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THE GENERAL SHOP

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LETTER OF TRANSMITTAL

DEPARTMENT OF THE INTERIOR,
OFFICE OF EDUCATION,
Washington, D. C., October 19, 1929.

SIR: The general shop as a form of instructional organization for offering work in a variety of shop activities is an outgrowth of the general recognition of the need for providing in the school curriculum exploratory and developmental types for experiences for children of approximately the junior high school age. It also meets an outstanding need of small schools, unable to provide unit equipment and instruction in a number of shop courses, for providing some training in mechanical manipulative processes and for gaining some useful technical knowledge.

The number of schools adopting the general shop as a plan for offering instruction in a number of different activities has increased rapidly during the past two years. The demand upon this office for information relative to the organization of a general shop, the activities to be included, and for the arrangement of class schedules is constant. This manuscript prepared by Maris M. Proffitt, senior specialist in industrial education, is for the purpose of supplying this information.

I recommend that it be published as a bulletin of this office.

Respectfully submitted.

WM. JOHN COOPER,
Commissioner.

The SECRETARY OF THE INTERIOR.

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The General Shop

Aims of Industrial Arts in the Junior High School

In keeping with the ideas centered about the development of the junior high school movement, the objectives and instructional organization for the industrial or manual arts in the junior high school period are undergoing considerable change. Whether or not a school system has a formally organized junior high school, the commonly accepted educational principles governing the junior high school generally prevail in the organization of instruction included in these grades. The work carried on in the industrial arts is no exception to this general tendency. Changes of a fundamental character have taken place in reference to the function, the subject matter included, and the methods of instruction for industrial arts courses. Less often than previously are the ultimate values stated in terms of aims based upon either the idea of the transfer of training and including such objectives as accuracy, neatness, and character development, or upon the idea of preparation for trades. More often the ultimate aims are stated in terms of function in accordance with the interest and achievement levels of the pupils and in harmony with the spirit and the principles underlying the junior high school.

For pupils of approximately 12 to 16 years of age chronologically, there is general agreement that good practice includes provision for developmental and exploratory experience in various human activities; that these experiences be on the interest and accomplishment levels of the pupils; that they provide for individual differences by means of enriched and differentiated curricula and methods of instruction; and that in addition to their immediate educational values they may serve for the discovery of interests and aptitudes that will have significance for determining a life interest.

With these aims of the junior high school the industrial arts courses correlate most admirably, and when properly organized and conducted are a very important factor in their realization. To be effective for this purpose, however, the work must be more than formal exercises in joinery and wood-turning or traditional courses in furniture making, examples of which are so commonly found in

manual-training shops throughout the country. An efficient program in the industrial arts for pupils of junior high school age will be characterized by:

1. Opportunities for experience in a variety of fundamental activities characteristic of different trades, such as woodwork, sheet metal, machine-shop practice, wood finishing, electricity, printing, and auto mechanics.

2. Selection of activities and types of projects and the organization of instruction so as to realize exploratory and developmental experience values rather than specific trade preparatory values.

3. Selection of projects and maintenance of standards of accomplishment which are in accord with the interest and achievement levels of the age-grade group.

4. Provision for some individual work and for individual instruction in keeping with individual differences and the number of projects carried on by a teacher at any one time.

5. Integration of the shop work with the whole educational program of the pupil paying special attention to its correlation with other school subjects for the purpose of securing maximum results and also for educational guidance.

6. Provision for studying and rating pupils relative to mentality, interests, aptitudes, and environmental influences for the purpose of educational and vocational guidance.

7. Provision for shop and shop equipment that will serve for the realization of the objectives set up.

8. Providing teachers with special qualifications for the work undertaken.

From courses conducted in accordance with these standards the following pupil outcomes may be expected:

1. Development of industrial intelligence and of an intelligent appreciation of industrial work and its place in society.

2. Discovery of special interests and aptitudes that may have significance for life work.

3. Development of elementary, fundamental manipulative ability, and job intelligence with respect to common tools and materials, particularly useful for the performance of the nonspecialized manual-industrial jobs found in connection with home life and leisure-time activities.

4. Ability for the intelligent selection, use, and care of industrial products and services commonly found in the home.

Probably the greatest value of the industrial-arts courses is the contribution they make through exploratory and developmental forms of experience toward the discovery of interests and aptitudes. These courses have guidance values not only of a positive character, but

also of a negative character. They serve to eliminate from future industrial courses pupils who have no interest nor aptitude for it; to select those who do have aptitude, and where there is not already an interest in such work to arouse it. In some instances such courses function further. They help boys to choose specific trades which they wish to follow, and at the end of the junior high school period they may enter upon training for the trades chosen. The training may be secured either through a vocational course in school or through apprenticeship on the job. Some pupils become interested in the technical phases of industrial courses and continue their studies through the technical high school and possibly the engineering college.

While the exploratory and guidance values of the industrial arts are of great import, the other pupil outcomes are not to be overlooked in evaluating the contribution which these courses can make toward the realization of the aims of the junior high school. Of special importance are the abilities which function in connection with the use of industrial products and services. Modern life has become so complex and production so highly specialized that the consumer has little opportunity to learn much about trade operations, materials, or manufacturing processes which would be of value to him in the purchase, use, and care of the many industrial products for which he has need. The buyer or builder of a home is a case in point. He needs to know something of carpentry, masonry, painting and decorating, electricity, plumbing, heating, etc., with reference to building construction. A knowledge of blue-print reading is also important if he is going to build a house.

Although abilities to meet these needs can not be developed fully on the junior high school level, properly organized courses will furnish some basic, fundamental training for such needs. This training is not for actual skill in the trades represented, but rather for an understanding and appreciation of values in the final product. Industrial arts courses given over a period of three or four years may not give all the information that the consumer needs, but they will give knowledge of industrial work and they will stimulate an interest in it that will serve as a solid foundation on which to build such knowledge where the need for it arises.

The ability to appreciate the place of industry in modern life is a part of our social adjustment. The contribution of the industrial arts toward this end is accomplished not so much through manipulative processes in the school shop as by directed observation and directed study. Plant visits, industrial films, well-selected reading material, industrial exhibits, talks by industrial men, and the many other types of activities included in a well-rounded exploratory and guidance

program will aid the pupil very materially in understanding the important place which industry holds in our social and economic life and the problems which arise in connection with it.

Values of the General Shop

Among the various plans for industrial arts work in the junior high school grades, the general-shop plan of organization is particularly adapted to the realization of the objectives as they have been outlined. This is especially true for the work done in the small schools, but with proper modifications the plan can be used advantageously in the schools of a large city system. The general-shop plan offers special advantages:

1. For giving experience in a variety of shop activities.
2. For unified direction and supervision of all the shop activities carried on.
3. For the opportunity to carry on continuous work on a project involving a number of different shop activities until the project is finally completed.
4. For the opportunity to carry on at any one time a variety of shop activities with the same group of pupils.
5. For the assignment of projects in accordance with the interest and with the accomplishment abilities of the pupils.
6. For general developmental experience with respect to the use of tools and construction materials rather than for teaching the beginning of one or more trade subjects.
7. For the realization of exploratory and guidance values.

Industrial Arts in the Rural Consolidated School

Any program of industrial education in order to be effective must be flexible enough to be adapted to a wide variety of local situations. The objectives set up in the foregoing pages may apply almost universally, but the means of realizing them will vary rather widely with the local plan of general school organization as well as with quite a number of other local factors. In view of these varying conditions several suggested programs are offered, each being based upon an assumed typical situation.

The first type of industrial program to be given consideration is one suitable for a consolidated school of 12 grades, located in a rural community. Such a school ordinarily will have from 100 to 200 pupils in the six higher grades, usually thought of as junior and senior high-school grades. Since a school of this type is usually too small to have more than one shop and one shop teacher, any industrial program should be built around a single general shop to accommodate both the junior and senior high school pupils. The fact that such a

school is in a rural community does not indicate that all or even a large percentage of the boys will become farmers. However, the logical core for school-shop activities in such a community should consist of work related to the jobs about the farm and home. Wherever other shop activities in which the boys are interested can be introduced this should be done, but most of the work should be centered in the activities connected with farm and home mechanics.

The brief outlines of courses of study together with the short lists of projects and equipment given below are not meant as standards to be rigidly followed, but are intended as suggestions showing how the work may be organized in a typical rural consolidated school having one shop teacher. Not all the suggestions would likely be carried out in any one school. In every case the course in industrial arts should be developed to meet any outstanding local need or situation. The suggestions are particularly applicable for a school having as a maximum the number of boys indicated and distributed as shown below:

Grades	Classes	Number of boys
Seventh	1	20
Eighth	1	20
Ninth	1	18
Elective group from tenth, eleventh, and twelfth	1	15 to 20

Each group should meet as follows:

Grades	Number of periods per week	Length of period in minutes
Seventh	2	90
Eighth	3	90
Ninth	5	90
Elective	5	90

By this arrangement the teacher has three 90-minute periods, or the equivalent of six regular class periods, of teaching per day. A larger number of boys could be cared for on this plan by increasing the shop facilities and adding an assistant instructor for either full or part time. This would also make it possible to increase the number of shop activities that could be offered at one time.

The following outline of industrial arts work for the different school years is based upon six common shop activities, namely: Woodwork and wood finishing, electricity, sheet metal, forging, machine-shop practice, and auto mechanics. Drafting, with emphasis upon its relation to shop activities, is included in the outline as an additional subject.

Seventh Grade

Woodwork.—Twenty weeks, 40 periods. Emphasis is placed upon elementary carpentry, painting, and drafting, the last mentioned to be correlated with the shop work.

Electricity.—Twelve weeks, 24 periods. Some elementary wiring and study of electric-light circuits.

Eighth Grade

Sheet metal.—Three weeks, 9 periods. Soldering and simple sheet-metal repairing.

Forging.—Five weeks, 15 periods. Tempering tools, welding broken pieces of farm machinery.

Machine shop.—Eight weeks, 24 periods. Farm repairs involving simple lathe and drill-press work. Making one or two small projects, such as a screw driver.

Auto mechanics.—Eight weeks, 24 periods. Study of automobile with emphasis on motor. Simple disassembly and reassembly of parts. Some repair jobs of a simple nature may be attempted. Tractor, auto, and farm stationary engines will be used in this work.

Drafting.—Eight weeks, 24 periods. Simple mechanical drawing, emphasizing the type of work done in wood and metal. Blue-print reading should be given attention.

Ninth Grade

Auto mechanics.—Eight weeks, 40 periods. Continued study of automobile, farm engine, and tractors with more time spent in repair and overhauling.

Machine work.—Eight weeks, 40 periods. Lathe, drill press, bench work, forging, brazing, soldering; tool sharpening and care of tools, farm repairs, auto parts and repairs. A few simple projects, such as making hammers, parallel clamps, and other tools.

Building.—Sixteen weeks, 80 periods. The time may be varied to suit the convenience of school. It may be necessary to use eight weeks in autumn and eight weeks in spring on account of weather conditions. On bad days pupils may do drafting indoors. The drawing work will include simple architectural drafting and blue-print reading. The building work will consist largely of garages and farm outbuildings, including cement work, brick work, carpentry, painting, and electric wiring.

Elective Group

Boys in this group from the tenth, eleventh, and twelfth years may specialize in any of the following: Building work, auto mechanics, machine and metal-shop work. More advanced work in each of these may be given. These boys may often carry on larger pieces of work, using the elementary boys as helpers.

Type projects and jobs.—The work in the different activities will include both new construction projects and repair jobs together with

some assembly work, especially in connection with the replacement of parts in repair jobs. Most of the jobs for the farm and home will be done in the school shop; a few are of such a nature that the work can be done only at the place where the project when completed will be used. This is particularly true for building projects and building-repair jobs which are in the nature of permanent improvements to real estate.

Most of the projects listed below will be constructed entirely by the students; a few will call for the use of parts that will be purchased and assembled into the completed project. The projects selected by the teacher may include a number of industrial products on which only certain operations will be performed, such as sanding and painting, and other forms of wood finishing, installing hardware, boring, reaming, etc. The amount of work to be undertaken in the completion of any industrial product will be determined by its educational value, the abilities of the students for performing the operations, and the facilities of the shop for doing the work.

The projects listed here include work suitable for the different school years arranged to some degree in an instructional order. They have been classified roughly into levels according to their relative degrees of difficulty. Level 1 includes projects having the least degree of difficulty and suitable for beginning students. Level 2 and level 3, when given, are for students who have had some previous work.

SUGGESTED PROJECTS, IN ACCORDANCE WITH THE ACTIVITIES PREVIOUSLY OUTLINED, FOR THE RURAL CONSOLIDATED SCHOOL

I. BUILDING

Level 1

Hog trough.	Stepladder.	Wagon jack.
Chicken feeder.	Teeter board.	Rabbit trap.
Vegetable crate.	Vine trellis.	Chicken coop.
Ladder.	Lawn bench.	Flower boxes.

[Where possible these projects should be painted or varnished]

Level 2

Push cart.	Lawn chair.	Forms for concrete work.
Pushmobile.	Hog house.	Shingling building.
Wheelbarrow.	Chicken brooder.	Siding building.
Dog house.	Seed-corn tester.	Flooring building.
Farm gate.	Board walk.	Lathing building.
Auto creeper.	Board or picket fence.	Farm sled.

[Projects should be painted where possible]

Level 3.[1]—Frame garage and other similar buildings; cement floors (brick or block foundations); painting; wiring for lights; and cement walks.

[1] Intermediate carpentry and building.

RELATED DRAFTING FOR CARPENTRY AND BUILDING

Level 1.—Principles of orthographic projection. Three views. Pencil drawings of simple projects, such as hog trough, lawn bench. Blue-print reading from drawings of projects to be constructed. Most of the jobs should be from blue prints and pupils should learn to work from them. Some time should be spent in instruction in interpreting blue prints. Free-hand sketches should be made of some projects to be constructed.

Level 2.—Continuation of level 1 with more advanced work.

Level 3.—Continuation of levels 1 and 2 with more advanced work. Some time should be given to architectural drafting. Plans for garage and other buildings should be drawn in class before being built.

II. ELECTRICITY

Level 1

Wire simple bell systems on board with (1) one push button and one bell, (2) two push buttons and one bell, and (3) two push buttons and two bells.

Wire simple light systems with (1) one light bulb, (2) two bulbs in parallel, (3) two bulbs in series, (4) bulb and switch, and (5) bulb and 3-way switch arrangement.

Auto electricity: (1) Wire up auto lighting circuit, (2) wire up auto ignition system, (3) wire up starter-generator system, and (4) wire up complete electrical system.

Level 2

House wiring: (1) Wire garage for lights (3-way switch).

Auto electricity: (1) Overhaul electrical system of car, find trouble and make repairs.

Motors: (1) Experimental study of electric motors. (2) repair jobs on electric motors such as used on vacuum cleaners and washing machines, and (3) other electrical repair jobs, such as repairing electric iron and electric toaster.

[All electrical work should be accompanied by discussion and carefully selected readings on the principles of electricity involved]

Related drafting should consist of making and reading wiring diagrams. In some rural communities where the use of electricity is not common this part of the course may well be omitted and more time devoted to other work.

III. SHEET METAL

Level 1.—Soldering. Simple repair jobs on home utensils and apparatus.

Level 2.—Projects to be made. Scoop, funnel, cooling basin for forging. Fly-trap, hand fly catcher made with net.

Related drafting should consist of simple development and layout work.

IV. FORGING

Level 1.—Cold bending of iron used in projects and repairs.

Level 2.—Tempering and hardening of tools such as chisels.

Level 3.—Welding broken parts. Making parts for farm machinery, farm and shop tools, etc. Making tools such as hammers and chisels. Making links for chain. Brazing small parts.

V. MOTOR MECHANICS

Level 1.—Farm stationary engines (study of principles of single cylinder gasoline engine): (1) Make and break, magneto type; (2) battery type, low tension; and (3) high-tension jump spark.—(*a*) magneto type and (*b*) battery type.

The manipulative work will consist of overhauling, cleaning, retiming valves and ignition. Carefully selected reference reading, accompanied by class discussions and demonstrations, should be used.

Level 2.—Study of automobile and tractor motors: (1) Overhauling and reassembling demonstration motors (the test is to make the motor run well); (2) valve grinding; (3) adjusting bearings; and (4) installing new pistons and rings.

[2, 3, and 4 may be done as repair jobs where cars are available]

Level 3.—Differential, transmission, and clutch: (1) Install new ring gear; (2) install new gear in transmission: (3) install new clutch plates; and (4) general repair and overhaul jobs.

[These jobs may be done as repair jobs where cars are available]

It should be understood that the purpose of this work is not to train boys to the extent that they may go out as auto repairmen, but to give a general knowledge of the mechanical construction and working principles of the automobile, the tractor, and the farm engine.

Related drafting.—Blue-print reading dealing with automobile parts and assemblies should be given. Also sketching of auto parts.

VI. MACHINE SHOP

Level 1.—Simple drilling in repair projects. Hand and drill press.

Level 2.—Straight turning between centers in lathe; repair work for auto or other machinery (axles, motor commutators, etc.); chucking and face plate work; facing end of commutators; drilling to closer dimensions in drill press; repair parts for auto and farm machinery: taper turning in lathe; turning tapered part of auto axle; and turning mandrel.

Level 3.—Thread cutting: Rethreading auto axle, off-center turning, aligning crank shaft, boring, and turning inside of bushings.

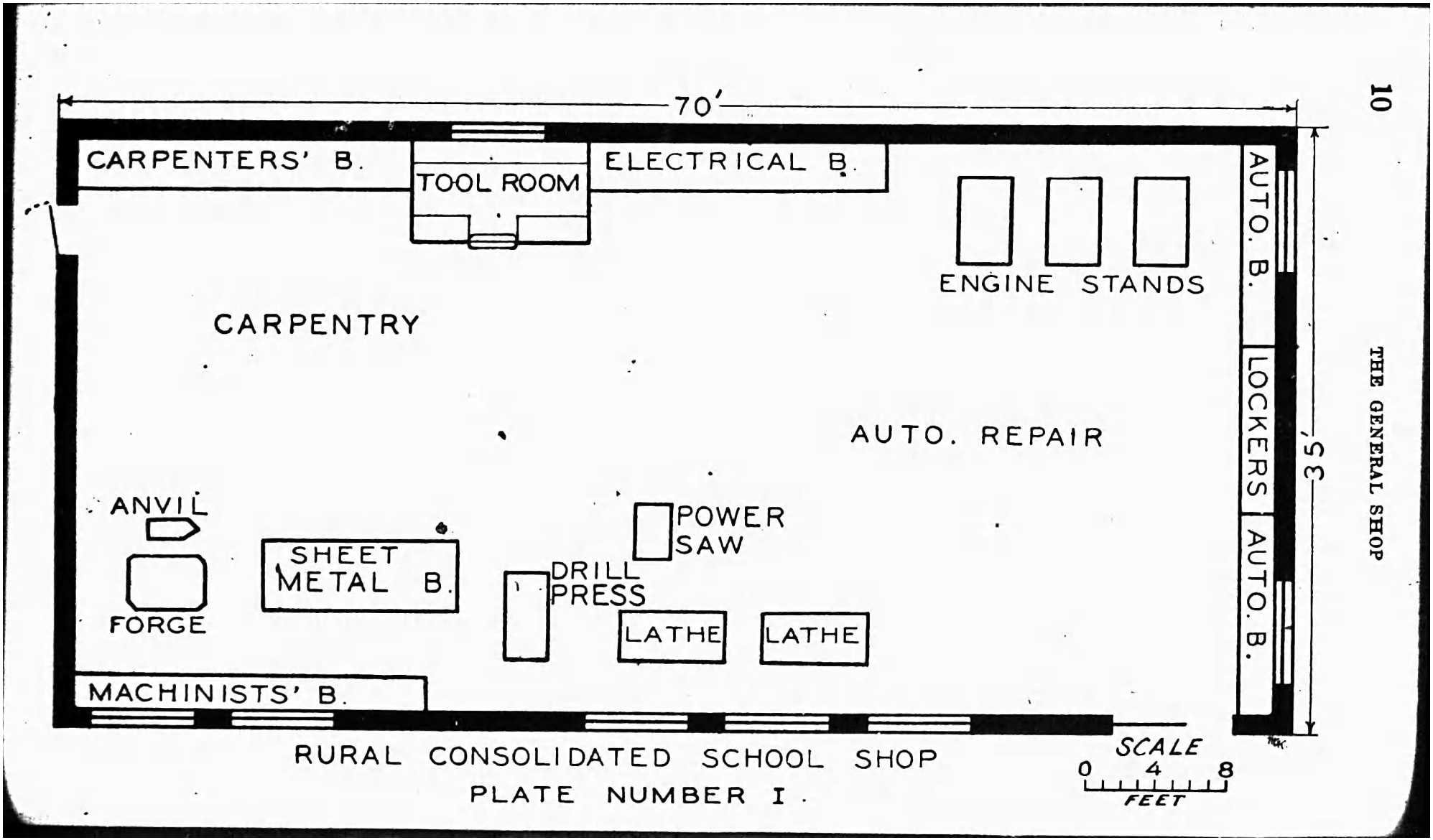
Miscellaneous.—General repair work on autos, tractors, and farm machinery involving work on lathe, drill press, and bench.

A few projects such as hammers, clamps, screw drivers, and other tools may be made when sufficient repair work is not available. In rural communities where machine shops are not available a good deal of repair work can be secured from the neighborhood. This will provide excellent production work for the advanced pupils.

Related drafting.—Boys should be taught to make orthographic sketches of broken parts and make new parts from sketches. Blue prints of projects should be provided and work done from these drawings. In addition, some formal instruction in blue-print reading and orthographic projection should be given. It is not necessary to do inking.

VII. MISCELLANEOUS FARM AND HOME MECHANICS

There are many repair and construction projects which can be accomplished around the farm and home that are not listed here. The teacher should keep the course flexible enough to permit such work when the need for it arises.



RURAL CONSOLIDATED SCHOOL SHOP

PLATE NUMBER I.

Examples of such projects are: Harness repair, rope splicing, wagon or truck repainting, screen door repairing, pump repairing, plow sharpening, cultivator and other plow repairs, sharpening of harrow teeth by forging, and many other similar jobs.

Equipment for the Rural Consolidated School

INDUSTRIAL ARTS FOR CLASS OF 20 BOYS IN GENERAL SHOP

I. SHEET METAL

(Equipment for four boys at one time)

One gas plate for soldering furnace; two straight blade snips; one circular blade snips; one 10-inch bastard, single-cut file; one 10-inch dividers; two punches (make in shop); two scribers (make in shop); one cold chisel; two riveting hammers; one burring machine; one pair of pliers; two hand groovers; one rivet set; two soldering coppers with handles; one bench (make in shop); two clamps; and stakes, including beakhorn and hollow mandrel.

This equipment can be purchased for about $35. Experience has proved that as special sheet-metal equipment for the general shop it is sufficient to do the limited amount of sheet-metal work outlined for the rural school.

II. ELECTRICITY

(Equipment for five boys at one time)

Five wiring boards, each equipped with two light sockets, two bells, two push buttons, one 2-way switch, one 3-way switch, one 25-watt bulb, one 60-watt bulb, and two 150-watt bulbs; assortment of wire (including cotton covered and twin pair); four 6-inch pliers (including side-cutting and square-nose types); two snips; two 8-inch screw drivers (wood handles); two 6-inch screw drivers (wood handles); two 2-inch screw drivers (wood handles); one claw hammer, 10 ounces; one 2-foot rule (24-inch straight rule); one voltmeter; one tungar rectifier; two small transformers; 12 auto-light bulbs; four sockets for eight bulbs; five buzzers; soldering equipment; and several Christmas-tree lights.

Coils, starters, generators, ammeters, and other parts of auto system can be secured from junk cars.

This equipment costs not to exceed $100.

III. FORGING

(Equipment for two boys at one time)

One forge; one anvil; one vise (machinist's swivel vise); 3 pairs tongs (one straight, two curved lips); one shovel; one poker; one ball-peen hammer; and one sledge.

The price of this equipment will depend largely upon the kind of forge that is selected. A good forge with blower and equipped with a ¼-horsepower electric motor will cost about $125. A suitable anvil, $35 or more.

IV. AUTO MECHANICS

Four junk cars for parts (estimated cost $50), which will provide four engines, four differentials, and four transmissions (all of the foregoing should be cleaned and mounted on stands); two sets wrenches (including both socket and end wrenches); one set ignition wrenches; one chain hoist; two jacks; one 12-inch monkey wrench; one 18-inch Stillson wrench; one valve grinder; one thickness gage; one inside micrometer; one 6-pound sledge; one 12-inch screw driver; two 8-inch screw drivers; one 6-inch screw driver; two valve lifters; and one grease-gun outfit.

The total cost of this equipment is about $150. Some of the tools, such as screw drivers, can be made as machine shop projects, thus cutting down the total cost.

V. MACHINE SHOP

Two 10-inch lathes (one 6-inch, and one 14-inch lathe would be more desirable); two center rests; two 8-inch independent chucks; two 8½-inch universal chucks; one drill chuck; one set boring tools; two sets forged lathe tools; two sets lathe dogs; one knurling tool; two 6-inch inside calipers; two 6-inch outside calipers; one combination set; one micrometer; two thread gages; two sets taps and dies, one S. A. E. threads, one U. S. S.; two machinists' vises; two ball-peen hammers; two 10-inch hack saws; four center punches; one prick punch; two cold chisels; two 3-inch machinists' squares; two machinists' scales; one ½-inch electric drill (portable), (for economy a breast drill may be substituted); one bench attachment for drill; one set drills; and one bench grinder.

The total cost of this equipment is about $1,800.

VI. CARPENTRY

Ten 22 to 26 inch saws, five 10-point crosscut, three 8-point crosscut, two 6-point ripsaws; one 14-inch keyhole saw; one coping saw; six steel squares; one 18-inch foreplane; two 14-inch jack planes; four 9-inch smooth planes; two 7-inch block planes; one 8-inch drawknife. Twenty wood chisels (four 1¼-inch, four 1-inch, four ¾-inch, one ⅝-inch, four ½-inch, one ⅜-inch, one ¼-inch, one ⅛-inch); two cold chisels; two ratchet braces; two butt gages; one set auger bits (¼-inch to 1-inch, 13 in number); one saw set; two saw vises; two mill files; six assorted screw drivers; two marking gages; one butt gage; one glass cutter; two putty knives; ten claw hammers; one shingling hatchet; two 4-inch hatchets; six nail sets; one carborundum stone; one oil can; eight 6-inch try-squares; two 6-inch dividers; two T-bevels; one 50-foot steel tape; ten 6-foot folding rules; one spoke shave; four wood clamps; two pairs iron beam clamps (4 feet); three wrecking bars; four chalk lines; one dozen cakes carpenter's chalk; one monkey wrench; one pair tin snips; and three levels.

The total cost of this equipment is about $175.

One carpenter's bench (make in shop); two 6-foot straightedges (make in shop); and three pairs sawhorses (make in shop).

VII. DRAFTING

Twelve sets drawing instruments; twelve drafting boards (18 inches by 24 inches); twelve T-squares (18 inches); twelve scales (graduated); twelve 30°–60° triangles; twelve 45° triangles.

Blue-print equipment: Printing frame; washing tray (make in shop); blue-print paper; and tracing paper and cloth.

The total cost of this equipment is approximately $125, estimating each set of drawing instruments at $6. Sometimes the drawing instruments are rented to students at about 50 cents per year. Again, the students are required to purchase their own drawing instruments.

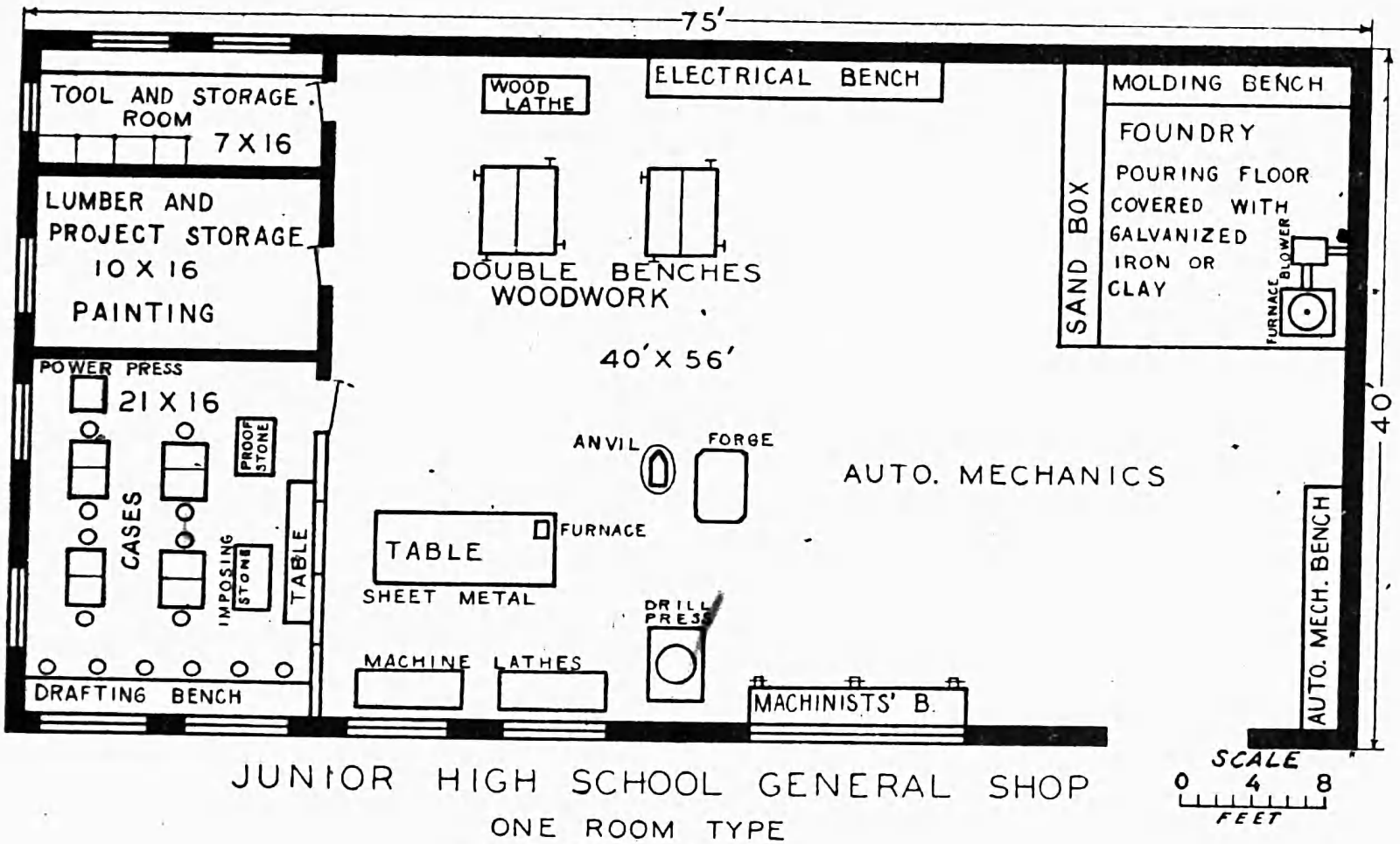
Some of the tools and equipment listed for the above activities may be made in the shop. Many additional ones also can be made, so that in a short time a good supply will be available.

The suggested shop plan is based upon a shop which is designed for the purpose. In many cases rooms will have to be utilized which were originally designed for entirely different purposes. Under such circumstances the arrangement as well as the choice of equipment will have to be determined largely by the possibilities of the shop space available. It is advisable in some instances to have the advanced classes build the shop. It makes a good carpentry project which also involves cement and brick work, wiring, and painting.

The General Shop in City Schools

The general shop in city-school systems will be affected by several factors which do not enter into the rural consolidated school situation. Some of these factors are size of city; whether separate junior high schools exist; whether the system is on the 8–4, 6–2–4, or 6–3–3 plan; the size of the various schools; the type of school communities; and many other factors. In order to deal with this problem it is necessary to classify the kinds of shops on the basis of what seem to be the outstanding needs. The type shops here described are not necessarily actual shops, but are composites made up from rather commonly existing situations. In most cases, however, a particular shop plan has been followed with a few variations.

1. *The single-shop type.*—This type of general shop follows about the same plan as the rural consolidated general shop. There are some differences in the activities, due to the different environment. Such a general shop is common in departmentalized seventh and eighth grade systems and in junior high schools having either seventh and eighth or seventh, eighth, and ninth grades. Where the school is small, as in a small city or in a large city with several small junior high schools, a single shop will accommodate all boys. In larger



JUNIOR HIGH SCHOOL GENERAL SHOP

ONE ROOM TYPE

PLATE NUMBER II

schools it is necessary to have more than one such shop, and under such conditions the weight of evidence seems to be in favor of having certain of the activities in one shop and others in another. The logical conclusion, then, is that a single-shop plan should be used in those schools that are small enough to need only one shop room.

The number and character of activities that may be carried on by a single teacher in one shop is an open question. Much depends on the size of the shop, the character of the equipment, the plan of instruction, and probably more important than all others, the teacher himself. Usually from four to eight activities is the maximum range for the three years. If more than eight are offered the time devoted to each is too short for the work to be of much value.

Commonly included groups of activities are:

Group 1.—Metal work: Sheet metal, forging, machine work, auto mechanics, and foundry.

Group 2.—Woodwork: Carpentry, cabinetmaking, and pattern making.

Group 3.—Electricity: House wiring, motor and dynamo operation, and automobile electricity.

Group 4.—Drafting: This would be correlated with all the others.

Group 5.—Printing trades: Hand composition and press work.

Not all of these five groups with their subdivisions could profitably be offered in any one school. A suggestive typical shop program follows:

Seventh year	Eighth year	Ninth year
Carpentry and drafting, one semester.	Pattern making, one-half semester.	Machine shop, auto mechanics, auto electricity, drafting. No specified time for any one activity, but all are correlated.
Sheet metal, one-half semester.	Forging, one-half semester.	
Electric wiring, one-half semester.	Auto mechanic, one semester.	
	Drafting correlated with all shop work.	

This program includes activities which are fundamental to the wood and metal trades. It also gives a boy enough try-out experiences to discover whether or not he has any aptitude for trade work. It gives him an opportunity to become interested in trade and industrial work and is a means for gaining some appreciation of trade and industrial processes.

It does not, however, touch the field of printing and it leaves room to take up home mechanics only in an incidental way. However, carpentry, sheet metal, electricity, forging, and machine shop all offer some opportunity to include home repair jobs.

Whether or not printing should be offered depends upon the community. If there are opportunities for observation of printing trades

so that the boy may add to his knowledge of and increase his interest in printing as well as have some opportunities for employment in the trade, it would be advisable to offer it. A half semester to one semester of printing is sufficient for exploration and guidance purposes. In the above-outlined course printing could be substituted very successfully for auto mechanics for one semester of the ninth year.

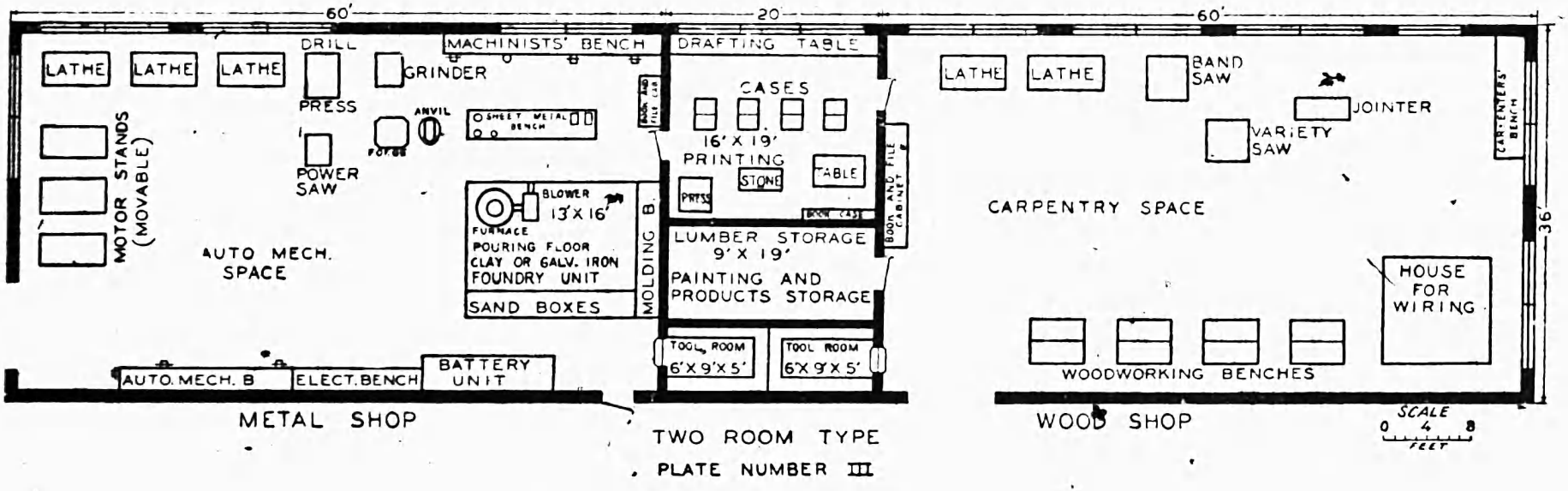
Where printing is offered as suggested here it would be necessary to have the printing equipment in a room separate from the other shop equipment. An ideal arrangement would be to have the printing and drafting at one end of the shop and partitioned off from the other part by a combination of wood and glass partition. This would give the teacher an opportunity to handle all the activities at one time.

There are some other activities which could be offered in a general shop as well as those named. Plumbing, cement work, bricklaying, acetylene welding, tailoring, and many other trades might be represented; but unless there is a strong local reason for such, as the dominance of a particular trade in the community, there is little advantage in offering other activities than the ones given in the first list. They are fundamental mechanical trades upon which a very large number of others are based. Much of this learning is transferable to other trades and industrial processes since there is a large fund of common content.

In addition to the shop work in the activities suggested some time should be devoted to securing information about the trades which they represent. Visits to industrial plants in the locality, moving-picture films of industries not available for visits, reading and discussions, all should be used. Many schools are offering such work as a part of the social science and are correlating it with the industrial shop wherever possible.

2. *The 2-shop type.*—Where a junior high school is large enough to need more than one shop it seems advisable to organize the industrial curricula so that part of the activities are in one shop and part in the other rather than to have the second shop a duplication of the first. This gives fewer activities in a shop at one time under one teacher and lessens the teaching problem. It also permits more equipment in each activity since there is more space for it.

There is some question as to how the activities should be grouped in the two shops. A very successful plan is where the activities of one shop center around metal work and the activities of the other around the building trades. There are a few activities such as electricity which might be included in either, and others such as printing which should be in separate rooms.



TWO ROOM TYPE

PLATE NUMBER III

Where a 2-shop plan is used the industrial curriculum may be much the same as with the 1-shop school or it may be expanded to some extent. Two suggestive curricula are offered here:

Seventh Year

Woodworking and related drafting, one semester. This work should consist of elementary carpentry and cabinetmaking. The drafting should include orthographic drawings in pencil of such projects as are made. Boys should learn to read drawings of projects and should work from drawings. They should make bills of material from drawings and calculate costs. Painting rather than varnishing should be emphasized.

Electricity, one-half semester. This work should consist of bell wiring, electric-light wiring, and a study of electrical principles.

Sheet metal, one-half semester. This would involve changing shops, but with the 2-shop plan it would be advisable to give each activity in half-semester units, which would make changing at this point a matter of no difficulty.

The work in sheet metal should be home repair jobs, simple projects in which a boy of junior high school age would be interested, and sheet-metal work as a part of carpentry and other elementary production jobs. Some elementary drafting work in development should be correlated with the shop work.

Eighth Year

Printing, one semester. The work in printing should consist of hand composition with some related information about the printing trades. Each boy should have an opportunity to run one or two jobs through the press.

Foundry and pattern making, one semester. Patterns should be made in the wood shop accompanied by related information concerning the pattern-makers' trade. These should be cast in the foundry. Other foundry projects should be made from patterns already available. Where possible a large foundry should be visited and some reference reading on iron and steel making should be given. There is a fine opportunity to correlate the informational content with the English and social-science work and the shop teacher should take advantage of it.

Ninth Year

Machine shop, auto shop, automobile electricity, and forging, two semesters. It is not advisable to separate these four activities into hard and fast units. There should be much overlapping. In gen-

eral, the machine-shop work should teach the boy to do the elementary operations on the lathe, drill press, and at the bench.

The auto repair work will furnish many jobs. Others may be added in the way of shop tools and equipment.

The forging should be largely a study of heat treatment of iron and steel. A gas furnace would be of as much or possibly more value than a forge. Little time should be given to developing forging skill. Ornamental forgings should usually be avoided and the jobs selected from auto repair, machine shop, and home-mechanics projects.

Auto mechanics should consist of a study of the automobile motor, based upon exercises and demonstrations with school motors. There should be three or four types of motors available, and the boy should disassemble and reassemble one or two. They should run correctly when he has completed the reassembly. Electrical work should be done in the wiring and study of the electrical systems on these motors. Some battery charging can be done. Boys who show proficiency may be given some repair work on cars. The shop is large enough to accommodate one car for this purpose. Many repair jobs from the car can be done as machine-shop and forging projects.

The content of the courses will vary for different boys. There should be a great deal of individual instruction and individual progress.

3. *The combination general shop and shop-cycle type.*—Both the single-shop and 2-shop plans have been discussed from the standpoint of junior high school programs, which include the seventh, eighth, and ninth years. For schools organized on the 8–4, 6–2–4, or other plans this arrangement will not work successfully. Most schools that are not organized on the 6–3–3 plan have an organization which is adapted to the use of shop curricula which include the seventh and eighth years in one shop, and the ninth year in another. This has caused the development of a very successful general-shop program, which uses general shops for the seventh and eighth years and gives short try-out periods in several unit shops during the ninth year.

In such a program the general-shop system for the seventh and eighth years would not be widely different from that described under 1 and 2. Only two years would be available for general-shop activities, which would necessitate cutting down the number of activities for which the shop is equipped. The nature of these activities would be determined to a great extent by the unit shops in which the pupils could be given some experience during the ninth year.

The objectives of the industrial program are not changed by this situation. It is simply a matter of accomplishing them in a slightly different manner. The determining factor in setting up a plan is the administrative organization of the school system and the building facilities.

The following is a suggestive curriculum for industrial arts in the seventh and eighth year general shop or shops when the ninth year is to be spent in any four activities which the pupil may select from these unit shops: Machine shop, auto mechanics, foundry, printing, carpentry, cabinetmaking, electricity, and drafting.

Seventh Year

Woodwork, one semester. This would include simple carpentry and cabinetmaking.

Foundry and forging, one semester.

Eighth Year

Carpentry and electric wiring, one semester. A small building should be constructed, wired and painted.

Auto mechanics, one semester. A study of the automobile much the same as outlined under the 2-shop plan should be made. It should include the electrical system.

A lathe and drill press where some simple machine operations could be learned would also be advisable.

Ninth Year

When the boy enters the ninth year he has had foundational work in wood and metal. He should now be given opportunity to learn something of printing and to do more advanced work in each of the other shops. At the end of the ninth year he should be in a position to decide whether he wishes to specialize in the work of any one shop or to drop shopwork altogether.

Some boys may be in a position to make such a decision at the end of the eighth year. Such boys will fall into two groups; those who expect to quit school as soon as the legal age is reached and enter employment, and those who expect to continue in school and to secure a liberal arts, a technical, or a commercial education. The former group should in many cases choose one unit shop and get as much training as possible that will function in a vocational way when they leave school; some of the latter group will have discovered that they have no aptitude for shop work and will profit more by dropping it at this point.

Selection of General-Shop Activities

An examination of the curricula of general shops reveals a wide variety of activities. There is very little standardization of subject matter and a lack of common practice with respect to generally accepted policies of curriculum construction. While it is true that

schools under different conditions should vary their industrial-arts courses to meet local situations and needs, the principles governing the selection of shop activities should not vary widely.

In harmony with the objectives previously set up for the junior high industrial arts, the following principles may be used as suggestions for constructing general-shop curricula:

1. Activities should be selected which include a variety of manipulative operations. There are too many industrial occupations in the modern world for a junior high school boy to make a study of any appreciable part of them. The only hope of realizing the exploratory and guidance objectives is to find a limited number of activities that will have some significance for the discovery of interests and aptitudes for various fields of occupations. A study of trade and industrial occupations reveals that they require abilities: (*a*) In manipulative processes requiring different degrees of motor skill varying from the amount which an average person without specific training has as a minimum, up to a degree of skill which is acquired only after years of intensive training. (*b*) In knowledge of a technical nature including the ability to think about the work and to plan work in accordance with such knowledge. The technical knowledge needed also varies in accordance with the nature of the work.

2. The selection of any trade activity for a general shop curriculum should be based upon an analysis of the manipulative operations and technical knowledge included for the purpose of determining its value in accordance with 1.

3. The shop activities should be of a character that will furnish opportunities for the development of types of manipulative abilities and technical knowledge similar to those needed for performing non-specialized manual-industrial jobs of common occurrence in the maintenance of the home and in the performance of avocational and leisure-time activities.

4. Shop activities and projects should be selected in accordance with the primary objectives for the industrial arts, and not in accordance with any indirect values they may have for other types of studies.

5. Activities existing in the locality should have preference in the general-shop work in so far as these activities involve fundamental trades and industries.

General Lists of Projects and Equipment

After the shop activities have been chosen the next problem in curriculum making for the industrial arts is the selection of the projects and jobs with their corresponding operations and technical knowledge and the organization of all this material into an instruc-

tional order. The selection of appropriate equipment and the necessary shop facilities naturally follows.

The following lists of projects and equipment for the activities included have been compiled from those used in a number of junior high school general shops. In almost every case the lists contain more than would be used in any one junior high school. Both the projects and the equipment are intended to be sufficiently comprehensive to offer the teacher a wide range from which to make his selection. In some instances the projects are too advanced for most junior high school pupils. Some are sufficiently difficult for senior high school boys who are to take one year of work in the industrial arts. The teacher will need to select the projects making up his course to suit the time to be given to it and to the age and accomplishment abilities of his pupils. No attempt has been made to arrange projects in order of their difficulty.

Where the shop cycle or rotation plan is used in the ninth year or in the senior high school, the equipment lists given here do not include enough tools and machinery. In most cases, however, adding more equipment would mean, except for some special machine, duplicating items included in the list:

Sheet Metal Projects

Apple corer.
Bird house.
Book ends.
Blotter holder.
Bread box.
Bait box.
Cookie cutter.
Cup.
Chicken feeder.
Camp stove.
Cheese grater.
Candle holder.
Cash box.
Canteen.
Candle lantern.
Correspondence case.
Dustpan.
Dipper.
Drip pans.
Fruit-jar filler.
Funnel.
Fern-stand pan.
Feeding trough.
Flour box.
First-aid cabinet.
Fire shovel.
Garbage can.
Helicopter.
Handkerchief box.
House number.
Horn.
Jewel case.
Lunch box.
Letter rack.
Match box.
Measuring cup.
Megaphone.
Mail box.
Napkin ring.
Nail box.
Oil can.
Puzzle.
Pencil tray.
Paper weight.
Pancake turner.
Sink strainer.
Scoop.
Sign.
Seed-box lining.
Seed box.
Soap tray.
Safety-deposit box.
Sugar can.
Salt box.
Sifter.
Tool kit.
Tackle box.
Torch.
Tourist water can.
Vases for flower baskets.
Wastebasket.
Watering trough.
Whistle.

Sheet-Metal Equipment

Six straight snips.
Five curved snips.
Four 10-inch wire pliers.
One 8-inch wire snips.
Four rivet sets.
Sixteen wood files.

Eight scratch awls.
Twelve foot rules.
Four bench brushes.
Three riveting hammers.
Five tack hammers.
One dustpan.
Sixteen assorted soldering coppers with handles.
Four table cups.

One bar folding machine. } Or combination machine for these operations.
One forming rolls. } Or combination machine for these operations.
One wiring machine. } Or combination machine for these operations.

One turning machine.

Two square-head stakes.
Two conductor stakes.
One beakhorn stake.
One blowhorn stake.
One mandrel stake.
Six gas bench furnaces.
One gallon galvanized can.
Three hollow punches.
Five square-end punches.
Two 6-inch dividers.
One hatchet stake.
Five wire chisels.
Two stake and tool benches.
Two large work benches.

Several of the items such as benches can be made in school shops, thus cutting down the total cost. A fair statement would be that the sheet-metal equipment in a junior high school general shop will cost between $150 and $350.

Machine-Shop Projects

Bolt and nut.
Center punch.
Bushings.
"C" clamps, machinists.
Dies and punches.
Foot scrapers.
Flower-pot stands.
Gears:
Refacing, truing, boring, drilling, and reaming.
Hack-saw frame.
Hammers.
Jack.
Luggage carrier.
Lathe centers.
Nail set.
Wrenches.
Wheel pullers.
Porch-box supports.
Paring knife.
Paper weight.
Punches.
Plumb bob.
Set screws
Shelf bracket.
Screw drivers.
Tool sharpening.
Valve facing.
Vise.

Machine Shop Equipment

It is difficult to give a satisfactory general list of equipment without having the needs of a particular situation in mind. Much depends on the size of shop, length of course, and several other factors. The following is a minimum list. If a larger shop is desired, much of this equipment may be duplicated.

One 13-inch motor-driven quick-change lathe. (More desirable, two lathes, one 6-inch and one 14-inch.)
One milling-machine attachment.
One 8-inch independent lathe chuck.
One 8½-inch universal lathe chuck.
One drill chuck.
One set boring tools.
One set lathe tools.
One set lathe dogs.
One knurling tool.
One 6-inch inside caliper.
One 6-inch outside caliper.
One 12-inch combination square.
Two micrometers, one 1-inch, one 2-inch.
Two thread gages, one S. A. E., one U. S. S.

One portable electric drill.
One bench attachment for drill.
Two sets of drills:
  Numbered drills 1 to 60.
  ¼-inch to 1-inch in thirty-seconds.
Three sets taps and dies:
  One set of S. A. E.
  One set of U. S. S.
  One numbered set of taps from 2-56 to 14-24.
Four 10-inch files.
One 10-inch monkey wrench.
One 6-inch machinists' scales.
One 12-inch machinists' scales.
Two ball peen hammers.
One claw hammer.
Two 10-inch hack saws.
Four center punches.
Two cold chisels.
Two scribers.
Two machinists' squares.
Two oil cans.
Four machinists' vises.
Two rivet sets.
Two screw drivers.
Two pair pliers.
One hand drill.
Two "C" clamps (make).
Two parallel clamps (make).
One set reamers.
One bench grinder.
One sledge—8 pounds.
One lead mallet.
One set mandrels.
One oilstone.
One pipe cutter.
One power saw.
One combination square.
Two threading tools.
One tool holder.
One set wrenches.
One speed indicator.

Forging and Metallurgy Projects

Cold chisel.
Chain hook.
Eye bolt.
Fire shovel.
Fire rake.
Fish knife.
Foot scraper.
Gate hook with twist.
Lathe tools.
Poker.
Punches.
Screw-driver blade.
Straighten parts of machinery.
Toasting fork.
Tongs.
Wedges.
Tempering machine tools.
Chain links and hook.

Operations

Annealing.
Bending.
Brazing.
Burnishing.
Casehardening.
Cutting stock.
Drawing out.
Filing.
Fullering.
Grinding.
Hardening.
Heating.
Heading.
Pointing.
Punching.
Riveting.
Scarfing.
Shrinking.
Shouldering.
Tempering.
Twisting.
Upsetting.
Welding.

Tools and Equipment

One forge or heat-treatment furnace.
One anvil.
Three pairs tongs (one straight, two curved).
One shovel } if forge is used.
One poker }
One ball peen hammer.
One sledge—8 pounds.
One forging vise.
One burnisher (to use on grinder).
One buffer (to use on grinder).
Other equipment from machine-shop list.

Foundry

A brief course in molding and general foundry work is one of the most desirable for all general shop activities. This is true for these reasons:

1. Pupils like molding things from molten metal. It has a peculiar fascination for most boys.

2. The development of the foundry industry in the past few years has been very striking and this development is still in its infancy. The production of malleable castings, for example, has almost displaced the forgings of a few years ago. With the increased use of the electric furnace, with the improvement of steel castings, and many other metallurgical developments, foundry work is assuming an importance as a basic industry that makes some study of it worth while in any general shop which has for its objectives industrial exploration, guidance, and appreciation.

Jobs

Iron

Book ends.
Candlesticks.
Door knocker.
Dumb-bells.
Hammer.
Rope sheave.
Repair parts.

Aluminum or brass

Book ends.
Candlesticks.
Name plates.
Ornamental ships.
Statuary.
Pancake griddle.
Paper weights.
Pencil trays.
Radiator emblems.
Eight-pound shot.
Toaster parts.

If a cupola is available, iron castings can be made, but otherwise the projects must be confined to aluminum and brass.

Operations

Bench molding.
Core molding.
Core baking.
Core setting.
Dumping and cleaning castings.
Furnace operation.
Pouring.
Polishing castings.

Equipment

For general shop work a gas furnace and crucible are sufficient to melt aluminum and brass. Where a general metal shop or unit shop is used, it is often advisable to have a small cupola so that iron may be melted.

One bucket.
Two bulb sponges.
Four draw pins.
Two flat-head shovels.
One dozen flasks, assorted.
Two gate cutters.
Two iron ladles.
One iron-bar hook.

One long heart and square slick.
Six molding boards.
One burner furnace.
Two molding boxes and sand.
Two No. 10 crucibles.
Two patching tools.
One pair tongs.
Four rammers.
Two rapping bars.
One sprinkling can.
Two small bellows.
Two small trowels.
Two sprue pins.
Two strike-off bars.
One wire brush.

Auto Mechanics

The auto-mechanics trade involves much technical knowledge as well as manipulative skill, and since the objective of the industrial arts course in the subject is to give some introduction to it as a possible trade and to furnish knowledge of the automobile which everyone should have, the course should consist of much that is informational rather than manipulative.

Exercises and Jobs

Auto electricity: (1) Study principles of ignition (demonstrations and experiments); (2) coil, breaker, distributor, spark plugs (experiments); (3) trace ignition on demonstration motors; (4) wire up ignition system on board; (5) wire up ignition system on demonstration motor; (6) study lighting system (examine different bulbs for contacts, candlepower, voltages); (7) wire up at least three lighting systems on board; (8) make tests on generators and motors; and (9) clean commutator and replace brushes on generator and starter.

[NOTE.—For suggestions as to repair jobs and equipment see the discussion of motor mechanics in the rural consolidated school, this bulletin.]

Printing

In a general shop course in printing it is not possible to do more than teach pupils the elementary operations of printing. They can, however, learn to do easy composition and to run a small press. This is enough to give them some insight into printing as a trade and for the discovery of interests and aptitudes with respect to the work.

It is advisable to use a combination of exercises and production methods of teaching. There is no shop activity that is so easy to teach by the production method as printing, because there is always plenty of production work available. The result has been that in many shops instruction has been sacrificed for production. In order to avoid doing this it is necessary to determine for every production job what its instructional content is and use it only as it fits into the scheme of instruction outlined. For illustration, a boy has just been taught to use lines and different size type for an ornamental card. If at that time a production job of printing admission tickets is brought to the printing teacher it makes a fine piece of instructional

practice work for the boy. Many exercises will have to be used and wherever production jobs are available they can be used to follow up the exercises and thus give good practice in the operation learned and also serve to keep the pupil's interest.

Exercises

Name and address.
Paragraph of plain matter.
Lines—simple exercise.
Lines—more complicated exercise.
Tabulation of figures.
Varied sizes of letters in heading.
Poetry.

Projects and Jobs

Name cards.
Envelope heads.
Letterheads.
Admission tickets.
Report cards.
Form letters.
Small school paper.

Operations

1. *Composition:*
   - Learning arrangement of type case.
   - Learning point system.
   - Picking up type.
   - Placing in stick.
   - Spacing.
   - Justification.
   - Dumping a stick.
   - Tying up type.
   - Proofing on stone.
   - Proofing on proof press.
   - Learning proof reader's marks.
   - Correcting stick.
   - Locking up forms.
   - Unlocking forms.
   - Washing up type.

2. *Press work:*
   - Oiling.
   - Inking.
   - Placing chase.
   - Making ready.
   - Press proofing.
   - Press feeding.
   - Cleaning press.
   - Cleaning form.

3. *Miscellaneous:*
   - Cutting stock.
   - Folding.
   - Assembling.
   - Binding by stapling.
   - Binding by sewing.

Tools and Equipment

Six cases and type.
Six galleys.
One cutter.
One imposing stone.
Six sticks.
One small power press.
One proof planer.
One case.

Other miscellaneous small equipment, such as rules, mallet, tables, cabinets, etc.

[NOTE.—For a more comprehensive list of both projects and equipment for printing in the junior high school see Bureau of Education Bulletin, 1924, No. 11, Manual Arts in the Junior High School, Government Printing Office, price 15 cents.]