Dr. Robert M. Eastman

Professor of Mechanical Engineering, and secretary of the Missouri Conference, sums up results of two-day meeting on

utilizing engineers and scientists

In spite of the current downtrend in business, the long term demand for engineers and scientists is steadily rising. Modern complex technology requires far more engineers per one thousand employees than did manufacturing in the past. An expanding population requires more scientists and engineers to maintain and increase our standard of living. Current military equipment needs many more scientifically trained personnel for its design and operation.

Although the output of engineers and scientists from the colleges and universities has risen, it has not kept pace with the soaring demand. One solution to the discrepancy between demand and supply is better utilization of present scientifically trained personnel. On April 5, 1956, President Eisenhower established the President's Committee on Scientists and Engineers as an action group to coordinate and stimulate the nation's efforts to meet the shortage of scientific manpower. Part of the Committee's program is promoting conferences of industrial executives on the Utilization of Engineers and Scientists.

After four pilot conferences in other parts of the country, the first regular conference on Utilization of Engineers and Scientists was held at the University of Missouri on December 16-17, with about one hundred persons attending. The conference was co-sponsored by the College of Engineering of the University of Missouri and the Missouri Society of Professional Engineers. Many individuals gave freely of their time and effort to make the conference a success. The participants were enthusiastic about the value of the conference and believed that the ideas brought out will help both the individual organizations and the nation's overall scientific effort.

After three keynote speakers and a luncheon, the conference divided into four panel discussion clinics. The topics of the discussion clinics were:

1. Technicians for Non-Professional Work; 2. Recognizing Engineers as Part of Management; 3. Increasing the Effectiveness of the Present Engineering and Scientific Staff; 4. Training and Professional Development of Engineers.

Each clinic had two or three papers on the designated subject followed by a discussion. On the second morning the entire conference met for reports from each clinic and a general discussion. The exchange of ideas in the discussion was one of the most valuable parts of the conference.

The conference was fortunate in having fine speakers for the luncheons and banquet sessions. After the first luncheon, John M. Dalton, Attorney General of Missouri, spoke on professions and ethics. At the banquet, Edwin M. Clark, president of Southwestern Bell Telephone Company, St. Louis, spoke on "Education for Tomorrow." At the final luncheon session, Dr. Howard L. Bevis, chairman of the President's Committee for Engineers and Scientists, reported on the work and accomplishments of the committee.

The conference agreed on certain trends and principles, although no formal report was drawn up. The first is that better utilization of scientists and engineers requires greater use of technicians and sub-professional personnel. This will release the professional engineer or scientist for truly high level creative work. A major difficulty is the short supply of adequately trained competent technicians. Another is the reluctance of many engineers (and company managements) to delegate non-professional work to technicians.

Since additional personnel with scientific training are not readily available, the nation must increase the effectiveness of presently available personnel. This can be done by upgrading, additional training, more recognition, better pay, and assignment of truly engineering work to the engineer and scientist. More effective use of present engineers would reduce the demand to levels more in line with the future available supply. This is particularly important since it takes several years to educate and train a professional person.

More attention must be paid to the on-the-job training and the professional and personal developmment of engineers and scientists. The formal education is not enough for professional work and must be supplemented by added training. Graduate work is becoming increasingly popular as our technology increases in complexity and coverage.

Finally, modern industry requires more and more men with scientific training for management positions. Many of today's engineering graduates will end up in supervisory positions in which they do little or no technical work. Our plans and training must consider this demand for engineers and scientists for management.

There were many other ideas, reports of present practices and suggestions. These ideas will help our country as well as our employers of engineers meet this critical shortage of scientists and engineers.

excerpts from some of addresses heard at conference

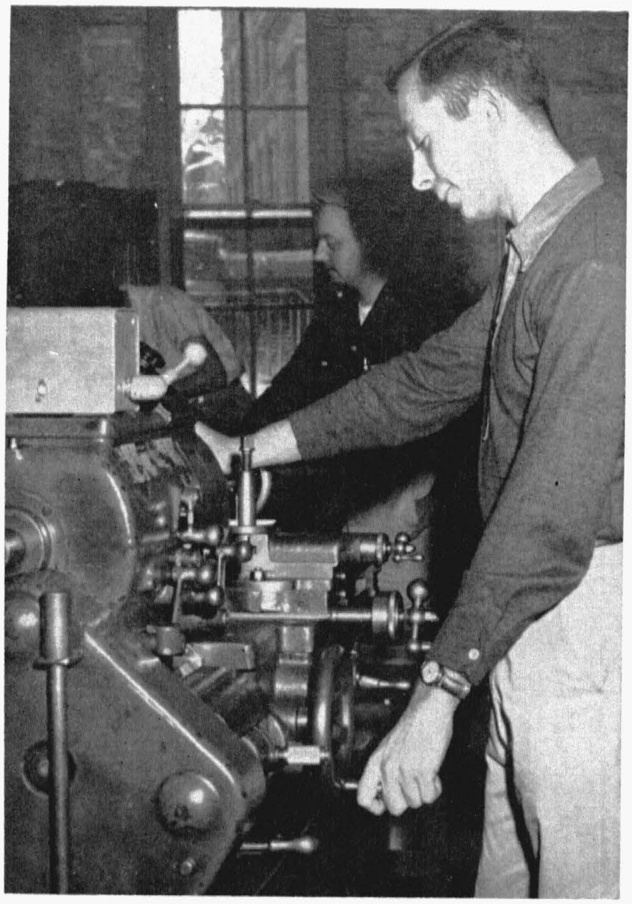
W. C. REDMAN, head of Experimental Physics Section, Reactor Engineering Division, Argonne National Laboratories:

Training for a technical profession begins in earnest following completion of high school, but only about 10 per cent of the potential professional life is spent in the acquisition of academic degrees. Industrial and business organizations owe a tremendous debt to our colleges and universities for the production of technically trained personnel, but ideally the process of education is never completed. Thus the basic problem is to provide an environment commensurate with the effective utilization of graduate scientists and engineers to assure that professional development continues throughout the working life of the individual.

The first step toward effective utilization of technical personnel is the elimination of stockpiling and misuse of their intellectual potential, and their assignment to activities for which they are mentally and physically suited. Stockpiling in anticipation of future need is a situation which is definitely limited, if not eliminated, by economic considerations. It is my opinion that misuse of technical personnel is not as prevalent as is normally supposed. Much concern is expressed over the diversion of science and engineering graduates into sales, management, supervision of production, time and motion studies and the like.

However, I believe that the attitude that we must take is that these people have found a situation wherein their educational background is utilized in a manner consistent with their special interests and capabilities. An analogous situation exists in regard to formal training for the legal profession. Only about half of those possessing law degrees are actively engaged in the practice of law.

The term environment describes the totality of external conditions and influences affecting the life and development of a person. Long before an individual acquires professional employment, a tremendous variety of influences have served to mold his character, interests and aptitude. Furthermore, since less than half his waking hours are confined to job-related activities, his social, religious and civic contacts, and probably most important of all, his relations with his family, all exercise an important influence on his technical productivity.



JOHN D. COLEMAN, staff engineer, Frigidaire Division, General Motors Corporation:

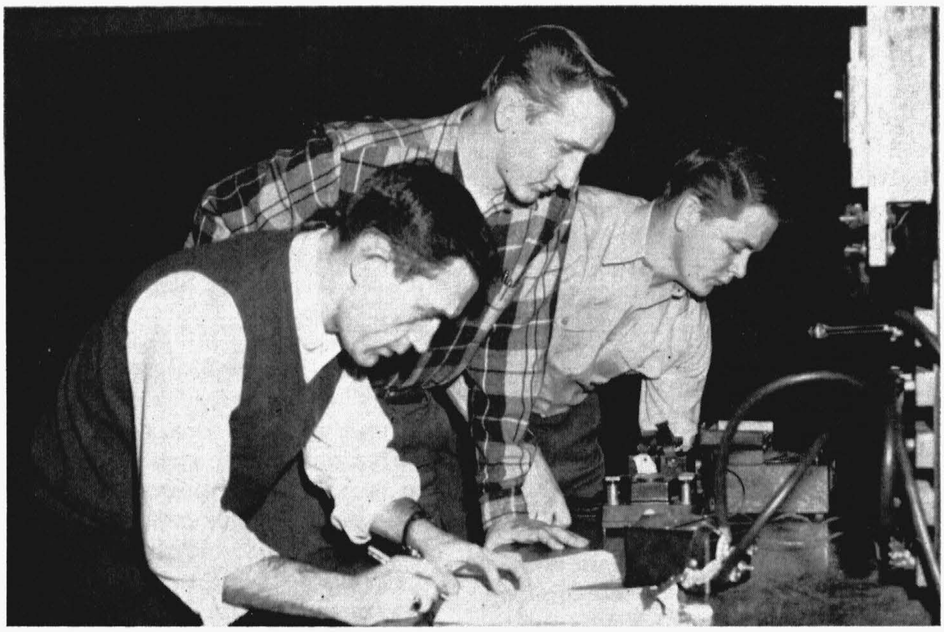
There is widespread recognition of the importance of continuing education and upgrading of members of the technical staff through graduate study and the attainment of advanced degrees. Encouragement in this respect is provided by partial or complete refund of tuition upon successful completion of courses and frequently by salary increases and advancement after attainment of graduate degrees. In some instances where graduate study facilities are not available locally, industrial organizations individually or cooperatively arrange for extension courses from recognized universities.

Of equal and sometimes greater importance is encouraging technical personnel to keep in touch with developments and advancement in their fields by subscriptions to technical publications and memberships in technical societies.

Where presentation and publication of technical papers is not possible due to the classified nature of the work recognition is often provided within the organization by periodic seminars which provide the recognition for individual accomplishment that is such an important component of job satisfaction, and professional development.

Receiving more and more attention today is the continual evaluation of latent supervisory and managerial potential in technical staffs.

Often overlooked in the past but more generally recognized today is the need for professional development paralleling the technical development of engineers and scientists. All too frequently, as stated some years ago by William J. Ryan, President of the American Society of Mechanical Engineers, such individuals are "professional illiterates" with little or no knowledge of ethical concepts relating to their responsibilities to their employer, their fellow technologists and the public. Enlightened employers recognize that it is not desirable or beneficial to be largely staffed with "technical robots" and endeavor to encourage the development of well balanced and adjusted individuals who can capably acquit themselves not only in their industry but their communities and professions.



WILLIAM G. TORPEY, consultant, President's Committee on Scientists and Engineers:

This conference at the University of Missouri is the first in the second series of local utilization conferences sponsored by colleges and universities and professional societies under the auspices of President Eisenhower's Committee on Scientists and Engineers. The first series comprised four pilot conferences which were recently held at Charleston, West Virginia; Houston; Boston; and Denver.

One of the fundamental factors considered has been the value of an effective recognition program applicable to scientific and engineering effort. Here in Missouri the planners of this conference have realized the importance of recognition as a means of developing maximum potential of scientific and engineering staff.

Recognition is attention and status given to an individual for job accomplishment. For the scientist and the engineer, the accomplishment is generally significant to the mission of the individual's organization or to the skills or knowledge of a profession or both. The accomplishment may represent individual effort or group effort.

A recognition program refers to an organization's total plan, in operation for granting recognition. Equitable recognition means that the company or agency or institutional program is administered on a basis fair and just to all in the group covered by the program. A program of equitable recognition for scientists and engineers is an essential to retain such personnel and to develop maximum potential of scientific and engineering staff.

Types of recognition particularly applicable to professional employees may be classified, basically, as monetary or non-monetary.

The more common forms of monetary types of recognition are: (1) increase in basic pay; (2) supplemental pay; (3) lump sum amounts. With respect to non-monetary types of recognition, some of the more common forms are: (1) change of nature of assignment, (2) opportunity to attend meetings of professional societies, (3) opportunity to publish professional papers, (4) additional vacation, (5) letters of commendation and of appreciation, and (6) outstanding efficiency ratings.

In management circles there is an increasing acceptance of the human relations approach to administration.

The human relations approach recognizes that a prerequisite to effective performance is incentive.

HOWARD L. BEVIS, chairman, President's Committee on Scientists and Engineers and president emeritus, Ohio State University:

In meeting the Soviet challenge in science—and this is of crucial importance to America—the United States must not be misled into seeking to match purely military accomplishments with Russia. The Soviet challenge to the United States in science and technology is not only a military challenge—it is economic, ideological, even psychological.

America's response to the Soviet challenge must be the marshalling of our brainpower resources in company with other nations of the free world, not only for military defense, but to meet the broader challenges of the scientific age we have entered.

For the immediate future, our success in meeting the Russian threat will depend primarily on utilization—on the effectiveness with which we use the scientists and engineers now trained and available. In plain words—we must make do with what we've got.

Thus, the most important outcome of this conference, and others like it, will be the action it produces in the plants, laboratories and industries over the country.

Our job would be simpler if the creation of scientific manpower began in college. Unfortunately it begins much earlier. It take a good many years to turn out a scientist or engineer. The young person who is to become a scientist or engineer must make the right decisions in junior high school or even before. The decision at this early stage is primarily concerned with the selection of courses, and not with ultimate career choice. He must decide to take appropriate courses in science and mathematics, since without them he will not be admitted to courses in college that will lead to a degree in science or engineering. This means that it takes a minimum of eight years to make a scientist or engineer, starting at the beginning.

But current shortages of qualified scientific personnel cannot be met by waiting for this long-time educational process to provide more scientists and engineers. We must conserve the manpower we now have.

We speak of "utilization" and "conservation" of creative manpower resources. What do we mean? The term "utilization" or "conservation" does not embrace a single specialized type of effort. Rather, utilization refers to the sum total of several personnel activities. Thus, opportunities for advancement as scientists and engineers, the elimination of routine, non-challenging assignments, the scope and adequacy of training, recognition of the professional atmosphere under which the scientist and engineer thrive best, the breadth of employee services—these approaches are among the components which make up the area usually described as utilization.

PAUL H. ROBBINS, executive secretary, National Society of Professional Engineers:

You have probably seen from time to time predictions for the need for scientific manpower which have ranged all the way from a feeling that we have a sufficient number available now, to what appear to be totally unwarranted estimates. Often times these predictions are expansions of statistical information of the past ten or 20 years. One of the most common bases of such predictions is a comparison between the 1940 and 1950 census figures. You will recall that the 1950 census recorded some 535,000 engineers, nearly double the number recorded in the 1940 census. Some have automatically said we must, therefore, double the number of engineers by 1960 to something over a million in the profession. While there is a slight difference in the criteria by which the 1940 and 1950 census were tabulated, the basic item which should be noted is that in the 1950 census only 54 per cent of those recorded as engineers had four years or more of college education. This then leads to the rather evident observation that in the decade of 1940 to 1950 the census began to report an item of considerable concern to those who are endeavoring to give recognition to scientists and engineers and to those who are in such dire need of their services. It stems from the failure to distinguish between those who are well qualified by education and experience to be recognized as professional people and those who have some product or service to which they wish to give more dignity or prestige by calling the people who are associated with it "engineers." Thus, it seems apparent that to use this as our base for the prediction of future requirements of scientists and engineers is open to much more careful analysis.

Actually, we must realize that the problem we face in technology is one that is common in many fields of specialized education and training in the country today. It extends from the fact that we are endeavoring to service the high birth rate population of the 40's with the low birth rate population of the 30's. It may also be observed that our most critical times are probably past. We have only to look at our high school and elementary school populations to recognize that our problems in training engineers and scientists of the future are not so much in numbers as in facilities for providing the training that those who desire such education may secure it. Those of you who have the privilege of visiting various colleges know that the majority of our engineering schools today are about at their capacity. Serious problems of providing facilities and particularly of obtaining sufficient teachers for the numbers of young people who may wish to receive training in engineering and science in the next ten years are perhaps our most difficult national problems.

KARL O. WERMATH, president, Milwaukee School of Engineering, Milwaukee, Wis.:

The advancing technology in the United States is calling for an enlarged and broadened team of technical specialists. Occupations in science and engineering fall into a broad spectrum, from the craftsmen on one hand to the scientists and engineers on the other. To our best calculations we now have about 9,000,000 skilled craftsmen who apply scientific and engineering principles to the building processes, assembly lines, production work and trade and service functions. On the other end of the spectrum are 950,000 scientists and engineers—the creative team which now makes up one half of one per cent of our total population. Between these two extremes of the spectrum of our engineering manpower is emerging a new occupational group, called "The Technician." It is estimated that for each engineer we need five technicians. Among these are the engineering technicians —supporting personnel to engineers.

While the engineer plans, the technician makes and does; while the engineer creates, the technician applies. This engineering technician is often the liaison between the professional man and the craftsman. He has the same basic characteristics and fundamental educational requirements as the engineer, except that his interest and education are more in the direction of application, with less mathematical and theoretical depth, combined with the ability to understand the instructions of the professional engineer and translate these to action either by applying his own abilities or in the direction of other supporting technicians and craftsmen.

There are various estimates as to the needs of engineering technicians in proportion to engineers. The American industrial nation requires about 200 four-year engineering graduates per million population to parallel closely the existing ratios of other modern industrial nations of the world. As for supporting technical personnel, our studies point up the need for five technicians per engineer on the engineering team. One of these five should be an engineering technician produced through a technical institute type program. This would call for approximately 35,000 such technicians per year. Last year we graduated some 11,350 from courses in 66 schools. To meet the need, technicians have been developed through other sources, including programs and on-the-job training. It is safe to say that the shortage of technicians is even more significant in America now than the shortage of engineers.

EDWIN M. CLARK, president, Southwestern Bell Telephone Company, St. Louis:

To produce the engineers required by the nation, I think engineering schools should offer full curricula all year long—12 months a year—with perhaps only two breaks. One break in the winter, one in the summer. In other words, an accelerated program such as the one that was in effect in many colleges and universities during World War II.

I understand, of course, some students work during the summer to help pay for their education. But I think engineering schools should be open during the summer for those students who want and can afford to go to school then.

The practice in a number of engineering schools now, as I understand it, is to ask students in the winter how many would like to attend summer school and find out what courses they want. If enough sign up for a course, it is offered. But the number of subjects offered during the summer in engineering schools usually is pretty skimpy. If need be, put in air conditioning in college buildings and run classes throughout the summer. This means professors would have to teach a longer period of time each year, say at least 11 months.

Because engineering schools now practically close down during the summer, many professors take jobs in industry and government. I don't know whether the professors leave the classrooms because the schools close down, or whether the schools close down because the professors take summer jobs somewhere else.

(Continued on page 23)

Alumni directors' meeting

A review of the Alumni Association's awards program was among several matters discussed at a meeting of the association's Board of Directors last month.

President Flavius B. Freeman of Springfield presided at the meeting, held in the Student Union, with these board members present:

L. W. Helmreich and John Morris, Jefferson City; Kenneth Edscorn, Kansas City; Robert Niedner, St. Charles; Moss Rudolph, Savannah; Maurice Kirk, Higginsville; Hartley Banks and Jack Hackethorn, Columbia; Dennis Davidson, Hannibal; Robert W. Mills, Boonville; Marshall Harris, St. Louis; Edward W. Sowers, Rolla; and Ray S. Graham, Mount Vernon. At the same time, William R. Toler of Kansas City held a membership committee meeting at Read Hall.

It was announced that nine district alumni meetings would be held in February and March. Efforts will be made to have the University represented by President Ellis; Don Faurot, athletic director; and Dan Devine, the Tigers, new head football coach who is making the rounds trying to meet as many Missouri followers as possible.

Dates and places of the meetings:

District 12, Joplin, February 6; District 5, Jefferson City, February 11; District 8, Nevada, February 12; District 4, Carrollton, February 17; District 2, Chillicothe (to be set); District 11, St. Louis, March 1; District 10, Rolla, March 11; District 6, Mexico, March 13; District 7, Kansas City, April 3.

A change in the publication schedule of the *Alumnus,* effective with the next publishing year, was unanimously approved. The January issue will be omitted, but the remaining nine issues of the year will be enlarged so that the same number of reading pages for the year will be printed. It was explained that the Christmas holidays work a hardship in maintaining editorial and publishing schedules. Under the new plan the *Alumnus* will become a 44-page magazine. The method of dating the issues will revert to the plan used up to two years ago, which means the first issue in the fall will be dated September (rather than October) and the last one in the spring will be dated June (rather than July).

UTILIZING ENGINEERS AND SCIENTISTS

from page 6

But if engineering schools speed up their programs, professors in some subjects will have to teach more classes a week than they currently are. With the need for engineers as great as it is, can we afford to continue on the present system of professors teaching only 15 or 16 hours a week? Shouldn't teachers go on a longer work week to train as many engineers as possible?

From time to time professors will require a leave of absence—perhaps for a year—to study new subjects and learn about new developments relating to their work. This would make their teaching more meaningful to students. Such a leave should be granted, with full or partial pay. But if pay is granted during the leave, shouldn't there be an agreement that the professor teach at the university—say, for at least five years—on his return?

H. M. MILLER, personnel relations manager, Engineering Department, E. I. du Pont de Nemours & Company:

The career of the average engineer in industry might be divided roughly into four ten-year periods.

The first ten are years of orientation and adaptation to the industrial environment. This is the period where aptitudes must be detected by conscientious management, with generous use of an intellectual irrigating system to develop steady growth and sturdy roots for the more fruitful years ahead. The exceptional individual must be spotted and given the opportunity for exceptional service, and others must be encouraged to realize their full potentials.

The second ten are the years of practical application of technical skills to tangible problems, such as the designing of plants and facilities, or the accomplishing of major research or development. During this period the engineer becomes schooled in the basic principles and techniques of management. He notes that not all the world's problems are technical if he hasn't discovered this previously, and that many of them deal with day-to-day human relations.

This marks the transition to the third period, where he becomes concerned with questions of organization and people. The emphasis shifts from designing a new plant to supervising those who do the designing. The engineer finds he is responsible for getting jobs done on schedule and within the estimate, not by doing the work himself, but by guiding the hands and brains of those who do.

And finally, in the fourth period, the engineer who rises through management finds himself busy with the problems of long-range planning of techniques to insure growth and progress, and to safeguard the future of his company. Engineers in supervision or management carry a heavy responsibility—that of not over-supervising, over-managing, other engineers. The fundamental purpose of supervision is achievement, not control. This we much too often forget, and *figuratively* harness our engineers with martingales; *literally* blanketing their creative efforts, their enthusiasm, even their ability to perform. The goal of professional engineering is responsible, independent contribution of substance to the solution of problems. The engineer in supervision or management must re-identify himself with this goal if he is to encourage his engineers to achieve full professional and technical competency.