Apollo, there has been much discussion of the fuel cell recently as an operational system for an automobile. The power output and weight ratio is poor. We are used to 200 horsepower under the hood, and at the touch of the accelerator we move out quickly. This isn't going to happen with the fuel cell in the foreseeable future, but the ecological balance is ideal. Oxygen and hydrogen are combined to produce electricity; the by-product is water. Take the water and, by transforming energy, convert it back to oxygen and hydrogen; you have a complete ecological system.

Woods

Designs of most space probes and vehicles are modeled in wood. In this area we present how wood products and forming processes are utilized in the aerospace industry.

Metals

Types of metals used in launch vehicles, new methods in metal forming, and new alloys utilized in the aerospace industry enrich this segment of industrial arts.

This brings us back to the important part of this presentation. What is NASA doing, and what is Kennedy Space Center doing for the industrial arts teacher and student?

First of all, we distribute materials to teachers that provide tools for enrichment of their classroom situation.

In 1967 a document, "Space Resources for the High School," was prepared for NASA by a representative committee of leaders in industrial arts education under the chairman-ship of Dr. John L. Feirer, Western Michigan University. This document provides the teacher with specific suggestions on ways and means that space-related elements may be fused into the industrial arts course. Some of the teaching ideas are in the form of units, some in the form of activities. Each teaching topic has a bibliography of NASA publications and commercially available texts of the latest development in technology. Since 1967, the Government Printing Office and NASA have distributed 50,000 of these documents to industrial arts teachers and supervisors. This publication is not a course of study in space technology. It is designed to motivate and interest teachers and students in aerospace education. We feel every industrial arts teacher and supervisor should have access to this bulletin.

At the Kennedy Space Center, the Educational Programs Branch places a priority on teacher programs. At several universities in our regional responsibility, we conduct teacher education programs for both in-service and pre-service teachers. These programs are conducted by professional educators on our staff and present basic aerospace concepts in the area of industrial arts plus lab periods. In these lab periods, activities and demonstrations utilizing simple equipment are participated in by the teacher. Recently the Florida University system and Kennedy Space Center entered into a cooperative agreement to conduct teacher programs at the Kennedy Space Center. Florida State is part of this program and will offer workshops to industrial arts teachers the summer of 1972. This program will utilize Kennedy Space Center facilities, engineers, and scientists.

We also have carried the industrial arts programs to the junior high and high schools in our region of Georgia, Florida, and Puerto Rico. We schedule this in cooperation with the state industrial arts supervisor, and he selects the schools in which we will work. Our office contacts the chairman of the industrial arts department in these schools and arranges a program to meet the needs of the industrial arts curriculum in the school. The lecturer, with models and demonstration equipment, will spend one day at the school giving a general presentation and working in the basic industrial arts areas. This type of program has gained great momentum in our area, and it has been impossible for us to schedule all schools requesting this special industrial arts approach.

In 1968, working with the Georgia Department of Education and the Georgia University System, a curriculum was developed connecting basic areas of industrial arts with the aerospace industry. This aerospace material is now a part of the high school industrial arts curriculum in Georgia.

The Educational Programs Branch at the Kennedy Space Center feels that its attempt to bring new ideas and technology to the industrial arts teacher and student has been most fruitful, and we intend to expand our programming in this area in our regional responsibility.

Mr. Nixon is Chief of Educational Programs, NASA, John F. Kennedy Space Center, Florida.

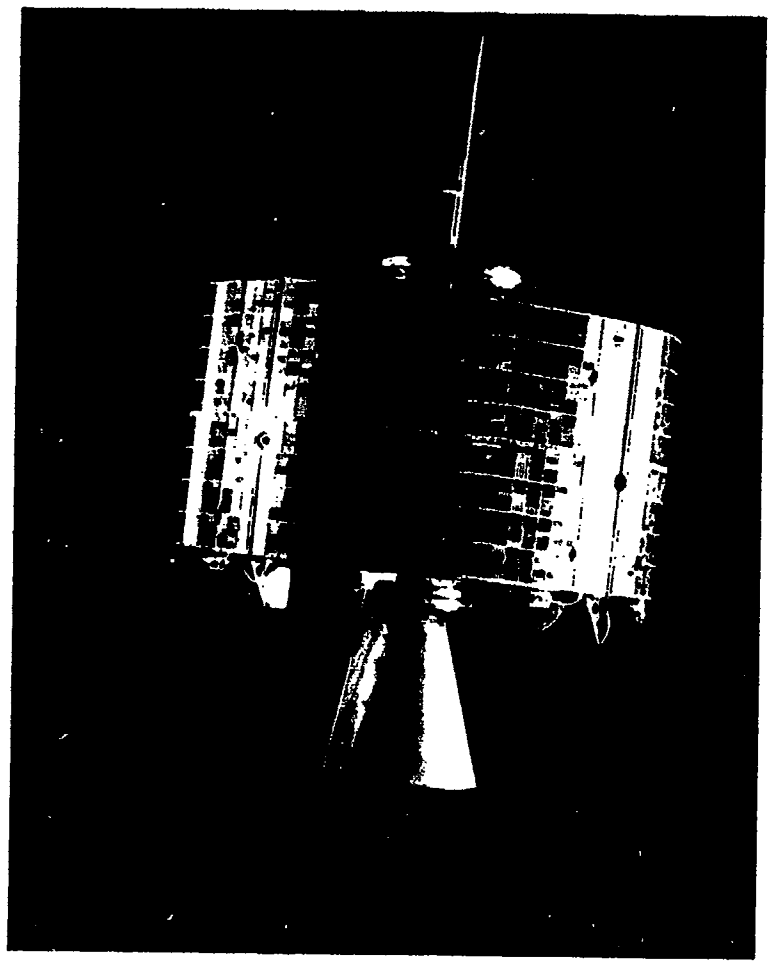
Utilizing NASA Resources for Industrial Arts Education

Ernest G. Berger

I suspect many of you feel about space technology as I feel about nuclear physics—I'm entranced by its possibilities, but feel sure it is well beyond my ability to comprehend.

It's something like looking up at the moon and trying to reconstruct "how it was" from "how it is."

For centuries, the moon has dominated the night sky and provided a continuous challenge to man. Now, man stands on the surface of the moon, looks back at the earth, and sees a cloud-covered turquoise sphere rising over its own cratered and mountained horizon. He now makes frequent trips back to the moon to dig into its surface, photograph and map it, explore its highlands and valleys, and set out a host of scientific instruments to record its life cycle.



Hughes Aircraft Company photo

The Syncom communications satellite is shown in a fixed position against a starry sky at 23,300 miles per hour over the Pacific Ocean. Satellites such as this one located over the Atlantic Ocean and Indian Ocean provide world-wide communications for telephone and television circuits. Building models of such satellites is a fascinating experience for industrial education students who are interested in a different type of project.

Next, man plans to launch an orbiting skylab which will study the earth, the sun, his own galaxy, as well as the galaxies beyond. In the perfect vacuum of space, he will experiment with optimizing of earth-bound manufacturing processes in the space environment.

There are two ways of looking at these space accomplishments. The first is the "glamourous" look—the look that sees only man walking around in space. This look staggers the imagination and stimulates both wonder and reverence. The second is the "practical" look—the look that sees space as another region in which man has begun to travel and which holds much useful data for him. It is this second look that is of immediate concern to us in our discussions on utilizing NASA resources for industrial arts education.

Let's look for a minute at the relationship of industrial arts to the aerospace industry. As you may know, space vehicles require products made of plastics, ceramics and metal, as well as power and electronic components. Even woods play an important part as a research tool in the space industry. Industrial arts is interested in the same areas as the aerospace industries. Therefore, it would seem that each can make a significant contribution to the other through the mutual understanding of this important segment in our technological society. Because of this close relationship, we should be able to translate many space-related ideas into useful laboratory experiences for our in-service and pre-service industrial arts teachers.

Some of the NASA educational services and resources available to teacher training institutions (and teachers as well) are workshops and the spacemobile program, which I would like to see renamed "techmobile" when directed toward industrial arts education. In addition, there are numerous educational publications, films and new processes, materials and instructional methodology. I shall deal with each of these educational resources and show how we utilize them in some of our teacher training courses at F.S.U.

During the summers of 1967-68-69, we were fortunate enough to be granted a USOE-funded institute for advanced study in space age technology. These institutes brought together 25 industrial arts teachers and faculty from across the nation to investigate space technology and its implication for industrial arts education in the 1970's. Inasmuch as these institutes were directed toward space age technology, it was only natural that field trips to NASA facilities become a part of the educational experiences. Arriving at Kennedy Space Center, our participants visited the space museum, with its historic array of the early rockets, the launch control facilities for the early Gemini flights, and then on to the Vehicle Assembly Building (VAB). Inside the VAB, one could see the various sections of the Saturn rocket being assembled and tested prior to rollout. The rocket was carried to its launch site by a huge crawler-transporter, one of the largest prime movers in the world. Next, they visited the Apollo launch control center (a tremendous contrast in size and function to the early Gemini facility) with its individual control and monitor consoles keeping track of each vital function of the spacecraft. Glancing out of the windows toward pad 39, the institute group viewed the Saturn V on its mobile launch platform.

Conducting some of the greatest research efforts in human history, NASA has on its staff many world authorities in their respective fields. During the visit to Marshall Space Center, our participants took full advantage of the opportunity to consult with these scientists and engineers on a firsthand basis. These are some of the ways we have utilized NASA facilities in our program.

Sharing NASA's "spacemobile" program for industrial arts activities was a major attainment for our profession. These NASA lecturers are all former secondary school science teachers who fast become knowledgeable about the role industrial arts plays in the educational scheme of things. They bring with them many scale models of NASA spacecraft and other devices, and very effectively utilize them in their presentations and demonstrations to our pre-service and in-service teachers.

For example, a lecturer demonstrates the capabilities of a solar cell in an electricity/electronics class. Another NASA lecturer demonstrates the relative heat of combustion and the different burning rates of common fuels which provide thrust for the space vehicles. Here is an opportunity for a learner to experience a new dimension in power technology.

A chalk-talk on the principles of telemetry followed by an actual demonstration using a NASA-developed telemetry device is an effective way of explaining this complicated process to a communications class.

Another highly motivational activity is the exploration of the "ablative" capabilities of eopxy-filled soda straw stubs, using a Benzamatic torch as the heat source, producing some charred remains which can be readily analyzed and compared for their ablative qualities.

Some of the outputs of such workshops are different types of space vehicles, many of which are designed to meet the hazards of hostile environments—such as Mars and Venus. This is how we have utilized the spacemobile in our teacher training program.

A tremendous amount of technical literature, the results of all the NASA research activities, may be found in NASA publications. For example, if you were interested in introducing the latest metal-forming technique to your classes, you would want to consult "Conference on New Technology"; if you wish to supplement one of your courses with career information, you would want to use the "Space Career" booklets which are written at different levels of understanding for grades K-12. "Model Spacecraft Construction" would be of interest to a woods instructor looking for a new source of project ideas. General shop people might prefer "Selected Shop Techniques" to enrich their exploratory courses in this area.

The free-loan films produced for NASA are all top quality. We use them for two purposes, to extract new ideas for R & D projects and to use them as motivational devices for our regular courses. It is rather difficult to surpass the animation and technical quality of these films. More important still, many of the films bear a direct

NASA photo

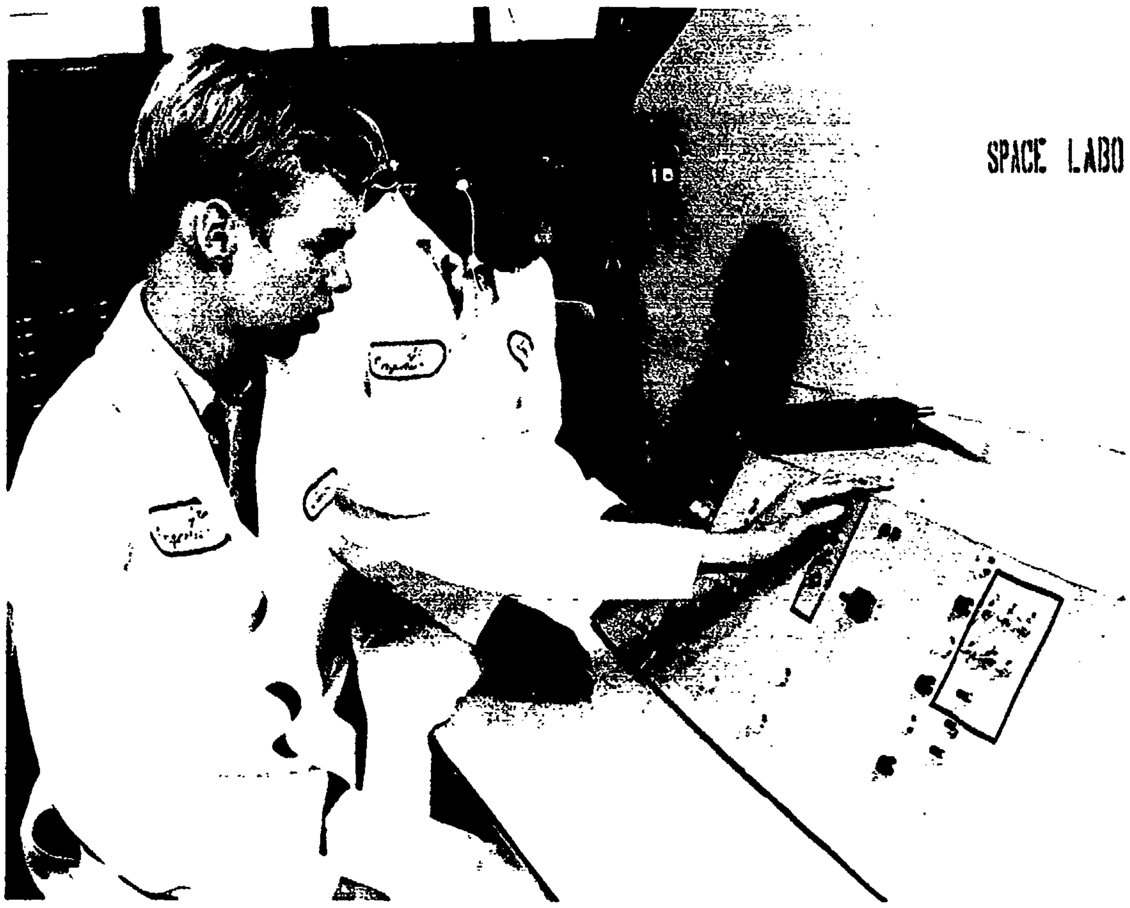
The 85-foot parabolic antenna at Goldstone, California, is part of the deep space tracking network that supplies vital telemetry data to the computers at Mission Control Center in Houston. The spin-off into industrial arts programs is almost limitless. With a simple receiver and antenna system, and NASA's publication SP-5080, a weather station picture receiving station can be built as a class project. The device interrogates the ATS weather satellite, which sends back a complete picture of the cloud cover over the United States.

relationship to the major subject areas we teach each day.

We utilize this RL10A-A liquid fuel rocket engine in an advanced class in power technology. This engine can produce up to 15,000 pounds thrust and is capable of making multiple starts after long coast periods in space. It uses liquid oxygen and liquid hydrogen in a 5:1 mixture ratio as well as gaseous helium to actuate valves for starting and stopping the engine. This has proven to be a very effective training aid for our graduate students.

The space program has suggested some exciting new learning concepts for industrial arts education. One such approach is Research and Development (R & D), representing a major departure from the traditional program to one which involves the student in the solution of technical problems of an interdisciplinary nature and using space technology as its content base. An example of this type of project is the paper car which is built of 19 layers of newspaper impregnated with resin. The exterior is painted with gelco, while the interior is trimmed with a durable paper lining. It is powered by a zero-emission flywheel propulsion engine.

Space vehicles require specially designed tools for repair or assembly operations



FSU photo

Spin-off ideas are one of the best of resources NASA has to offer industrial education. Shown above are two students performing an operational test of instruments and readout indicators for the Space Laboratory Simulator built at FSU's Industrial Arts Department. The "Junior Space Engineers" developed a telemetry system which provides accurate information about the three on-board "astro-kids" inside the simulator as they fly a twenty-hour operational flight. The simulator provides for such space flight functions as life support systems, flight problems involving power failure of the fuel cells, and changes in the orbital path of the vehicle.

during actual flight. When force is applied to a component in a weightless condition (such as turning a bolt with a crescent wrench) the space vehicle itself reacts by turning in the opposite direction. Simple prototype space tools have been designed in our R & D classes that solve this action/reaction problem. A polariscope, fabricated from a large orange juice can and a galvanized pipe, provides the learner with a visual presentation of the stress points in a tool or other type of structural member.

The study and application of holography and infrared photography have already been introduced into our graphic arts programs. As you know, infrared film is now readily available at most photographic stores.

The fuel cell is an extremely efficient energy conversion device. For example, one Apollo-type fuel cell could more than take care of the one kilowatt per day power requirement for the average household.

If you do not want to use the volatile oxygen/hydrogen fuel cell, then try the biochemical fuel cell in which active microbes living in sea water produce up to a volt of electricity on demand. All they ever ask is a thimblefull of sugar for fuel every Saturday night.

In the area of the more exotic power systems, you might want to consider fabricating a "nuclear battery" which is fueled by a speck of Carbon-14.

Another interesting power device is the thermocouple which uses plutonium as its source of heat energy.

Another R & D project responsive to the current drive to clean up our environment, while trying to reduce the costs of car accidents, utilizes beer cans in various configurations as a possible material for absorbing shock in car bumpers. Surprising as it may seem, the cans filled with a certain well-known beer seemed to absorb the shocks best.

Fluidics, a relatively new technology, makes use of a small stream of liquid or air which flows through intricate and precise channels within a solid substance. Some can be made to perform a computer function, while others can replace the carburetor in conventional gasoline engines.

Another new use for air is to provide propulsion for a lunar flying unit designed by a junior high school student in an R & D program. This prototype can lift, support, and maneuver itself on three small jet streams of air.

It has been said that electricity and electronics is the heart of the aerospace program in that it ties all systems and subsystems together. Communication by light waves can be accomplished with a simple light beam modulator circuit for the transmitter and a photo cell circuit for the receiver.

Model spacecraft construction is a unique aspect of space technology which fits in nicely with our woods programs. For example, building a Mariner II spaceprobe can be a very educational experience as well as providing a type of technical project that really challenges a student in the selection of materials and use of tools.

A scale model of a space station simulator can involve modeling techniques along with design and drafting courses.

The educational values of model rocketry are clear in that it provides a safe, practical, and effective means of arousing increasing interest and motivation in industrial arts. Stimulated by the design of spacecraft for other environments, many students learn to solve technical problems in the areas of power, electronics, and woods along with mathematics, physics, and meteorology. The moment of truth comes when the prototypes are test flown at the school's athletic field. Use of model rocketry is a natural offspring of space technology and perhaps the easiest thing to introduce into industrial arts programs.

There appears to be no limit to the possibility of transferring many elements of space technology into cognitive educational experiences involving technical problem solving and designed to match the students needs for living and working in the world of tomorrow.

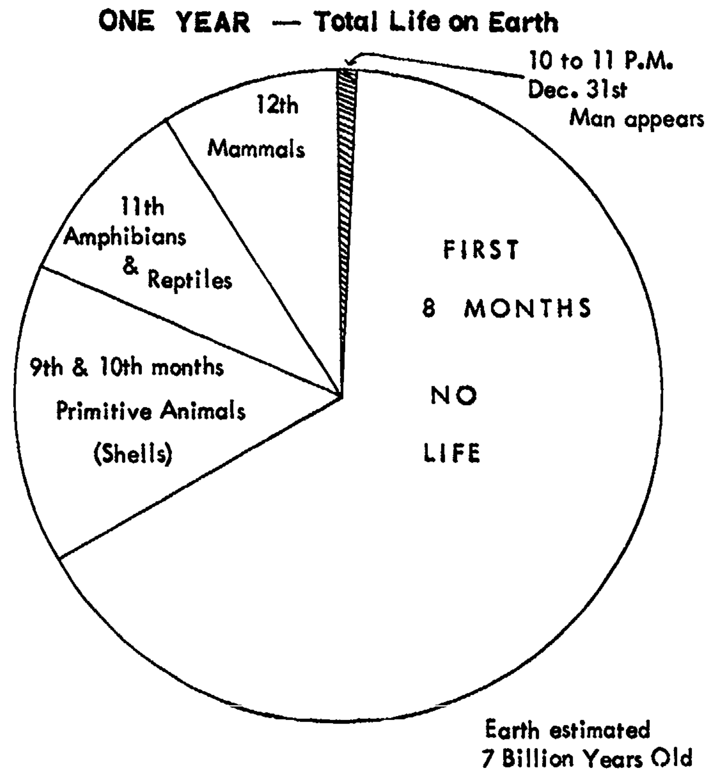
It does mean, however, a different type of take-home project. It suggests a transition from the birdhouse to the fluidic circiut. By adding such usable space technology projects in meaningful and interesting learning packages, we might really be able to prepare our industrial arts students for the world of tomorrow.

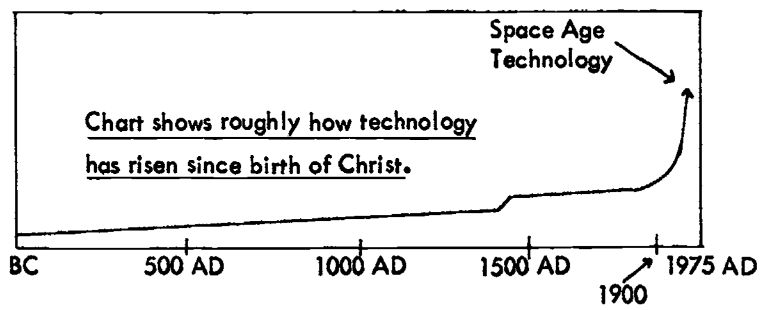
Mr. Berger is an associate professor of industrial arts education at The Florida State University, Tallahassee, Florida.

Establishing the Course and Transferring NASA Materials and Resources into Laboratory Experiences

Frank J. Zima

The greatest difficulty of establishing a new and unorthodox course of study is twofold: convincing your principal and locating the course in your state accreditation standards. Too often we find school systems that have for years followed set patterns in the school curriculum that necessitate nothing more than adjusting to the rising cost of implementation. There is resistance to any change that could require expensive retooling and experimentation. Implementing a course such as will be discussed here creates no real hardship for anyone, except possibly the industrial arts instructor. He may have to





give up a well-defined curriculum that has for years operated smoothly with very little effort on his part.

A course in space technology[1] need not be expensive or create immediate curriculum changes. Its flexibility and possibilities are endless. My first encounter with this R & D approach was in Woods II. A senior, watching a pre-school boy flying a kite, wanted to build one. Permission was granted, but only if he could build one large enough to pick up and fly a 32-pound building block. It took eight weeks of wood testing, laminating, cord and wire testing, and fabric testing before the project was completed. The boys learned about destructive testing, wood processing, aerodynamics, fabrics, and most important, researching the problem in the library. The kite picked up the block, and we almost lost an 89-pound student as well. All of this was accomplished with scrap stock, tools any wood shop is equipped with, and at very little cost to the student. This type of activity is easily adapted to power mechanics.

The time of day and the type of students are two important points to consider. I have found that the second period of the day is best. The student reaches his most active mental point at that time of day. This year I tried the last period of the day with the thought that they might want to work after school on their projects, but they are generally mentally exhausted. I found it a very poor choice.

If the space technology course is to be full-time, it is best to have a selection of seniors and juniors. Also, I like a prerequisite of some industrial arts course. With several students working in different technical fields, you find little time for lengthy individual instruction. It is a good idea to screen your students for their reliability and industriousness. They must be trustworthy when not directly supervised, still functioning as desired in order to complete their chosen research. I often find myself with a few students in the machine area while others are in the resource room, the school library, or on pass from the school searching out new materials in town.

A course such as Florida's "Introduction to Space Technology" is wide open for utilizing NASA's publication, "Space Resources for the High School." One of the most difficult parts of the project is to introduce the course to the students. This can be a good springboard for success or it can start you off in a quagmire. I find it effective to begin with a chart showing the rise of technology from the Stone Age to the present, how it stayed almost dormant until the turn of the century, and how in the past two decades it rises almost perpendicularly. Free films from NASA and Florida State University, among others, can bring the space age and its advancing technologies into focus.

By using a hand-out of space age technology and assigning each student one or two topics to make short verbal reports on, one can establish a good base for project research and development. Many choose their technical reports as their projects.

To aid them in their quest, it is important to build up a softwear resource area. Much of the NASA material is free. "Space Resources for the High School" and NASA Tech Briefs, among others, provide a very good start. "Anatomy of Automation" by Amber & Amber[2] is a fine textbook to teach the latest technical processes and methods. At New Smyrna Beach Senior High, the library and school are buying many new research volumes each year to support this approach.

One of the most enjoyable phases of the course is the introduction and discussion of space age materials and processes during the period in which they write letters pertaining to their research and development projects and receive answers from industry. Experiments with rockets, nose cones, plastics, etc., are most rewarding and prove to be highly motivational. NASA materials and resources can be an invaluable aid in providing industrial arts laboratory experiences for the Space Age.

FOOTNOTES

(1) Additional information can be obtained by writing to Prof. E. G. Berger; Bldg. 218, Industrial Arts Department, Florida State University, Tallahassee, Florida 32306.

(2) Publishers: Prentice-Hall, Inc.

Mr. Zima teaches at New Smyrna Beach Senior High School, New Smyrna Beach, Florida.

More from the 1970 Louisville Convention

Industrial Arts in Developing Countries

Fred J. Baars

The Peace Corps was established in 1961, with the primary goal being to assist developing countries in meeting their trained manpower needs during critical developmental stages. Early volunteers tended to be liberal arts graduates who wanted to do something constructive. These volunteers built latrines and chicken coops, set up science labs, and taught English as a foreign language, among many other jobs. However, because many of the volunteers were liberal arts graduates, they were somewhat limited in assisting countries to meet their skilled manpower needs. In the past few years, there have been increasing requests for the Peace Corps to provide volunteers to assist in building industrial arts and vocational education programs. These programs call for volunteers with college degrees in industrial and vocational education and also for skilled tradesmen with a number of years of experience to teach technical subjects in schools and to work with the teachers in these technical schools.

For a few dynamic countries, the phenomenon of technical innovation, research, and development has been widening a gap in growth, power, and prestige between the so-called developed countries and the emerging nations. For right or wrong reasons, the governments of the developing nations have placed technology in high priority. Many of these countries have been independent less than 10 to 20 years, and by developing their manpower and resources, they can become more economically independent. The developing nations are going to several sources to obtain technological assistance as quickly, cheaply, and efficiently as possible. The U.S. Peace Corps is one source of help. Peace Corps volunteers work alone or may be serving alongside volunteers from some 17 other nations, the United Nations, Colombo Plan, or experts from many other programs. Not all forms of aid are designed to help developing nations build themselves into self-reliant countries. Instead, in some instances, the developing countries by accepting some forms of aid become even more dependent upon another, stronger nation. Rather than help people help themselves, some forms of aid have caused a situation in which a country will depend on foreign texts, foreign equipment, and even a foreign working staff.

In order to avoid this situation, Peace Corps volunteers are assigned to work for host country governments in positions set up and supervised by host country officials. The Peace Corps volunteer usually works with a co-worker—a host country citizen who can take over the work when the volunteer leaves. The volunteer can work closely with one or sometimes more individuals to train them in specific skills areas, so that at the end of two years, he will often have worked himself out of a job.

There have been several Peace Corps projects which have been completed—in which the entire program worked itself out of a job, so to speak. In fact, this is what happened to the program in which I worked while in Malaysia. After five years and 50 volunteers, the Peace Corps support for the industrial arts secondary education program in Malaysia was completed. During that time, Malaysia developed an industrial arts program in over 300 schools, set up a full-time staff for teacher training, and had their administrative staff trained in industrial arts in overseas universities.

Of course, Peace Corps volunteers played only a small part in this development, but it was a significant part. For many years, Malaysian schools had taught woodworking and metalworking to students in secondary schools. These were not very prestigious courses and were often offered only to those who had or were about to drop out of school. In a society that placed emphasis on the professional occupations—doctors, lawyers, teachers, etc.—there had to be a change in the image of industrial arts subjects. Many times, the students enjoyed working in the industrial arts classes but parents discouraged them from pursuing the subject beyond junior high level as they felt the schools were training their sons to become laborers. When several technical institutes were opened to students who had passed their examinations with high grades in the sciences and mathematics, to study science, math, and industrial arts on a teacher training level, and when these institutes became extremely hard to get into, parents and students began to change their attitude toward the technical subjects.

The Canadian government gave equipment and expert technical assistance to the Malaysian Ministry of Education to expand and improve the industrial arts programs in secondary schools and colleges. In addition, the Malaysian government spent money to buy equipment to furnish more schools and colleges and to train teachers in colleges and universities in Malaysia and overseas.

Peace Corps volunteers were requested and sent during a five-year period to work in all levels of the industrial arts program. Some volunteers were assigned to teach in the teacher training colleges, others to vocational training schools, and others to secondary schools. Some of these volunteers in the secondary schools found themselves in industrial arts labs that were equipped far better than labs they had seen in the U.S., while others started from scratch with an industrial arts lab set up in a bicycle shed, without electricity. Working through the Ministry of Education on the federal and state levels, volunteers and host country teachers organized and taught several in-service training courses for teachers in secondary schools. These courses were usually taught in the areas of power mechanics and electricity, with emphasis given to setting up these areas in the schools and making teaching aids to use for teaching these subjects. In-service courses were held during the year on weekends with follow-up courses during the long school vacation periods. Through these in-service courses, the majority of the teachers who had had training only in wood and metals were trained to teach the basic courses in electricity and power mechanics.

Another project in which volunteers participated was the formation of a professional organization of industrial arts and vocational education, and the publication of a professional journal. Volunteers and host country teachers felt the need for professional development through an organization, so the Malaysian Industrial Arts and Vocational Teachers' Association was formed. Some of the first officers were Peace Corps volunteers because they had the time to give to such an organization and had had experience in working with similar programs in the U.S.; however, the second slate of officers was entirely composed of Malaysian teachers. The Association began publishing a journal called the Malaysian Technical Education Journal. The first edition was largely the work of the association officers, but later editions carried articles, ideas for projects, and suggestions for lab layouts submitted by other teachers. Both the association and the journal have had some problems in getting started, but as the members begin to realize the benefits of exchanging new ideas and solving problems together, improvements and developments in the association and journal will be seen.

It was a real opportunity for me to have been a part of the rapid and dynamic development of the Malaysian industrial arts program. I was assigned to teach in a secondary school which had just received new equipment for the industrial arts labs. There was one other industrial arts teacher in the school, a new graduate of a good teacher training college. We worked together to make improvements on the existing woodworking and metalworking areas and to establish new power mechanics and electricity shops. During the second year at this school, the two of us worked with another volunteer and teacher from a neighboring school to hold two in-service courses in electricity and power mechanics for the other teachers in the area. We developed some very good teaching aids to use in the courses and for the teachers to use back at their own schools. During the school vacation, I worked with other volunteers and teachers from other states to hold another workshop in electricity and power mechanics. I was part of the fourth group of industrial arts volunteers to come to Malaysia, and during my second year there the fifth and final group of industrial arts teachers was sent. At the end of my second year, I was given a chance to work in the Technical Education Division of the Ministry of Education in the capital city, Kuala Lumpur.

My duties as senior organizer for industrial arts included working with seven state organizers in tendering equipment, planning with these organizers and individual teachers for improvements in lab layouts, and working with the Association for Industrial Arts and Vocational Teachers with the publication of the journal. I traveled to the majority of the schools to meet with teachers and to give them assistance in machine repair, improving lab plans, and other areas in which they requested help.

When I left Malaysia in 1970, there were only three volunteers remaining in the industrial arts teaching program. Future help had not been requested by the Ministry of Education because Malaysia knew they could handle the job themselves. We had provided through the Peace Corps a small but significant amount of help to speed up the development of their industrial arts teaching program. This development would have certainly taken place without the help of the Peace Corps volunteers, but it probably would have taken considerably longer. Volunteers were privileged to be able to take part in this program to learn what they as individuals were capable of doing. It isn't often that an industrial arts teacher has the chance to set up an industrial arts shop from scratch, or to work as an organizer for industrial arts, or to work in setting up a professional association and help with the publication of its journal.

Technical assistance is only a part of the role of a Peace Corps volunteer. The specifics of the industrial arts volunteer's job vary from the very unstructured rural farm mechanics programs to the very structured education programs using a syllabus and giving external examinations that are required by vocational guilds. There are positions that vary from elementary industrial arts education to teacher training to administrative posts with the Ministries of Education according to the needs of the various developing nations.

These jobs call for the volunteer to be extremely flexible, not just to teach what he wants or only in the way that he has been taught, but he must first learn what needs to be done and begin from there. Many countries want to get away from the educational system imported by a foreign country and to develop a system that is appropriate to the needs and goals that they have identified. To give you an example of the mistakes that have been made in adopting a foreign educational system, I once saw students in a vocational school being taught to build beautiful fireplaces—in a country that rarely sees the temperature drop below 80°F. By stressing that the volunteer adapt himself to the local situation and the supervision of host country officials and work with a co-teacher, this type of situation can be avoided and programs can be developed to suit needs of a particular country.

The developing countries who are asking the Peace Corps for professional help in industrial arts are not stagnant countries. They are actually offering, for a few years during their early growth in technical education, an opportunity for a few American teachers to be partners in their growth. We must never think that we are such great educationalists that programs cannot be built without us. They can! It may take a few years longer, they may repeat some of the same mistakes we made, but good, strong programs will be developed. Those of you who have that distant faith in a new world, who can respect differences in others, may wish to respond to the rewarding and soon to be rare invitations for a valuable international opportunity for you and your profession to help when asked. The work to be done in helping in these programs is limited only by the volunteer's skills and willingness to lend a friendly hand.

Mr. Baars is the Peace Corps industrial arts vocational education recruiter for the Southern Region of the United States.

Organized for Action

James E. Good

What are we doing? What should we be doing? Where are we going from here? How should we relate to vocational education and the academic areas? These are the questions taken into consideration by a special committee appointed in the summer of 1966 when the Greece Central School District undertook a study to determine the direction industrial arts should take to enable the district to meet the industrial and technological needs of its students.

In January 1968, an organizational plan was adopted along with an implementation schedule that appeared to have all the ingredients of a complete program that could be realistically implemented and provide a nucleus for meeting the industrial and technological needs of the students. The entire program revolves around the following six criteria which were felt to be consistent with the over-all philosophy of industrial arts, as well as that of the school district.

First, industrial arts must be open to all students with the basic assumption that, regardless of the ultimate vocational choice, the experiences gained in the program will broaden the student's perspective and increase the validity of that decision.

Second, the program must contain a systematic study and exploration of the world of work that will assist in preparing a student for a realistic and satisfying career selection when the time comes for serious vocational preparation. Since students interests vacillate through high school and vocational maturity and adequate understanding of self varies greatly and is often slow to develop, it was agreed that a breadth of experiences be provided as a basis for eventual career selection.

Third, the content must come from industry and be relevant to the facts, principles, and concepts of modern technology. There was general agreement that the program should be devoted to the study of the tools, materials, processes and products of our American industries and, as such, should be designed to acquaint students with the technological society in which they live and must make their living.

Eight curriculum committees undertook the task of identifying the subject matter content. By the end of the 1968-69 school year, over 2000 man-hours had been spent in the development of the program, not to mention the time expended by outside consultants from industry and higher education. Each committee made maximum use of formal and informal industrial advisory committees as well as representatives from the State Department of Education, higher education, and numerous vendors. The support received from these people proved invaluable in the development of the program, not only in terms of technical assistance, but also in moral support and encouragement.

The content was identified by each committee, then converted into behavioral objectives following the criteria outlined by Dr. Robert Mager in his book, Preparing Instructional Objectives (Ref. 1). Each objective was written to include:

a. The type of terminal behavior desired. Key words like identify, compose, list, or construct were used to describe the type of student activity desired.
b. Conditions under which the behavior is expected to occur are described as accurately as possible. This would include the tools, materials, and software available to the student in his attempt to achieve the desired outcome.
c. The minimum standards of acceptable performance became an integral part of each objective to eliminate any possible confusion in identifying the point at which a student has obtained the desired level of performance.

Fourth, industrial arts must become an integral part of the total education picture rather than isolated from the rest of the school curriculum in its content, activities, and program. Consequently, all areas were developed with an eye toward interdisciplinary activities that could assist a student having difficulty verbalizing or thinking on the abstract level to learn essential concepts more effectively by presenting the material in more concrete forms and allowing him to demonstrate knowledge manipulatively.

Fifth, in order to avoid over-specialization and in-depth instruction, it became important to concentrate on broadening student experiences in selected areas of study. For example, rather than have a course in machine shop where the total emphasis would be on machine operations, a course in metal technology was developed to offer students experiences in such areas as heat treatment, materials testing, precision measurements, and fabrication.

Finally, maximum flexibility not only in the selection of student activities, but in effective teaching techniques employed at each level of instruction was desired. This is an essential element in a program designed to meet individual needs, interests, and capabilities. It seemed fruitless to establish valid content while ignoring the best techniques in motivating students to create the desired behavioral changes. The activities selected by both students and teachers should eliminate any locked-in feeling and provide the latitude necessary to accommodate individual differences while not losing sight of the identified student outcomes.

The organizational pattern of the program basically begins at the seventh grade. There is, however, some pilot elementary work being done in respect to setting up a model multi-activity technology center and arrangements are made for high school students to assist elementary students with such activities as rocket launching and publications.

The junior high program (grades 7 and 8) is designed to provide the broadest possible exposure to industrial concepts for the greatest number of students. Using the New York State curriculum guide as a base, the program revolves around eight selected technologies: drafting, electronics, woodworking, graphic arts, plastics, metalworking, power technology, and manufacturing. Each unit involves meaningful activities that, hopefully, will enable a student to develop basic conceptual understandings related to the tools, materials, processes, and products most commonly associated with our current technologies. In addition, each unit provides enough exposure to the broad general field from the standpoint of occupational orientation to assist the student in making more intelligent decisions concerning his educational and vocational future.

High school industrial arts is a three-level program in which all courses are open to all students with no mandated prerequisites. There is no pre-conceived limitation as far as year—i.e., sophomore, senior, etc.—to limit the flexibility of the students, either. Nor is there any reason why a student cannot be registered in a Level I course in one area, and a Level II or Level III course in another area at the same time. For example, Bill Schmidtman, a senior, has taken Levels I and II metal technology and is now registered in the Level III independent study program where he is working on a special project involving the design and fabrication of a valve grinder. At the same time, his interest in the field of power has created the need for him to enroll in the Level I power technology course.

Where time permits, a student may work in one or all of the Level I courses or elect to follow a specialized area of interest through the three levels. It is important to note that the flexibility of the program not only permits but encourages students to take related courses and broaden their experience at the introductory level as well as continuing through more concentrated experiences in the advanced levels of a particular area.

The Level I courses are semester offerings designed to provide a broad general survey in the technologies of plastics, drafting, electricity, power, metals, graphic arts, and woodworking. This level is specifically created to assist students in further exploration of likes, dislikes, and aptitudes which should help with educational, avocational, and occupational guidance. It is looked upon as an introductory experience for those who have not had the initial exposure to industrial arts at the junior high level and as a broader basic survey of the field for those who did.

One example of the Level I program is the area of power technology. The program contains not only the traditional small engine disassembly experience for the students, but a broader understanding of the principles of operation are included by using the dynamometer and air-fuel consumption at various horsepowers and under given load conditions. In addition, students become actively involved in other forms of energy converters, such as electric motors, thermo-electric generators, solar cells, and fuel cells. Rocketry becomes an integral part of the course at this level, with major activities in rocket construction, static testing, and flight charting. The enthusiasm generated by this unit results in expansion into extra-curricular rocket clubs whose competitions rival the school athletic programs in appeal and excitement. Large piston engines are not excluded from this level, as they still have a place in power technology, and students are motivated by their presence in the lab even though they are mounted on test stands and student activity is limited to minor adjustments and tune-up. Expanded units in two-cycle and rotary combustion, steam power, nuclear power, liquid fuel rocketry, jet power, and diesel engines will be introduced into the program in September.

The Level II program is for the student who wishes to broaden his knowledge in a selected technology. Whereas the Level I courses are introductory in nature, providing a survey of the specific area, the Level II courses offer concentrated experiences of a broad nature in a selected technology. Emphasis is on interdisciplinary activities and total student involvement centered around an identified area of study. Presently, full-year courses are offered in transportation, metal technology, construction, technical drawing, electronics, and graphic communications. Plastics technology will be offered in 1970-71 and manufacturing is projected for 1971-72. Common student activities at this level would include a student analyzing a Wankel engine on a dynamometer or using a simulator to reinforce the basic principles of wheel alignment or an ignition system in the transportation course; a group of students surveying a field or attempting to solve a structural problem in technical drawing; students using the tensile or hardness tester to test wood, metal, or plastic samples; a group of students attempting to solve a publications problem in the graphic communications course; a student performing a basic repair on a piece of electronic equipment or sophisticated laboratory experiment in the electronics course. The construction course allows the students to be working on electrical, plumbing, or foundation problems as they are working on framing, masonry, or interior finishing.

Level III is designed for students who have an avocational or vocational goal that cannot be reached through the Level I or Level II course offerings alone. A student has four options at this level:

1. If he has made a specific vocational choice and desires to receive specialized job entry skill training, he may enroll in one of the vocational courses offered

at the area vocational school which is an extension of the comprehensive high schools in the district and serves all of the schools in western Monroe County.

2. The student who wishes to pursue a special interest or project may enroll in the independent study program. Students enrolled in the program are assigned a teacher closely associated with his area of interest who will assist him in the development of a contract and work directly with him on laboratory work, special assignments, and selected readings on the topic. In pursuit of the desired goal, many students enrolled in the program become actively involved in co-op observation cycles and industrial field trips as part of their experiences.
3. The student whose level of maturity has enabled him to identify a particular job career choice that cannot be pursued through the other program options may enroll in the cooperative education program which enables him to gain employment in his particular field of interest.
4. A further option at this level includes special interest offerings. When the student need, interest, desire, and demand becomes high enough in a particular area of interest, a special-offerings course is established to eliminate confusion with the independent study program. Currently, semester courses are offered in photography and blueprint reading.

Student interest and reaction to the total program is extremely promising. Last year more than 2000 students took advantage of the secondary electives and, from all indications, the number should be exceeded this year.

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Mr. Good teaches in the Greece Central School District, No. 1, Rochester, New York.

New Techniques in Teaching Plastics Technology

Donald J. Jambro

Plastics is one of the nation's fastest-growing industries, having a growth rate about five times that of all other industries.

Only 102 years old, it has grown to a 17 billion pounds of resin per year industry. The early 1980's has already been designated the "Plastics Age," when the volume of plastics used will exceed that of metals. One has only to look around him and see the increasing use of plastic products to realize the importance of this material.

There is a critical need for trained personnel in the industry. A graduate engineer in plastics is non-existent. The need is not just for engineers, but for all types of skilled personnel such as foremen, supervisors, set-up men, draftsmen, and technicians.

To satisfy this critical shortage, education must begin in the junior high school where a conceptual understanding and an interest in the plastics industry can be stimulated. The student must then have the opportunity to continue his study of plastics in the high school and in a 2-year technical program or 4-year college.

Presently there exist some programs in the junior high school and very few in the high school; 2- and 4-year programs beyond high school are almost non-existent.

Based on the foregoing rationale, the Greece Central School District began the development of a district-wide plastics program which was implemented in the three junior high schools in the fall of 1968. A high school program was implemented in the fall of 1969. There is a tremendous amount of enthusiasm shown by the students for both programs, mainly because it only takes a student one or two periods to complete a product, and he can manufacture an item of equal quality to that which could be purchased.

Initial guidance on the development of the program was provided by Robert Ullery of the New York State Department of Education and Maurice Keroack of the Plastics Department at the State University College at Buffalo, New York. Advisory help was obtained from various plastics processors in the Rochester area and the Rochester Section of the Society of Plastics Engineers on the selection of relevant content to teach principles and concepts of modern technology and to provide a systematic study and exploration of the plastics industry.

Plastics in the junior high program is a five-week exploratory program designed to acquaint the student with as many processes and materials as possible so that he will have a basic understanding of the plastics industry. The students experience processes in rotational, injection, and compression molding. Various coating processes include hot dipping, cold dipping, and fluidized bed coating. A foaming process unit includes experiences with flexible polyurethane foam and polystyrene expandable beads. A unit on laminating covers both low- and high-pressure laminating as well as reinforced plastics. Other processes include thermoforming, embedding, heat sealing, and shrink packaging.

Less than $2500.00 was invested in each school to implement an exposure unit to include 15 processes, half the cost of a woodworking area. Material cost, depending on what material can be donated, will run approximately $1.25 per student. The program provides the broadest possible exposure to industrial concepts and occupational orientation in plastics.

Level I is a one-semester course in plastics which is open to both boys and girls, grades 9-12. The course serves to introduce students to the plastics industry and provides basic instruction on the chemical structure of polymers, their properties, and methods of identifying materials. On this level, plastics becomes more integrated with science, especially chemistry, physics, and math. Other areas of industrial arts, wood and metal, are a part of the program.

As a survey course, it covers various molding processes, laminating, thermoforming, coating processes, foaming processes, welding and sealing processes, casting and encapsulating, finishing and decorating processes, and applications of plastics throughout our industrial society. A total of 30 processes are included on this level.

Basically, the course involves instruction on more sophisticated equipment so various processing variables can be more accurately controlled and a materials-oriented course in that the student learns about the structure and properties of the material he is using The student also becomes more aware of the economics involved in each process.

The Level II plastics technology course is an advanced course offered for an entire year. The more important processes of the industry selected from Level I will be included to provide a more concentrated in-depth study of the processes. For example, the students in Level I will study injection molding and operate the machines after operating conditions have been set up. Level II students will set up their own operating conditions such as processing temperature, pressure, cycle time, and mold temperature with at least three different materials and thus become involved in the problem-solving process.

Special emphasis will be placed on the design and construction of molds from wood, metal, epoxies, ultracal, hydrocal, and silicone rubber for the various processes. Production on the various processes will be studied from the design to the completed and packaged product. Materials testing and chemical structure of plastics will become more important considerations at this level.

A Level III course has been designed for the student who wishes to pursue a study of plastics beyond Level II to provide an opportunity for independent study in a particular plastics process or a work study program that will allow a student to gain valuable on-the-job training and experience.

Mr. Jambro teaches at Greece Atheno High School, Rochester, New York.

Metal Technology

John C. Duggan

Metalworking in some form has been done for thousands of years. It was one of the first trades or skills introduced into the public schools about 1880. Because of the long tradition and methods that have been developed in the teaching of metals, it is difficult to introduce changes. Seventy of the 98 natural elements are metals. While scientists and metallurgists develop these metals to send man to the moon, most metal shops teach students how to forge chisels using blacksmith's tools.

It was with these thoughts in mind that we started to develop a curriculum for metalworking in the Greece Central school system. Specialists from the community and local colleges were consulted during the curriculum development.

It was decided that the junior high program should provide a broad exposure to the metalworking industry which would enable the student to make a more intelligent decision concerning his educational and vocational future. Students receive instruction in the basic conceptual understandings related to the tools, materials, processes, and products commonly associated with the metals industry.

The Level I program provides a broad general survey of the technology centered around manipulative activities. The program allows the student to investigate each area of metals more thoroughly and make a decision as to continuing on to the Level II metals program or surveying another Level I technology.

Level II metals is designed for that student who wishes to broaden his knowledge in metals technology. Considering that a boy has taken several Level I courses, when he enters Level II metals he is doing so because of a desire to study metals in depth. What is the study of metals in depth?

In September, five Level III students and myself toured several plants in the Rochester area including the Farrel Company, the Gleason Works, several Kodak facilities, Alliance Tool and Die, and several other metalworking plants. We did not see chisels being forged on anvils, heat treating being done by color observation, or men heating soldering coppers in gas furnaces. What we did see was mass production, in some cases from raw material to finished product. In every facility, the watchword was precision.

Precision measurement is an integral part of the Level II program. Students receive instruction in the use of many types of measuring instruments including steel rules, calipers, squares, micrometers, vernier calipers, radius gages, telescoping gages, vernier height gages, gage blocks, dial indicators, machinist protractors, vernier bevel protractors, go, no-go plug gages, thread plug gages, thread ring gages, hole gages, and optical comparator.

Heat treatment is accomplished using industrial-type heat-treating equipment and quenching media. Each student selects a steel and, using the manufacturer's specifications, runs a series of heat-treating tests including hardening, tempering, and annealing.

Students in most cases work from blueprints drawn by themselves in the drafting lab. They are encouraged to develop their ideas, select materials, produce patterns, and complete a process from raw material to finished product.

Mass production techniques can be accomplished in many different ways. One item being developed by a student at this time is a valve refacer. The mass production of a nylon bearing led to an excellent mass production set-up on a lathe using a collect release, turret, and aloris tool holder. When mass producing items in the metal lab, industrial-type jigs and fixtures should be developed and fabricated. Drill jigs using hardened drill bushings and milling machine fixtures are two methods that can be used to closely align the program to industrial techniques.

There are many types of welding processes in use in industry. Four types of welding fit into the metal lab situation: resistance welding, oxygen acetylene welding, electric arc welding, and tungsten inert gas welding. These welding processes should be incorporated into the making of jigs, fixtures, and testing as well as mass production.

Materials testing should be an integral part of any metals program. The study of the physical and mechanical properties of metals is as important as their fabrication. Each Level II student runs a complete tensile test. He utilizes his machining ability to make accurate test specimens. He marks his specimens for identification, records dimensions, makes a hardness test, punches his one-inch marks, makes his tensile test recording stress and strain, measures his specimen for hardness, elongation, and reduction of area, records his results, plots a stress-strain diagram, and does his mathematical calculations.

In this limited amount of time I have tried to convey the idea of bringing the metals industry into the school lab. Our metal curriculum committee will constantly be on the alert for new ways of bringing modern metalworking techniques into the public schools.

Mr. Duggan is Curriculum Chairman for the Industrial Arts Department at Greece Arcadia High School, Greece, New York.

Graphic Arts in General Education

Douglas G. Skeet

It is not the purpose of this presentation to convince you that this program should be in your school or the nation's schools or that it is utopia, but to describe the graphic arts program in the Greece Central School District.

In 1969, the total value of receipts for printed products was estimated to be 23.5 billion dollars. This is no longer a small handset print shop on the corner producing stationery and business cards. Just think for a moment of all the printed material in our society, from the time of birth when a printed name band is secured to an infant wrist to the time of death and the use of an engraved tombstone. In between the two extremes we have books, advertising mailers, newspapers, and packaging, and the list goes on and on. We truly live in a cradle-to-grave world of graphics. Think of all the people required behind the scenes to get each printed piece into your hands. Someone once said that if the value of all the related aspects of printing, the advertising, layout, photographics, chemical, and equipment industries could be added up, we would have the largest industry in America. Yes, we are dealing with a large industry, and we have a formidable task to teach this giant of an industry in our public schools in a relevant manner.

In the Greece school district, formal graphic arts instruction starts in the 7th grade as a five-week unit. Here the students have an introductory experience in relief, stencil, planographic printing, and black and white photography.

The Level I graphic arts program is designed as an introductory experience for all students, both boys and girls, in grades 9-12. The enrollment in Level I graphic arts has quadrupled over the enrollment when the course was 40 weeks long. By having the course on a semester basis with the advantages of flexible modular scheduling, the program can reach out to many more students.

The Level I graphic arts program emphasis is placed on basic conceptual principles related to communication, the four basic methods of printing, related areas such as binding, and photography. Importance is placed on activities to teach the basic principles rather than on time-consuming skill development.

Each student in the program will have experience in each of the following major units of study: communication cycle, planographic printing, relief printing, stencil printing, intaglio printing, bindery, and basic photography. In the stencil printing unit, the student not only is involved with silk screening on flat materials, but a silk screen unit is also available for printing on cylindrical objects. The student prepares a stencil master and operates a stencil duplicator. In the basic photography unit, each student is issued an instamatic camera. The assignment is to express an idea, thought, or situation visually. After receiving the basic lessons, the student's responsibility is to expose, develop, enlarge, and submit his particular photo essay as outlined in the unit. Field trips are planned to local plants that will reinforce classroom activities of the particular units. For example, in the planographic unit, each student completes the total process of lithography including the making of line negatives, offset plate, and press work. On the field trip, he sees the exact same thing in terms of classroom principles applied to industrial occupations. The program is concerned with teaching the basic principles by use of meaningful student activities that pertain to each unit and not with teaching skill development. In this introductory level, the principles of lithography can be taught equally well, for example, with a table-top offset press as with a large expensive floor model.

The student in this program represents a cross-section of the total student body. Honor society senior girls are enrolled in the course with ninth grade industrial arts boys, students who have been accepted in four-year engineering schools, and those students entering the world of work via industrial apprenticeship programs. Each segment of the student body is receiving from the course what his particular interest dictates. Some students are interested in knowing what methods and procedures are used to produce the multitude of printed material we receive in our society. Other students are searching for occupational and career choices.

A student at the end of the Level I course may terminate his formal graphic arts education, depending upon the particular individual needs, or enroll in the Level II program. At this point, he has received an introductory course related to the basic printing processes, including photography.

The Level II graphic arts program is designed for those students who have completed Level I graphic arts and have indicated a desire to continue studying in this area. This level is a full-year course giving the student a broader and more than introductory experience in graphic arts.

Each student in Level II covers six major units of study: offset lithography, photography, packaging, photo screen process printing, field studies, and a research project. In the offset lithography unit, the students become very proficient in each of the major steps of the process. Activities are directed so that the students become involved with design, layout, paste-ups, line and half-tone negatives, offset plates, and press and bindery operations. The activities may include the school newspaper, programs, posters, interdisciplinary activities, or any agreed-upon printing project. The photography unit finds the students involved with composition, techniques of camera handling, using 35mm, 2-1/4 x 2-1/4, and 4 x 5 size cameras, and developing, enlarging, and mounting photographs. The subjects of the photographs range from still lifes to portraits, to the abstract, and to the emotions. The packaging unit allows the student to apply what he has learned about printing and at the same time broaden his knowledge by the study of design, advertising, creasing, and diecutting. Besides completing major units of study in lithography, photography, and packaging, each student is responsible for completing a unit of research. This is an individual project in an area of the student's interest. It may include such topics as photomicrography, underwater photography, holography, lithographic ink, or a study of web presses. Whatever the topic, the student is responsible for researching the material on his own, using the school and community as resources.

The graphic arts laboratories in Greece are very well equipped to support all of the units of instruction. In the area of offset lithography, there is a separate darkroom for a horizontal process camera, temperature-controlled sink, and an ectamatic processor. Composing equipment consists of a selectric typewriter, varityper, and photographic headliner. The platemaker and plate developing sink support the offset presses that have a maximum sheet size of 11 x 17. The black and white darkroom has four enlargers and a center isle temperature-controlled developing sink with a continuous drum washer and drum dryer. Each course is written with measurable educational objectives that define the principles of printing; then and only then is the equipment purchased to support the identified program.

The Level III graphic arts program is designed for those students who have decided to pursue a life-long career in graphic arts. At this level, students are preparing themselves for when they leave school.

The program at this level depends upon the particular interests, desires, and capabilities of the individual student. A student may indicate that he desires to be an offset pressman. His course would then be designed to help him achieve this desired outcome. The individual contract for this student would include many activities on the offset presses, a work observation program in the press room of industry, and participation in the district co-op program. While this contact of skill development and work observation is designed for one type of student, it is not relevant for all Level III students. A student applying to a college of printing would require a different program. His contract would call for math, science, and research as applicable to graphic arts. He would be researching and performing tests related to paper, ink, and the chemistry of photography. At the same time that individual contracts are being filledout, common core units in color separation, skill in making line and halftone negatives, and offset press work are being completed. This level of graphic arts is characterized by flexible specialization in a career choice.

One of the most exciting aspects of the high school graphic arts program at Greece Arcadia High School is the printing of the Arcadian Reed.

Each week at Arcadia High School, the Arcadian Reed is published. This is completely student-oriented from start to finish and is edited by the student staff. On Monday of a typical week, the student editor is responsible for the collection and editing of the articles that are to appear in the Reed for that particular week. Besides the regular department staff editors handling sports features and news, everyone is encouraged to write for the Reed. Once the selection of articles has been made, they are turned over to the business department fot the secretarial skills. The business department is responsible for transforming the typed or handwritten articles into justified galleys of type on an IBM MTST composer. On Wednesday, the art department is responsible for making the mechanical, or paste-up copy and any other art work or illustration. On Thursday morning, the graphic arts department gets the camera-ready copy. The graphic arts students then make the line and halftone negatives, plates, and necessary presswork to produce

2000 copies printed on both sides of an 11 x 17 sheet of paper. On Friday at lunch time, the Arcadian Reed is distributed free to each member of the student body.

With this formal style and procedure, many more students are involved in producing the student paper and writing articles. Each department of the school has specifically defined tasks and due dates for these responsibilities. The students learn quickly what happens to the end product when one department fails in its responsibility. The most important aspect of this paper is the humanistic attitude developed between the departments of the school. It is very exciting to watch a national honor society girl beside an industrial arts boy in the print shop, working together on a common goal. Each segment of the school gets to know and respect the other a little bit better.

Operating simultaneously in the graphic arts room is the district production printer. While many industrial arts teachers would find this objectionable, the graphic arts teacher has found it an almost ideal situation. The district production printer is responsible for all of the production work that would be required in a district our size. The teacher is responsible for the graphic arts education, but can use any part of production for education without being responsible for district production schedules.

After school, vacations, and summers, the program has a district printing co-op program where students who have completed the Level I program can apply to work. The co-op program has three levels of performance and three corresponding pay levels. Students on the third level basically perform bindery operations such as cutting, stapling, and collating. The second level is mostly machine operation such as operating offset presses, process camera, and the platemaker. The top-level job is production planning and supervision. At this level, a student would plan and estimate printing jobs along with supervising student workers. All co-op students start at the third level of performance. As the student's ability improves and production needs develop, he can be promoted to the second and top levels. This program provides real "on the job" experience for the students.

The program now has a tri-level course structure, weekly newspaper production, district co-op program, and flexible specialization for all Level III students. Industry is changing, and it is the responsibility of the industrial arts teacher to keep abreast of these changes. The task is not as impossible as it may at first sound when the industrial arts teacher concerns himself with basic principles and is not overpowered with merely the machines of technology.

Mr. Skeet teaches at Greece Athena High School, Rochester, New York.

Business of the Association

Minutes of the Delegate Assembly Business Meeting

April 22, 1971
Miami Beach, Florida

Edward Kabakjian

President Sherwin Powell called the meeting to order at 3 p.m. and instructed the seating of the delegates. Mr. Powell appointed Dr. Ralph Bohn as Parliamentarian for the business meeting.

Mr. Powell called for the reading of the minutes of the 1970 Annual Business Meeting. Dr. Edward Kabakjian, Executive Secretary, read the minutes. Dr. Lou Ecker, Michigan, moved for acceptance of the minutes. Frank Hayes, Indiana, seconded the motion which carried.

Mr. Powell called for the reading of the treasurer's report. Dr. Kabakjian read the treasurer's report dated March 31, 1971. Paul Kube, Pennsylvania, and Bill Scarborough, South Carolina, moved and seconded a motion accepting the report. The motion carried.

Some questions concerning the AT&T bond owned by the association and other securities were raised and answered. Herb Roster, New Jersey, mentioned that other organizations provide a breakdown of their income and expenditures. The suggestion was accepted by the treasurer with the promise of giving the idea some thought for future annual reports.

Mr. Powell called for old business. No old business was presented from the floor.

Mr. Powell presented the president's report. He announced that his oral statements were just a summary of the formal report to the membership which was scheduled for appearance in the Monitor and convention proceedings. His report included activities of the committees of the association and of the regional forum project.

Mr. Powell moved into new business by asking Dr. Kabakjian to read the proposed changes in our bylaws as recommended for consideration by the Executive Board. After reading the proposed changes, Dr. Kabakjian responded to questions raised by the Delegate Assembly on the details of limiting life memberships in the association. Jack Ford, Ohio, moved to endorse the proposed changes in the bylaws, and Garth Hill seconded the motion before it passed.

Dr. Ditlow, Immediate Past President, was asked by Mr. Powell to present the proposed resolutions to the delegates for their consideration. Dr. Ditlow moved the acceptance of the acknowledgment resolutions A-71-1 through A-71-10. Gerald Steele, Indiana, seconded the motion which received full support of the delegates.

A series of editorial changes were moved and approved on the standing resolutions which were presented by the Resolutions Committee. All five standing resolutions were moved for acceptance by Dr. Ditlow and approved by the delegates. The resolutions received their seconds from: S-71-1, Dr. Walter Brown, Arizona; S-71-2, Earl Quinn, Georgia; S-71-3, Dr. Kenneth Shank, New York; S-71-4, Dale Jones, Ohio; and S-71-5, Charles Earhart, Ohio.

Dr. Ditlow presented the current resolutions and individually moved for their adoption. Each resolution was individually seconded and approved. Seconds were rendered by: C-71-1, Ted McCoy, California; C-71-2, Robert House, Georgia; C-71-3, Robert Sharp, Maryland; C-71-4, John Geil, Florida; C-71-5, Horace Mayo, Minnesota; C-71-6, John Sellerole, California; and C-71-7, Arthur Roser, New Jersey.

After several brief announcements were made, the meeting was adjourned at 5 p.m.

Teacher Recognition Program

Recognition of Outstanding Teachers

Thomas B. Doherty

As you are well aware, many most complimentary things have been said about good teachers. In some cases there may have been some exaggeration, but in most instances, I am sure these are true.

I am in complete accord that the quality of a school system is closely related to the quality of those who teach. The nature and excellence of education in our country will be determined largely by the ability, preparation, devotion to duty, and responsibility on the part of those who teach. Education in America cannot rise above the general level of the quality of the membership of our profession.

Love of learning, curiosity, self-discipline, intellectual honesty, the capacity to think clearly—these are the consequences of a good education. The performance of the teacher then is the key to this type of education. In the last analysis, what really makes the difference is how the teacher does his job. In his hands lies the realization of the goals and objectives for which the students go to school and the public pays the bill.

There are still many people in our society (and I think this is good) who look to the teacher as a kind of ideal. In fact, some expect the teacher to be an almost perfect example for our youth to emulate. In truth, then, perhaps teachers constitute a kind of conscience in our society. Closely related to this concept is an old adage about teaching that says, "What you are cries out so loudly I cannot hear what you say."

With great concern today for accountability and the quality of teaching, there is also considerable debate over the question of what are the criteria that are applicable in determining what constitutes a good teacher. It all relates also to questions of teacher evaluation, about which there are some fine efforts being made.

I think this group would agree that there is no doubt that skill in using a saw is certainly an important requisite for a teacher of woodworking—but not for the teacher of literature. Likewise, knowledge of the best method in presenting certain algebraic concepts is vitally important to the teacher of mathematics—but not to the teacher of French. However, I believe that just as the various disciplines exhibit common features, so does good teaching, in general, have a body of important characteristics.

If the features common to good teaching of the various subjects are emphasized, then criteria can be formulated which apply not merely to the teaching of a particular subject, but actually to all teaching. This will provide an important body of information on the perplexing question of how to teach. Much higher standards and greater competency must be the future goals of our teaching profession.

I think it is indeed most appropriate that your association sees fit to recognize those whose performance and competence have been judged to be outstanding. I commend you for this action and urge your colleagues in their related associations to do likewise.

To those who have been selected, we all join in a most hearty congratulations on this distinction which is yours today. I know that you will always maintain these same standards of performance in your continuing years of professional work. And lastly, let me remind you, our country must remain strong and vigorous. Our economy and our productivity must improve. The individual must be free to shape his life in a manner of his own choosing—but must be prepared to master his own destiny. Industrial education must and will play an important role in this adventure, and you who teach it face a great challenge and a great responsibility.

The future can be promising, but very difficult. It likewise can be tremendously exciting.

Again, congratulations and best wishes to those who have been recognized as the Outstanding Teachers of 1971!

Mr. Doherty is the Superintendent of Schools, Colorado Springs Public Schools, District No. 11, Colorado Springs, Colorado.

Teacher Recognition Committee Report

At the annual AIAA convention in Miami, a record 56 teachers were honored as "Outstanding" among their peers, representing 50 states, four Canadian provinces, Puerto Rico, and the District of Columbia.

In his report on the Teacher Recognition Program, Jere M. Cary, AIAA Vice-President for Classroom Teachers and Chairman of the Teacher Recognition Committee, noted that the number of teachers receiving the award has risen from 21 in 1963 to the all-time high of 56 this year. This remarkable increase indicates a significant degree of support and a lot of hard work on the part of many individuals and state associations, as well as on the part of the Teacher Recognition Committee itself. This committee consists of seven members, besides Mr. Cary. as follows: Russell Amling, Dennis Harley, Frank Kanzaki, William Wilkinson, Sivert Joramo, Dan Lopez, and T. L. Bay.

Criteria established for teachers receiving the award are as follows: The teacher who will receive the award should be selected on the basis of his demonstrated ability in the classroom teaching of industrial arts, and the following suggestions are for consideration:

(a) rapport with students
(b) ability to motivate student interest in industrial arts
(c) success in upgrading industrial arts in the total school
(d) ability to use ingenuity in organizing the situation at hand
(e) a well-grounded philosophy in industrial arts education

The recipient must be an industrial arts classroom teacher below the college level. The recipient should be an active participant in pertinent professional educational associations on the local, state, and national levels. The recipient must be a member of the AIAA at the time of his nomination.

These are basic guidelines for teacher selection. Many state associations set up additional criteria, so that the award will be the most meaningful in that state.

Following are the Outstanding Teachers for 1971 and the associations which sponsored them.

Nicollena Kirkland, Alabama Industrial Arts Teachers Association; John E. Hurlbut, Alaska Industrial Arts Association; Lee BeDillon, Arizona Industrial Arts Education Association; Ed Hogan, Arkansas Industrial Arts Association; S. Bud Gallaro, California Industrial Education Association; Alfred Perrella, Colorado Industrial Arts Association; Robert A. Mercuri, Connecticut Industrial Arts Association; Carl V. Dreisbach, Jr., Delaware Industrial Arts Association; Virgil Ewing, District of Columbia Industrial Arts Association; Lowell T. Hudson, Florida Industrial Arts Association; Billy R. Page, Georgia Industrial Arts Association; John T. Masuhara, Hawaii Industrial Arts Association; Layle F. Bagley, Idaho State Industrial Arts Association; William E. Borror, Illinois Industrial Education Association; Dennis M. Benson, Indiana Industrial Education Association; William R. Reams, Iowa Industrial Arts Association; William P. Elrod, Kansas Industrial Education Association; George W. Martin, Kentucky Industrial Education Association; Joseph Mickey Hebert, Louisiana Industrial Arts Association; Robert C. Reed, Maine Association for Industrial Education; Robert L. Norris, Maryland Industrial Arts Association; Gardner P. Sherman, Massachusetts Industrial Education Society; Stig E. Ralstrom, Michigan Industrial Education Association; Floyd W. Wurscher, Minnesota Industrial Arts Association; Owen W. Keeling, Mississippi Industrial Arts Association; Tony L. Killen, Missouri Industrial Education Association; Howard L. Vanover, Montana Industrial Arts Association; Evan L. Boller, Nebraska Council on Industrial Teacher Education; Eldon P. Quinney, Nevada Industrial Arts Association; Neal D. Gadwah, New Hampshire Industrial Education Association; Fred W. Puhlfuerst, New Jersey Industrial Arts Education Association; William A. Simmons, New Mexico Industrial Arts Association; Alfred E. Wieda, New York State Industrial Arts Association; Jeff J. Laws, North Carolina Industrial Arts Association; Earl B. Marshall, North Dakota Industrial Arts Association; Charles E. Earhart, Ohio Industrial Arts Association; Joe B. Richards, Oklahoma Industrial Arts Association; Ivan B. Burkert, Oregon Industrial Arts Association; Paul A. Kube, Pennsylvania Industrial Arts Association; Albert R. Mezzanotti, Rhode Island Vocational & Industrial Arts Association; Ephriam G. Cope, Jr., South Carolina Industrial Arts Association; David C. Walker, South Dakota Industrial Education Association; Roger T. Brown, Tennessee Industrial Arts Association; Curtis O. Oliphant, Texas Industrial Arts

Association; G. Duane VanAusdal, Utah Industrial Arts Association; Richard W. Cole, Virginia Industrial Arts Association; John Bicknell, Vermont Industrial Arts Teachers Association; Dale C. Hasselberg, Washington Industrial Arts Association; Robert M. Hardy, Sr., West Virginia Industrial Arts Association; Donald R. Anderson, Wisconsin Industrial Arts Association; Dwight J. Jundt, Wyoming [illegible]ustrial Arts Association; Luther E. Judt, Manitoba Industrial Arts Association; [illegible] Peters, Industrial Arts Council of the New Brunswick Teachers Federation, Provincial; [illegible]. Peter Lawson, Ontario Industrial Arts Association; Harold A. L. Pym, Saskatchewan Industrial Education Association; and Angel F. Aviles, Puerto Rico Industrial Arts Association.

Resolutions and Expressions Approved by the Delegate Assembly

ACKNOWLEDGMENT RESOLUTIONS

A-71-1 Appreciation to the President. Whereas Sherwin Powell, as president of the American Industrial Arts Association, has given so liberally of his time and his talents, exhibiting an outstanding capacity for leadership, and

Whereas the Association has made exemplary progress under his leadership,

Be it herein recorded that the Association, through its membership, officers, and executive board, express its fullest appreciation to him.

A-71-2 Appreciation to the Convention Committee, the Program Committee, and the Program and Convention Participants,

Inasmuch as the Thirty-third Annual Convention was possible through the direct dependable and efficient service of great numbers of members of the Association, and inasmuch as the convention has achieved a resultant outstanding level of success,

Be it herein recorded that sincerest appreciations are expressed to B. Stephen Johnson, general chairman; Ralph V. Steeb, program chairman, to the members of convention committees, and to all the teachers, supervisors, teacher educators, and students whose efforts in total produced this convention.

A-71-3 Appreciation to the SHIP. Inasmuch as the continuing support for and participation in the conduct of the annual convention of the Association, and in view of the excellence of this year's commercial exhibits as a dominant feature of the convention,

Be it herein recorded that the American Industrial Arts Association expresses its appreciation to Educational Exhibitors for their participation in the 1971 convention.

A-71-4 Appreciation to the Teacher Recognition Program. Inasmuch as the Association is dedicated to encouraging excellence in teaching, and inasmuch as its program of recognition of outstanding teachers is marked with increasing excellence,

Be it herein recorded that expressions of appreciation are tendered Jere Cary, vice president for classroom teachers, and his committee for their contribution in the conduct and promotion of this program.

Be it also recorded that appreciation is expressed to the officers and members of state associations who have participated in this program.

A-71-5 Appreciation to the Governor of Florida. In view of his support for industrial arts in Florida and for the 1971 Conference of the Association in Miami Beach,

Be it herein recorded that the Association expresses its appreciation to Governor Rubin Askew for his and their assistance in making this convention a success.

A-71-6 Appreciation to the Commissioner of Education. Because the progress of industrial arts education within each state reflects the philosophy and efforts of the Chief

School Officer, the Association expresses its appreciation to the Florida Commissioner of Education, Floyd T. Christian, for his demonstrated support of industrial arts education and this convention. This appreciation is extended further to Dr. Carl W. Proehl, Florida Director of Vocational, Technical, and Adult Education, for his cooperation toward this convention and for his achievements for the improvement of industrial arts education in this state.

A-71-7 Appreciation to the Public Schools. Inasmuch as the success of the 1971 convention was insured by the fullest cooperation of Dr. Benjamin C. Willis, Superintendent of Public Instruction of Broward County, and Dr. Edward Whigham, Superintendent of Dade County, and their staffs,

Be it herein recorded that the officers and members of the Association express their gratitude for their assistance.

A-71-8 Appreciation to the National Office. Because of the vital role of the national office in the effectiveness of the service of the Association and in view of the excellence of his management and leadership in his second year as its executive secretary-treasurer, the full appreciation and confidence of the membership and the executive board is herein expressed to Edward Kabakjian and all of the National Office staff under his direction.

A-71-9 Appreciation to the Puerto Rico Delegation. Inasmuch as the success of the 1971 convention can be attributed to both the professional and social functions of the various committees and participating groups, the AIAA commends the Puerto Rico Delegation for their exemplary participation and contributions to the Espri de corps of this convention,

Be it herein recorded that the officers and members of the Association express their gratitude for their continued loyalty in furthering the purposes of industrial arts on an international level.

A-71-10 In view of the magnitude of the personal service to the American Industrial Arts Association rendered by George H. Ditlow, who has served as its convention chairman since 1958, as well as its president for 1969-70, giving unduly generously of his time, leadership, and expertise without thought of recompense, the membership of the organization herein acknowledges its appreciation with the realization that if the increasing successes of its national conventions can be attributed to any one person, that person is George H. Ditlow.

STANDING RESOLUTIONS

S-71-1 The AIAA believes that excellence in the classroom is the foundation of a good education system. The Association therefore supports the philosophy that only properly certified individuals be permitted to teach industrial arts. The Association further seeks the abolishment of all substandard teaching certificates currently being issued.

S-71-2 The AIAA believes that an industrial arts program offers one of the best educational opportunities that can be used to help young people grow to the maximum of their individual abilities; therefore the Association further believes that a program of industrial arts should be offered in all elementary, middle, and secondary schools in the nation.

S-71-3 The AIAA believes that program and institution accreditation assures the continued development of quality programs of instruction. To this end, the AIAA encourages its committees and member councils to formulate accreditation standards for all programs of industrial arts conducted in elementary, middle, and secondary schools, colleges, and universities. The standards should be designed to promote improvement through self-evaluation as well as provide criteria used by accreditation agencies.

S-71-4 The AIAA believes its effectiveness would be greatly enhanced if its total membership more closely approached the maximum potential number of industrial arts teachers. The Association therefore encourages its members to make a personal commitment to put forth a sustained effort to increase membership.

S-71-5 The AIAA believes that a maximum effort should be expended in soliciting membership for and continuing the development of the industrial arts student clubs.

CURRENT RESOLUTIONS

C-71-1 The AIAA endorses and lends its support to the international movement to standardize and convert to the metric system. This Association shall employ such activities or actions so that

*a goal of complete conversion to the metric system within the decade of the 70's be adopted by the government of the United States of America,

*instruction in the metric system be made effective in all elementary and secondary schools, colleges, and particularly in teacher education institutions,

*the metric system be used in professional, technical, and general communications and publications of this association, and

*industry be encouraged to convert its equipment, products, and publications to the metric system.

C-71-2 The AIAA recognizes the valuable contributions in the establishment of interdisciplinary communications and program development produced by the Consortium of Professional Associations (CONPASS). The exchange of ideas and the cooperation among disciplines has been of great value to the AIAA. The Association, therefore, encourages the U.S. Office of Education and CONPASS to take all necessary steps leading to the continuation of CONPASS and the valuable contributions to education produced by the cooperative efforts of the member associations.

C-71-3 The AIAA encourages the allocation of funds and staff personnel for the development of college courses reflecting recent industrial arts curriculum changes. Further funds are also requested to effect certain changes in the physical plants to implement these new curriculum patterns in schools, colleges, and universities throughout the nation.

C-71-4 The AIAA believes that a program of continuing education is vital to the professional growth of in-service teachers. The Association endorses the establishment of a financial reimbursement program which would compensate school districts for monies expended in reimbursing their professional employees who were enrolled in in-service programs for the purpose of improving the teacher's expertise in teaching industrial arts.

C-71-5 WHEREAS the National Education Association has taken a stand for, and

WHEREAS it would be of direct benefit to the AIAA, and

WHEREAS to have a separate cabinet post for education would help all students in the nation,

THEREFORE, be it resolved that the American Industrial Arts Association is in favor of establishing a Department of Education with cabinet-level status within the federal government.

C-71-6 A resolution that the title "Annual Convention" of the American Industrial Arts Association be changed to "International Conference...."

that the conference format include workshops, demonstrations, and seminars

that professional credit and recognition be granted for participation in the conference activities

that every professional effort be made to obtain released time, pay, and allowances for participation in the conference.

C-71-7 WHEREAS occupational and career training is only one element in the education of youth in a highly advanced and complex civilization and should not become the major thrust of education in the United States and

WHEREAS general education programs in the public schools of the United States provide and contribute directly to the development of substantive foundation for all vocations and

WHEREAS industrial arts has been and continues to be a major contributor to the development of basic and fundamental knowledge, attitudes, and understandings of career and occupations related to industry and technology, and

WHEREAS the present practice of federal funding subverts these basic elements of education concerning the critical role of education in the preparation of youth for effective decision-making with respect to career or occupation;

Therefore, be it resolved that the American Industrial Arts Association advise all audiences that it is the only national professional organization that speaks specifically for industrial arts;

BE IT FURTHER RESOLVED that educational programs with general education objectives relating to career and occupational goals in the area of industry and technology be identified as "industrial arts;"

BE IT FURTHER RESOLVED that the American Industrial Arts Association establish a liaison structure to represent industrial arts in all forums relating to the question of educational programs involving subject grouping and general education objectives which contribute directly or indirectly to the capability of youth to make decisions regarding the proper selection of a life's work.

BE IT FURTHER RESOLVED that a planned program of action be developed and initiated by the Executive Board of the American Industrial Arts Association for the preparation and distribution of a definitive position statement concerning youth, careers, and occupations together with the proper funding by the states and the federal government of programs related to these goals.

The President's Report, 1970-71

Sherwin Powell

While serving my sixth consecutive year on the Executive Board of the American Industrial Arts Association, I have had the opportunity of working with a group of men whose dedication to our field of industrial arts could not be surpassed. It has been my fortunate experience during this period of time to work with three Executive Secretaries —Dr. Ken Dawson, Dr. Howard Decker, and Dr. Edward Kabakjian. All three have done much to promote and improve industrial arts in our educational system.

I am happy to report that during 1970-1971 the American Industrial Arts Association has continued to grow both professionally and in services to its members. To illustrate this growth, I would like to review some of the Association's activities for this year.

PUBLICATIONS

This is the first year that your journal was published in eight issues instead of five as in previous years. The new format and the new name MAN/SOCIETY/TECHNOLOGY has produced positive results. Our journal is presently being subscribed to by many people and organizations not only in industrial arts but in other areas of education as well. Under the leadership of our Executive Secretary and Miss Linda Taxis, the journal was organized with a central theme for each issue. The many favorable comments from members of our profession and others have proved that this change was most welcome.

The MONITOR, which is presently being published three times a year, brings us timely up-to-date news of industrial arts activities in the United States as well as from overseas.

HANDBOOK FOR OFFICERS AND COMMITTEE CHAIRMEN

A complete organizational handbook was developed and presented by George Ditlow, your immediate past president. This has been placed in the hands of all officers and committee chairmen for their use in conducting the affairs of the Association in line with the Constitution and By-laws.

DIRECTOR OF PUBLIC RELATIONS AND ADVERTISING

This year Mr. Rick Barrow was hired to design and create brochures and publications with a new look to promote our Association as well as industrial arts. These have been distributed directly to our advertisers and exhibitors which has resulted in new memberships and new advertising.

MAN, SOCIETY, TECHNOLOGY FORUMS

In January 1970 your entire Executive Board attended the first Man/Society/Technology Forum held in Washington, D.C. A direct result of this first forum was the plan to proceed to the second phase of this project—Regional M/S/T Forums. Dr. C. Dale Lemons was named Project Director. To date three of these forums have been held, with five more scheduled. Dr. Lemons, with the assistance of regional coordinators and state coordinators, has done an excellent job of organizing these forums.

The intent and purpose of the forums was to bring together leaders from government, business and industry, labor, and education. These participants have informally discussed mutual problems, with suggestions for possible solutions. The ultimate goal is for group cooperation to improve industrial arts teacher education programs and industrial arts education for the teachers and the youth in our classes.

Through opportunities to discuss, organize, and plan phase three of this project, leaders in each state are beginning to reach all industrial arts teachers using workshops or inservice seminars so that industrial arts programs can be revitalized for our youth.

CONFERENCES

The American Industrial Arts Association took active leadership roles in several conferences held this year.

1. On an international level, we were represented at The International Education Year Conference, October 15-16, at Kansas State University. Dr. Victor Sullivan of Kansas State University was AIAA's representative.

2. We were represented at the White House Youth Conference December 14-18 by Walter Comeaux, President of the American Industrial Arts Student Association.

3. Your association was represented at and played an active part in The Williamsburg, Virginia, Conference for NEA Executive Secretaries and affiliated association officers. This conference sparked a better relationship between the other subject matter NEA-affiliated associations and produced a group of resolutions of common concern to the NEA. These resolutions were printed in the winter issue of the MONITOR.

4. Dr. Bohn and Dr. Kabakjian represented the AIAA on the Executive Board for Consortium of National Professional Associations commonly called CONPASS. It was this organization which helped to finance our first M/S/T forum. Late news tells us that the funding for CONPASS has been terminated. Your association is formally exploring possible means of continuing funding for this consortium.

5. Lambert Sailer, one of our Classroom Teacher Vice Presidents, and your Executive Secretary attended a hearing sponsored by Health, Education, and Welfare in Pennsylvania. Dr. Robert Woodward attended a similar hearing in San Francisco, and Dr. T. Gardner Boyd attended one in Kansas City. These hearings were held across the country to resolve some of the details of President Nixon's plan for financing education.

6. Metric System Conference. Our Executive Secretary presented a report at a Department of Commerce hearing on the effects of metrification on Industrial Arts Education. Reports were submitted to him by the Curriculum Committee of AIAA, the Council for Elementary School Industrial Arts (ACESIA), and by the American Council on Industrial Arts Teacher Education (ACIATE). A compilation of these reports was presented to the Department of Commerce hearing, along with testimony of other educational specialists.

7. The YEAR OF THE LIBERAL ARTS CONFERENCE was sponsored by the Trainers of Teachers Trainers (TTT) in Phoenix, Arizona. AIAA was represented by Dr. Kenneth Brown and Dr. C. Dale Lemons.

8. Your officers are presently preparing information and factual material to be presented to several congressional committees and subcommittees in the very near future. Most of these committee hearings will be to inform, clarify, answer questions, and present the purposes of industrial arts education.

These are just a few of the many activities pursued by the officers and members of your association. We can be proud of these accomplishments and look forward to your participation in the years ahead.

EDUCATION - NATIONAL LEVEL

The AIAA has taken a leadership role in promoting a Department of Education at the Cabinet level. This was one of the resolutions developed at the Williamsburg, Virginia, Conference and members were informed in our last MONITOR. The NEA in its journal last week is also adding momentum to this drive. Your president is requesting the membership of our organization to write individual letters to President Nixon asking for this cabinet-level Department of Education.

The American Industrial Arts Association is still actively working with the Emergency Committee for Full Funding of Educational Programs. This was the committee which had much to do in influencing congress to override President Nixon's veto of the 1971 fiscal educational appropriations bill.

Your immediate past president and your Executive Secretary represented AIAA in an NEA hearing on the Constitutional Convention. AIAA and the 27 other affiliated organizations made their wishes known to the NEA Con-Con Committee. The Con-Con will meet this summer in Fort Collins, Colorado, with delegates from all states.

NEW EDUCATIONAL PROPOSAL

Your Executive Board has submitted a proposal for funding a new project. This project, if funded, will be for the improvement of teacher education programs and will involve teacher trainers and classroom teachers during the summer of 1971. The title of the project is "Man, Society, Technology—An Integrated-Interdisciplinary Approach to Teaching the Culturally and Economically Disadvantaged Middle School Student."

If funded, this project would be the first of many tangible outcomes from the M/S/T national forums.

NATIONAL ASSOCIATION OF MANUFACTURER'S REPORT

This year the NAM made a study of and offered recommendations concerning industrial-vocational education in the United States. They are recommending closer cooperation of members of industry with industrial arts educators to keep our programs updated and current with the latest technological advances.

INTERNSHIP PROGRAM

Dr. Paul DeVore was named chairman of an Ad Hoc committee to study the feasibility of a Professional Association Internship Program for AIAA. He will make his report to the Executive Board here in Miami. Dr. DeVore will investigate the possibilities of an intern to work in our national office to learn professional association activities. If this is possible, our Executive Secretary would gain some much needed professional assistance in our AIAA office.

NATIONAL OFFICE PERSONNEL

We have had some changes in the staffing of the National Office. All positions presently are filled with the exception of the Editor's position. Miss Linda Taxis resigned and her position has not been filled. The Association regrets the loss of Miss Taxis because of her fine work on our publications for the past 4 years.

COUNCIL ACTIVITIES

Our Councils, who are the active backbone of our Association, have been very active this year in promoting industrial arts in their areas of responsibility as well as their association with AIAA.

I will review only the major contributions completed by each of the councils for this year. All councils have on-going programs which continue to promote industrial arts education throughout the country.

AMERICAN COUNCIL FOR ELEMENTARY SCHOOL INDUSTRIAL ARTS (ACESIA)

Robert G. Hostetter serves as the president of ACESIA this year. He reports that members of ACESIA received copies of the National Conference on Elementary School Industrial Arts. This conference was held during the school year of 1969-1970. Many members of ACESIA were involved in this conference.

AMERICAN COUNCIL OF INDUSTRIAL ARTS SUPERVISORS (ACIAS)

Dr. Ralph Steeb served as president of ACIAS this year. He reports that this council's bulletin, Guidance in Industrial Arts Education for the 70's, was printed in two issues of MAN/SOCIETY/TECHNOLOGY journal this year. This bulletin has been printed and is now available from our national office.

The revised bulletin, Industrial Arts Education: Philosophy, Program, Facilities, Supervision, is now available, also from our national office.

A new bulletin on Industrial Arts in the Middle School, which has been in progress for two years, will appear in the M/S/T journal and also as a separate bulletin.

The Supervisors found that their special meeting in last year's Louisville convention was a success so they have met here in Miami for a full day before the beginning of this convention.

AMERICAN COUNCIL ON INDUSTRIAL ARTS TEACHER EDUCATION (ACIATE)

Dr. Donald G. Lux is President of ACIATE this year. He reports that the 1971 yearbook is printed and is available to members at this convention. This year's publication is devoted to an intensive study of the basis for improving the technical and professional elements of the undergraduate teacher education curriculum.

Dr. Lux reports that all committees are working on job-oriented assignments. The research committee under the direction of Mr. David Jelden of the University of Northern Colorado has published the most comprehensive compilation of industrial arts research which has ever been written. The second compilation is now available, and it will be updated each year.

AMERICAN COUNCIL OF INDUSTRIAL ARTS STATE ASSOCIATION OFFICERS (ACIASO)

William Kabakjian, Jr., is the President of ACIASO. This organization achieved council status during the summer Executive Board meeting in 1970. President Kabakjian currently represents this council as a Vice President on the AIAA Executive Board. The council is electing seven vice presidents, one to represent each region of the country.

The purpose of the council is to strengthen and promote state associations. State association officers have been meeting yearly for the last 15 years at our annual conventions. The official formation of the council with a member on the AIAA Executive Board has been the dream of many of our leaders for the past 10 years.

State Representatives as well as present and past state officers are encouraged to join this council. All state associations are encouraged to have officers present at all meetings to assist in reaching solutions to common problems.

AIAA COMMITTEES

The work done by our AIAA committees cannot be overemphasized or underestimated. The committees function throughout the year and use the convention as a starting and continuing point. New members have been encouraged to "sit in" and be "oriented" to the committee work at this convention. A regional system for appointment and function of committees assures members across the country that all regions are represented. New appointments will be made to keep regional representation on all committees.

Very briefly, I would like to report on the work of the committees:

ACCREDITATION AND EVALUATION COMMITTEE

Chairman, Dr. Howard S. Decker

The committee has developed three working papers entitled (1) Standards for Industrial Arts Programs, (2) Standards for Industrial Arts Professionals, and (3) Industrial Arts Evaluation Instrument. The committee has presented these papers to the Association at this convention. They will be printed and made available to the profession for revision and evaluation.

COLLEGE CLUB COMMITTEE

Chairman, James Snyder

This year the Industrial Arts College Clubs will have a series of programs designed to interest and challenge their members. They have reserved times on Wednesday, Thursday, and Friday during the convention for their special meetings.

CONVENTION COMMITTEE

Convention Director, Dr. George Ditlow

While serving as President of the Association, Dr. Ditlow recommended appointment of a new Convention Director. Dr. Irvin J. Shutsy was selected by the Executive Board to fill this important position. He will assume his new duties at the close of this convention.

Your convention committee has selected sites and established dates for the following conventions:

1972 - Dallas, Texas - March 26-30.
1973 - Atlantic City, New Jersey - April 2-7.
1974 - Seattle, Washington - April 16-19.
1975, 1976 - Still under investigation and pending.

CURRICULUM COMMITTEE

Chairman, Jarvis H. Baillargeon

The curriculum committee has spent two years on a breakdown and comparison of 10 industrial arts curriculum proposals. This report completed during the last convention in Louisville was printed in the Fall 1970 issue of the MONITOR. This committee has made a study of the metric system and how the change to the metric system would affect industrial arts teaching. The committee will present a resolution to the delegates of this business meeting for their reaction.

AMERICAN INDUSTRIAL ARTS STUDENT ASSOCIATION

Chairman, Andrew Gasperecz

The American Industrial Arts Student Association Committee has developed a proposal this year relating to securing outside financing for the operation of the club program. This proposal was presented to the Executive Board and is being considered for implementation.

INTERNATIONAL RELATIONS COMMITTEE

Chairman, Thomas Brennan

The committee has developed an international mailing list of personnel who should receive professional and AIAA literature. These people were invited to attend this convention.

Because of the location of this year's convention, the committee prepared a special mailing to South American Industrial Arts Administrators.

Members have been added to this committee from Hawaii and Puerto Rico to round out its representation.

The committee has made a study of the World Confederation of Organizations of the Teaching Profession (WCOTP) and made its report and recommendations to the Executive Board at this convention.

TEACHER RECOGNITION COMMITTEE

Chairman, Jere Cary

Jere Cary, one of our classroom teacher vice presidents, has headed this committee during his two-year term. For the second time, the committee has achieved 100% participation by all states. The committee also has four provinces from Canada with teachers receiving this recognition.

You are invited to honor these teachers in the program to follow at 4:30 and take part in the reception which follows at 5:30 at poolside in the Deauville Hotel.

Special thanks are extended to all State Representatives and State Association Officers for their cooperation with the teacher recognition committee. Let's help keep all of our states participating in this most important public relations program for recognizing classroom teachers.

NOMINATIONS COMMITTEE

Chairman, James L. Grossnicklaus

The nomination of candidates and election of officers was completed prior to the convention this year. The elected officers were notified more than 30 days before the start of the convention. This advance in the timetable was an extra burden on the nominating committee. The nominating committee for 1971-72 has already started work under the leadership of Dr. John Geil, and Dr. C. Dale Lemons will serve as chairman for 1972-73.

PUBLIC AND PROFESSIONAL RELATIONS COMMITTEE

Chairman, E. L. Barnhart

Our Association has been requested to provide for a traveling display for conventions and conferences to explain or advertise industrial arts. This committee has designed an attractive display which can, with very little effort, be shipped to any location and set up to display industrial arts with brochures, pictures, and publicity information. This committee is designing a brochure, This Is Industrial Arts, as a publicity handout.

The committee is also investigating the desirability of promoting an "Industrial Arts Week" on the local and state levels.

PUBLICATIONS COMMITTEE

Chairman, Ronald Koble

This committee has seven projects underway at the present time. The committee has completed three projects this year. (1) The publication of ELEMENTARY SCHOOL INDUSTRIAL ARTS FILMS. (2) The publication of the BIBLIOGRAPHY FOR ELEMENTARY SCHOOL INDUSTRIAL ARTS. This was a joint project with ACESIA, and (3) University of Maryland Motion Pictures.

RECRUITMENT COMMITTEE

Chairman, Dr. Everett R. Glazener

Report by: James L. Boone, Jr.

This committee is making a list of an ex-officio committee member from each state.

The committee approved the recruitment brochure that was prepared by the publications committee.

RESEARCH COMMITTEE

Chairman, Dr. Paul DeVore

This committee has developed suggestions for a revised statement as to the purposes and functions of their activity.

The committee is cooperating with ERIC at Ohio State University to identify research problems and help to identify potential contributors. The committee is investigating the possibility of improving the acquisition of industrial arts materials by ERIC.

RESOLUTIONS COMMITTEE

Chairman, Dr. George Ditlow

Procedures for developing and presenting resolutions have been adopted and publicized by the Executive Board. The entire membership through their affiliated associations, committees, or groups have been encouraged to present resolutions for the good of the organization.

At this convention, for the first time in the history of AIAA, the official delegates of AIAA met last night to discuss the resolutions which had been previously presented. The delegates were also able to add resolutions to be included in the business meeting today. The Executive Board hopes that this improvement will help to speed up the business meetings and make them more valuable.

SAFETY COMMITTEE

Chairman, Donald Perry

This committee has taken the study of eye protection as its main project for the year. The committee has studied eye safety legislation and ways of promoting eye safety. They are focusing on definite recommendations after further investigation this year.

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This report is by no means a complete compilation of your Association's activities and accomplishments for this past year. Your president has attempted to mention only the outstanding events of the year.

Your Association is growing and expanding its services to members. Professionally, we are growing in our involvement with other professional associations. It has been a privilege and an honor for me to serve as your President this year.

CHRONOLOGICAL INDEX
(Convention Session Personnel)

1.12 ACIAS
ACIAS Executive Committee
Chairman, Ralph V. Steeb; Recorder, Rodney E. Anderson

1.13 ACIATE
ACIATE Executive Committee
Chairman, Donald G. Lux; Recorder, Daniel L. Householder

1.14 ACIASAO
ACIASAO Executive Committee
Chairman, William Kabakjian, Jr.; Recorder, Richard M. White

1.20 AIASA
AIASA High School Clubs Student Contests
Chairman, Jerry Kruse; Co-Chairman, Bill Elrod; Recorder, Ennis H. Rush; Technical Writing Contest, Judges, Richard Broekhuizen, Harley Myler; Host, Phil Schooley; Technical Speaking Contest, Judges, John O. Murphy, W. A. Mayfield; Host, Robert N. Thomas; Poster Contest, Judge, Richard Vedrines; Host, Harold H. Bretz, Jr.

1.30 ACESIA
ACESIA Committee Meetings
Chairman, Robert G. Hostetter

1.31 ACIAS
ACIAS Committee Meetings
Chairman, Ralph V. Steeb; Middle School, Herbert Bell; Publications, Robert L. Woodward; Program Relationship, Cyril W. Johnson; Elementary School Industrial Arts, A. E. Pagliarini; High School Program, John E. Bonfadini

1.32 ACIATE
ACIATE Committee Meetings
Chairman, Donald G. Lux; Accreditation, Ralph C. Bohn; Evaluation, Kenneth R. Clay; Graduate Studies, Lawrence S. Wright; Liaison, Rex A. Nelson; Man of the Year Award, Daniel L. Householder; Membership, Bill Wesley Brown; Nominations and Elections, Daniel L. Householder; Plant and Facilities, Sam R. Porter; Publications Raymond L. Cornwell; Research, David L. Jelden, Undergraduate Studies, Jack W. Chaplin; Yearbook Planning, Frederick D. Kagy

1.33 ACIASAO
ACIASAO Leadership Development Meeting for State Association Officers
Chairman, William Kabakjian, Jr.; Recorder, Richard M. White; Host, Bernard Dutton

1.40 AIAA
AIAA Committee Luncheons
Chairman, Frederick D. Kagy

1.50 ACESIA
ACESIA Sponsored Program—"Elementary School Industrial Arts"
Chairman, W. Hugh Hinely; Presenters—"Elementary School Occupational Orientation Program," James Heggen, John J. Geil; "World of Work—K-6, Elementary Industrial Arts," Eugene Woolery; Recorder, John K. Horn; Host, Bruce C. Rogers

1.51 ACIAS
ACIAS Sponsored Program—"Major Problems Facing Industrial Arts Supervisors"
Chairman, Louis Culpepper; Discussion Leaders—"Improving Instruction," Cyril W. Johnson, "Suggested Goals for ACIAS," Earl R. Zimmerman, "New Teachers—Recruiting, Attitudes, Competencies," Leonard F. Sterry, "Securing Better Understanding of Industrial Arts by Legislators, Lay Persons, Parents, and Other Educators," Neil E. Ballard, "Curriculum Development and Mate-

rials," Theodore E. Guth, "Implementing a State Curriculum Plan," Lawrence Foth, "Effective Supervisory Techniques," Daniel L. Householder; Recorder, Marion A. Brown; Hosts, David A. Rigsby, John W. Hampp

ACIATE Sponsored Program—"The Age of Aquarius and Space Age Technology"
Honorary Chairman, Frederick D. Kagy; Chairman, Donald P. Lauda; Presenters—"Technology, A Question of Values," Donald P. Lauda, "Education for Survival," Marshall Hahn; Discussion Leaders, C. E. Strandberg, John J. Humbert, Hugh L. Oakley, Carroll A. Osborn, Elmer S. Ciancone; Recorder, John H. Erickson; Hosts, John L. Boone, Thomas J. Brennan

ACIASAO Sponsored Program—"State Association Functions"
Chairman, Bernard Dutton; Presenter—"Taking Our Subject to the Public Through a State Fair Exhibit: New York State Industrial Arts Association," Arthur J. Figurski; Recorder, Richard M. White; Host, William Kabakjian, Jr.

1.54 AIASA
AIASA High School Student Club Program II
Chairman, Walter Comeaux; Co-Chairman, Wayne Smith; Ceremonies Monitor, Phil Schooley; Presenters, Bill Elrod, Andrew E. Gasperecz, Tommy Landry, Billy Mayes, W. A. Mayfield, Bruce King; Recorder, Joseph Hebert; Host, Bill Cady

1.55 EEA-SHIP
EEA-SHIP Board Meeting
Chairman, George A. Bamberger

1.60 ACESIA
ACESIA Business Meeting
Chairman, Robert Hostetter; Recorder, Delmar L. Larsen; Host, William A. Downs

1.61 ACIAS
ACIAS Business Meeting
Chairman, Ralph V. Steeb; Recorder, Rodney E. Anderson; Hosts, Lawrence Foth, Eugene W. Bower

1.62 ACIATE
ACIATE Business Meeting
Chairman, Donald G. Lux, Daniel L. Householder; Hosts, Paul W. DeVore, William T. Sargent

1.63 ACIASAO
ACIASAO Business Meeting
Chairman, William Kabakjian, Jr.; Recorder, Richard M. White; Host, Marion A. Brown

General Session I
Presiding, Sherwin D. Powell; Music, Acappella Choir, Miami Beach High School; Greetings, Floyd T. Christian, John F. Standridge; Introduction of Speaker, Ralph V. Steeb; Address, "Polygon of Technology," A. Wright Elliott; Remarks, "Evaluation of the Industrial Arts Program," Walter Comeaux; Recorder, Rodney E. Anderson; Hosts, J. Russell Kruppa, Richard Fries, Richard Slater, James F. Snyder

2.20 AIAA
AIAA President's Reception
Chairman, AIAA Executive Board; Hosts, Earl R. Zimmerman, Edward B. Sincic, James D. Dixon

Industrial Arts," Herbert Siegel, "Implications for a High School/Industry Correlated Model Astronautics Program," Richard A. Nygard; Recorder, Oswald W. Holtman; Hosts, Thomas J. Morrisey, Wirt L. McLoney

3.20.11 AIAA 383, 385, 390
Special Interest Session—"NASA Educational Programs and Resources"
Chairman, Irving E. Bach; Presenters—"NASA Educational Programs and Resources," William D. Nixon, "Utilizing NASA Resources," Ernest G. Berger, "Transferring NASA Materials and Resources Into Laboratory Experience," Frank J. Zima, Jr.; Recorder, Edward W. Kenyon; Hosts, Richard H. Buchholz, Anderson Taylor

3.20.12 ACESIA 81
ACESIA Sponsored Program—"Fifth Grade Children Demonstrate Plastics Technology"
Consultant, Janet Rabe; Cooperating Elementary School, North Beach Elementary School; Participating Students, Fifth Grade, North Beach Elementary School; Program Assistants, Harold G. Gilbert, Edward T. Schramm, George L. Hartsuch; Recorder, William R. Hoots, Jr.; Hosts and Reactors, Robert G. Hostetter, E. Arthur Stunard, Robert Thrower, William A. Downs

3.20.13 AIAA
Forum Coordinators' Meeting
Co-Chairman, C. Dale Lemons, Edward Kabakjian

3.20.14 ACIATE 33, 36
ACIATE Sponsored Program—"Technology in the Space Age"
Honorary Chairman, Paul W. DeVore; Chairman, William F. Alexander; Presenters—"Space Age Technology—Relevance for Industrial Arts," William Brown, "Technologically Oriented Experiences in Industrial Arts," Terence Trudeau; Discussion Leaders, John B. Tate, Everett R. Glazener, Dennis A. Dirksen, Robert D. Brown, William H. Kemp; Recorder, Clois E. Kicklighter; Hosts, Bernard Dutton, John D. Jenkins

3.20.15 IACC
IACC Program—"Executive Meeting of Retiring and New Officers"
Chairman, Stanley Bishop

3.30 ACIATE-ACIAS
ACIATE-ACIAS Yearbook Luncheon—Presentation of 1970 Yearbook
Chairman, Donald G. Lux; Co-Chairman, Ralph V. Steeb; Presenters—"Yearbook Report," William McKnight, II, "Presentation of the Yearbook," Wes Stephens, "Acceptance of the Yearbook by the Co-authors," Willis E. Ray, Jerry Streichler, "ACIATE Man of the Year Award," Daniel L. Householder; Hosts, William E. Heasley, George W. Reeser, Edward T. Anderson

3.40.1 340
Special Interest Session—"The AIAA Project—Man, Society, Technology"
Chairman, Donald F. Hackett: Presenter, C. Dale Lemons; Recorder, Roger M. Dengler; Host, Dwayne C. Gilbert

3.40.2 AIAA 171
Special Interest Session—"Light Building Construction in the Secondary Program"
Chairman, D. D. Nothdurft; Presenter—"Home Remodeling for Disadvantaged Students," Richard Buchholz; Recorder, Thomas J. Barber; Hosts, Paul Leland, Dennis S. Kusak

3.40.3 AIAA.. 181
Special Interest Session—"Utilization of Behavioral Objectives"
Chairman, James J. Buffer; Presenter, Tom E. Lawson; Recorder, John B. Tate, Eugene G. Sherrell; Hosts, Craig R. Wieser

3.40.4 AIAA 259, 262, 264
Special Interest Session—"Space Age Teaching Techniques"
Chairman, Vance B. Snyder; Presenters—"The Potential of Compressed Speech in Advancing the Learning Process in Industrial Arts Education," Gary Oakley, "The Utilization of Video Tape Recorders for the Teaching of Concepts and Techniques," Glenn M. Thatcher, "The Student Film-Makers," John J. Sladicka; Recorder, James D. Dixon; Hosts, Ralph E. Dyson, James O. Robertson

3.40.5 AIAA 186, 188, 190
Special Interest Session—"Using Individual Learning Packages"
Chairman, Kenneth L. Schank; Presenters, Lee H. Smalley, Denny M. Benson; Recorder, J. Russell Kruppa; Hosts, William H. Orr, Clyde A. Russ

3.40.6 AIAA 193, 199
Special Interest Session—"Educational Technology: Concept → Economics → Implementation → RESULTS?"
Chairman, John E. Falls; Presenters, Jerry L. Vaughn, Kenneth T. Smith, Peter Zanetti; Recorder, Charles L. Thomas; Hosts, Richard P. Callan, James W. McAlister

3.40.7 AIAA
Special Interest Session—"Newsletter Editors' Round Table"
Disucssion Leader, James O. Reynolds; Host, James F. Bignell

3.40.8 AIAA 250
Special Interest Session—"Human Behavior in Teaching Industrial Arts in the Space Age"
Chairman, Delmar L. Larsen; Presenter, Richard A. Warner; Recorder, William S. Scarborough; Hosts, Charles H. Wentz, William A. Downs

3.40.9 AIAA 204
Special Interest Session—"Articulating Industrial/Technical Education K-16"
Chairman, Donald E. Moon; Presenters, George Champion, Kenneth R. McLea; Reactors, Jesse Rathbun, Harold Resnick, Earl Mills; Recorder, Kenneth H. Bergman; Host, James F. Griffin

3.40.10 ACESIA 89
ACESIA Sponsored Program—"Innovative Programs in Elementary School Industrial Arts"
Chairman, William D. Wargo; Presenters, John Dierke, Richard J. Dahl; Recorder, Bobby L. Hayden; Hosts, William Cowen, Marvin D. Skinner

3.40.11 ACIAS 51, 62, 65
ACIAS Sponsored Program—"Technology, Senior High School"
Chairman, Allan Myers; Presenters—"Program of Relevance in Industrial Arts Dynamic Age—A Senior High School Program," Donald Maley, "Implementation of a Senior High School Program," Ralph Tanner, "Implementation of a Senior High School Program," Kendall Starkweather; Recorder, Thomas Hughes; Hosts, Andrew A. Kuban, John D. Ford

3.40.12 ACIATE 38, 40
ACIATE Sponsored Program—"Teacher Education in the Space Age"
Honorary Chairman, Willis E. Ray; Chairman, Lowell D. Anderson; Presenters—"Teacher Education Concerns," Walter Mietus, "Teacher Education: Update," Kenneth F. Stough; Discussion Leaders, Sam R. Porter, Robert W. Innis, William R. Erwin, Jr., Clifford Campbell, Nevin Frantz; Recorder, Paul D. Von-Holtz; Hosts, Robert D. Brown, Floyd D. Denton

3.40.13 IACC
IACC Business Meeting
Chairman, Stanley Bishop

Chairman, Jere M. Cary; Presenters, Ted McCulla, Mike Sorensen; Recorder, Harvey E. Morgan, Jr.; Hosts, John W. Hampp, Clyde A. Russ

4.30.7 AIAA
Special Interest Session—"Industrial Arts for the 70's Via Educational Television"
Chairman, Marshall O. Tetterton; Presenters, Mary Anne Franklin; Recorder, Bruce Fink; Hosts, D. Mark Delp, Samuel Powell, Edward W. Kenyon, James McAlister

4.30.10 AIAA
Educational Demonstration—"Materials Testing"
Demonstrators, Charles Hienrich, Jay Sheck, Billy White, Dick Wood, Jerry L. Vaughn; Recorder, Sterling D. Peterson; Hosts, James L. Grossnicklaus, Thomas J. Barber

4.30.11 AIAA
Educational Demonstration—"All Metal Aircraft Construction in the Metals Lab"
Demonstrator, James S. Criswell; Host, Dennis S. Kusak

4.30.12 AIAA
Educational Demonstration—"Fiberglass"
Demonstrator, William R. McNeil; Host, Craig R. Wieser

4.30.13 AIAA 336
Educational Demonstration—"Shop Built EDM Simulator"
Demonstrator, Samuel E. White; Host, Wallace H. Cable, Jr.

4.30.14 AIAA
Educational Demonstration—"Teaching Integrated Circuits in Space Age Electronics"
Demonstrator, Irving W. Larson; Host, John H. Shufflebarger

4.40 AIAA
AIAA Annual Banquet and SHIP's Program
Presiding, Sherwin D. Powell; Invocation, Reverend John O. Taxis; Installation of Officers, George H. Ditlow; SHIP's Program: Introduction of Deck Officers, George A. Bamberger; Presiding, Dick Snyder; Distinguished Service Award, Dr. Ralph Bohn; Scholarship Award, East Central State College of Ada, Oklahoma; Hosts. Florida Convention Committee Chairmen

COMPREHENSIVE INDEX

A

B

C

D

E

F

G

H