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SEMINAR ON CONTINUING EDUCATION FOR ENGINEERS (UNIVERSITY OF BRITISH COLUMBIA, MARCH 26, 1966).

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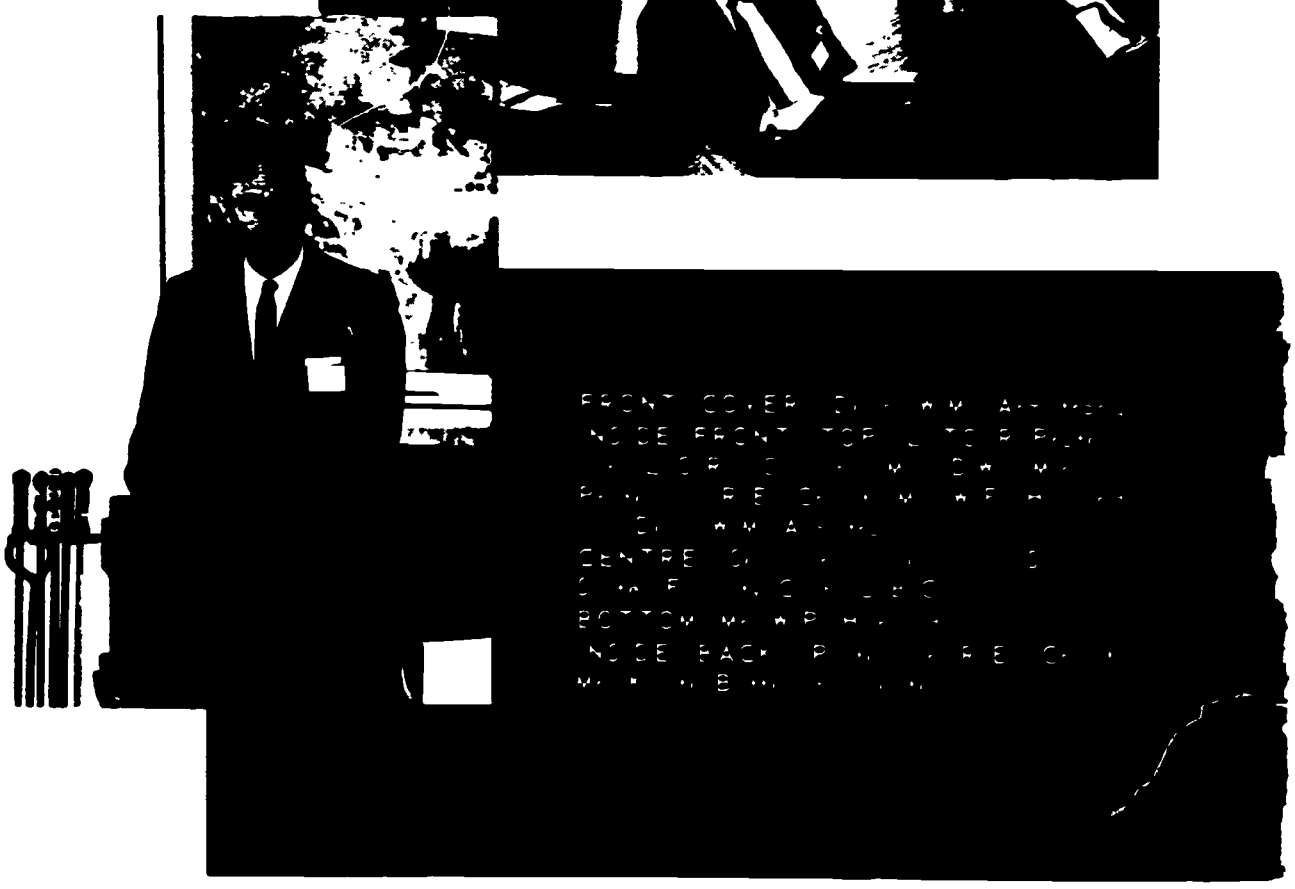
IN THIS 1966 SEMINAR AT THE UNIVERSITY OF BRITISH COLUMBIA, THE NATURE OF CONTINUING EDUCATION WAS DISCUSSED IN TERMS OF COMPANY PROGRAMS AND SUBSIDIZED PART TIME GRADUATE STUDY. PAST EXPERIENCES IN CONTINUING EDUCATION FOR ENGINEERS BY ENGINEERING SOCIETIES AND THE UNIVERSITY OF BRITISH COLUMBIA WERE REVIEWED, AND NEW PROGRAMS FOR ENGINEERS IN THE PROVINCE WERE SUGGESTED AGAINST THE BACKGROUND OF EXISTING ACTIVITIES IN EUROPE, THE UNITED STATES, AND WESTERN CANADA. INDUSTRY'S CONCERN FOR CONTINUING EDUCATION WAS ALSO REAFFIRMED. REPORTS OF THE DISCUSSION GROUPS REVEALED CONCERN FOR GEARING PROGRAMS TO DIFFERENT STAGES OF AN ENGINEER'S CAREER, COURSES ON MODERN MATHEMATICAL LANGUAGE, TECHNICALLY ORIENTED EDUCATION FOR ENGINEERS IN MANAGEMENT AND FOR OLDER ENGINEERS, AND MANAGERIAL AND ECONOMICS EDUCATION FOR YOUNGER ENGINEERS INTERESTED IN POSITIONS IN MANAGEMENT. THE PROPER EDUCATIONAL ROLE OF UNIVERSITIES AND OTHER BODIES WAS ASSESSED. IT WAS THEN RECOMMENDED THAT A JOINT PLANNING COMMITTEE BE FORMED AND THAT AN EXPERIMENTAL SEQUENCE OF COURSES BE OFFERED. (THE DOCUMENT INCLUDES A PARTICIPANT ROSTER AND A CALENDAR OF TECHNICAL AND MANAGERIAL COURSES.) (LY)

CONTINUING EDUCATION



SEMINAR ON
CONTINUING EDUCATION FOR ENGINEERS

Held at the University of British Columbia
March 26, 1966

University of British Columbia, 1966
Vancouver, B. C.

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OPENING REMARKS

Professor L. G. R. Crouch - Chairman
Department of Mineral Engineering
President, Professional Engineers Association of British Columbia

Gentlemen: It is my pleasure to welcome you to this invitational seminar on continuing education for engineers. As I view the sunny landscape outside the window, I feel you have made a considerable sacrifice in taking time out from your gardening and recreational pastimes to respond to our invitation and spend a day on campus for intensive discussion. Hopefully you will be well rewarded for your devotion to professional duty.

Let me bring you up to date on the origin and purpose of this meeting. Several months ago Dean Armstrong and I had informal discussions with the Extension Department to ascertain the position of continuing education for engineers both at the university and through other agencies. As President of The Association of Professional Engineers of British Columbia, I agreed with my university colleagues that we should invite representatives of both the Association and the Engineering Institute of Canada to explore the entire field of continuing education for engineers. The result was a series of informal meetings attended by Messrs. David Bakewell, Lewis Davies, Keith Douglass, and Fred Milligan, and from the university, Dean W. M. Armstrong, Professor L. G. R. Crouch, Professor W. G. Heslop, Dr. J. K. Friesen and Mr. Knute Buttedahl. These discussions culminated in the proposal that a one-day seminar be held on this topic. We agreed to invite representatives from the professional organizations and industry, and from the university faculty and Extension Department.

In order to provide us with some past activities in continuing education, the Extension Department engaged a graduate student to survey the various programs for engineers conducted in recent years in British Columbia.

Fortunately, we were also able to persuade Professor R.E. Chant of the University of Manitoba, who is Chairman of the Engineering Institute of Canada's National Committee on Continuing Education, to attend this meeting and share with us his wide observations on

continuing education for engineers as he found them in Canada and in several European countries.

The seminar program has allowed considerable time for individual participation in discussions. On the basis therefore of both the formal presentations and surveys and of the group discussions, I trust we shall have a good deal of evidence on which we can chart more clearly the road ahead for continuing education in our profession.

When Dean Armstrong assumed his present position earlier this year, he expressed the opinion that one of the items of unfinished and new business for the Faculty, in co-operation with the profession, would be the exploration of continuing education. Throughout our planning sessions for this seminar, the Dean has translated belief into action. Your program committee felt it was altogether appropriate, therefore, that he open the seminar with his address on "What is Continuing Education?"

WHAT IS CONTINUING EDUCATION?

Dean W. M. Armstrong
Faculty of Applied Science
President, Canadian Council of Professional Engineers

Chairman, gentlemen. I don't know if it is my position to welcome you but I suppose since engineers and Engineering I aculty are involved in this matter of continuing education, I should say I'm very pleased to see this enthusiastic group who, otherwise, would be digging in their gardens or digging on golf courses and, as our chairman said, it is interesting to see that you have taken time out from a very busy life in order to come here and discuss the matter.

Perhaps the most obvious definition of Continuing Education is to say that, after an engineer receives his degree training at a university, it is the sum total of personal reading and study, professional association with colleagues and consultants, attendance at company training courses and meetings of technical societies, and formal courses.

Until recently, it was generally accepted that university education and possibly a subsequent formal training program in industry were something to be completed at an early age, after which any engineer who was sufficiently ambitious could depend on his own initiative to continue his training by the methods described in my definition. However, because of the complexity of modern engineering, the voluminous technical literature, and the other demands on our spare time, it is increasingly apparent that an unprogrammed, casual effort at self-education is neither realistic or adequate.

For the purposes of this discussion we can divide the professional education of an engineer into three phases:

Phase I - consists of the undergraduate and graduate education which provides the basis for a man's professional life.

Phase II - provides the opportunity for him to undertake

additional formal training in which the emphasis is on the acquisition of knowledge, either related to what he already knows or in some new field, but always in depth. The courses may deal with mathematics as a descriptive language, with design and evaluation of systems, or may be designed to prepare engineers who are already involved in management for top executive positions in their industry.

Phase III - is concerned primarily with stimulation. It is designed to keep the mind alert and willing to accept new ideas. New areas of interest are explored through reading, discussion groups, lectures and workshops. It keeps the individual stimulated so that he continues to be productive.

Phases II and III involve continuing education and may take the form of credit and non-credit courses, degree and non-degree programs, full-time or part-time study, work-study arrangements, etc.

Let me give you a few examples of the various types of programs:-

Graduate Study Assistance Programs (Part-time only)

Engineers studying for diplomas or graduate degrees at recognized institutions of higher learning outside of the employer company. In this presentation I will include only part-time studies.

Most U. S. employers of the participants refund 50% to 100% of the tuition fees and most companies set no maximum on the annual amount of such support and require only "satisfactory completion of the course".

Many companies allow time off from work to attend lectures but set limits on a per week, per course or per year basis; e. g., (a) every Monday morning from 8.30 - 12.30; (b) all day Friday for a course on Friday and Saturday (the student is giving up his Saturday activities).

University of California Extension reports that last year 55% of its enrolments were in graduate professional courses and, in our own profession, that during the year one in every eight engineers

in California attended one of their courses.

I should point out that the Faculty of Medicine at U. B. C. has a Department of Continuing Medical Education which, in the period from July 1, 1964, to June 30, 1965, gave on-campus and off-campus courses to about 870 physicians for a total of 456 course hours.

The Oregon State System of Higher Education has established a Portland Center for Continuing Education which is offering courses in continuing education for engineers. One of the notices for the current year is for a course in "Decisions in Engineering Economy." This is a non-credit course given from 7 to 10 p.m. one evening per week, from April 7 to June 9, at Portland State College.

At the end of the spectrum, we find that a new degree - Master of Engineering - is being offered by the University of Toronto to meet the needs of the engineering graduate working in industry at a senior level. The program requires some period of residence on the campus - a total of about three months - but this may consist of several short periods and the degree is based on part-time study and an industrial project approved by the University. Although this is the first course of this type in Canada, several American universities have similar programs.

Another form of continuing education is found in the company "in-house" course or company sponsored course programs on university campuses.

Company Programs

Many large companies have initiated their own "in-house" programs of continuing education or may sponsor a course on a university campus for their employees only. Instructors are often drawn from universities so that such courses may be restricted to periods between university lecture terms. Course duration may be from two to six weeks.

The General Electric Company in the United States offers such a course for engineering managers in its various manufacturing divisions. The list of participants in the 1964 course shows that all were graduates in engineering or science and years of graduation ranged from 1932 to about 1952. Most held a Bachelor degree only.

I have a copy of the curriculum for this six-week course and it is far from a general-interest program. A few typical lectures

are:

> Linear systems analysis, statistical mechanics, band theory in solids, basic feedback theory, statistical decision theory, transport phenomena, - in all, about 90 lectures.

One of my graduates in metallurgy, of about 1950 vintage, took the 1964 course and reported that about six weeks before the course he received a set of mathematics texts and printed notes reviewing math and science backgrounds in several fields, with the request that he read them before starting the course. His comments on the course are interesting and I would like to repeat some of them - I quote:

"Most important, from a personal standpoint, is the fact that the course gave me an interest in more self-study and the confidence to undertake it. I now find that I get enjoyment from it. I admit that, before the course, I was not doing any studying but have continued to do so since the course ended in May 1964 and find it very stimulating. Also, I find that I am better able to assess and direct the work of younger technical men in my division."

These are a few examples of the many forms of continuing education for engineers. It is very noticeable that most of the programs are completely inter-disciplinary and in some cases it has been necessary to create new textbooks for the course.

Conclusion

We hear many statements to the effect that a graduating engineer today faces the prospect that half of his knowledge will be obsolete in ten years, and half of what he will need to know in ten years hasn't been discovered yet!

Regardless of the method of expressing our concern, it is apparent that, at present, many Canadian engineers have experienced a large time-gap between Phase I and Phase II of their education and remedial action must be taken. At the same time, we must never again permit the new graduate to get out of the learning habit. This can be accomplished only with the co-operation of employers, professional groups and universities by creating the proper job situations, incentives, and work schedules to ensure that a definite portion of each engineer's time is regularly devoted to the process of formal education.

However, I would like to emphasize that, whether or not the studies lead to a degree or diploma, the objective of "continuing

engineering studies" is the improved competence of the individual as a practising engineer. In the words of the Committee established by the Engineers' Council for Professional Development to study this problem:

"What is most urgently needed for the future is a more direct provision for maintaining the competency of all members of the profession at a high level regardless of the year of graduation and regardless of the degree level at which the individual enters engineering practice."

CONTINUING EDUCATION FOR ENGINEERS
PAST EXPERIENCE IN BRITISH COLUMBIA

Mr. W. P. Harland, Caseco Consultants Ltd.
Chairman, Vancouver Branch, Engineering Institute of Canada

Chairman and Gentlemen,

As Mr. Crouch said, the first thing we should do in studying the problem of continuing education is to look at what has been done and what is being done.

With the assistance of the Extension Department a survey has just been made of past achievements in this regard. This study was not definitive by any means. It was limited both by time and by records available. However, we have been able to come up with some tabulations for courses that have been given in the past. These involved four phases. First, Industry; secondly, the Faculty of Engineering here at U.B.C.; thirdly, the Extension Department; and fourthly, Engineering Societies in the Vancouver area.

Industry Involvement

Ten companies, chosen from a list provided by the Association of Professional Engineers, were contacted in an attempt to gain a general view of what industry is doing in regard to continuing education for engineers.

All companies contacted expressed some concern for the continuing education of engineers in their employ, although the extent of their concern varied widely. No company seemed to have a formal policy for continuing education. Decisions are usually based on the particular needs of the company at a particular time.

Companies generally pay between 50% and 100% of the employees' tuition expenses. In a small number of cases an extended educational leave of absence is granted. Estimates of the number of engineers employed by a company who will take a course or will attend a seminar in a one year period range from 25% to 75%.

Three of the larger companies contacted indicated that from time to time outside consultants were brought in to conduct a course for engineering employees on company premises in company time. Four companies indicated that they had sent engineers to schools such as the Banff School of Advanced Management or the Harvard School of Business Administration.

Business and industrial firms seemed to be concerned with two general areas of continuing education for engineers. The first area of concern was technical, expressed in the idea that the engineer must "keep abreast of current developments in his field." Several companies noted, however, that once an engineer begins to move into management ranks, managerial and administrative skills are required. In this second area of concern, companies send engineers to the Banff School of Advanced Management, the Harvard School of Business Administration, or other places where similar programs are offered.

Faculty of Engineering

The second phase investigated was the involvement of the Faculty of Engineering at U.B.C. Interviews were conducted with representatives of the Departments of Chemical, Civil, Electrical, Mechanical, Metallurgical and Mineral Engineering.

Civil Engineering appears to have been the most active department in continuing education, having offered programs in co-operation with either one or a combination of the following: the Engineering Institute of Canada, the Extension Department, business firms, and other engineering departments.

This same pattern of co-sponsoring programs prevails in much work of the other engineering departments, (as you will note from examination of the tables in the appendix). The few exceptions to this pattern follow.

The Department of Metallurgical Engineering held a two-week refresher course on "Metallurgical Thermodynamics" in the summer of 1965.

The Department of Chemical Engineering conducted a five-week summer course in 1965 on "Unit Operations" for the technical and engineering employees of Columbia Cellulose, Prince Rupert. This, incidentally, seems to be one of the very few courses which was conducted for British Columbia engineers outside of Vancouver.

The Department of Mineral Engineering conducted a one-

week course on "Rock Mechanics" in January, 1966, and a one-week course on "Flotation" in March, 1966. A third course is planned for May, 1966.

The Departments of Electrical and Civil Engineering have offered graduate courses on Saturdays in which about fifty engineers from the Vancouver area have participated since 1963.

U.B.C. Extension Department

The third phase surveyed was the involvement of the U.B.C. Extension Department. The Department is concerned mainly with programs in the management area, although many of the technical programs have been conducted with the aid of facilities and resources supplied by Extension. Of the management-type programs conducted by the Extension Department, approximately one-half have been in the computer field. Programs offered by the Department have been organized as short courses, usually lasting for ten sessions of two hours each.

Engineering Societies

Fourth, and finally, we looked into the work being carried out by the Engineering Societies in the Vancouver area. For the past three seasons, the Engineering Institute of Canada has offered lecture series dealing with "Power in B.C.," "The Forest Industry," and "Construction in B.C." Each of these series ran weekly for a four month period, with between 500 and 700 people participating in all. The E.I.C. has also co-sponsored short courses and seminars with various departments of the Engineering Faculty and with the Extension Department.

Other societies have expressed varying degrees of commitment to continuing education for engineers.

The American Society for Metals (B.C. Chapter) has conducted yearly short courses since 1963, involving from six to twelve sessions on specialized topics. Demand for these courses has been quite high, with between 45 and 150 participants enrolled in each course.

In March of 1963, 1965, and 1966, the Institute of Electrical and Electronic Engineers conducted three lecture series of four to five evening sessions each, dealing with mathematics, computers, communications, etc.

Studying the tables I think one will come to two main

conclusions. First, the courses that have been provided are mainly in the Vancouver area with very, very little being available to engineers in other parts of the province. Second, although there are 59 programs identified in the tables, there has been no systematic program of development in continuing education for engineers in B.C. Programs have been designed to meet specific and immediate needs, but no planning has been conducted to meet long-term needs.

I think, gentlemen, the central problem is the need for some sort of co-ordination. A great deal has been done, a great deal is being done, but each thing is being done from an individual point of view. If this program of continuing education is to be successful, then there must be some joint planning and overall co-ordination.

CONTINUING EDUCATION FOR ENGINEERS
WHAT COULD BE DONE?

Professor R. E. Chant
Head, Department of Mechanical Engineering, University of Manitoba
Chairman, National Committee on Continuing Education
Engineering Institute of Canada

Gentlemen, it is my pleasure to be on this side of the Granite Curtain again, to renew old acquaintances, and to catch up in the activities of your engineering groups.

In my estimation, the organization of the proceedings today represents a very significant and dynamic move on the part of the groups involved. I was appointed in June of 1965 to chair a Committee on Continuing Education for the Engineering Institute of Canada which was to bring in recommendations as to what part the E.I.C. should play in continuing education.

Thus, gentlemen, you will understand my interest in participating, and although I am going to make a contribution, I am sure that I will take away far more than I can contribute.

My defined purpose is to outline, "What could be done?" I think maybe this was an invitation to turn my imagination loose. However, I am a very serious individual and I believe I can best make a contribution by outlining what has been done in other parts of the Western world. Then, if time permits, we could dwell briefly on what can be done, and what could be done.

CURRENT ENDEAVOURS

Mr. Harland has outlined your past experiences in B.C. which are commendable, but most groups that have studied the problem believe the existing methods are inadequate and certainly are in need of organization. By the term "present methods" I am referring to such things as technical conferences, graduate programs, short seminars, evening courses, correspondence courses, program studies, and "in-house courses." These are all serving a very useful purpose and

many people are finding them helpful. However, they all tend to be an educational process by means of exposure and optimistic attrition.

U. S. A. Activities

A most significant study has been carried out by a committee sponsored by the (E.C.P.D.) Engineering Council for Professional Development, (E.J.C.) Engineers Joint Council, (A.S.E.E.) American Society of Engineering Education, and (N.S.P.E.) National Society of Professional Engineers. The result of this study is recorded in a report of the Joint Advisory Committee on Continuing Engineering Studies. The committee was comprised of four task forces representing industry, government, academic institutions, and engineering societies.

The conclusions and recommendations contained in the report cannot be reviewed in the time available. But briefly the report concluded that while the engineer as an individual must assume the responsibility of maintaining his competence, the onus to supply the appropriate procedures and tools for continuing study was placed upon the employer, technical societies, and the universities. The creatively driving engineer may be able to keep himself abreast, but technical manpower is a natural or national resource of limited availability and is thus too important to neglect. To motivate and assist the large number of very able engineers who need encouragement, the above groups must play an active role. A suitable form of continuing an education must be defined and cannot be left to "an if-and-when available basis." Regulated programs must be established and budgeted.

The Joint Advisory Committee recommended that experimentation be used to determine the most effective format. They further recommended that a "national agency of high prestige and unquestioned technical competence" should assume the leadership for a comprehensive and co-ordinated research effort to deal with the national problem of continuing education. The report was completed in September, 1965 and presumably was submitted to the executive committees of the sponsoring societies. The only action that I have noted is the establishment of a clearing house for information by the E.J.C.

European Activities

It is natural that countries which depend heavily upon their industrial production for their well being would assume a lead in continuing education of technical personnel. The technical societies

in the United Kingdom are not putting forward any particular direct effort. I have always been very impressed by the versatility and scope of technical education in the U. K. through their system of technical colleges and universities, and by virtue of their sandwiched type of course. I further suggest that they are relying on this organization to provide the continuing education needed.

The importance was realized and discussed in 1962 at the fourth conference of (E.U.S.E.C.) Engineering Societies of Western Europe and United States of America. It was concluded at that time that the crux of the problem was to persuade the employers of its importance. A 1966 meeting is planned in Copenhagen to report progress in the field of continuing education. Again, the main action has been to make known what is available; for instance, the Institute of Civil Engineers has set up a special registrar of post-graduate courses which now contains particulars of over a thousand courses and this institute answers approximately eighty enquiries per month.

In Europe the most significant programs that have come to my attention are the Danish and Swedish endeavours. The Danish program was organized as a result of the 1962 E.U.S.E.C. conference, under the auspices of an association representing all technical societies in Denmark. The result is a well-organized plan of "extensive education". The form is not evident from the information I have available, but it consists of three days per month and if participation can be used as a measure of success, the plan is effective. Total participation represents six hours per year of organized study for each graduate engineer in Denmark.

Courses were planned to suit the needs of the various engineering groups, a large number of them related to management (lateral courses). The first year of operation was subsidized by the societies, but prior to this it was estimated that 90% of continuing education was financed by industry and it is hoped that industry will assist in the future. The problem of organizing suitable programs in small countries with high population densities is different from problems we encounter, but ideas can be gleaned from the Danish and Swedish activities which certainly emphasize the importance of continuing education.

Sweden has also a well-organized program with high participation. In 1964, the program consisted of 54 courses with total attendance of 3,053 and in 1965, 60 courses were offered with a total attendance of 4,000. Courses were arranged to occupy not more than four days in a working week. Their experiences indicate that the concentrated course is the most effective, and they have concluded that

correspondence courses are of limited value for this level of instruction.

Sweden already had the organization necessary to coordinate the programs. This existed in the form of The Association of Engineers and Architects, which consisted of twelve technical societies including technical physicists, land surveyors, and even technical educators.

Western Canadian Activities

Region II of the Engineering Institute of Canada has experienced success with a series of technical development programs. These are comprised of intense short courses of three or four days duration, held in the early part of September alternatively at the University of Saskatchewan and the University of Manitoba. Attendance has averaged approximately 90 per year, registered in five courses.

The Association of Professional Engineers of the Province of Alberta has organized a comprehensive series of extension courses in conjunction with the University of Alberta.

It appears that nearly every type of program has been tried in Canada. The Canadian Welding Bureau, a division of Canadian Standards Association, has used correspondence courses for many years and reports success for the type of instruction offered. The Bureau points out that correspondence courses are not adequate for more advanced courses and that malpractices in this area must be controlled.

DISCUSSION AND PROPOSED ACTION

The Joint Advisory Committee has suggested the evaluation of various forms of continuing education by experimentation. Time to evaluate the various forms of continuing education is not available and such an evaluation can only prove one thing; namely, that each form will be quite satisfactory for certain types of subjects. I tend to favour the short course of an intense nature presented under suitable conditions but let us choose a well-proven method and concentrate on it.

Evening courses and "in-house training" courses are not considered suitable. The evenings of the engineer should already be well-filled with participation in family development, culture, and other

pursuits where his special talents can assist the community. The experience encountered in attempting to build up attendance at "papers nights" has indicated this is the case. The "in-house courses" involve release from one's duties for one or more hours per week to attend specially prepared courses. I submit that you cannot release an engineer from his duties in the normal working environment; the engineer lives with his work and is indeed fortunate if he can manage to leave it at the office. The potential student must be removed from the work environment for best pedagogical results. The universities have facilities, so why not use them?

What Can Be Done?

From the brief review of current activities and the few arguments developed, I submit the following can be readily accomplished:

(1) Promotion of the benefits of continuing education and the updating of engineering staff to be directed at the employers.

(2) Promotion of the value of continuing education to the practising engineer.

(3) Complete cataloging of available courses and establishment of a nationally co-ordinated series of technical development programs to be offered at the universities, but co-ordinated by the technical societies, industry, and the universities.

This is not the place to iron out the details of how these are to be accomplished or by whom, but we cannot afford to divide our resources. Technical manpower is scarce and these special students will require special instructors, some of which will have to be drawn from industry. To be worthwhile there will be a financial tab; while industry will have to absorb most of this, the engineers should attempt, either directly or indirectly, to shoulder some of the financial responsibility - for responsibility and authority generally go together.

What Could be Done

The following items are proposals, some of them desirable, some of them less desirable - however, there is no intent to

indicate that they are not so obtainable.

(1) Formal study in excess of the first degree could be required for registration and practice. The A.S.E.E. predicts this will be the case in the U. S. A.

(2) Retention of registration could be made dependent upon the successful completion of a certain number of hours of accredited study over a fixed time period.

(3) The preparation of video-tapes for television presentations followed by formal tests at certain centres and the issuing of diplomas for a fixed number of credits, (arm-chair education).

(4) Planned programs of study up to three weeks in length to be held at universities with the participants encouraged to stay in residence. Additional benefits could be accrued if this could be organized on the tutorial college pattern.

(5) Employers to be encouraged to grant one week per year to engineering staff members for the purpose of formal studies of an approved nature, (technical development programs). The time could be accumulative up to three years.

(6) Promotion of continuing education as a management tool in the same way that research and development is now being considered as a management function.

There is no doubt of the need for continuing education; the only consideration is the extent and timing, and the subject is far too important to dismiss or retard for lack of funds. The continuance of the buoyant Canadian economy depends upon the application of technology to extend and improve our manufacturing potential. Employers of engineers must be willing to create a stimulating working atmosphere which will induce the desire for further study among their engineering staff members. Industry should also be prepared to pay a large share of the costs for it will accrue both the direct and indirect benefits. The Canadian populace as a whole will be a benefactor and thus expenditures of public funds can be justified.

INDUSTRY'S CONCERN IN CONTINUING EDUCATION FOR ENGINEERS

Mr. D. W. Minion
Assistant Chief Engineer, B. C. Hydro and Power Authority

Mr. Chairman, Gentlemen:

Perhaps I am no more qualified to speak on this matter of continuing education than most of you present, but that doesn't mean that I have any less interest. My interest stems not only from the fact that part of my job is to recruit and to keep engineers, but also I stand before you as a living, breathing example of continuing education. I have been through evening courses, seminars, and in-house programs, and three years ago I took a year out to do graduate work at M. I. T. - which, incidentally, proved to be a very shocking experience. So I stand before you as a missionary in the field of continuing education.

While I know that the primary objective of business is not to educate people, but to produce results, nevertheless there can be little argument with the proposition that it is necessary to have better educated people if better results are to be produced. Professor Chant of the University of Manitoba has already outlined some of the things that can be done in the field of continuing education for engineers, and it is my hope that I can add one or two others based on my fifteen years experience in industry.

We can, of course, start with "in-house" programs. There are two basic types. One is where the program is designed, organized, and conducted by members of a particular company to meet their own needs. They may find it advisable to draw on other parts of their industry or a university for assistance, and may on occasion open the program to outside participants. There are also the more unusual schemes, such as the one that Du Pont Corporation uses, in which a university staff member joins a company for the summer and, together with company personnel, guides the work of a group of employees. This is an intriguing idea, a variation of which might be to encourage faculty members to obtain leaves of absence from the university for industrial work or to have this university permit its

faculty to carry on more extensive consulting work.

There are many types of programs in which universities can take the lead, provided they have the active co-operation of industry and the professional associations. These include courses in elected subjects given during off-time periods in the evenings or on Saturdays, etc. However, I question the value of a course on numerical analysis or fluid mechanics if it is taught after hours by a professor who has worked all day. While I cannot speak for the professor from my personal experience, I do know that it is most difficult to be an effective student after working all day.

The symposium on earthquake engineering co-ordinated by U. B. C. last summer was an excellent example of how seminars and symposia can provide a useful means of disseminating the latest information on technical subjects. However, there is not nearly enough of this done in the Vancouver area, and it is necessary for my company to send employees to university seminars in the United States to familiarize them with the latest technological developments in computer techniques and the solution of complex electrical network problems. Indeed, during the past year we have had refusals from people to whom we have made job offers because of the limited opportunities offered in the Vancouver area for continuation of formal education.

In Great Britain in recent years there has been a considerable increase in one-year specialist Master of Science courses offered by the universities in such technical specialties as automatic control systems, structural engineering, switchgear technology, etc. In many ways this program is similar to the diploma courses now offered by some Canadian universities, such as the University of Saskatchewan, and the Master of Engineering course now being offered by the University of Toronto. One of the real benefits of these courses is to provide the opportunity for "late starters" who did not obtain a sufficiently high academic standard in their bachelor degree program to take advanced training. Many of these "late starters" do very well in industry and find themselves in the technical research or development sections of a company with little of the necessary academic training.

For the truly outstanding employee there is, of course, no substitute for graduate training at a university, provided the employee has not been away from the cloistered halls too long. Where a company needs advanced technical knowledge, it should consider sponsoring employees' full-time or part-time attendance at a university, rather than hiring another person. The drawback is that to send

a present employee the company pays twice - it pays for his salary and expenses and it loses the services of one of its best people for the length of the course. However, in the present competitive market I see no alternative. Certainly a number of the large American firms, such as Monsanto, American Cynamide, Westinghouse, IBM and CBS, have determined that this is in their best interests.

For those senior engineers who have been away from school too long to compete with the present bright-eyed students, some other means of providing advanced graduate work must be found. You may be aware of the efforts that Massachusetts Institute of Technology has put into developing its Centre for Advanced Engineering Study, whose purpose is to explore ways of increasing the effectiveness of mature engineers. I do not have time at my disposal to go into this particular program at length, but wish to suggest that you take your own time to investigate its uniqueness and to keep abreast of its development and evolution.

You may be interested to know that there are companies that have reached agreement with universities whereby research carried out on the company's own premises may be substituted for graduate work. In this case, while it is necessary for the man concerned to spend some time at the university, it is nothing like the time that he would be away as a full-time student.

I think it is now obvious that there are many ways in which continuing education for engineers can be carried out. Unfortunately, none of these schemes can work unless the individual makes them work. Education can produce for the individual only what the individual brings to it. However, there are several ways in which companies can offer concrete aid to the individuals who desire to improve themselves. Firstly, they can sponsor seminars or other technical workshops and provide the necessary financial support to put on the programs that are needed; secondly, time off and financial support can be offered to the individual; finally, they can afford employees the opportunity to put their increased knowledge to use. One of the facts of life which must be recognized is that if an employee is not afforded this opportunity, the company runs a very real risk of losing that employee. For this reason alone companies cannot afford to be too altruistic, even though, as I have previously noted, competitive demand for engineers will make it necessary for companies to take a more enlightened approach in this field.

Where a company or industry has particular needs, then it must be prepared to enter into special relationships with a university. In some unusual cases this may involve the sponsorship, or

joint sponsorship, of a professorial chair at the university, so that companies have some means of bringing to the university's direct attention the needs of the industry. Or, as has been the case with the Bell Telephone Company and Queen's University in Kingston, it may be necessary to develop a course, such as their communications engineering course, that is exclusive to the needs of the company. What is obviously needed is to establish a means by which the universities can be informed of industries' needs. Perhaps the creation of an advisory council, such as those used by some American universities, might be worth consideration.

However, it is not always apparent to a company or industry what are the needs of the individual. In this respect, there is a very significant role to be played by the Associations of Professional Engineers and the Engineering Institute of Canada, and as well in seeing that there is the necessary degree of co-ordination at the national level.

On the basis of my experience, both on a personal level and as a manager of engineering personnel, I have found that the three most useful forms of continuing education, apart from work on the job, are these: firstly, technical workshops and seminars up to three weeks in duration, where the participants are removed from company premises and are thus free from the pressure of work; secondly, in-house programs involving technical industry experts, professors, etc.; and lastly, the chance to do graduate work at a university for the outstanding engineer.

DISCUSSION GROUP SUMMARIES

General Chairman		D. R. Bakewell
GROUP I	Chairman	Ralph Kluckner
	Rapporteur	Henry M. Rosenthal
GROUP II	Chairman	H. C. Gunning
	Rapporteur	Jindra Kulich
GROUP III	Chairman	V. S. Pendakur
	Rapporteur	Knute Buttedahl
GROUP IV	Chairman	F. H. Milligan
	Rapporteur	C. P. Jones

Question posed to four discussion groups: What are your specific needs, immediate and long range, in continuing education in the following areas:

(a) technical
(b) management
(c) other courses?

GROUP I

Group I differentiated engineers into three groups with separate needs for continuing education; recent graduates, out of school only three or four years: experienced engineers, out of school for some time but who still primarily engineers; and engineers now in management. With these groups in mind the following ideas were set forth:

1. Updating courses in modern mathematics used by most engineers was felt to be a real necessity and applicable to all groups - recent graduates, experienced engineers, and engineers in management.

2. A need was expressed for specialized teaching approaches geared to people away from formal education for some period of time.

3. A brief refresher course prior to enrollment in a full-time course was suggested for returning students. Such a course could acquaint participants with a new vocabulary and new terminology, or take the form of orientation reading programs. It was felt this type of refresher program should be broad and interdisciplinary, rather than narrow and specialized. It was also suggested that seminars or short courses would lend themselves particularly well in terms of format to this kind of interdisciplinary approach. Residential-type seminars would have special value in offering students the opportunity to learn from each other as well as from instructors.

4. It was suggested that wide-ranging courses of professional development, as opposed to technical updating, be organized to expose engineers to a variety of stimuli. Subject matter could range from appreciation of the arts to new scientific advances. An exploratory program of this nature could help determine needs and interests leading to courses of greater depth and specialization.

5. Special courses should be devised for senior management personnel which could win their support for programs involving their junior personnel.

6. A course on economics was seen as a vital need for engineers after three or four years' experience.

7. "Statistical methods and probability" was considered a necessary course in the continuing education of engineers.

8. A course on resource economics and ecology was considered to be of special relevance in British Columbia.

9. Courses relating to computer techniques were suggested as particularly needed for older engineers and managers.

10. In the area of managment courses, needs were distinguished in two main areas:

(a) the whole question of management relations, management staff relations and problems of communication, including some of the modern techniques now used in industry in the United States; and (b) courses on management relating to job evaluation, job specifications, cost analysis, feasibility studies, etc.

GROUP II

In the area of continuing education needs for engineers, Group II expressed the following ideas:

1. Refresher courses and updating courses were considered extremely necessary because of the current knowledge explosion, particularly in the areas of (a) new mathematics, (b) new scientific concepts, (c) new methods and techniques of problem-solving, and (d) new equipment available in the field.

2. The need for courses aimed at understanding broad general principles, as well as specialized courses, was considered important.

3. A need for the development of communication skills was seen primarily in two areas: (a) skills in selling new ideas to management, which was considered very important; and (b) training in written communication. It was not felt that there was a great need for training in oral communication.

4. It was suggested that whatever courses, seminars, or other methods of training were used be tailored specifically according to the needs of different industries and different people. As an example of the latter, it was pointed out that one would approach the experienced engineer who has been out of school ten to fifteen years in a slightly different way than one would approach a new graduate.

5. Management, in the view of Group II, does not only concern top level management. The Group pointed out that practically all engineers move into managing as soon as they start work, in the sense that they have people working for them.

6. Training needs in the management area were felt to include management skills, human relations skills, and communications skills (selling ideas both to the people immediately on the level below and to the management levels above).

7. Two other specific courses for management for which a need was felt were: cost analysis and engineering economics.

8. A course in contractual law was felt to be of particular use in civil engineering.

GROUP III

Group III listed six types of program needs which they felt

to be distinguishable in the realm of continuing education for engineers:

1. Updating Courses - updating basic knowledge, e.g., mathematics in relation to computers, areas of chemistry, and physics. The objectives of such programs would be to keep the engineer in the technical stream. These programs would be primarily for engineers who continue to produce and function as engineers in technical rather than management areas.

2. Refresher Courses - designed to meet specific needs and bridge gaps in knowledge and techniques. These courses would be offered to help older professional engineers keep up with recent graduates.

3. Appreciation Courses - offered to give the specialist a broader awareness of other things going on about him and to assist him in information retrieval. These courses might focus on questions such as "What can a computer do for you if you are an engineer, or for your firm, or within your industry?"

4. Mind Improvement Courses - designed to help engineers maintain their ability to solve large problems.

5. Management Courses - including the development of management skills and management appreciation of technical developments in their field.

6. Human Engineering or Human Relations Courses - developing the ability to supervise and manage in relation to getting along with people.

Group III foresaw most urgent needs in this area.

GROUP IV

Having listened to the reports by the three preceding Groups, Group IV expressed agreement with the ideas and suggestions set forth. Further suggestions by Group IV were:

1. There should be a separation of course content and instruction for the new graduate, the three to five year graduate and the older graduate.

2. Courses relating to scientific advances and new concepts were felt to be a "must" in a program of continuing education for

engineers.

3. Report writing, economics and resource economics all of which were mentioned by previous groups - were noted as particularly important.

4. It was felt that the employer was the key ingredient in any program - he must give his full support.

COMMENTS ON DISCUSSION GROUP REPORTS

Professor Chant
Dean Armstrong
Mr. Harland
Dr. Friesen

General agreement with the comments of the discussion groups was expressed.

Reiterated was the importance of gearing continuing education courses to different stages in an engineer's career . . . the engineer in training or just starting out, the practising engineer and the engineer who is thinking of, or is a part of, management.

In commenting on the general concern for continuing education courses relating to modern mathematical language, it was suggested that top management and older engineers are concerned because they don't know the language younger engineers are using. The line of communication is thus essentially broken between the younger and older groups.

It was suggested that it is the engineer in management, the older engineer, who is interested in courses such as modern mathematics, modern physics, and specialized technical courses applied to engineering. In contrast, it seems to be the younger engineer who is the man with an eye on a management position and who tends to attend courses on management skills, economics and business administration in general.

Project planning was a subject matter area which did not arise in the group discussions but which was suggested by one of the commentators as having potential for courses in continuing education for engineers.

DISCUSSION GROUP SUMMARIES

Questions posed to four discussion groups: To what extent can the needs for continuing education for engineers be met through university continuing education? Through what other organizations or agencies can these needs be met? What role can employers play in this need for continuing education for engineers?

GROUP I

1. Sponsorship of continuing education programs for engineers should stem from the professional organization with greater responsibility assigned to universities and in close co-operation with industries.

2. It was suggested that industry should not bear the full cost of such programs but that individuals taking courses accept some part of the financial responsibility. Employers should grant time off and extend some financial support to programs.

GROUP II

1. The university should utilize available resources by enlisting professional engineers to give lectures. At the same time, it was suggested that both industry and the university would berefit if engineers on the faculty entered industry for periods as residential officers.

2. The professional association should play a much stronger role in supporting and co-ordinating education in the profession. The association was visualized as the connecting link between industry and university.

3. A suggestion was made that the professional association recognize industrial achievements by establishing a program to parallel the university graduate education program, awarding a "Master Engineer" title to persons who cannot return to university for

graduate work.

4. Industry's facilities for research should be made available to university faculty and students working for degrees. It was suggested that a survey be made of existing industry research facilities and research underway to provide information for the university.

5. One-week leaves for educational purposes every three years were suggested for engineers in industry.

6. A recommendation was made for the establishment of an Industrial Advisory Council to the university.

7. A study of developments in continuing education for engineers abroad was suggested for its relevance in Canada.

GROUP III

Co-operation among industry, professional and technical associations, and the university was considered of utmost importance in developing a meaningful continuing education program for engineers. The following points were made:

1. As a practical means of giving immediate support to university continuing education, a unanimous recommendation proposed that the University Extension Department appoint a co-ordinator of Continuing Education in Engineering in consultation with the Faculty of Engineering. Further, it was suggested that this co-ordinator work in close co-operation with professional and technical societies to develop a program of continuing education.

2. Professional and technical organizations in working with a co-ordinator could help in (a) defining the needs of engineers for continuing education, (b) encouraging employers to give their support to programs, and (c) during initial stages, giving financial support to launching a program.

3. It was suggested that undergraduate and graduate courses should concentrate on theory, but that continuing education courses for engineers should deal with industrial applications.

4. Although evening classes might not be the optimum technique (as was suggested earlier in the seminar) they were seen by Group III as still serving a very important function in future plans for

continuing education.

5. It was felt that a major obstacle in continuing education at the university level is that university staff are strained with meeting the demands of undergraduate and graduate programs. It was suggested that, as in the past, continuing education programs should also draw upon resource people in industry.

6. Public funds and foundation grants should be explored for support of continuing education programs for engineers, particularly in initial stages of the program.

7. The role of employers in the continuing education of engineers should include: contributing toward fees, providing time for employees to pursue studies, and financially supporting the total program. In the latter instance it was felt that long-term financial support from industry should not be depended upon in view of general economic fluctuations.

GROUP IV

1. In order to fulfill its role of having the most advanced knowledge in engineering fields it was felt that the university must have a very strong post-graduate program.

2. The university should concentrate on general theory and fundamentals rather than specifics, leaving the sponsoring of the latter to various professional and technical associations.

3. Agreement was expressed as to the value of people from industry acting as resource personnel in university courses serving the profession.

4. Management should be responsible for making facilities and opportunities available for the continuing education of engineers.

COMMENTS ON DISCUSSION GROUP REPORTS

Professor Chant
Dean Armstrong
Mr. Harland
Dr. Friesen

Following the more general comments of discussion groups, which focussed primarily on the long-term picture, a proposal for specific action was suggested.

Three assumptions were stated: (1) that the university is a logical place for conducting continuing education; (2) that professional societies and associations are interested in the problem of continuing education and are anxious to contribute to the limit of their resources, but their resources are limited because these organizations operate on a voluntary basis; and (3) that industry must co-operate in supporting a program of continuing education for engineers.

Based on these assumptions, it was recommended that a committee be formed immediately, consisting of a member of the Faculty of Engineering, a member of the Extension Department, a member from each of the professional societies who have in the past few years conducted any professional development or continuing education programs, and representatives from industry.

This committee, which could have as many as twenty members, would not be established initially to expand the number of continuing education projects for engineers, but, for the present, to direct and give purpose to immediate continuing education programs for engineers.

An earlier suggestion from Group III was that a co-ordinator be appointed for such a function and act as executive director of the proposed committee.

A point stressed was the importance of having the opinions of the community - industry, associations, engineers - heard in the development and carrying out of a continuing education program.

A further suggestion for action was to see some experimental sequence of courses, based on the committee's recommendations, commence in the fall of 1966. Possible courses suggested for the initial step were modern mathematics, engineering applications, engineering economics, cost analysis and probability theory. Courses would be experimental in content and format, and in scheduling, e.g., working hours versus Saturdays.

It was pointed out that Federal support would probably be available for programs in continuing education for engineers. More specifically, the National Research Council would likely aid technical seminars and short concentrated courses. At the same time, support from industry should be sought.

A method of financing used in the United States for continuing education courses is to have the engineer register for a course, pay his fee, and then have his employer reimburse him for 50% to 100% of the fee on completion of the course. This was considered of value in that an individual must take the initiative and show genuine interest in a particular course.

GENERAL COMMENTS BY THE PARTICIPANTS

Concentrated seminars, extending over Thursday, Friday and Saturday were suggested as one effective method of offering continuing education courses to engineers. The course should be conducted with a view to generating and sustaining a high level of enthusiasm and providing wide opportunity for interaction among students. For such a program, an employer could contribute some of his employee's working time and the employee could contribute some of his own time. It was pointed out that some engineering departments have been offering such concentrated courses during the academic year. However, many departments find it difficult to do so because of heavy teaching loads. A suggestion was made that the month of May would be a particularly opportune time to offer concentrated courses as this did not interfere with the industrial holiday period or with the academic year at the university.

It was mentioned that most companies do not object to paying a portion of an employee's fees for continuing education courses; more objection is raised to giving a man time off work and causing industry a loss in production time.

Inviting engineers to a centre for three, four or five-day courses was suggested for those who do not have easy access to the university. Programmed teaching texts, special telephone hook-ups, closed-circuit television and correspondence cum lectures were suggested as a means of taking the university to the community and providing continuing education programs to engineers in outlying areas.

Special courses oriented to the University Summer Session, ranging from three to six weeks in length, were proposed as a method of offering intensive continuing education programs. It was mentioned that faculty from other universities could be sought for such summer programs.

A problem in the continuing education of engineers is determining the kind of courses which should be given. It was suggested that it is not the academic type of course, such as an academic approach to modern mathematics, but the use of modern mathematics that will be valuable for the practising engineer. Further, it was noted that the idea of having post-graduate students teach continuing education courses,

which has been considered in the past, would not be too effective because such courses might be too academic. Finding professors of engineering who can afford time to develop highly specialized courses was seen as another problem.

The Department of Extension was recognized as the branch of the university devoting full-time to continuing education in certain professions, e.g., education, agriculture, pharmacy and community planning. For this reason this Department was seen as the logical place to begin a program of continuing education for engineers. It was further proposed that as soon as possible the Department of Extension should have one person devoting full-time to examining the problems set forth by the seminar, of refining the university's role, and co-ordinating a program with industry, the Faculty of Engineering, and technical and professional societies. This recommendation also added that such a program supervisor working full-time with the continuing education of engineers would be the logical co-ordinator of an advisory committee with representation from the professional association, technical societies the Faculty of Engineering and industry.

It was suggested that, because of regular teaching and research commitments, university engineering departments would find it difficult to conduct a continuing sequence of courses with fixed demands. However, individual departments can respond to specific requests; one example given was the recent course on "Earthquake Engineering."

Repeated reference was made to the need for special teaching techniques in courses for engineers who had been out of school for some length of time.

The seminar agreed that the engineering profession has a responsibility to its members to stimulate the development of continuing education programs. Several members of the seminar expressed the feeling that, in its initial stage, a program in continuing education should not be too ambitious and might devote considerable effort in first co-ordinating present activities.

It was suggested that an organized plan for financing continuing education, with both employer and employee contributing, be presented to industry for consideration.

Finally, it was recommended that an advisory committee be established, composed of the Faculty of Engineering, the Extension Department, the professional associations and industry, to proceed with framing the purposes and procedures for a program to serve the engineering profession in British Columbia.

SUMMARY

Dr. J. K. Friesen
Director, Department of University Extension, U. B. C.

The engineering profession has today added another important landmark to British Columbia's Centenary. As a result of our presentations and discussions, you have decided to take a turn in the road and explore a new and exciting vista in education. One speaker gave us the key phrase of the day when he spoke of the need to take out "educational insurance." Dr. William Dunlop, one-time Extension Director of the University of Toronto, had another way of personalizing this need. A prospective adult student once came to him with the request that he wished to embark on studies toward a B.A. degree and wondered how long it would take to finish the program. Dr. Dunlop informed him it would take six years. "Six years - let me see, I am 37 now, and I will be all of 43 when I complete my studies." Dr. Dunlop's reply was straightforward: "My good man, in six years you will be 43 whether you take this program or not."

Throughout the day we have heard a good deal about the change of thinking from the idea of a completed education to that of continuing education. For the first time, the latter is beginning to enjoy a high priority in the scale of professional development and national goals. At long last, our political leaders at every level of government have found it popular to extol continuing education. In their pursuit of further education, some professions are already airborne, some are just walking to the 'plane, and few are only now discovering the airport.

The new trend is due in no small measure to our rapid advances in science and technology. Where we once spoke of progress in terms of decades, we now think of it in terms of years, even months. The computer is one good example to cite. We recently invited an expert in this field from the University of Washington to plan still another computer course this coming fall at U. B. C. Our colleague informed us that the generation of a computer is two and one-half years. He felt that his university was out-dated by a third of a generation and that B. C. lagged probably half a generation behind time in computer equipment and application.

The seminar reports presented this afternoon have referred to the financial gain that can be derived from continuing education for engineers. Professor Chant, to whom we are particularly indebted for his international survey of this field, pointed to the need for continuing education in expanding and improving the manufacturing potential. Another speaker stated that better results in industry can come only with better informed personnel. We could have added the considerable evidence which Dr. John Deutsch presented in his latest annual report of the Economic Council of Canada, stressing that our progress in national development is directly related to our advances in education. The point is well made in the August 1965 Monthly Economic Letter of the First National City Bank of New York with this observation:

> "A number of recent economic studies have revealed that investment in human capital - education, on-the-job training, health, etc. - has played a much bigger role in U. S. economic growth than previously realized. Thus, in his study, 'The Sources of Economic Growth in the United States,' Edward F. Denison calculated that the rising education level of the labor force (including managerial and technical personnel) was responsible for 23 per cent of the growth in real national income between 1929 and 1957. In contrast the increase in physical capital accounted for only 15 per cent, while the general 'advance of knowledge' was seen as contributing 20 per cent. Using a different method but with similar results, Professor Theodore Schultz of the University of Chicago has estimated that the yield on our investment in 'education capital' over roughly the same period accounted for about one-fifth of the rise in national output. Denison's study also indicated that the relative importance of education has been growing."

Finally, we are indebted to Mr. Harland for his valuable summary of continuing education in the profession itself and at the universities of this province and elsewhere in Canada. In short, there is a good deal of past and current activity on which to base future programs.

Repeated reference has been made throughout the seminar to the need for industry, that is, the employer, to adopt a policy for continuing education of engineers. Professor Chant referred to examples from the United Kingdom, Sweden and other countries where the trend is increasing for continuing education to be a built-in requirement of the engineer's regular responsibilities. Many such programs are conducted in the industry itself. In our North American society, however, the

universities have generally been expected to assume a measure of responsibility in professional education of alumni. The campus setting for a seminar such as this one is typical of many American and now a few Canadian universities. If my interpretation is correct, engineers through their professional associations are saying to the universities that no one has a monopoly in this field but that both should pool their resources to explore and promote continuing education to benefit the greatest number and to assure a high degree in program quality.

It was in this spirit, as the Chairman told us at the outset, that the planning of this seminar took place. Throughout our discussions in committee, Dean Armstrong kept stressing the fact that any program of continuing education would have to draw heavily on the resources of the profession and the industry in addition to the expertise of faculty.

I need not add how important it is that, for the success of continuing education, a great deal depends upon the enthusiasm of the Dean of the Faculty. We are fortunate indeed that Dean Armstrong is a person whose energetic co-operation has contributed so much to the launching of this seminar. It is also most fortuitous that Professor Crouch of the Engineering Faculty was this year the President of your provincial Association and ably chaired the planning meetings.

In looking ahead for a practical method of organizing our mutual enterprise, it was Mr. Harland's remarks and the opinions of several discussion groups here who pointed the way. They stated that continuing education should be a mutual endeavour of the professional organizations, the university and industry. In the university there is the Faculty with its program resources and the Extension Department with its administrative facilities. As you will have observed from our past courses for engineers, the Extension Department has a sizeable staff, experienced in many aspects of continuing education. As education is becoming more and more interdisciplinary in its approach - science and technology, management and general self-improvement are all aspects to consider - there are real advantages to locating administration in one place. In short, the university can provide a home base for continuing education for engineers. As has also been stressed, the professional bodies will want to conduct certain educational activities on their own; this applies to any other professional group. We have to find a mechanism by which the program is conducted in the most economic yet imaginative possible way.

The suggestion has been made that an Advisory Council of the groups concerned should now be struck, which would serve as an on-going body on policy and give initial assistance to plan the entire project in continuing education. We in the Extension Department would

be very pleased to see such a council set up without delay; I will go a step further and suggest that a supervisor of continuing education for engineers be appointed without delay. If this is a financial gamble for the first year, our Department is prepared to take the plunge. Judging from the enthusiasm this seminar and the professional bodies have displayed, I am sure we can venture into this field with confidence.

On behalf of the Seminar committee and of Dean Armstrong and Professor Crouch, I would like to thank you all for having taken time out from your various pastimes on this beautiful spring day to attend this meeting. Again, our thanks to you, Professor Chant, for presenting to the participants a very broad spectrum of activity in continuing education. We hope that we in British Columbia can develop this field with imagination and efficient mutual endeavour.

APPENDIX

APPENDIX

Introduction of Tables

Table I - Technical Programs

The major responsibility for technical programs has been assumed by the Faculty of Engineering and the various engineering institutes. The Extension Department has served as program manager in some cases.

Table II - Managerial Programs

Most of the managerial programs have been offered by the Extension Department in response to requests from business and industry. All computer courses have been included in the managerial category, although many of them have technical and highly specialized applications.

Notes

1. Programs involving a two year period were conducted as a series of weekly sessions. Thus a 20 hour program in 1963-64 would involve 10 weekly sessions of two hours each in the academic year 1963-64.

2. Programs with length described in terms of days or weeks were conducted on an all-day basis. Thus a one week course would involve up to or more than 40 hours of instruction.

3. Some of the data regarding dates, length, and number of participants may not be precise because of the inadequacy of available records.

4. Some of the managerial programs offered by the Extension Department are not composed solely of engineers.

KEY TO TABLES

Ext.	University of B. C. Extension Department
Chem.	Department of Chemical Engineering, Engineering Faculty, U. B. C.
Civ.	Department of Civil Engineering
Elec.	Department of Electrical Engineering
Mech.	Department of Mechanical Engineering
Met.	Department of Metallurgical Engineering
Min.	Department of Mineral Engineering
E. I. C.	Engineering Institute of Canada
A. S. M.	American Society for Metals, B. C. Chapter
I. E. E. E.	Institute of Electrical and Electronic Engineers
nk	Not known

TABLE I - TECHNICAL PROGRAMS

Year	Title
1963	Prestressed Concrete
1963	Steel Construction
1963	Specialized Topics
1963	Waterworks Short Course
1963	Structural Wood
1963	Space Seminar
1963 - 64	Power in B. C.
1964	Welding Seminar
1964	Roadside Development
1964	Specialized Topics
1964	Chemical Grouting
1964 - 65	The Forest Industry
1965	Roadside Development
1965	Unit Operations (Prince Rupert)
1965	Metallurgical Thermodynamics
1965	Specialized Topics
1965	Earthquake Engineering
1965 - 66	Construction in B. C.
1966	Flexible Pavements
1966	Rock Mechanics
1966	Flotation
1966	Specialized Topics

Length	Enrolment	Sponsors
3 days	182	E.I.C., Civ., Ext.
1 day	140	Ext.
20 hours	45	Met., A.S.M.
20 hours	58	Ext., Civ.
3 days	125	E.I.C., Civ., Ext.
1 day	150	Ext.
weekly for 4 months	700	E.I.C.
2 days	140	E.I.C., Ext., Civ., Mech.
1 week	58	Ext.
20 hours	50	Met., A.S.M.
2 days	40	Ext., Cyanimid of Canada, Civ., Min.
weekly for 4 months	500	E.I.C.
1 week	72	Ext.
5 weeks, 4 1/2 hours daily	20	Chem., Columbia Cellulose
2 weeks	20	Met.
20 hours	150	Met., A.S.M.
2 1/2 days	250	Ext., E.I.C., Civ.
weekly for 4 months	700	E.I.C.
2 weeks	45	Ext., Civ., Imperial Oil
1 week	15	Min.
1 week	18	Min.
20 hours	100	Met., A.S.M.

TABLE II - MANAGERIAL PROGRAMS

Year	Title
1963	Work Study Seminar
1963	Boellion Algebra
1963 - 64	Simulation Methods
1963 - 64	Legal Aspects of the Construction Industry
1963 - 64	Continuation Fortran
1963 - 64	Talking to Computers
1963 - 64	Operations Research
1963 - 64	Introduction to Digital Computers
1963 - 64	Computers in Structural Engineering
1963 - 64	Work Study Appreciation
1963 - 64	Introduction to Ele :tronics
1963 - 64	Legal Aspects of the Construction Industry (Victoria)
1964	Automation
1964	Work Study Workshop
1964 - 65	Introduction to Digital Computers
1964 - 65	Introductory I. B. M. 1401
1964 - 65	Introductory Fortran IV
1964 - 65	Fortran Programming and Numerical Algorithms
1964 - 65	Operations Research
1964 - 65	Legal Aspects of the Construction Industry
1964 - 65	Computers in Structural Analysis
1964 - 65	Fortran IV
1964 - 65	Work Study Appreciation
1964 - 65	Data Processing
1965	Value Analysis Seminar
1965	Computers
1965	B. C.'s Future in Forest Products Trade
1965	Technological Reality and Business Policy

Length	Enrol-ment	Sponsors
1 day	20	Ext.
8 hours	nk	I.E.E.E.
20 hours	10	Ext.
20 hours	54	Ext.
20 hours	9	Ext.
20 hours	20	Ext.
40 hours	26	Ext.
20 hours	37	Ext.
40 hours	32	Ext., Civ.
20 hours	18	Ext.
20 hours	24	Ext.
20 hours	66	Ext.
1 day	71	Ext.
2 days	14	Ext.
20 hours	101	Ext.
20 hours	36	Ext.
20 hours	42	Ext.
20 hours	44	Ext.
40 hours	45	Ext.
20 hours	120	Ext.
40 hours	16	Ext., Civ.
20 hours	30	Ext.
20 hours	30	Ext.
20 hours	65	Ext.
1 day	30	Ext.
8 hours	60	I.E.E.E.
1 day	150	Ext.
1 day	25	Ext.

TABLE II - Continued

Year	Title
1965	Automation
1965 – 66	Introductory Fortran IV
1965 - 66	Introduction to Digital Computers
1965 - 66	Introduction to I. B. M. 1401
1965 - 66	Numerical Methods for Computers
1965 - 66	Fortran IV Review
1965 - 66	Operations Research
1965 - 66	Computers in Structural Analysis
1966	Kepner - Tregoe Problem Analysis
1966	Communications Arts for Engineers

Length	Enrolment	Sponsors
1 day	200	Ext.
20 hours	80	Ext.
20 hours	120	Ext.
20 hours	50	Ext.
20 hours	25	Ext.
8 hours	15	Ext.
40 hours	40	Ext.
40 hours	80	Ext., Civ.
1 week	23	Ext.
10 hours	nk	I.E.E.E.

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