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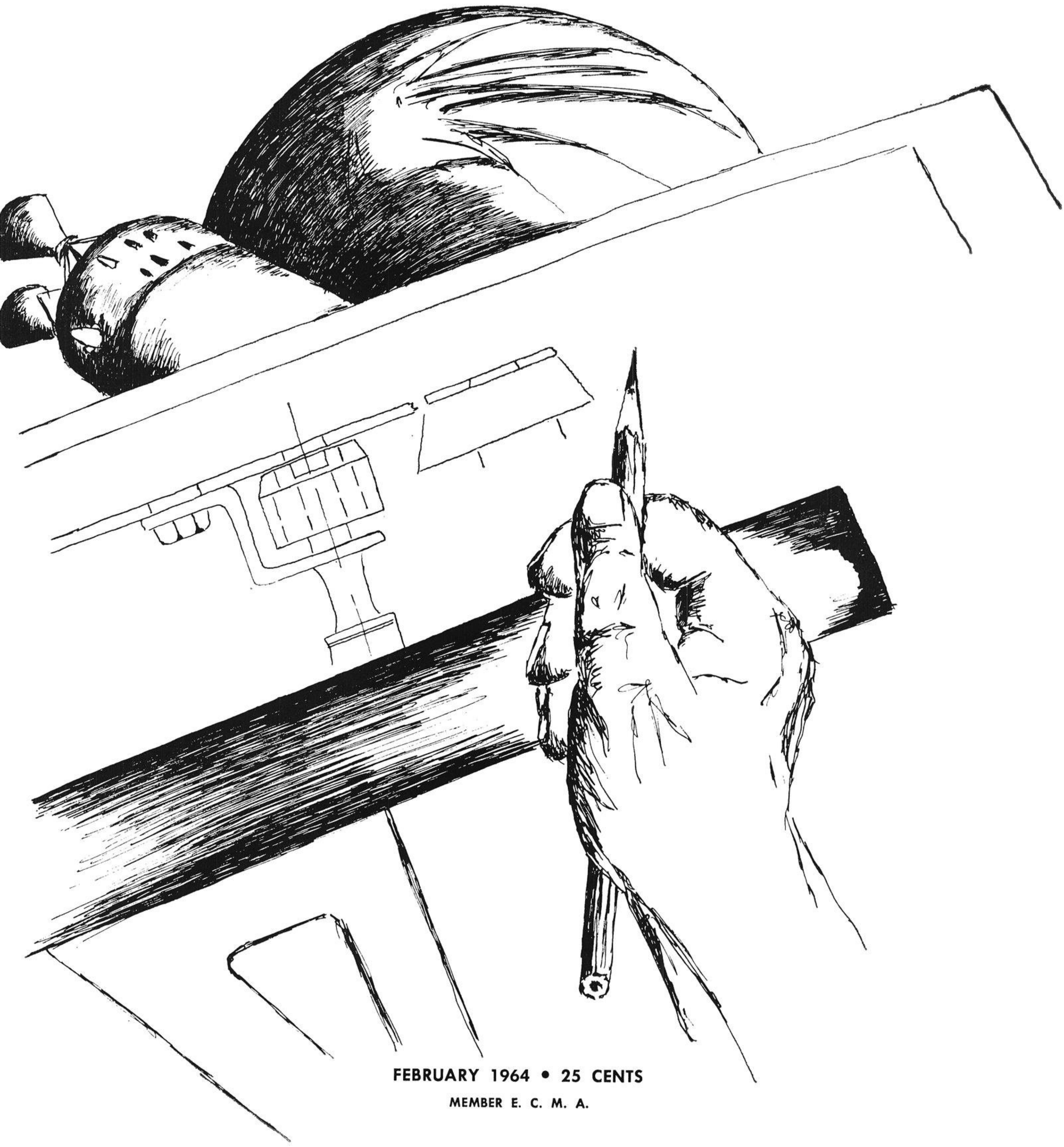
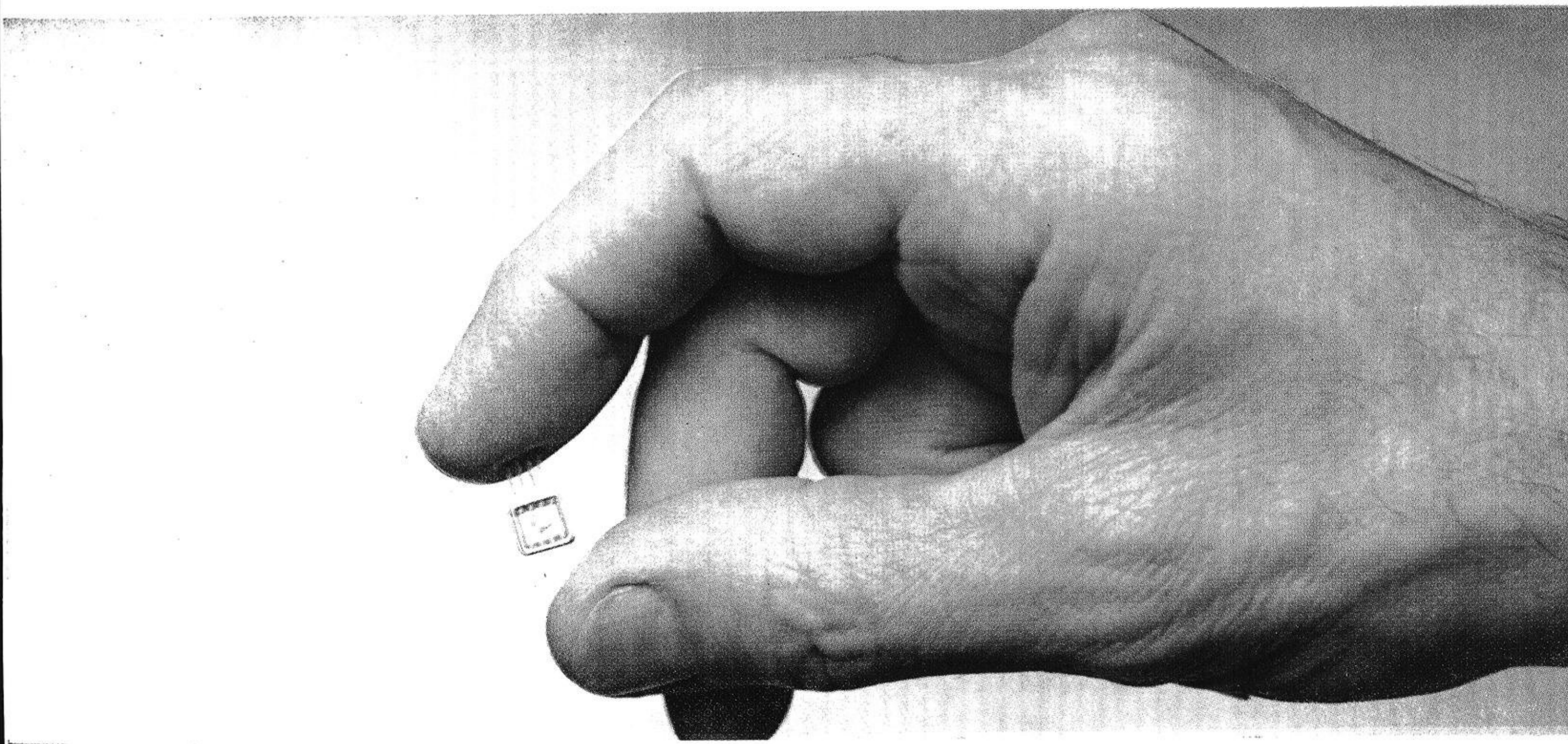
HIGH SCHOOL ISSUE

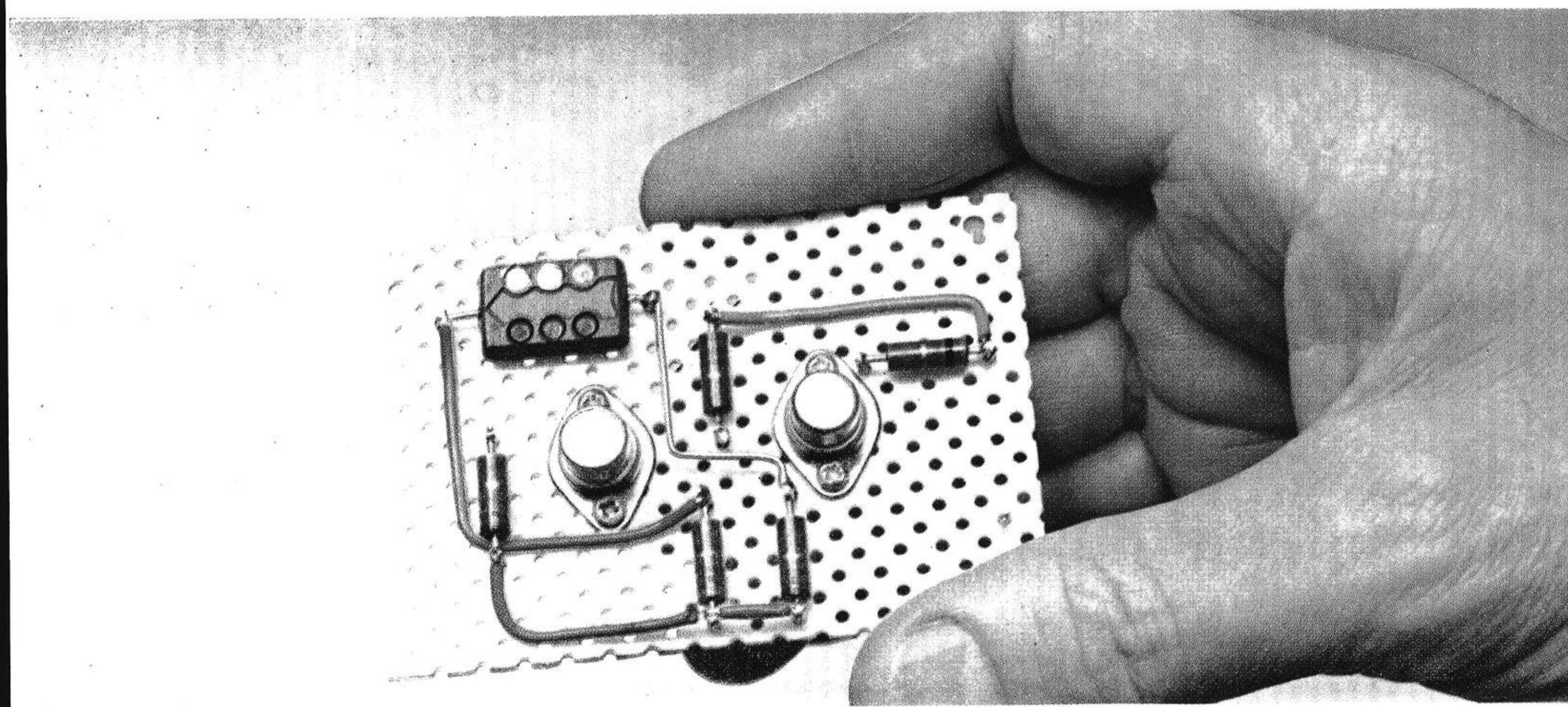


FEBRUARY 1964 • 25 CENTS

MEMBER E. C. M. A.

THE WISCONSIN ENGINEER





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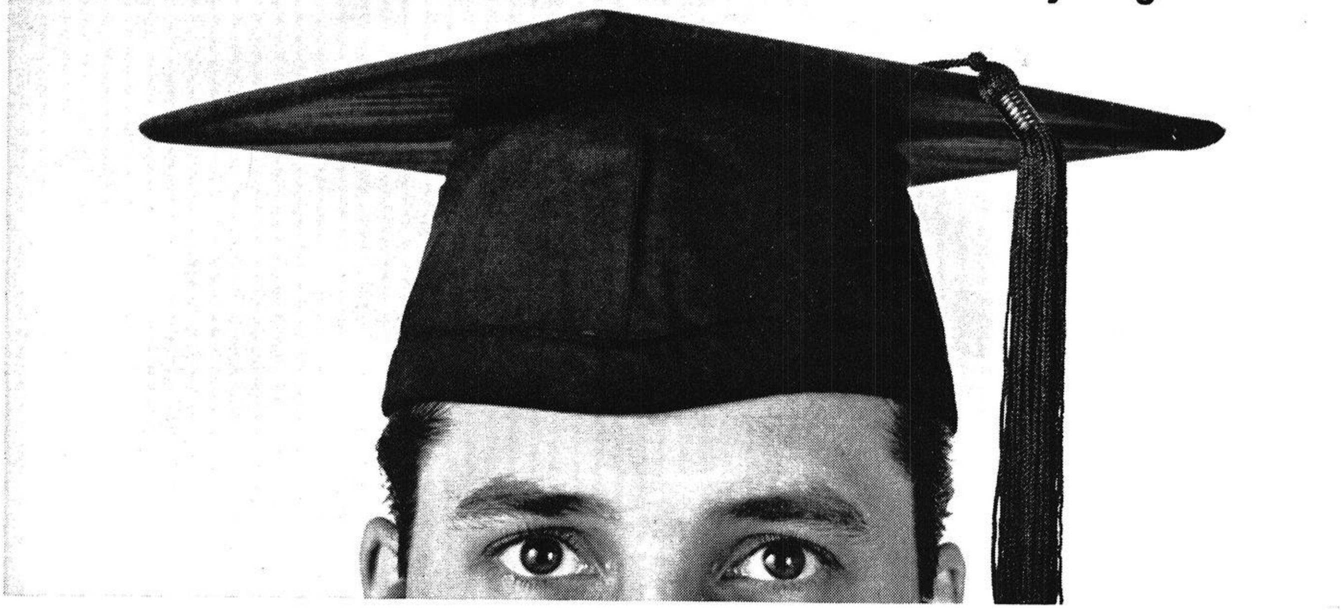

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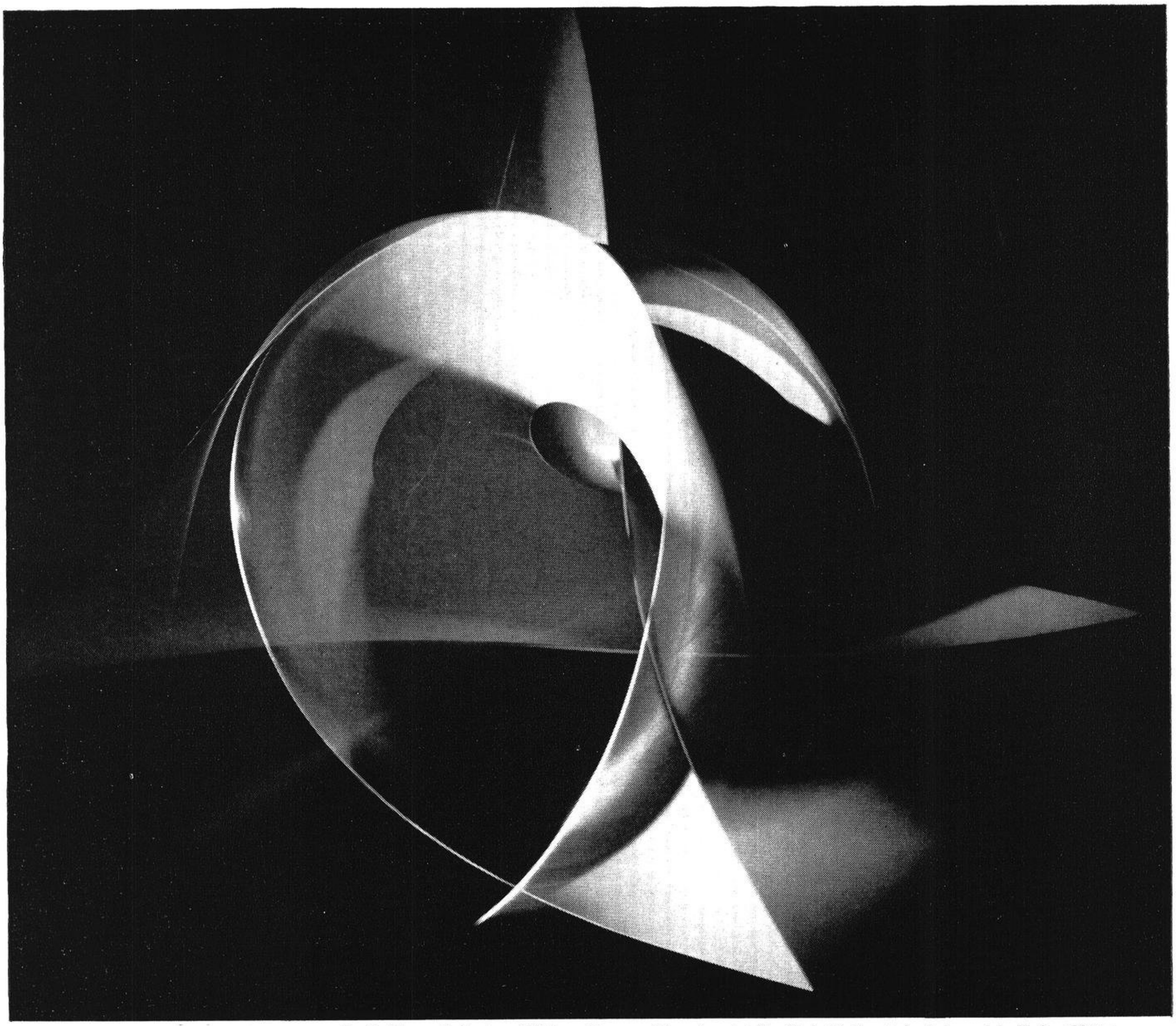

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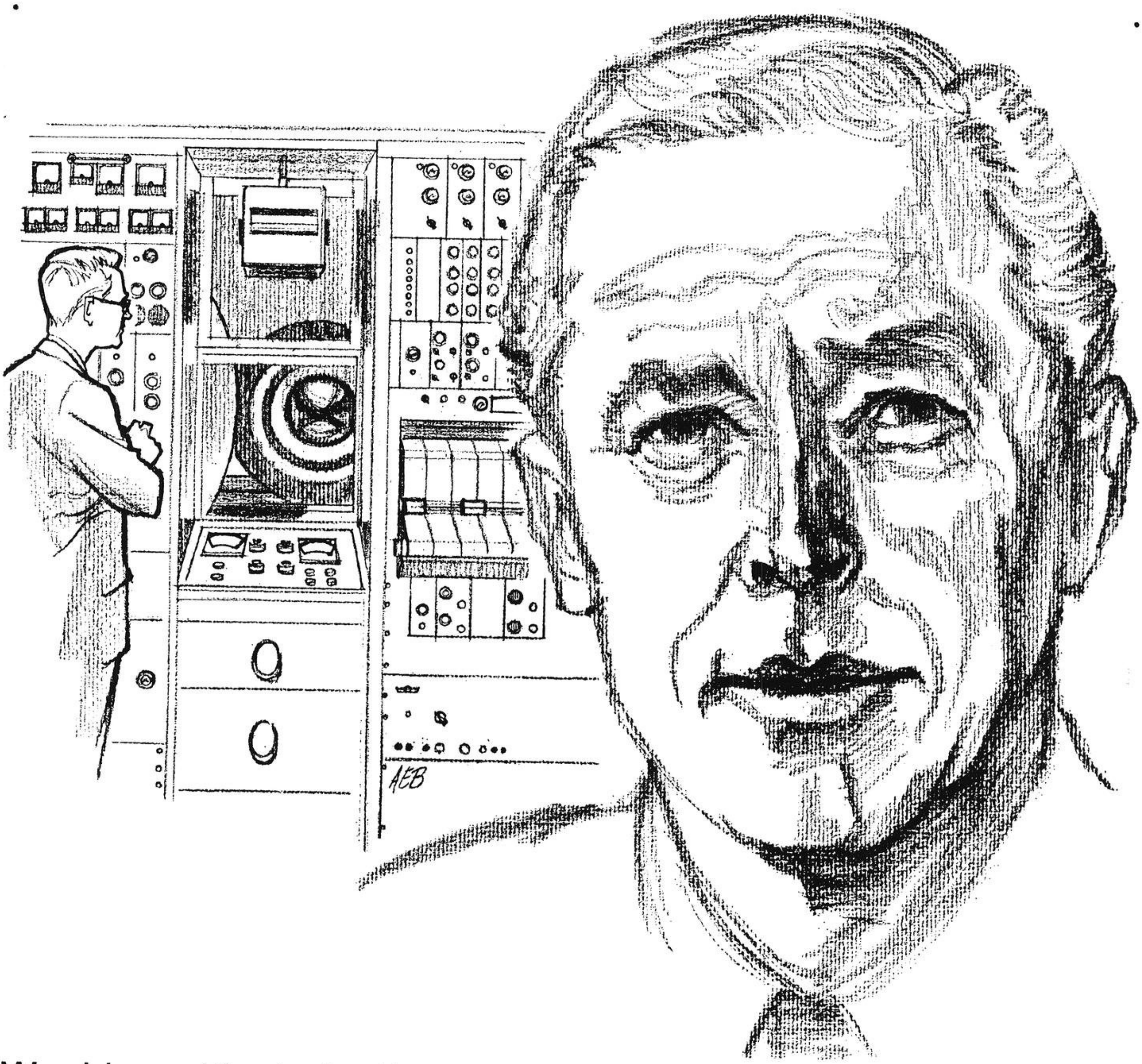

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HIGH SCHOOL SECTION

THE WISCONSIN ENGINEER

The Student Engineer's Magazine Founded in 1896

DEPARTMENTS

THIS MONTH'S COVER

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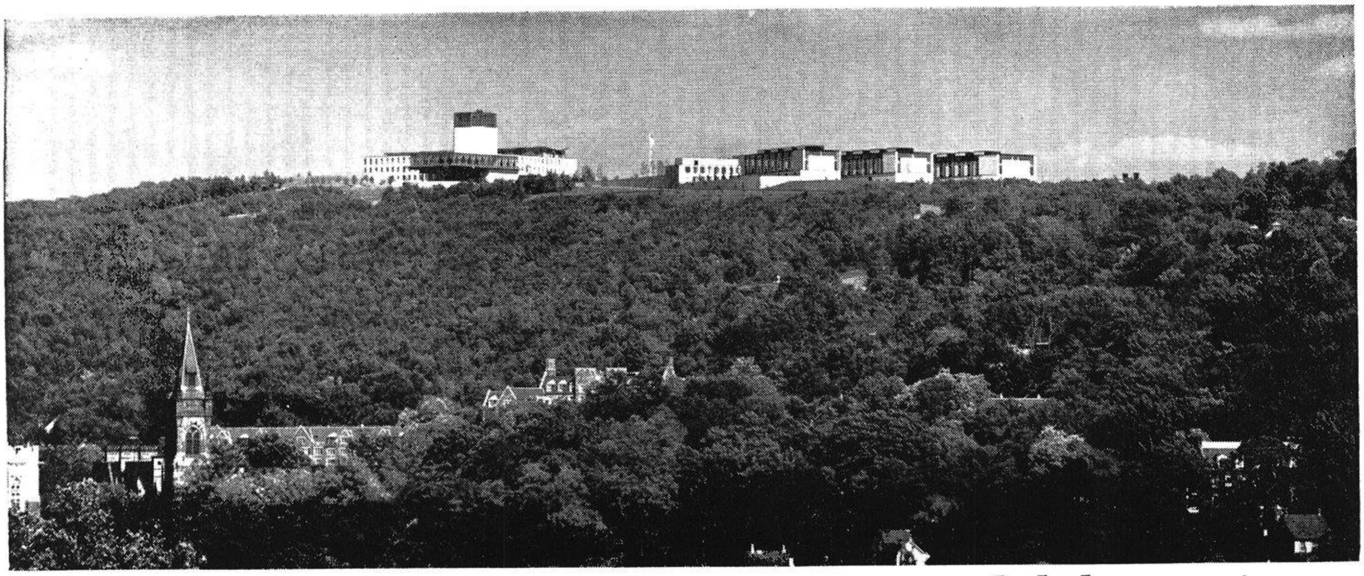
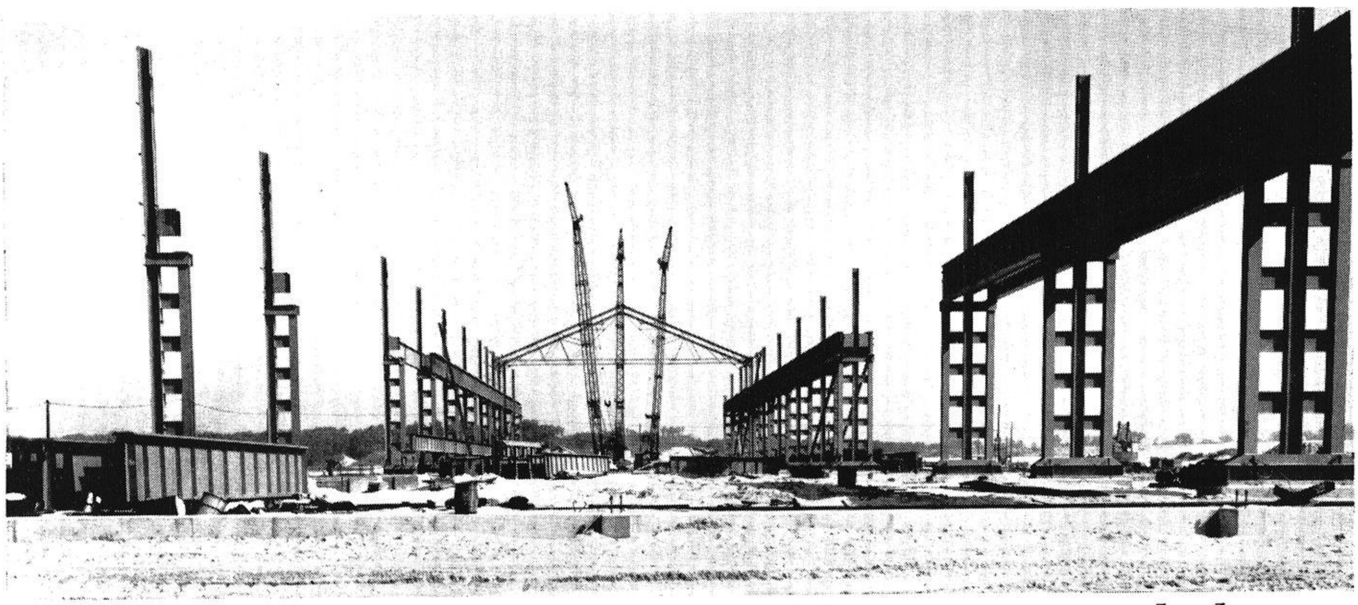


On a Pennsylvania mountaintop, new research laboratories . . .



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Aerial view of west end of campus, foreground engineering buildings and stadium, center agriculture buildings, top University dorms.

High School Section

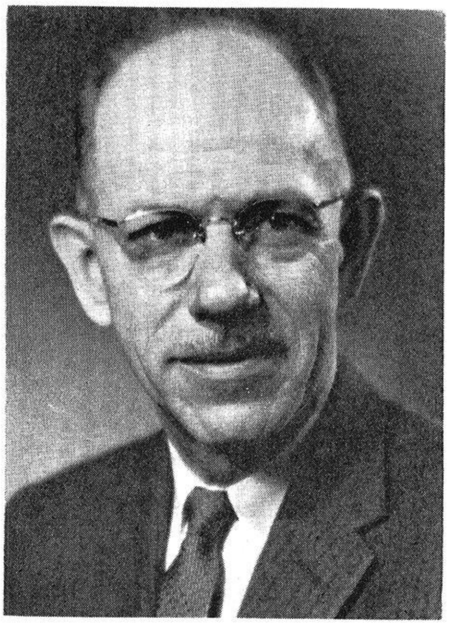
We of the Wisconsin Engineer staff would like to extend our greetings to all high school students, to whom this issue is dedicated. Our hope is that the following pages will inform the prospective college student about the different engineering fields in general, and about engineering at the University of Wisconsin in particular.

To give you this information we have asked a group of the top educators to comment on the facts and opportunities of their respective engineering fields.

We hope that this issue will help you in the selection of your future careers.

The Engineering Profession

By Kurt F. Wendt
Dean, College of Engineering



Dean Wendt received his B.S. degree in Civil Enginering from the University of Wisconsin in 1927 and has taught in the College of Engineering since 1927. For twelve years he was in charge of the Materials Testing Laboratory, then served as Associate Director of the Engineering Experiment Station, and now is Dean of the College of Engineering and Director of the Experiment Station.

ON BEHALF of the entire faculty it is a pleasure to extend greetings to all students in our Wisconsin high schools and to invite those who may be interested in the field of engineering to visit us. You will find much of interest in our laboratories and the opportunity to discuss your plans for the future should prove profitable. Dean Shiels, who is in charge of our program for freshmen, and members of his staff and of the college will make you most welcome.

During the past century engineering has made great strides and its many contributions to our high level of economic well-being are universally recognized. You need only look around to see the products of engineering on every hand. The automobile, the airplane, trains, ships, bridges, buildings, roads, electric light and power, radio, television, water and sewer systems, machine tools, refrigerators, and heating systems, to mention only a few, all are the result of engineering research, design and production. Today engineers are making major contributions in the fields of nuclear power, rockets, missiles, satellites, and space technology.

The past decade has seen discoveries and applications in engineering increasing at an unprecedented rate and it is the considered opinion of scientists, engineers, and industralists that we will see many more developments in the future than we have in the past. We have just begun to realize the potential in the fields of nuclear and solar energy, in solid state physics, in communications, in plastics, and in automation. The problems of space are only beginning to emerge. A great challenge and a most interesting and exciting future lie ahead for young men and women in all engineering fields.

Every week we receive many questions and among the most frequent are: What engineering courses are available at Wisconsin? Which courses are most popular? What does the engineer do? Should I be an engineer?

Wisconsin offers curricula in chemical, civil, electrical, mechanical, mining, metallurgical and nuclear engineering and has also recently introduced a curriculum in engineering mechanics to meet the demand for a broad basic course in engineering with strong emphasis on science. Both undergraduate and graduate work are available in each of these fields.

At the present time electrical engineering is the most popular program closely followed by mechanical engineering. Together these two account for about 60 per cent of our enrollment. Note, however, that the demands of industry and government are high in all areas of engineering and it behooves you to investigate the entire field to determine your special

(Continued on page 26)

Career Opportunities in Engineering

By James A. Marks

College of Engineering, Placement Director

Professor Marks received his B.S. degree in Mechanical Engineering from Purdue in 1948 followed by an M.S. degree in Industrial Engineering in 1951. After working in industry for several years he came to the University of Wisconsin in 1954 as an instructor in Engineering Drawing and Descriptive Geometry. In 1956 he was appointed to his present position of Engineering Placement Director.

NEWSPAPER articles, news releases and general reports about the new shortage of engineers are becoming more and more numerous. During the next four years the almost inevitable increase in demand along with the known decrease in the number of new graduates is certain to make the future in engineering extremely bright. Looking ahead even further, probably no other field can offer more rewarding careers than engineering.

But the baffling drop in enrollment in engineering over the past several years indicates that high school students are somehow misinformed about the opportunities in engineering or the difficulty of studying engineering in college. Even though freshman enrolment in the College of Engineering did increase this past fall it has dropped considerably since 1956—while overall university enrolment has gone up. Nationally, freshman enrolment in engineering has been decreasing since 1956 except for a modest increase last fall. Even this most recent increase does not begin to compare with the substantial increase in total college and university enrolment.

There is some indication that high school students fear that engineering is very difficult and demanding, and that "too much" mathematics and science are necessary. No one will say that engineering is easy but for those with any interest in the field the potential rewards in an engineering career certainly make it one of the most promising if not the very best career choices a high school student could make.

The expected increase in demand along with the intense competition for better students has meant that starting salaries are not only staying as high as they have been in the past but in most cases are increasing. It is not unusual for the graduate engineer to receive a salary of $7,200 during his first year after graduation. There is every reason to expect that starting salaries will continue to rise at least as much, if not more, than general income levels rise. Certainly engineers can expect handsome financial rewards in the years to come.

Of course, salary should not be the prime reason for anyone choosing a career in engineering, or in any other field, for that matter. Instead, the individual should consider the kind of work he (or she) will be doing and whether or not he will be happy doing it. While this might imply that only those who have a deep interest in things mechanical, for example, would consider engineering, it should be pointed out that many jobs normally considered to be nonengineering in actual practice virtually demand an engineering background. Sales, production supervision, management, and many other jobs have become exceedingly technical in nature and an engineering education is a real asset in almost any field. Under these circumstances the high school student who has the ability will find an engineering education to be better basic training than perhaps any other college program and a real asset in any field of endeavor.

The individual who would enjoy a career in education and who has the ability and interest in engineering will find an extremely bright future in engineering education. The demand for engineers will create more and more opportunities in the teaching of engineering.

Because of the interest in engineering graduates, the Placement Office of the College of Engineering has become one of the busiest spots on the campus. Each semester up to five hundred representatives from companies throughout Wisconsin and all over the country visit the campus to inter-

(Continued on page 26)

Let's Take A Look At Engineering College

By K. G. Shiels

Assistant Dean and Freshman Advisor

Professor Shiels was born in Baraboo, Wisconsin, and received his B.S. and M.S. in Mechanical Engineering from the University of Wisconsin. In addition to his duties as adviser for engineering freshmen, he is chairman of the Department of Drawing and Descriptive Geometry.

HAS anyone ever told you something like, "You're so good in math., you ought to go into engineering," or "With a talent like that, you'd make a good engineer." If so, you're probably wondering what engineering college is really like, what kind of education it might give you, or what it means to "go into engineering." Here are a few clues . . . .

Only a few of the hundreds of young men and women who enter into the study of engineering directly from high school are absolutely certain that this is the *one and only* field for them. Most seventeen and eighteen year olds do not see themselves or their futures so clearly. They must, therefore, while still in high school, explore their talents, evaluate their skills, enumerate their interests, and read about many fields and talk to many people who are employed in their areas of interest. If they find that they enjoy and are interested in mathematics and science, and do very well in these subjects in high school, if they find that they have an inquiring mind, ability to concentrate, capacity for hard work and sustained application, facility in oral and written communication, and if they are intrigued by unsolved problems, they might well consider the possibility of attending an engineering school. This is, however, only a calculated risk. Enrollment is not irrevocable. Youngsters with these same talents may find other fields more suited to their tastes. If, however, a youngster has some interests along these lines, he may well find that following his enrollment, increased knowledge of engineering and increased motivation to become an engineer may well go hand in hand. As the prospective engineer becomes better acquainted with the fields of engineering, the potentialities open to the engineer, and the challenging nature of the occupation, his interest in and determination to succeed in the field may well increase.

As the engineer's role has changed in our ever-changing world, the curriculum the engineering student studies in preparation for this role has changed. By virtue of its highly technical nature, with required courses of a sequential nature, the engineering curriculum have become tougher, and in some ways, less flexible. On the other hand, flexibility has been increased through greater freedom in choice of electives and more emphasis on liberal studies. Although the engineering student does have time to indulge in a variety of different courses, he cannot graduate as an engineer by dabbling in a great number of fields. As courses have been upgraded, and updated, more weight has been thrust upon the high schools to correspondingly upgrade and update their preparation.

The engineering curriculum begins with a study of the tool subjects, basic to the applied engineering courses which follow. Emphasis during the freshman year is on the acquisition of facility with the tools of mathematics, chemistry, physics, English, drawing, and perhaps speech. Generally, all freshman engineers carry a common core of these subjects. These subjects are acceptable to any college in the event a freshman would decide to change his major area. Specialization in the particular branch of engineering begins after the freshman year. Descriptions of the branches of engineering offered at the University of Wisconsin are given on the following pages.

Engineering college trains professionals, but in a manner different from other professional schools, such as law or medicine, where the prospective student first takes general undergraduate work in the liberal arts or sciences. The engineer begins his professional training immediately upon entering college, and, by carrying a somewhat heavier load than his contemporaries in the liberal arts colleges, completes both his general education and his first professional training within four or five years after his graduation from high school. Of necessity, the liberal studies courses to which the prospective engineer is exposed in college are fewer in number than if he were

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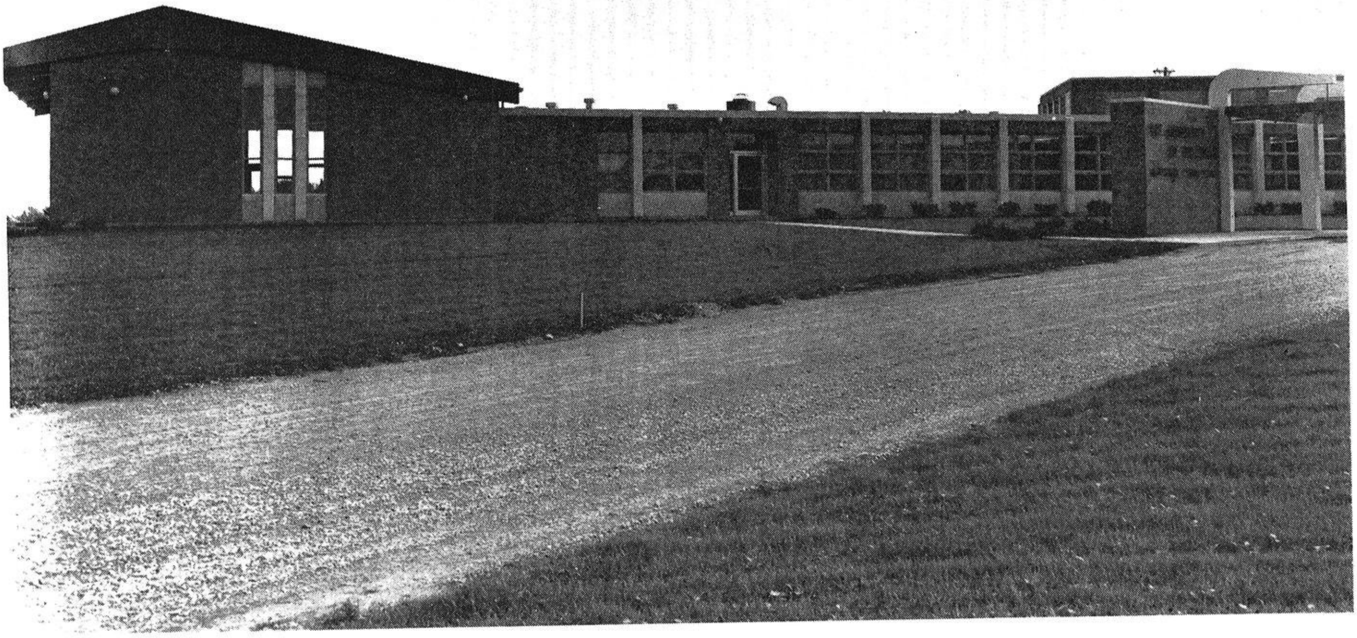

University Extension Center at Manitowoc.

University Extension Center at Kenosha.

University Extension

By Professor Paul J. Grogan
Chairman, Extension Engineering Department

Professor Grogan has served in the above capacity since 1951. Earlier, he taught mechanical engineering subjects at both The University of Wisconsin and The University of Notre Dame. His educational background includes a B.S. from Purdue and M.S. from UW. The professional field in which Professor Grogan has gained the greater amount of his practical experience is power generation. This has been reflected in his extensive writings on the subject in professional and trade journals.

UNIVERSITY Extension is the off-campus arm of The University of Wisconsin for teaching as well as public service. One of the units of University Extension is the Department of Engineering. The program of undergraduate instruction in engineering at the several Freshman-Sophomore Centers in the state have been included among responsibilities of this department. Centers are located at Kenosha, Racine, Sheboygan, Manitowoc, Marinette, Green Bay, Menasha and Wausau. A new center is under construction in Marshfield. Other centers are under active consideration by several communities and we might expect new centers as the numbers of high school graduates in a given area warrant their foundation.

The enrolment in these Centers in recent years has been increasing more rapidly than the University as a whole. This may be due in part to the excellent new facilities now in use or under construction at every center excepting Marinette, or may be due to a realization that the easier financing of the first two years may make possible a fifth and sixth year of college work now often thought of as being a good investment in terms of time and money.

Substantial blocks of credit toward a degree in any of the several fields of engineering offered by The University of Wisconsin may be obtained through the Freshman-Sophomore Program. It is only fair to mention at this time that The University of Wisconsin–Milwaukee (UW–M) offers an excellent opportunity for the study of engineering at both the undergraduate and graduate levels. There are further opportunities for beginning an engineering career at the State Colleges in several locations throughout Wisconsin. These latter operations are not linked administratively with University Extension but a great deal of harmony and accord exists within the entire state-supported system of higher education in Wisconsin. For example, credit classes are taught by Extension in the State Colleges from time to time as another method of broadening the opportunity for an engineering education in Wisconsin.

Questions are often asked 1) whether or not an individual is able to obtain "full credit" for work taken in an outlying institution, and 2) whether or not an engineering program can be completed in a normal four years if one starts off campus. These questions will be treated in some detail in the remainder of the article.

Transfer of Credit

Credits earned at the nine University Centers may be "transferred" to the University at full grade-point value. The quotes on the word transferred are purposeful. Actually, credits *are* UW credits and no "transfer" ever takes place. The original and permanent record card of the University Center student is maintained among residence study records in Bascom Hall, the main admistration building of the University. Transfers from UW-M are at full gradepoint value, although the record card in this instance actually is moved from Milwaukee to Madison.

Transfers from the State College System may be made on a "credit-for-credit" basis where the course work is applicable to any part of the requirements for the degree program of particular interest. Grade points, however, are entered on the same basis as transfers between any pair of accredited institutions; this being a nominal "C" or 2.0 grade points per credit for all work of "C" quality or better. Grades originally below a nominal "C" are entered on the transfer record at the lower value.

However, full credit towards the requirements of the particular degree in mind requires wise selec-

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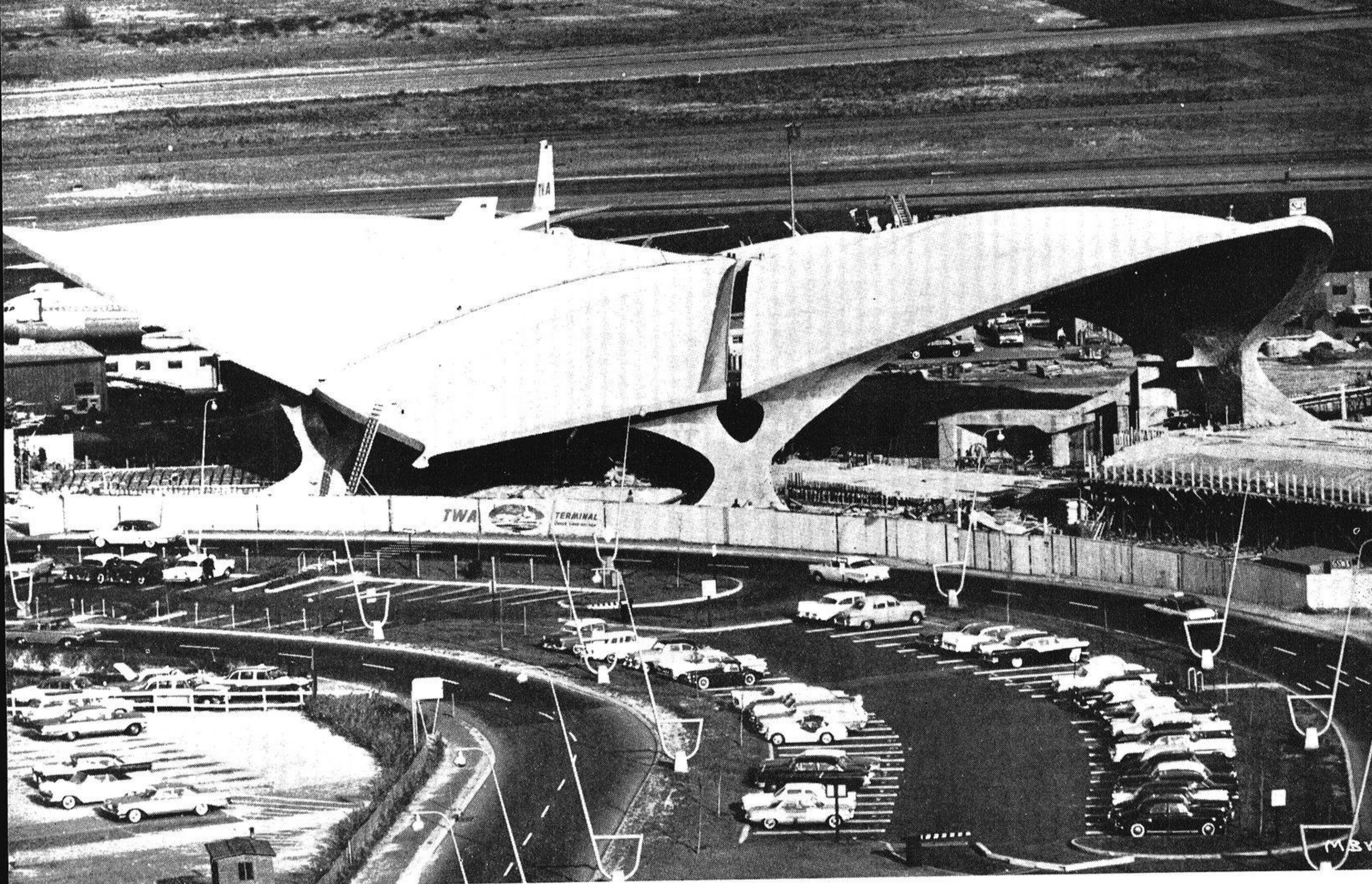
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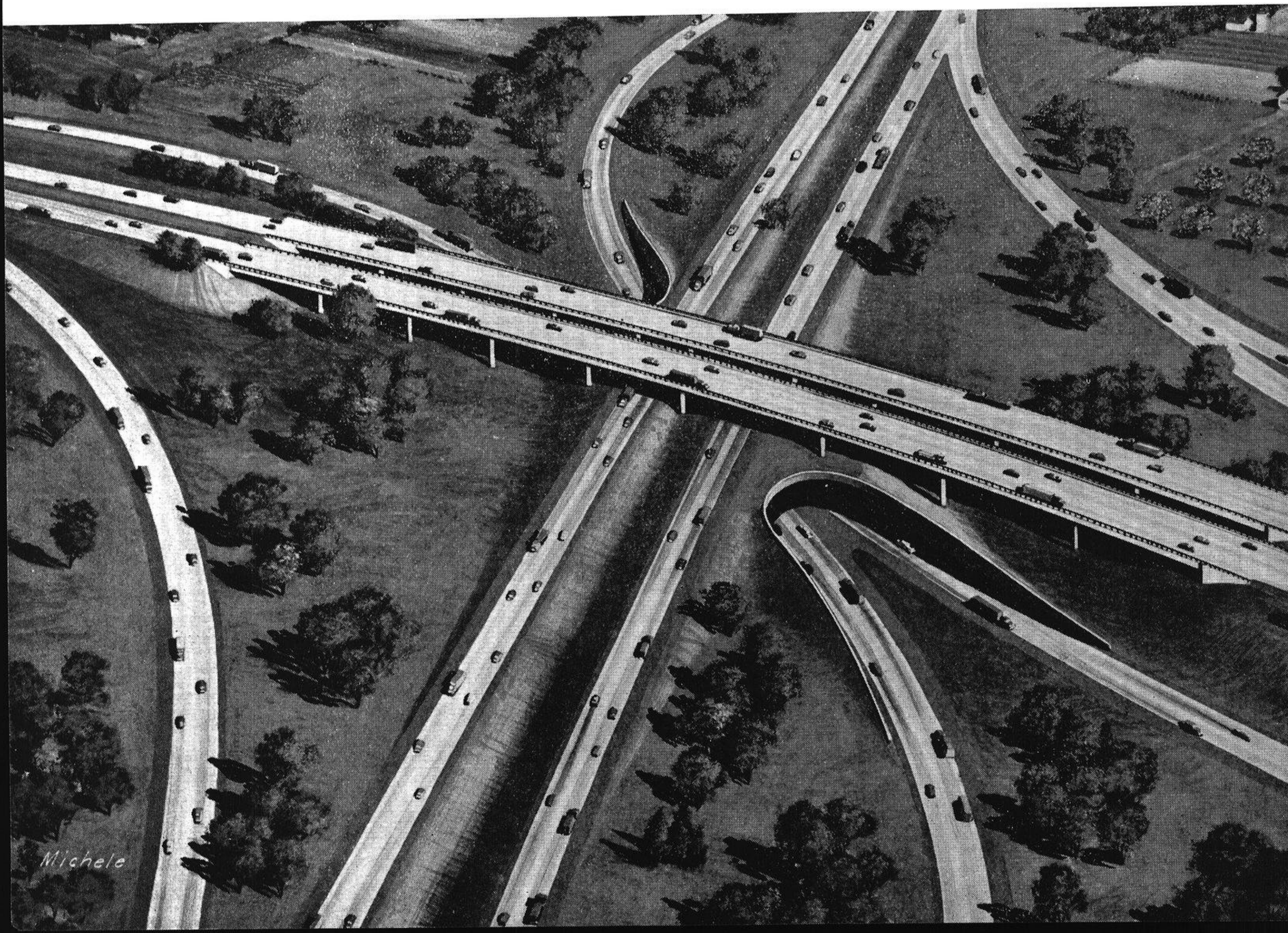

Michele

The Course in Civil Engineering

By Arno T. Lenz
Chairman, Civil Engineering Department

Professor Arno T. Lenz is in his sixth year as chairman of the Department of Civil Engineering. He is a Wisconsin native, having been born in Fond du Lac, and has received four degrees from the University. The last was the Doctorate in 1940. His professional work has been in hydraulic engineering, with special emphasis on water resources studies and model tests of dams. He is chairman of the University Committee on Water Resources. In addition to his teaching and research, he has spent several summers on engineering work for the Tennessee Valley Authority, U. S. Bureau of Reclamation, and Wisconsin industries, and as a consultant in law suits concerned with water problems. He is chairman of the Hydraulics Division of the American Society of Civil Engineers and past-chairman of its committees on hydrology and flood control.

A NEW civil engineering curriculum was inaugurated at the University of Wisconsin in September 1963. This curriculum provides opportunities never before possible in either four or five years for the civil engineering student to become educated to take his place in professional life. If he so desires, a student may now specialize to considerable depth in one or more areas of civil engineering activities, procure a broad training in several areas or prepare himself for graduate work in any one of many areas. At the same time, he will secure more training in humanities and social studies. All this is possible only because of the relatively large number of elective courses which permit the student to study in the areas of his greatest interest. This curriculum places greater responsibility on the student and his advisers to coordinate elective course selection into a comprehensive program of greatest value.

The curriculum will prepare the student for work in the broad field of civil engineering, which includes: surveying, mapping, and photogrammetry; highway, railway, and air transportation; city and regional planning; municipal engineering; buildings, bridges, soil mechanics and foundations; construction; waterways and harbors, irrigation and drainage, and pipelines; water resources, dams, and flood control; and water treatment, sewage disposal, and environmental health.

A four-year program leading to the Bachelor of Science degree in Civil Engineering is available which gives the student a rigorous treatment of the necessary basic principles and physical concepts. In addition, 25 elective credits are provided, of which 9 deal with liberal studies and 16 with technical subjects. A six-weeks summer camp is required which provides training in field activities generally associated with civil engineering.

The four-year program consists of work in the physical sciences, engineering sciences, professional divisions, and liberal studies and other areas as follows:

Physical Sciences

	Cr.
Mathematics	18
Chemistry	8
Physics	10
Geology	3
	39

Engineering Sciences and Communications

	Cr.
Engineering Mechanics	15
Electrical Engr.	3
Thermodynamics	3
Technical Writing	2
Descriptive Geometry and Civil Engr. Drawing	5
	28

Professional Divisions

	Cr.
Transportation and Surveying	10
Structural	12
Hydraulics & Sanitary	9
	31

Liberal Studies (Socio-Humanistic)

	Cr.
English	6
Economics	4
Poly. Sc.	3
Liberal Studies Electives	9
	22

Technical Electives (All May Be Taken in One Division or Distributed)

	Cr.
Designated in one Professional Division	6
Free	10
	16
Civil Engineering Summer Camp	6
	Cr.
Total	142

(Continued on page 31)

← Two fields of Civil Engineering are shown here: Structures and Highways.

R. G. Bell (above was born in Ironwood, Michigan, April 22, 1933. He moved to Ladysmith, Wisconsin at an early age. He graduated from the University of Wisconsin with a B.S. Degree in Chemical Engineering in 1956 and joined the Du Pont Company following graduation.

He was employed by the company as an engineer in a process development group at their plant near Charleston, West Virginia. Since employment, he has worked as a development engineer in the Nylon Intermediates, Methyl Mthacrylates, and Ethylene Glycol processes.

In 1960 he was promoted to an Assistant Division Superintendent in the Technical Department. In this capacity he currently supervises a group of engineers who are responsible for the engineering development work in the Nylon Intermediates process at Du Pont's Charleston plant.

M. W. Butenhoc was born in Wausau, Wisconsin, July 20, 1918. He graduated from the University of Wisconsin with a B.S. degree in Chemical Engineering in 1940. He joined the Du Pont Company in August of that year and has continued to make his career in engineering with that company.

He joined the company as an engineer in a process development group at their plant near Charleston, West Virginia. He continued in process development work in a wide variety of products at that location and was promoted into a supervisory position in a process development group in 1949.

His responsibilities and training in supervision increased with experience, including a period of duty at one of the Du Pont plants in Texas. In 1958 he was put in charge of the entire process development group for the plant at Charleston. He remained in this position until 1960, when he was given responsibility for manufacturing operations of the plant.

In his current position he is responsible for the supervision and handling of 800 wage roll people and 180 salaried people, many of whom are technically trained.

Chemical Engineering

By Professor R. A. Ragatz

Chairman, Chemical Engineering Department

Professor Ragatz is a true native of Wisconsin, born in Prairie du Sac in 1898, and receiving his B.S., M.S., and Ph. D. degree at the University of Wisconsin, the latter in 1931. He was a Research Engineer for A. O. Smith Corporation from 1929 to 1930. He is joint author of two widely used texts in chemical engineering, and has been Chairman of the Chemical Engineering Committee of the University of Wisconsin from 1941 to 1946, 1949 to 1951, and from 1955 to the present.

THE chemical engineers' function in industry is to translate the laboratory discoveries of research chemists into large-scale manufacturing operations. The research chemist generally makes the basic discoveries, and he almost always work with small-scale equipment in the laboratory. His apparatus usually is made of glass, and his product yields are small, usually a few grams at most. The chemical engineer, on the other hand, is assigned the task of designing and operating the large-scale apparatus required to produce the desired material in commercial quantities.

The chemical engineer finds employment with companies engaged in the manufacture of gasoline, fuel oil, lubricating oil, greases, asphalt, rocket fuels, synthetic rubber, rubber products, plastics, synthetic textile fibers, paper, synthetic detergents, soaps, insecticides, weed killers, sulfa drugs, and antibiotics. The chemical engineer produces a host of "petrochemicals" such as toluene, formaldehyde, ethyl alcohol, ethylene glycol, and benzene. In all of the foregoing manufacturing activities, research chemists and chemical engineers form a coordinated team.

The manufacturing processes in which the chemical engineer engages are usually quite complex and require a series of well-defined processing steps, some of which are chemical in nature and some of which are essentially physical in character. Typical chemical processes are polymerization, sulfonation, chlorination, nitration, hydrogenation, oxidation, reduction, hydrolysis, and alkylation. Typical physical operations are pumping of fluids, transport of solids, heating or cooling of materials, crushing and grinding, mixing, filtration, drying, absorption of gases by liquids, solvent extraction, crystallization, distillation, and evaporation. Chemical engineers select the various chemical and physical operations needed to make the desired product. They work out the best conditions for each step; they build and operate the complete plant.

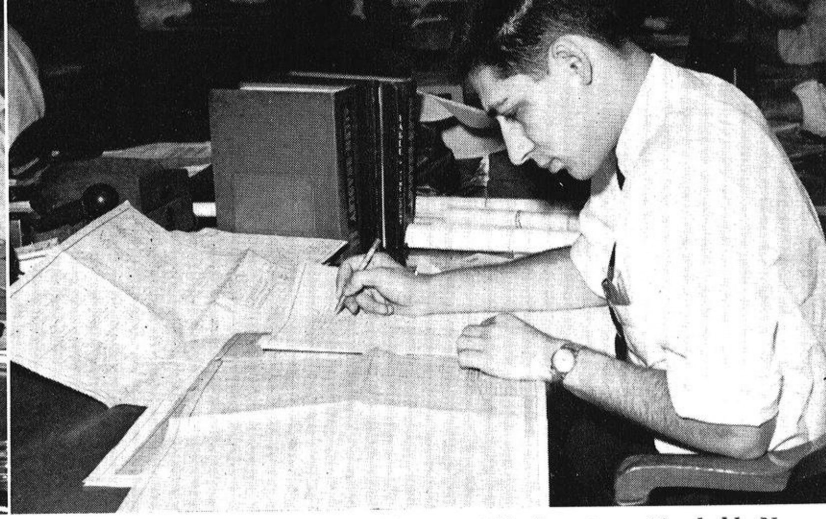
In a large company employing many chemical engineers, the type of work carried out by a particular individual may be restricted to one of the following general lines of activity: development, production, maintenance, process control, inspection and testing, design, construction, technical sale and customer service, and administration. If a chemical engineer works for a smaller company, his duties probably will encompass several of the foregoing types of work.

The Department of Chemical Engineering has excellent instructional facilities. The Chemical Engineering Building has well equipped undergraduate laboratories for instruction in unit operations, chemical manufacturer, process measurements and control, applied electrochemistry and plastics. Facilities for graduates MS and PhD thesis projects are also provided.

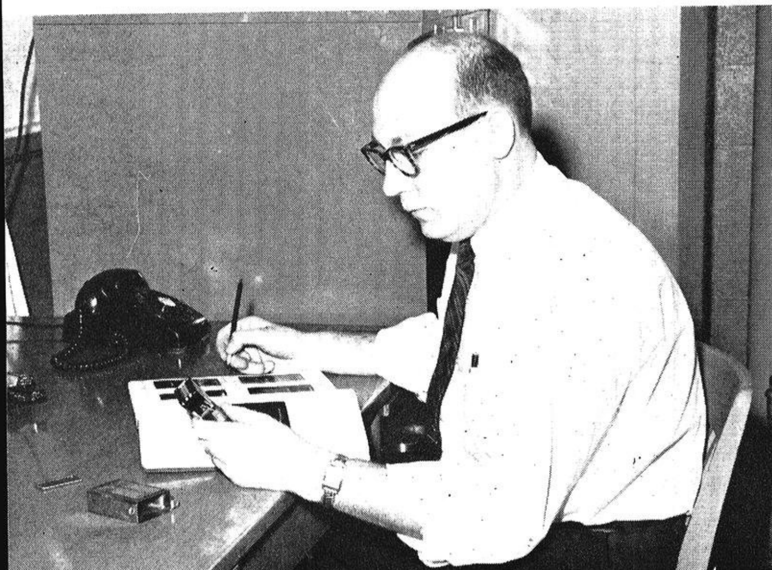
The curriculum in chemical engineering has, for many years, been accredited by the American Institute of Chemical Engineers and also by the Engineers' Council for Professional Development. The curriculum is constantly under scrutiny, and periodic changes are made as called for by new scientific discoveries and changed industrial conditions.

The tremendous growth of the chemical industry since World War II has created many employment opportunities for graduates from the chemical engineering course. Prospective students should bear in mind, however, that Wisconsin has relatively few chemical industries, with the result that most of our graduates secure employment outside of the state. A notable exception is Wisconsin's large pulp and paper industry, in which many of our graduates have secured employment.

James N. Pearse hired in 1957 as an EE, hometown La Crosse, Wis-
onsin, started as a Research and Development Engineer Trainee then
vorked as a Development Engineer and is presently a Project Engineer.
Photo courtesy Allen–Bradley Co.

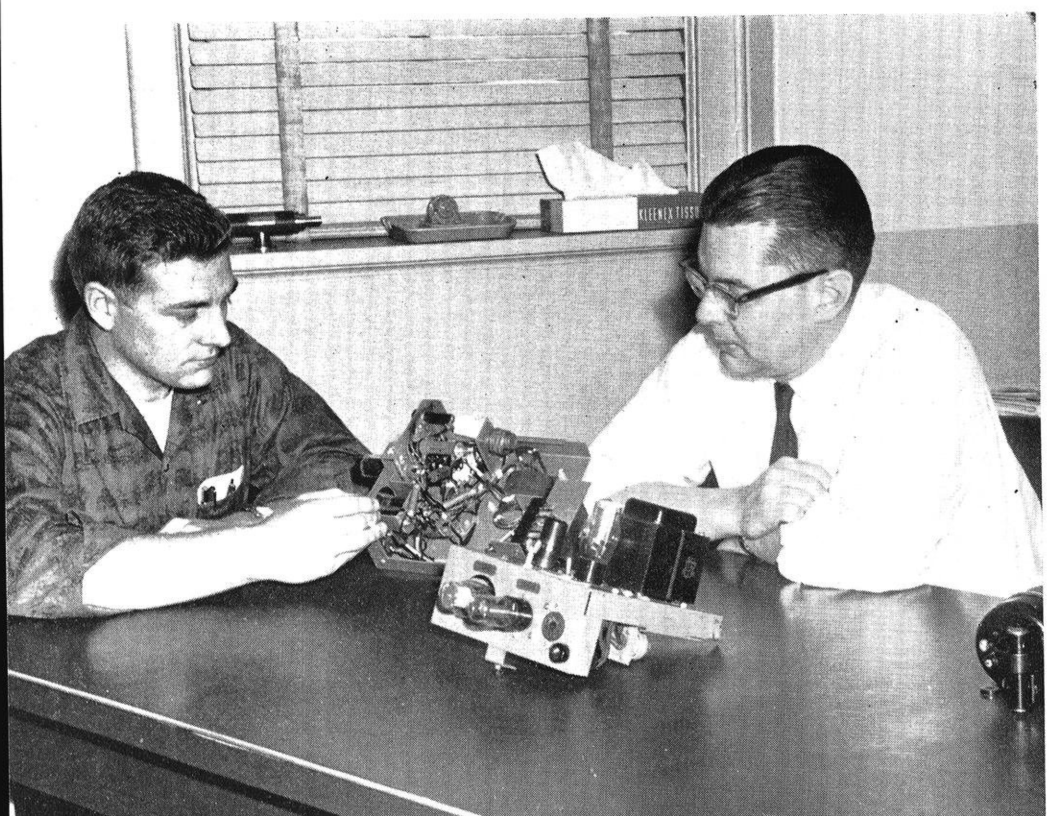


Paul V. Raab hired in 1957 as an EE, hometown Freehold, New Jersey, started as a Research and Development Engineer Trainee then worked as a Development Engineer and now is a Project Engineer. Photo courtesy Allen–Bradley Co.



Floyd R. Woldt hired in 1956 as an EE, hometown Oshkosh, Wis-
onsin, started as a Sales Trainee then worked as a Sales Engineer and
s presently in Sales Promotion. Photo courtesy Allen–Bradley Co.

Milan Damjanovich hired in 1957 as an EE, hometown Milwaukee, Wisconsin, started as an Application Engineer Trainee and now is an Application Engineer. Photo Courtesy Allen–Bradley Co.



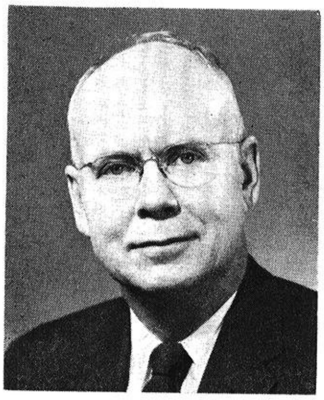
Left to right, Don De Meuse ('58) and Richard Nelson ('38) Mr. De Meuse is a graduate in electrical engineering and his home town was Algoma, Wis. He is an electrical design engineer.

Mr. Nelson, whose home town was Madison, is a graduate in electrical engineering also. He is assistant to the vice president of engineering with responsibility for staffing utilities function of Kimberly–Clark.

Electrical Engineering

By Professor H. A. Peterson

Chairman, Electrical Engineering Department



Prof. Harold A. Peterson has been Chairman of the Department of Electrical Engineering since 1947. In 1957 he received the Benjamin Smith Reynolds Award for outstanding teaching of young engineers. In 1961 he was on leave from the University, serving as Senior Fulbright Lecturer for one semester at the Technical University at Hanover, Germany. He is a Fellow in IEEE (Institute of Electrical and Electronics Engineers) and Past Vice President of AIEE, now merged with IRE to form the new IEEE. He is also a member of several other engineering societies and holds eight patents. His background includes 12 years in industry with the General Electric Company and a considerable amount of consulting experience.

"ELECTRICAL and Electronics Engineering" might more appropriately serve as the title of this short article. As I write here for the benefit of you young people who are now in our high schools I want to make this point very clear. When you see the words "Electrical Engineering" remember that all of the broad, basic, and rapidly expanding field of "Electronics" is included, for this too is modern Electrical Engineering to a very great extent. It is vitally important for high school guidance counselors, teachers, and students to be well aware of this fact.

Electrical Engineering is a very young profession. Only eighty-one years ago the first waterwheel-driven electrical generator in this country was put in operation at Appleton, Wisconsin. There was rapid growth and development of the profession in those early years. Even more phenomenal has been the expansion in more recent years. After two years of careful study and planning, the American Institute of Electrical Engineers (AIEE) and the Institute of Radio Engineers (IRE) have merged as of January 1, 1963 into one organization named the Institute of Electrical and Electronics Engineers (IEEE), having a membership of approximately 160,000 engineers! It is by far the largest unified Engineering Institute in the world. The challenging opportunities for employment and professional development are such as to attract the best of our high school graduates.

A few generations ago, electricity was available in the homes of only a few. Now, it is available in almost every home. Electrical engineers have been largely responsible for bringing this about. Today, heavy tasks around the farm home and other tasks in all homes, can be done quickly, efficiently, and without drudgery. Radio and television have been brought to most homes. These are some of the more obvious consequences of Electrical Engineering.

While Electrical Engineers can point out with pride these many accomplishments, the High School Student should *look ahead* to the opportunities and challenges of the profession ten or twenty or more years in the future. These opportunities and challenges are many, for with the coming of the Space Age now upon us, there comes also a multitude of new problems. The Space Science and Space Engineering fields are full of fascinating problems for the Electrical and Electronics Engineer. Electronics is basic in the Space Age because radio communication and control are so essential to even the simplest experiment involving a satellite or space vehicle. And this Space Age has only begun! Certainly, Engineering and Scientific realities of tomorrow must surpass our vision of today.

Electrical Engineering has expanded tremendously in scope in recent years. Automatic control theory, information theory, the transistor, new analytical techniques, analog computers, digital computers, extra high voltage power transmission, the tunnel diode, medical electronics, plasmas, magnetohydrodynamics, satellites, orbiting astronomical observatories, meteorological instrumentation, space technology, lasers, new materials, fuel cells nuclear fusion and fission, and may other developments have been basically important in this expansion. The control of guided missiles, and the

(Cnotinued on page 40)

The Engineering Profession

(Continued from page 15)

interests before choosing a particular branch. To assist you in this task the chairman of each of our engineering departments has an article in this special issue of the Wisconsin Engineer briefly describing the field.

Combined courses in engineering and agriculture, commerce, city planning or law are also possible and are becoming more popular. Such programs should be planned carefully during the first year at the University.

A comprehensive study by the National Science Foundation predicts that the need for engineers in the years ahead will seriously exceed the supply unless many more young men and women prepare now to enter the field. Industry is already taking all available graduates, and the National Science Foundation predicts that by 1970 the number of engineers needed will be almost double the total number of engineers in the United States today.

It should be recognized that engineering is demanding a much stronger grounding in chemistry, physics, and mathematics than ever before. To handle adequately the increasingly complex problems confronting the profession requires that engineers be able to understand and apply the most advanced concepts of the basic sciences. Consequently you will find all curricula giving greater emphasis to these subjects and to synthesis and design at the expense of purely informational courses.

Every profession demands of its members integrity, industry, perseverance, courtesy and good personality. Success in engineering requires all of these and, in addition, a strong aptitude for mathematics, the sciences, and written and oral expression. If you possess these qualities and aptitudes you can and should become an engineer. The opportunities today, and in the years ahead, are almost limitless. The rewards, materially and in personal satisfaction, are substantial.

Career Opportunities in Engineering

(Continued from page 16)

view seniors. These companies provide literature and other information about the opportunities available. The seniors examine this material and interview companies that are interesting to them and which have expressed a need for people with their particular qualifications. If, after the campus interview there is mutual interest between the company and the student, he will very likely receive an invitation to visit the company to further discuss employment possibilities. In some cases, seniors must enter military service after graduation, but some companies will hire these individuals and grant military leave when they are called to active duty. If the graduate prefers, he can use the Placement Office after returning from service. At any time after graduation. College of Engineering alumni can use the Placement Office if they wish to relocate.

New opportunities are also developing in terms of summer employment for engineering students while still in college. Even after the freshman year it is possible to find summer work in some phase of engineering. Besides just providing the chance to earn money, the student can gain worthwhile experience in summer work and see how engineering theories are applied to industry. And he may discover special interests in a particuar phase of engineering and tailor his selection of courses accordingly. As a result, he will be better prepared to continue his career after graduation.

What do the companies look for in the new engineering graduate? Scholastic achievement is one of the most important factors, but by itself doesn't mean everything. Companies are just as much interested in personality, character, and all-round potential. The student who demonstrates these attributes through such things as extra curricular activities along with scholastic ability is the most sought after college graduate.

These are some of the things that should be considered by the high school student interested in engineering. But most important, any high school graduate with ability and interest in things technical should seriously consider engineering. Careers in engineering have never had a brighter future—and probably surpass career opportunities in any other field.

Let's Take A Look . . .

(Continued from page 17)

to take a liberal studies undergraduate degree before specializing in engineering. However, by judicious choice of his free electives, the prospective engineer may sample many and varied fields, as his taste dictates.

Engineering students work hard. Even with the present reduced curriculum requirements, they find they are carrying a heavier program of studies than their contempoaries in other colleges. If, however, they have mastered the secrets of organization, have learned to budget their time, discipline themselves, and study effectively, engineering students can and do participate in a variety of extracurricular activities on their college campus.

The Office of the Freshman Adviser is open at all times for freshman engineers to come for consultation about any special problems, with scholastic difficulties, and with redefining their vocational objectives. If more specialized help is needed, the adviser can refer the troubled freshman to the proper person or agency. The Freshman Adviser is sincerely interested in the welfare of each student.

Inquiries from interested high school students are welcomed by the Freshman Adviser. If you should visit the campus and wish to talk over your plans before enrolling in college, you will be welcome to come to Room 22 of T24 Building for a visit.

University Extension

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tion of program within the offering of the outlying institution of choice. Student counsellors are generally very well informed on matters of local course selections

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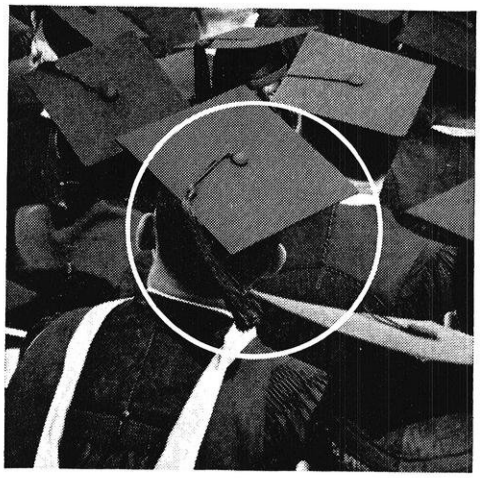


THERE WILL BE AN EAGLE
PRATT & WHITNEY AIRCRAFT
DEPENDABLE ENGINES

University Extension

(Continued from page 26)

applicable to the degree program of choice. Any doubtful matters may be cleared up quickly by a telephone call, a letter, or a personal visit to the appropriate departmental chairman in Madison.

Years to Completion

The first point of understanding about the time it takes to graduate in any college program is more of a matter of "credits earned" rather than "time spent." Traditionally, the engineering programs at Wisconsin have required from 146 to 152 semester credits for graduation. This means that you will have to earn an average of better than 18 hours per semester just to stay abreast of the schedule. There is some indication that these rigorous requirements for the first degree may be slackened somewhat in the years ahead. However, such changes in requirements are never retroactive, so the current bulletin of courses in the College of Engineering should be your guide.

When your Freshman and/or Sophomore programs contain a sufficient number of courses in the required areas of English, mathematics, chemistry, drawing, physics, economics, history, speech, and mechanics, you stand a good chance of maintaining pace with your contemporaries in Madison. An excess of credits in music, sociology, or other subject matter specialities not particularly related to engineering, will simply mean that you are better informed than the average engineer and that your total credits upon graduation will exceed the number spelled out above by virtue of courses taken outside of the rather rigid curriculum requirements in most engineering programs.

There is not space here to spell out the particular requirements of each degree program or some of the allowable course substitutions that may be made. Nevertheless, it is easy for you to visualize a course in geology being useful to a mining or metallurgical engineer, and an extra year of physics being useful to an electrical or a mechanical engineer.

A recent study completed here showed that the average time required to complete a course in engineering is very close to nine semesters. This figure was quite standard from curriculum to curriculum and varied little whether the student spent all of his time on the Madison campus or transferred here after one or two years at Milwaukee, the State Colleges, or any one of the University Centers. Returning then to the typical degree requirements of 146 to 152 credits, the typical semester load becomes more like 16 to 17 credits. This would appear to be a sensible approach to consider when undertaking an engineering program.

The current favorable career prospects for engineering graduates should supply the incentive for the additional semester's work that is required by the average student.

The opportunity to effect some overall economies by two to four semesters' study close at home where living costs are lower and part-time and summer employment prospects are better should go a long way toward financing the extra semester's study so many engineering students find to be inescapable. A study of your personal situation may strongly suggest to you that you begin work in one of the University Centers or the State Colleges. If you do, there is every reason to believe that the test of time will bear out the overall wisdom of your selection.

Other Extension Services

Bear in mind, too, that University Extension stands ready to serve you through its Correspondence Instruction program. This may be useful to you in any of several ways:

1) High school credit courses—e.g. *chemistry, physics, English, languages, mathematics, social studies, etc.*
2) Zero-credit college courses—e.g. *mathematics, English, slide rule, etc.*
3) College credit courses—e.g. *English, languages, economics, mathematics, engineering drawing, physics, mechanics, etc.*

These courses may be taken by qualified students at appropriate times and serve handsomely to clear up deficiencies, to establish proficiency, to remove prerequisites, or to regularize one's program.

Whatever your choice, University Extension looks forward to the opportunity of serving you as a correspondence instruction student while finishing high school, a student in one of the Freshman-Sophomore Centers, a Summer Session student, a summer student in correspondence instruction while enrolled at Madison, or as a practicing engineer returning to the Madison campus for engineering institutes, short courses, and conferences throughout your career.

Civil Engineering

(Continued from page 21)

Courses of study in the Department of Civil Engineering are arranged into three divisions: (1) transportation and surveying, (2) structures, and (3) hydraulics and sanitary engineering. In each of these areas three courses must be taken for totals of 9 to 12 credits in order to provide the student with the basic fundamentals upon which he must build in order for him to become registered and practice professionally in this division. In at least one of these divisions he must take two or more courses (at least 6 credits) which are known as designated electives in order to give him greater depth of training in one specialty. The remaining ten technical elective credits are chosen by the student to add to his professional competence in areas he may select.

Liberal studies must include required courses in freshman English, political science, economics, and electives to supplement these courses or to give education in other phases of the humanities or social studies.

A student who makes a sufficiently good scholastic record to be admitted to the Graduate School is encouraged to take a five-year program culminating in the Master of Science degree in Civil Engineering in order to better prepare himself for greater responsibilities in the profession. The decision to work for the Master's degree need not be made until after the B.S.

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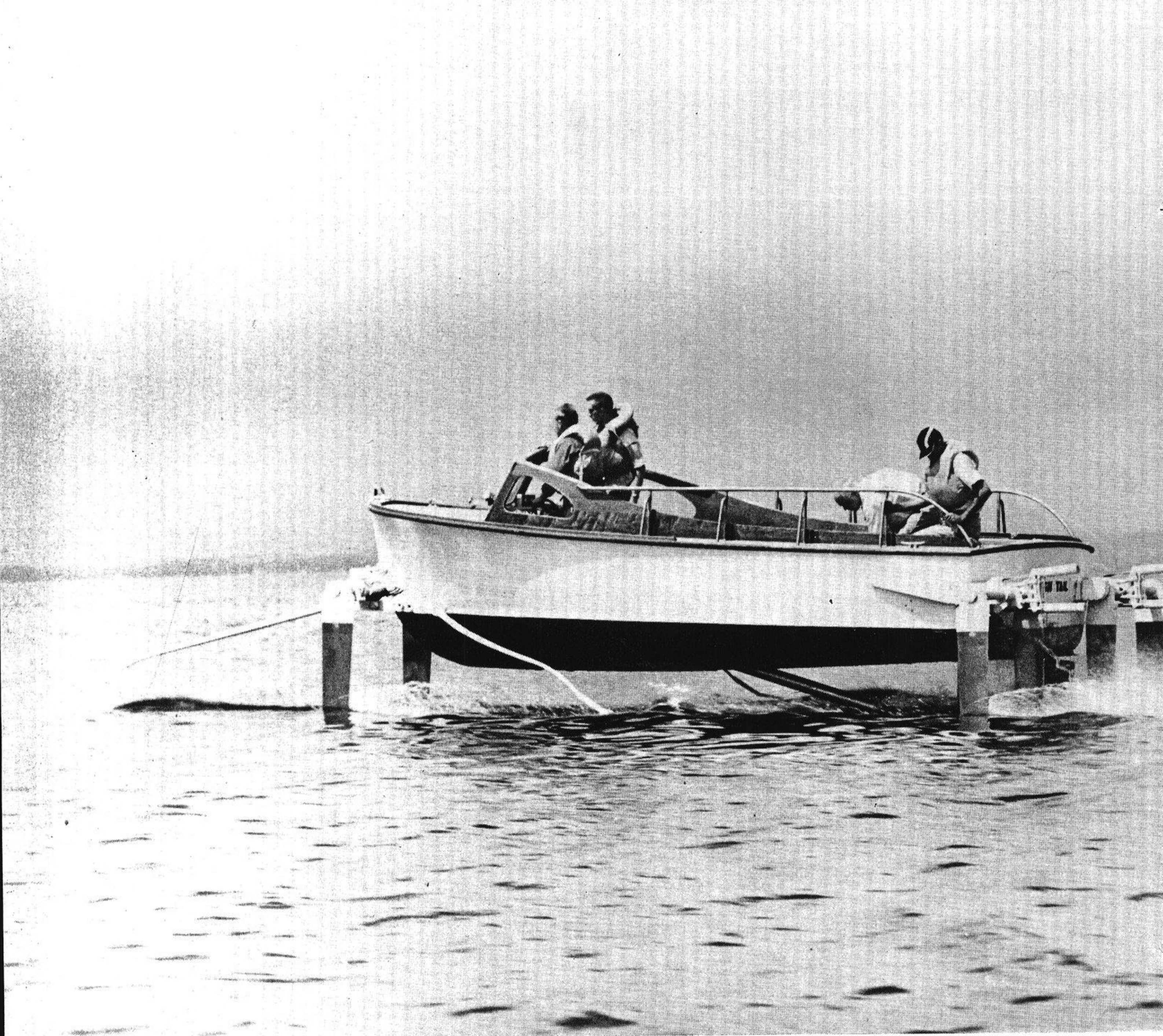
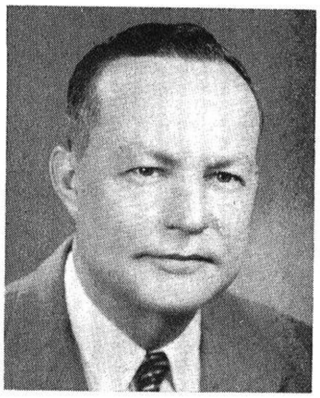


Courtesy of Baker Manufacturing Company, Evansville, Wisconsin

The design of a hydrofoil boat such as the one shown here involves to some extent the same problems in Engineering Mechanics that face the designers of ballistic missiles. These include problems in *Properties of Materials, Fluid Dynamics, Aerodynamics,* and *Experimental Stress Analysis.* Note the ski type sensor in front of the boat which is dynamically coupled through the control system to change the angle of attack of the submerged foil in order to keep the boat on a level course.

Engineering Mechanics

By Professor George W. Washa
Chairman, Mechanics Department



Professor George W. Washa has been chairman of the Department of Engineering Mechanics since 1953. He was born in Milwaukee, Wisconsin, and received his B.S., M.S., and Ph.D., degrees from the University of Wisconsin. He has been very active in ASTM and ACI. He has served as chairman of several ACI committees and has also served on the Board of Directors. He is co-author of two textbooks in Engineering Mechanics.

THIS undergraduate engineering curriculum of the University of Wisconsin was started to meet the need for training in the more fundamental aspects of engineering. It is matched by similar curricula in many of the leading egineering colleges throughout the country. They may not always be called Engineering Mechanics, but similar aims and objectives are present in many curricula such as Engineering Physics and Engineering Science.

What Is Engineering Mechanics?

Engineering Mechanics serves as a bridge between work in the basic sciences—mathematics, physics and chemistry—and the various engineering curricula. The mechanics course common to all engineering curricula are: *Statics,* concerned with forces and equilibrium of bodies under the action of forces: *Dynamics,* concerned with the motion of particles and bodies and the forces necessary to cause such motion; *Mechanics of Materials,* concerned with the stresses and strains within beams, shafts, columns, and other elements performing their usual functions in structures and machines; *Properties of Materials*, concerned with understanding and measuring the mechanical and physical properties of materials such as metals, plastics, concrete, soils and wood. The curriculum in Engineering Mechanics provides for more courses in physics, chemistry and mathematics than required in most engineering curricula along with advanced courses in Engineering Mechanics. It includes a course in *Experimental Stress Analysis* which is concerned with the use of photoelasticity and various mechanical and electrical strain gages for the purposes of determining stresses when theoretical calculations are not practical. Graduate courses leading to the Master of Science and Doctor of Philosophy degrees, which have been given by the Department for many years, consider further such fields of study as elasticity, plasticity, vibrations, plates, shells, and elastic stability.

Why Was This Curriculum Started?

There are many reasons and a few of the more important are listed below:

First, many engineers now frequently work as a team with chemists, physicists, and mathematicians and must be able to understand them.

Second, many returning graduates have indicated that they thought an undergraduate curriculum in Engineering Mechanics would have been of great benefit to them in their professional activities and recommended strongly that such a curriculum be activated.

Third, most industrial organizations, both large and small, prefer that their men come to them with a broad fundamental scientific background. Generally they themselves prefer to teach the details relating to their specific activities.

Fourth, recent studies of the American Society for Engineering Education have recommended a strengthening of the work in the basic sciences.

Fifth, perhaps the most important reason for the formation of the curriculum in Engineering Mechanics has been the great changes that have taken place in science and engineering during the past years. Among the most important of these have been the rapid diffusion of scientific knowledge and disciplines into engineering, the increasing use of the analytical approach to the solution of practical problems, and the need for a better understanding of the properties and mechanics of materials. While engineering is still both an art and a science, some fields are based largely upon empirical data and

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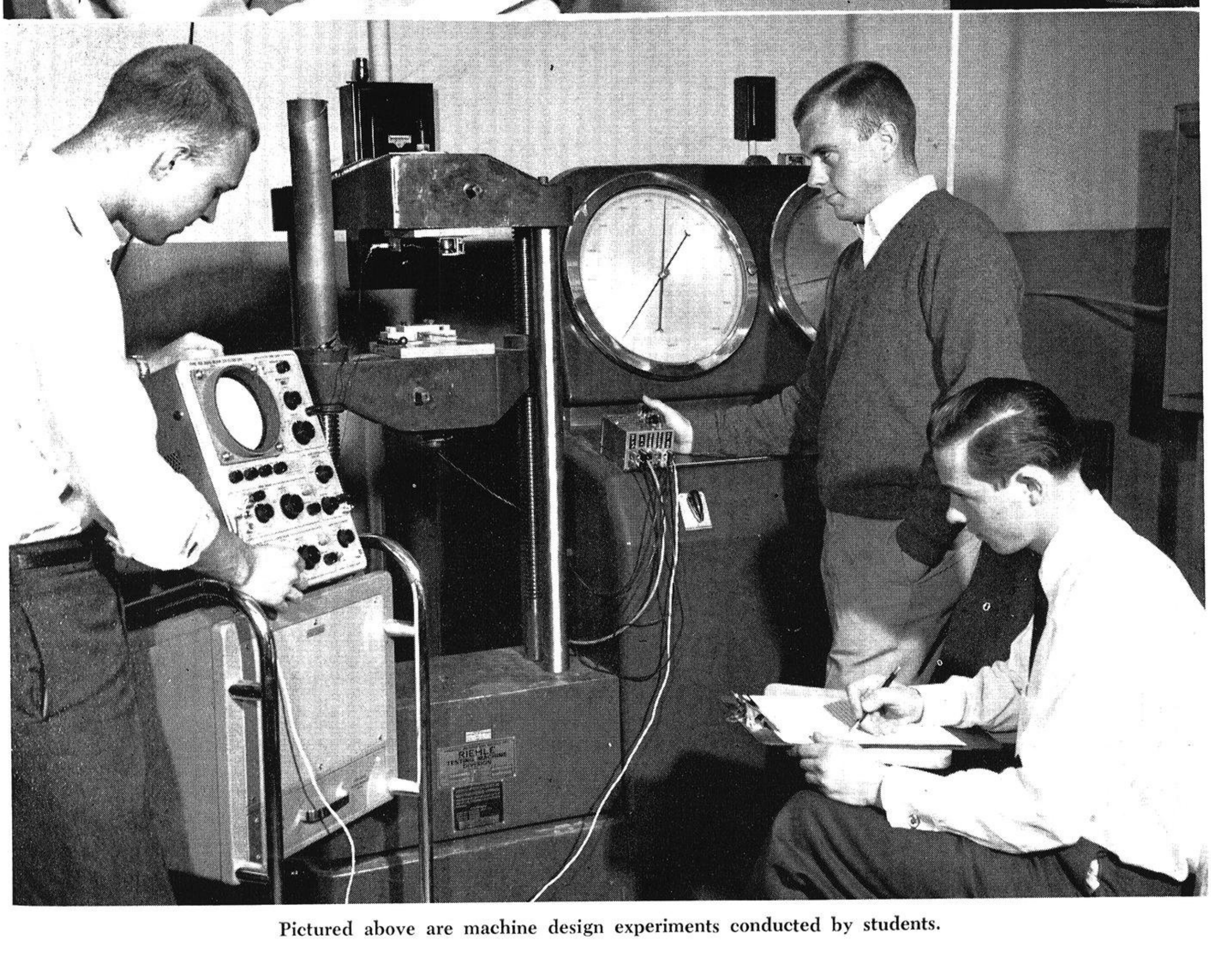


Pictured above are machine design experiments conducted by students.

Mechanical Engineering

By Professor Edward F. Obert

Chairman, Mechanical Engineering Department

Professor Edward F. Obert is completing his first year as Chairman of Mechanical Engineering. He was born in Detroit, Michigan and received his B.S. from Northwestern University and M.S. from the University of Michigan. He has written books on thermodynamics and combustion engines. He is the eighth recipient of the George Westinghouse Award of the American Society of Engineering Education for outstanding teachers.

MECHANICAL engineering is that phase of engineering which deals principally with the conception, design, analysis, test, production, and utilization of mechanical equipment. Engineers in this profession have been a major factor in the developing in this country of the highest standard of living in the world, which has been largely achieved by the effective mass-production system which has been developed. The mechanical engineer, although contributing to our present technology in every industry and in every phase of design, development and production, has played a dominant role in the transportation, power generation, and manufacturing fields.

In the field of transportation he has been largely responsible for the development of modern aircraft, including the turbo-jet engine, landing gear, hydraulic controls, and inertial navigation systems. Our current cars, trucks, and buses are the result of his extensive efforts in the development of engines, brakes, transmissions, steering mechanisms, chassis structures and the associated mass production technology by which they are manufactured. Railroad and marine equipment is also designed and built by the mechanical engineer, as well as the many types of heavy earth-moving equipment which make possible our expanding super-highways systems.

In power generation the mechanical engineer is responsible for the conversion of fuel energy, nuclear energy, or water power, to mechanical energy. This involves the design and construction of turbo-machinery, steam generators, pumps, and condensers, which are essential components of our natural electrical power generating capacity.

In the field of production machinery, the mechanical engineer has designed and developed the automated equipment now used in the manufacture of castings, stampings, extrusions, forging, and of machined parts of all kinds. As this equipment becomes more complex, various types of hydraulic, pneumatic, electrical, and numerical controls must be understood and applied by the mechanical engineer.

Mechanical engineering is perhaps one of the broadest in scope of all branches of engineering. An individual mechanical engineer may design products or production methods, he may supervise production, he may administer business operations or technical projects, he may test individual machines or complete plants, or he may conduct research. Although many special areas exist in the profession the field is traditionally divided into three broad activities. They are heat power, design, and industrial engineering.

In the heat power field, engineers are interested in the analysis of liquids, gases, and vapors, as they are used in all types of engineering applications. Thus, the internal combustion engine, the steam turbine, the refrigerator, and the rocket engine are but a few examples of equipment requiring this type of engineering. To be proficient in this area the engineer must have a knowledge of thermodynamics, heat transfer, fluid flow, gas dynamics, combustion, and related subjects.

In the design field mechanical engineers are called upon to conceive new devices and machines,

(Continued on page 41)

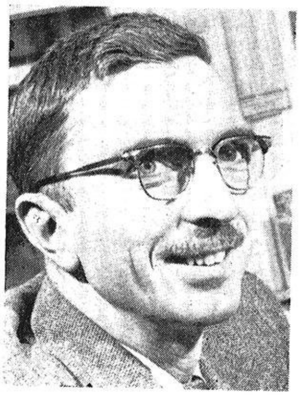
The Minerals and Metals Engineering Building on the University of Wisconsin Engineering Campus.

A huge self1powered vehicle, as shown to the left, provides one answer to the problem of providing the raw materials needed by our industry.

Minerals and Metals Engineering

By Professor P. C. Rosenthal

Chairman, Department of Minerals & Metals Engineering



This is Professor Rosenthal's 9th year as department head. He received his B.S. and M.S. in Metallurgical Engineering from the University of Wisconsin. In addition to teaching he has spent seven years in industrial research, and has served industry as consultant on metallurgical problems. He has been very active in the AFS and ASM, being chairman and vice-chairman of the local chapters. He is co-author of "Principles of Metal Casting."

IN THIS era of electronics, nuclear energy, magneto hydrodynamics, plasmas, lasers and masers, satellites and rockets, and other glamorous titles, it is often overlooked that all of these developments depend on materials and materials processing. By their very nature, materials cannot be glamorized to the extent that other Space-Age developments have, yet the progress in materials science and engineering has been just as spectacular and fascinating. Recognize for example that it is now within our power to develop the theoretical strength of materials which is on the order of 1000 times as great as that of present commercial materials. Recognize that techniques are now available to examine materials at magnifications so high that atomic defects and the individual atoms themselves can be made visible. But more importantly, recognize that the minerals industry furnishes the foundation of our entire technology, conventional or exotic, that it is a relatively uncrowded field, and that the opportunities accordingly are that much greater. To quote A. W. Futrell, Jr. from his book on "Orientation to Engineering": "there is probably more opportunity and greater challenge in this area than in any other branch of engineering".

Our industrial technology is based on a complex array of alloys and non-metallics which involve almost every known element. Even the inert gases are used in metal processing. While physics and chemistry are the basic sciences underlying the production and development of these materials, there are so many problems that lie outside the normal scope of these subjects that it is common nowadays to think in terms of "materials science" as well. This is the science which deals with the relation between the structure and properties of matter. It is a relatively new science and has deep roots in such fields as metallurgy, ceramics, and solid state physics. It bears directly on such problems as the development of materials for higher strengths, high temperature resistance, extremely low temperature properties, nuclear power application, solid state electronics devices, etc.

Since this department offers courses covering the engineering problems which begin with the discovery of the original source of materials—the ores—and end with the final metallic or non-metallic products, one undergraduate curriculum cannot cover the entire spectrum of subjects. For this reason, the undergraduate program is divided into two general categories beginning with the junior year. One of these is directed toward mineral procurement and mineral processing including petroleum as well as metallic minerals, while the other curriculum involves extractive metallurgy, physical metallurgy and materials science. There is some necessary overlap in the curricula. The first one leads to a B.S. degree in Mining Engineering and the second to a B.S. degree in Metallurgical Engineering. Again, these are generalized titles and do not represent all aspects of the programs. Some idea of what is involved is indicated by the following descriptions.

Utilization of metals begins with the discovery and development of mineral wealth. This is the work of the *mining engineer*. The curriculum for mining engineering includes, in addition to courses in mine evaluation, development and ore removal, related courses in geology, mineral concentration and chemical processing. There are also courses in related fields such as hydraulics, surveying, electrical engineering, and heat and power.

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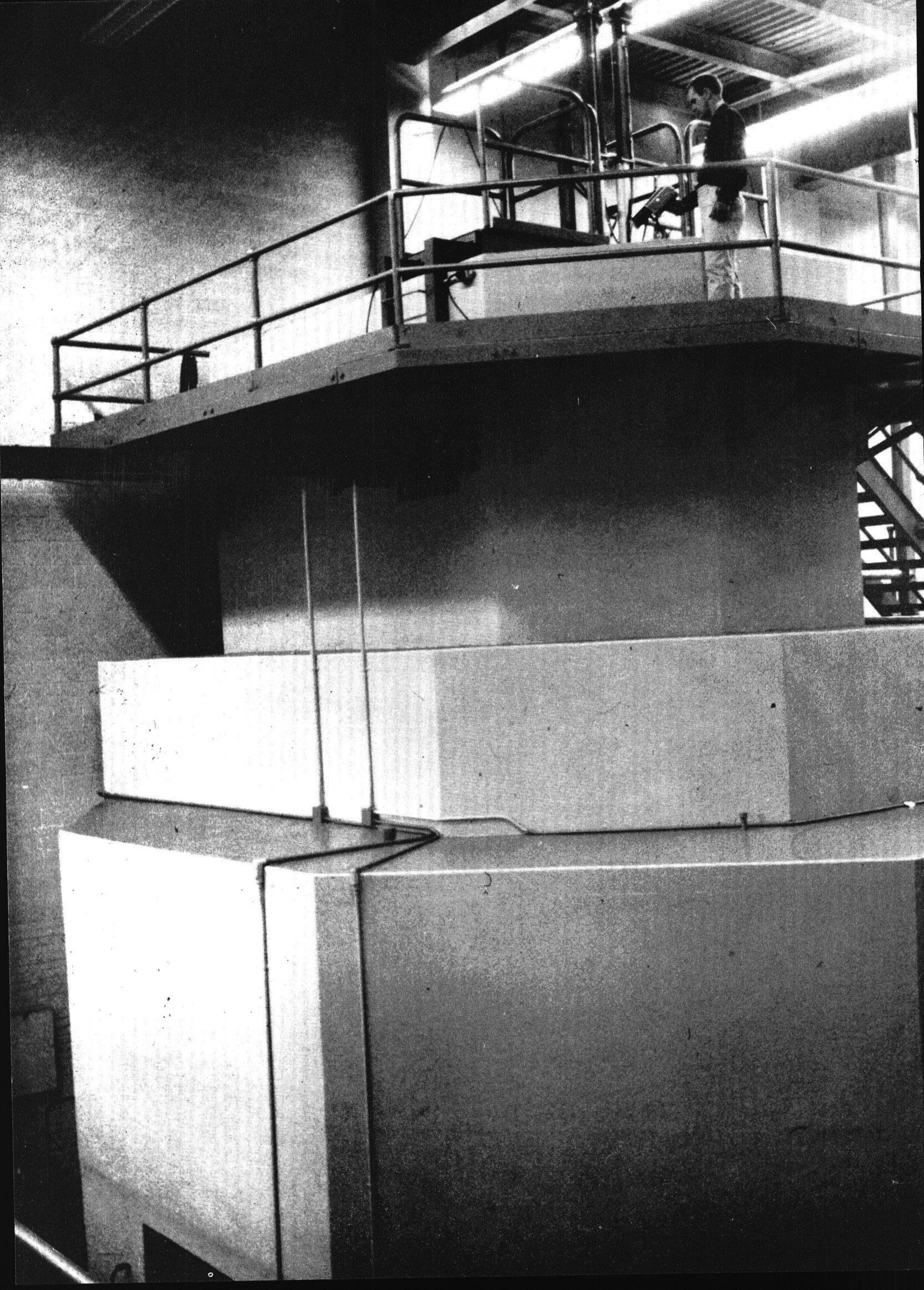

Nuclear Engineering

By Prof. Max W. Carbon

Chairman, Nuclear Engineering Department

Professor Carbon was born in 1922 and received his Ph.D. in Engineering from Purdue University in 1949. From 1949 to 1955 he served as head of the Heat Tarnsfer Unit at the Hanford Plutonium Works operated by General Electric Company. He was the Chief of the Thermodynamics Section of Avco Manufacturing Corporation from 1955 to 1958, doing design of ICBM nose cones. Since 1958 he has been at the University of Wisconsin and is presently Chairman of the Nuclear Engineering Department.

NUCLEAR Engineering is a modern profession concerned with the release of energy from the nucleus by fission or fusion and with the utilization of the properties of radiation. Since the discovery 25 years ago that a uranium nucleus could be made to split (or fission) and release energy, a vast new field has developed. In former times, generations frequently elapsed between discovery and application; for example, Hertz demonstrated radio waves in the 1880's, but they received very little practical use for over 30 years. In contract nuclear fission was discovered in 1939, plutonium was being manufactured on a large scale in 1943, an atomic bomb was tested in 1945, electricity was generated from nuclear energy in 1951, and nuclear engines to propel space vehicles were tested about 1959.

However, even though the application of nuclear energy has progressed at an extraordinary rate, Nuclear Engineering is only in its infancy and much remains to be done. Improved power reactors must be developed which will permit us to generate electricity from nuclear energy as cheaply as from coal throughout the United States and in undeveloped countries throughout the world (Power reactors, incidentially, are large "machines" in which tremendous numbers of nuclei are fissioned and from which the resulting energy is extracted in the form of heat.) The adaptation of similar reactors for the propulsion of ocean-going vessels and space vehicles must be accomplished. Later programs for space exploration will likely be severely limited unless nuclear energy can be utilized to power ion and electric propulsion systems as well as satellite communication systems.

Research is needed on methods to control the fusion process for the generation of power. (Whereas fission is the splitting of a nucleus with the release of energy, fusion is the combining of nuclei with the release of energy.) Since fusion takes place only at temperatures in the millions of degrees, resort must be made to the use of plasmas, and plasma physics becomes an important study. Other research is needed on means to convert nuclear energy more directly into electrical energy than the decades-old technique embodying turbines and electrical generators which is used at present. In addition, work is only beginning on studies of the use of radiation to fabricate materials having superior strength and thermal characteristics.

The use of radiation in industrial applications such as tracing, nondestructive testing, and thickness measuring is reported to result in savings to the country of $200,000,000 per year. Yet it is felt that the surface has only been scratched. The use of radiation to sterilize foodstuffs may revolutionize the food-packaging industry.

A serious study of the use of nuclear explosives to build harbors and canals, to allow extraction of petroleum from oil sands, and to assist in mining operations is just beginning. And the physicist needs help in the design, development, and use of high-energy particles accelerators for the unexplored ranges above a few billion electron volts.

Certainly not the least nor last, the development of improved nuclear weapons for the defense of the free world must continue unabated.

Although the applications cited above are numerous and diverse, no one can predict with certainty which particular one will prove most useful. In fact, it is quite pos-

(Continued on page 42)

← The University of Wisconsin Reactor.

Civil Engineering

(Continued from page 31)

degree has been obtained. It is, however, desirable to consider the entire five-year program when the student is selecting electives during his first four years of study. The recommended five-year program offers the student greater opportunities for diversified or intensive studies, because a total of approximately 50 elective credits is provided, of which 9 are devoted to liberal studies. The large block of elective credits which remains is devoted to technical subjects related to analysis, design, synthesis, and general engineering practice. The student therefore has the opportunity to:

a) Continue to develop in the broad field of civil engineering by dividing his electives fairly equally among the three divisions of instruction.

b) Specialize in one or more areas of activity of civil engineering.

c) Participate in interdisciplinary programs.

d) Participate in depth in elective programs in other departments of the Engineering College.

e) Pursue courses of study leading to the Ph.D. by choosing an elective program beginning in the junior year which will give maximum support to his area of specialization.

The educational goals of the recommended five-year program are to provide men for (a) public and civic works and general engineering practice, (b) education, research and development, and (c) areas of specialization.

In the fifth year the student may select either the professional option or the science option. Those selecting the professional option employed normally in professional engineering practice with consulting engineers, federal, state, or municipal engineering agencies or in industry. Those selecting the science option are employed normally in research and teaching, and frequently go on for the Ph.D. degree. An ultimate goal is therefore desirable when a selection is made but this objective is not mandatory. Entrance requirements for both programs are the same and are those for admission to the Graduate School. A grade point average of 2.75/4.00 is required but students with slightly lower grade averages may be admitted on probation if recommended by the department, particularly if their records during the last two years of undergraduate work are considerably better than during the first year or two.

A student in the professional master's program is required to take a minimum of 30 credits of resident graduate work. This normally takes one full calendar year. He must take courses in Contracts and Specifications, and Economic Selection, if he has not elected them as an undergraduate. He must complete at least two of the designated electives in each of the professional divisions of civil engineering, if he has no taken these courses as an undergraduate. The remainder of his program must be selected in conference with an adviser from one of the divisions.

A student taking the science option will select his courses in conference with an adviser from one of the divisions and must earn a total of at least 24 credits including five to eight credits of thesis research investigation. Normally, this work, including the thesis research, takes one calendar year of study. At the option of the major professor, the thesis requirement may be waived; however, in lieu thereof, the student must take three to nine credits of "advanced independent study" and complete a minimum of 30 credits of resident graduate work.

Within the programs outlined above, the civil engineering student can choose a program tailor-made to his individual requirements with a minimum of those courses in which he has the least interest.

Electrical Engineering

(Continued from page 25)

very special instrumentation problems associated with the recording of data and transmitting such data back to earth from satellites are largely the responsibility of the electrical engineer. The problems are fascinating and challenging, requiring much imagination and resourcefulness in obtaining solutions. Advanced training in engineering science and mathematics is generally required for creative work in these areas.

Graduate work in Electrical Engineering is strongly encouraged. About 100 graduate student's from many different states and foreign countries are currently enrolled in Electrical Engineering on the Madison campus. It is expected that from 8 to 10 Ph.D. degrees in Electrical Engineering will be awarded in 1964." Currently we are graduating each year about 160 Seniors in Electrical Engineering (B.S. in EE). The employment opportunities for individuals with such engineering-science training are indeed challenging and exciting.

At the University of Wisconsin, our facilities in the Engineering Building are among the best in the country. Our course of study in Electrical Engineering is constantly under surveillance so that improvements can be made from time to time to keep in step with the needs of industry. We have recently revised our curriculum in order to make it more suitable to the demands of our rapidly changing technology. It is fully accredited by the Engineers' Council for Professional Development.

There is a student branch of IEEE on the campus with a faculty member in charge as branch counselor. This student branch elects its own officers, holds regular meetings, and sponsors activities of interest to student engineers. It affords a means for orienting students with regard to professional activities within the IEEE following graduation.

The University of Wisconsin offers excellent opportunities for study in Electrical Engineering. Young men and women with good high school records and a real interest in science and mathematics would do well to consider enrolling in this course of study which leads to a most interesting professional life of basic importance to our economy and security.

Engineering Mechanics

(Continued from page 33)

experience while others have a highly organized scientific basis. The empirical approach necessarily involves specialization since the results are usually closely related to the specific problem. The methods of the analytical approach are general. For example, problems in electronics, fluid mechanics, elasticity, heat transfer thermodynamics, and others show remarkable similarity in the form of the differential equations that result from analyses. The analytical phases of engineering are therefore broad and not highly restricted by subject barriers.

Mechanical Engineering

(Continued from page 35)

and to refine and improve existing designs. Perhaps no phase of mechanical engineering places greater demands upon the imagination, ingenuity, and judgement of an engineer than that of mechanical design. Design requires the conversion of ideas to physical reality, which is the essence of engineering. The design engineer must be well grounded in kinematics, machine elements, mechanics, strength and properties of materials, dynamics, vibrations, experimental stress analysis, and many other subjects which relate specifically to design.

In the industrial engineering field all types of production problems are encountered. This is the domain of the engineer interested in the manufacture of finished products usually on a mass production basis. It is here that engineers are concerned with how a part or machine may be produced in the most economical manner. There are many subjects related to this field, including industrial organization, plant layout, cost analysis, time-and-motion study, personnel management materials handling, and inspection methods. With the increasing complexity of the mass-production techniques, industrial engineering is a rapidly expanding field.

Because the training of a Mechanical Engineer is rather broad, he is in demand in practically every type of manufacturing organization and in many research and governmental organizations. He may be employed in the electrical, chemical, petroleum, metal-processing, paper, plastics, or any other of a host of industries which require his services in connection with especially engineered production equipment, for plant engineering, or for administrative responsibilities.

Although the achievements of the mechanical engineering profession in the past are apparent, what does the future hold? What will the mechanical engineer of tomorrow do? With the rapid advances in science and technology such predictions are indeed difficult; however, from all indications industry will continue to require an increasing number of competent, well-trained mechanical engineering graduates to staff the many technical and administrative positions which are continually developing. In addition, with the ever increasing emphasis on scientific research, many mechanical engineers with advanced theoretical training will be required in this field. It is apparent than an increasing proportion of our students will undertake graduate study towards the M.S. or Ph.D. degree, and students with the necessary aptitude and ability are encouraged to plan on a program of academic training which includes graduate study.

Minerals and Metals Engineering

(Continued from page 37)

One option of the curriculum in this field concentrates on the geological aspects of mining. The graduate from this program is referred to as a *geological engineer* and would be primarily concerned with finding and exploring new ore bodies or oil fields. He would estimate the economic value of the ore and determine how it might best be extracted from the earth.

The *mining engineer* designs, constructs, and operates mining properties. He, in effect, begins where the geological engineer leaves off because his principal tasks are associated directly with the mining operation. He plans the method of removing the ore, designs the transportation system and handles related problems of ventilation and power supply.

In the petroleum field, the counterpart to the mining engineer is the *petroleum engineer*. His job is to plan and operate the oil-drilling and pumping equipment and arrange for the storage of the crude petroleum. He should also be familiar with methods used to locate new petroleum fields.

The geological, mining and petroleum engineering options are all available at Wisconsin.

Once the ore is removed from the earth, it must be processed further before the metal can be extracted. This is called mineral benefication, mineral dressing or mineral concentration. This field represents the link between mining on the one hand and metallurgy on the other. The *mineral processing engineer* designs and operates plants for the separation of the valuable minerals from the waste products. This field is becoming increasing more important as the richer ore deposits become exhausted and lower grade ores must be utilized. In Wisconsin, for instance, the use of the available low grades ores awaits development of economical methods for concentrating these ores to higher iron contents. The mineral processing engineer uses many methods and devices for concentrating ores such as gravity separation, "heavy media" separations, and flotation. His program of study is much the same as that of the mining engineer but usually contains less mining and more metallurgical engineering subjects.

After the mineral processing engineer has completed his work of concentrating the ore, the metallurgical engineer steps in to reduce the ore to the metallic state. In this work he may utilize heat, electricity, chemicals or a combination of these factors. Since this treatment usually involves chemical reactions, this metallurgical engineering field is called *chemical or extractive metallurgy*. An example of an extractive metallurgical operation is the reduction of iron ore in the blast furnace to produce pig iron, the pig iron being subsequently refined to steel. The large metal refineries scattered through the country all depend upon metallurgists for their design and operation. New Processes, increasing use of low grade ores, and new metal requirements, have all added to the scope and importance of the work done by the extractive metallurgists. When the extractive metallurgist has completed his job of reducing the ore to the metallic state, the *physical metallurgist* or materials engineer takes over to improve the product.

The alchemists of old were constantly striving to change base metals to noble metals. Had their efforts succeeded they probably would be no less spectacular than the efforts of the present day *physical metallurgists* who have succeeded in greatly improving the mechanical and physical properties of metals by alloying and special treatments. The physical metallurgist finds opportunities in a wide variety of industries.

For example, he may be employed in the automotive industry to specify the composition and properties of metals and other materials to be used for the various parts. He may be engaged in the nuclear field to design fuel elements, study corrosion problems, or to carry on research on radiation damage. He may be employed in the electrical industry to work with physicists and electrical engineers in the manufacture of solid state devices. Other opportunities exist in such fields as metal casting, welding, production of such metals as aluminum, copper and steel, and the production of rare or refractory metals like beryllium or tantalum. The possible areas of employment are almost unlimited because the advancements in our technology have required more and more attention to materials. Although work in ceramic engineering is usually handled by *ceramic engineers*, it is not difficult for metallurgists to function in this area also because of the similarity of the fundamental science underlying both of these fields. As a matter of fact training in physical metallurgy is such that it serves as an excellent background for employment in the general area of materials science or engineering.

Nuclear Engineer

(Continued from page 39)

sible that the long-range predominate application will prove to be one undreamed of today.

Thus, it is the job of the Nuclear Engineer to apply the principles of nuclear physics. This point is ill-appreciated by the general public and much confusion exists regarding the distinction between the work of the scientist and the engineer. However, science is the search for knowledge, and the physicist is engaged in attempting to understand the make-up of the physical world. When the physicist learned how uranium nuclei would fission, he was satisfied and ready to move on to a new subject. The engineer, in contrast, wished to apply the knowledge of fissioning to generate electricity, to advance space exploration, to protect the free world, to make new materials, and so on; and he is doing so.

To train engineers for work in the nuclear field, Wisconsin initiated a graduate-level program in the 1950's and offered studies leading to the M.S. and Ph.D. degrees. However, it was realized that the students could be offered significantly better training if they began nuclear studies earlier in their careers. Consequently, an undergraduate curriculum in Nuclear Engineering was developed and offered for the first time in September 1961. This new curriculum is an engineering-science type course tailored to give the student the background for the activities described above. The first three years of the program give him training in science-engineering fundamentals and liberal arts. Just as the scientists wants to know how and why something works, the engineer must also; thus, considerable emphasis is placed on science, and the Nuclear Engineering student will study essentially as much physics and mathematics as the physics student. He must also receive training in the liberal arts because he will usually work with other people, he must communicate his ideas and inventions to others, his promotions may come faster if he is able to organize and direct the activities of others, and also he must take an active role in our citizen society. Finally, he must also be trained in engineering skills since his aim will usually be to create some kind of device or design, and he receives specialized training in the fourth year in Nuclear Engineering so that industry and government will desire his services or so that he will be especially well prepared to go on to graduate work. (Although you are in high school now, you should already be giving serious thought to devoting at least a year to graduate study, regardless of the profession you choose.)

The Nuclear Engineering student receives an important, additional dividend in that his training is also ideal for a career in general research and development work. During the past few years both industrial and governmental laboratories have greatly increased the emphasis on research and development activities which cut across many fields of specialization. In this work it is frequently more important that the engineer understand the basic principles of a wide number of technical subjects than that he be a specialist in any one. This undergraduate curriculum is particularly suited to give the student the broad, fundamental background needed for that kind of job; and the graduate, if he chooses, may find himself moving into work having little relation to Nuclear Engineering. Thus, the undergraduate curriculum is not one aimed at turning out specialists in one narrow field.

In summary, Nuclear Engineering is a growing, exciting field which offers excellent professional opportunities. The undergraduate curriculum has been designed to train students for active participation and, with further graduate study, for leadership in the field. The curriculum is designed for the serious student who intends to apply his efforts diligently, and the graduate will find that he has chosen a very satisfying and worthwhile career.


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Work for a bearing and steel company? What's exciting about that?

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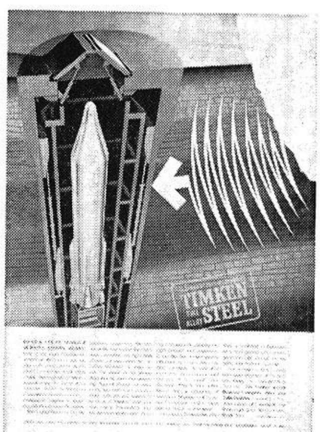
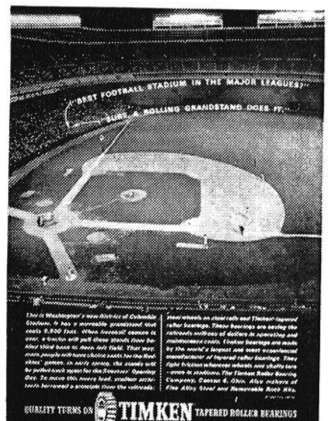
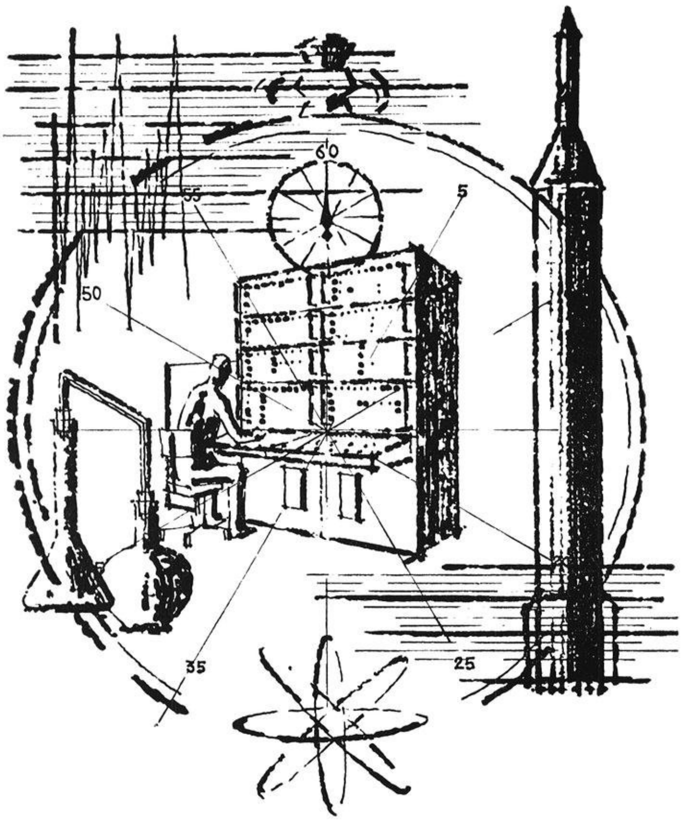






SCIENCE HIGHLIGHTS

By Robert Rosenberg, ME'65

27-OUNCE CAMERA FOR SPACE

A "molecularized" television camera that weighs only one pound and eleven ounces and is intended for space and military application has been built by Westinghouse Electric Corporation.

Believed to be the lightest and smallest television camera ever built using a one-inch vidicon camera tube, the unit is about as long as a two-cell flashlight. Without the lens, a 27-ounce camera is seven and one-half inches long, two inches wide and three and one-quarter inches deep. It requires 50 cubic inches of space and four watts of power.

Built as a development model of an advanced component for use in space or military systems, Mr. Brown said, the camera is not designed for commercial use; instead, it is intended for such space uses as on lunar reconnaissance vehicles, satellite inspection and for keeping an "eye" on orbiting astronauts or equipment.

The small size, weight and power of the camera are partly achieved by the use of an electrostatic vidicon tube rather than the more common magnetic type. Comparable space television cameras used aboard satellites weigh from four to 15 pounds, occupy from 100 to 200 cubic inches of space and require from nine to 30 watts of power.

The picture produced by the little Westinghouse camera compares favorably with a high quality home television picture. The camera includes a "binary countdown synchronizing generator" to produce standard interlaced scanning of 525 lines at 30 frames per second. The "binary synchronizing generator" and a circuit to give dynamic picture focus are features which are not ordinarily used in simplified television cameras.

For demonstration purposes, the molecular camera has a built-in transmitter capable of sending a picture 150 feet to a nearby TV receiver. In space use, however, the camera would be connected to telemetry equipment aboard the spacecraft through coaxial cables. In addition, for space applications, the camera can be provided with "slow scanning" capability to reduce telemetry bandwidth requirements. This can be achieved without any increase in power needed by the camera.

There are 197 components in the molecuralized TV camera including 36 molecular electronic blocks which perform such functions as amplification, sync generation and scanning. If conventional circuitry and components were used in an equivalent camera, 582 individual components would be required, nearly a three-fold increase.

ROLLING MILL DESIGNED FOR LIGHTWEIGHT TINPLATE

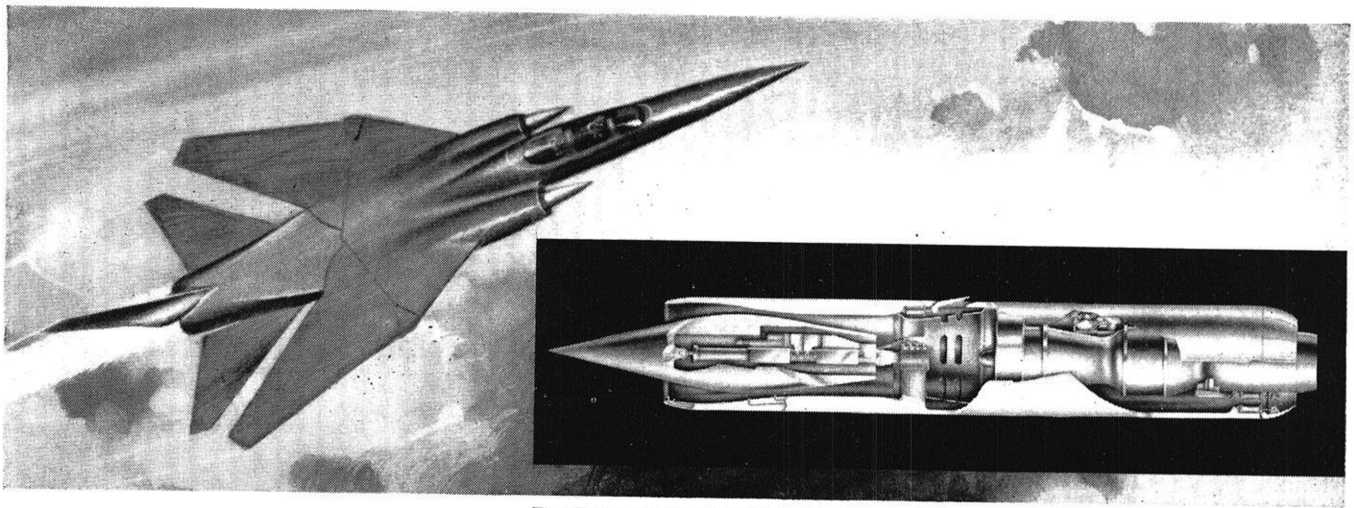
Quantity production of thin tinplate appears to be the most significant development of the early 1960's in the tinplate industry. The product enables can manufacturers to make more cans out of less steel. Iits light weight also saves money in shipping both filled and unfilled cans; moreover, it encourages development of entirely new uses for tinplate.

The thin tinplate now being produced is approximately 0.006 inch thick, compared with a thickness of around 0.009 inch for most tinplate. As with most new materials, development of the thin tinplate has necessitated development in processing equipment. Initially, steel companies modified existing cold-rolling mills to perform the reduction from hot-rolled steel strip.

(Continued on page 51)

WHAT YOU COULD BE ENGINEERING AT

Hamilton Standard



The F-111 (formerly T.F.X.) will use a variable wing which will sweep back like the one shown in this artist's drawing of a N.A.S.A. model. Hamilton Standard will develop and produce an Air Inlet Control for the F-111, similar to the system illustrated.

One possible assignment: help develop Hamilton Standard's Air Inlet Control for the F-111. Utilize your training in:

- **dynamic analysis**
- **servomechanisms**
- **thermodynamics**
- **mechanical design (high-temperature applications)**
- **compressible flow (pneumatics)**
- **incompressible flow (hydraulics)**
- **internal aerodynamics:**
  - **boundary layer**
  - **diffusers**
  - **nozzles**

to develop an AIC which will properly position shock waves and efficiently provide smooth air flow to engines. Pneumatic sensors will measure operational parameters, transmit signals to a computing device. The computer signals actuators which move the inlet spike and bypass doors.

Reliability, proven performance make Hamilton Standard a leader in AIC. We have a 14-year experience on many vital components. We have outstanding competence in pressure-ratio sensors, computing devices, and high-performance hydromechanical components for high-ram air temperature application.

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See your placement officer for a campus interview, or write:

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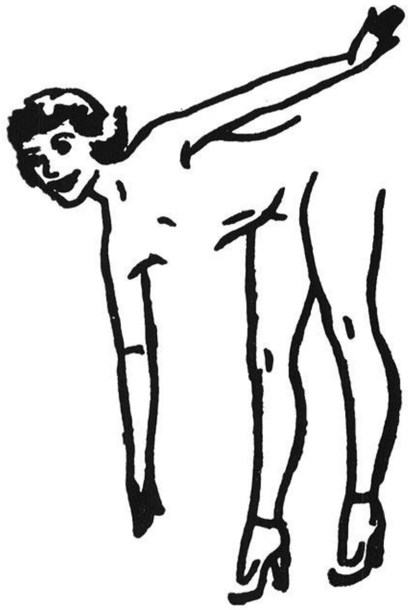


Fill in your Own Lines

Wife to sick husband: "What do you mean you have nothing to live for? The house isn't paid for, the car isn't paid for, the washing machine isn't paid for, the TV isn't paid for . . ."

* * *

On the license application he gave his vocation as "Following the horses." Only his bride-to-be knew he worked for the Sanitary Division at Pimlico.

* * *

The difference between a man and a woman buying a tie is about two hours.

* * *

History records no strikes to raise the wages of sin.

* * *

There's no denying the man who keeps trying.

* * *

Is there anything more embarrassing than jumping at a conclusion that isn't there?

* * *

Candidates peddle the same old hoke, but whoever wins we're always broke.

* * *

Parson Brown phoned the local Board of Health to ask that a dead mule be removed from in front of his house.

"I thought you ministers took care of the dead," answered a young clerk who thought he'd be smart.

"We do," replied the parson, "but first we get in touch with their relatives."

* * *

Small boy to father: "I wish you'd let Mom drive. It's more exciting."

* * *

An old timer is a man who remembers when a hairbrush instead of the courts, was used to curb juvenile delinquency.

* * *

A motorist was once driving in the country when suddenly his car stopped. He got out of the car and was checking the spark plugs when an old horse trotted up the road.

"Better check the gas line," the horse said, and trotted on.

The motorist was so frightened that he ran to the nearest farm house and told the farmer what had happened.

"Was it an old horse with a flopping ear?" asked the farmer.

"Yes, yes!" cried the frightened man.

"Well, don't pay any attention to him," replied the farmer, "he doesn't know a darn thing about cars!"

* * *

"Why won't you marry me?" he demanded. "There isn't anyone else, is there?"

"Oh, Edgar," she sighed, "there must be."

Four Marines were playing bridge in a hut on a South Pacific island during World War II. A sailor burst in shouting: "The enemy is landing a force of about 400 men on the beach."

The Marines regarded each other wearily. Finally one said: "I'll go. I'm dummy this hand."

* * *

A small town is where each resident knows everything that's going on, but has to read the local weekly to learn who's been caught at it.

* * *

Mother was entertaining her friends with an evening of bridge when she heard her children on the stairs. Sensing this was a great ceremonial moment, her guests paused as she raised her hand for silence. "The sweet little dears want to wish me goodnight," mother cooed. With that the silence was shattered by a shrill voice announcing, "Mama, Billy found a bed bug!"

* * *

Office worker, having cocktails at his desk, to boss: "Hope you don't mind, sir. Just a little celebration on the 10th anniversary of my last raise."

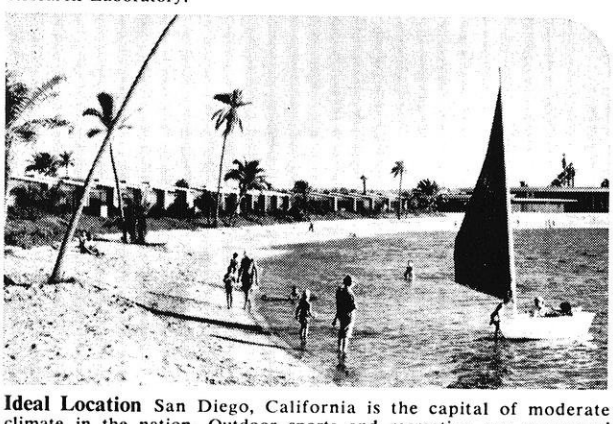
(Continued on page 51)

GRADUATING ENGINEERS & SCIENTISTS:

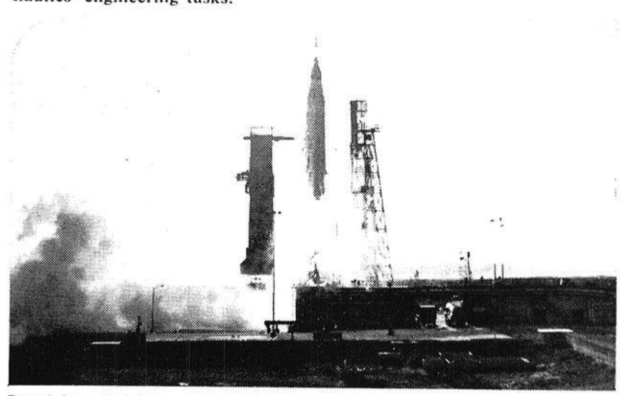
Some sound reasons why you should consider General Dynamics | Astronautics for a challenging and rewarding aerospace career are pictured below. We urge you to learn still more about Astronautics—the important completely space-oriented division of General Dynamics Corporation—by listening to the 33⅓ rpm recording offered below and by following news of Astronautics' activities and accomplishments in your newspaper, trade magazines and technical journals. For more information and a personal interview, visit the Astronautics representative who will be on your campus soon.

Advanced Programs An array of active projects and widely varied studies at Astronautics range from Atlas SLV-3, Centaur and Glotrac to Manned Space Stations, Lunar Base Support Systems and Orbiting Research Laboratory.

Modern Facilities More than $50 million have been invested in Astronautics' plant and equipment. Complete laboratory, test and computer facilities are established in-plant to enhance the performance of Astronautics' engineering tasks.

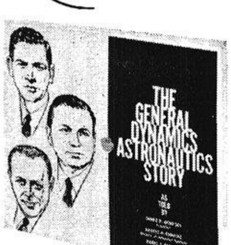


Ideal Location San Diego, California is the capital of moderate climate in the nation. Outdoor sports and recreation are year-round activities for enjoyment of your leisure hours. There is an abundance of academic and cultural opportunity in this city of more than 600,000 — a vigorous and growing community.



Inspiring Achievements The reliable Atlas, first ICBM in the free world, has also established a remarkable record as a launch vehicle — boosting more pounds of payload from the earth than any other vehicle in the free world to date. The impressive list of Atlas achievements includes a perfect performance in the Atlas-Mercury series—four for four!

WE WILL VISIT YOUR CAMPUS MARCH 2 AND 3



HEAR "THE GENERAL DYNAMICS | ASTRONAUTICS STORY" as told by the men who have had major responsibilities in the direction of such dramatic technological advancements as the Atlas-Mercury manned orbital flights and Centaur, the free world's first liquid hydrogen-fueled space vehicle. See your placement office for your personal copy of this 33⅓ rpm recording, or write to Mr. R. E. Sutherland, Chief of Professional Placement and Personnel, Dept. 130-90, General Dynamics | Astronautics, 5882 Kearny Villa Road, San Diego, California 92112.

GENERAL DYNAMICS | ASTRONAUTICS GD

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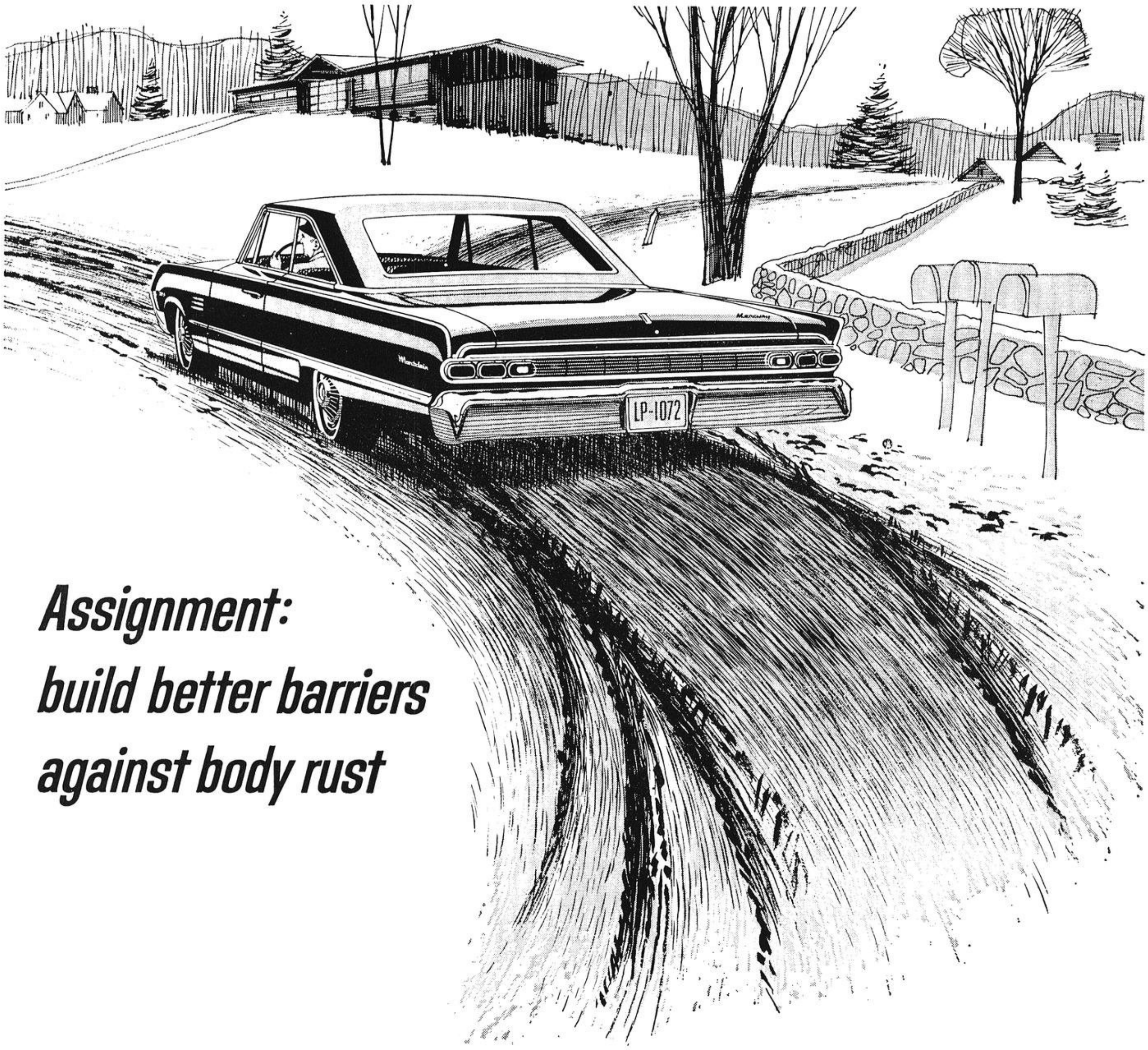


Assignment: build better barriers against body rust

Result: More rust-resistant steel than ever before on 1964 Ford-built bodies!

Ford Motor Company, pioneer in the use of galvanized (zinc-clad) steel, long noted for its ability to fight off rust, is using increased amounts of this superior material in 1964 car models. This marks further progress in our continuing efforts to solve the problems of metal corrosion in car bodies.

Other Ford-developed rust fighters include special zinc-rich primers . . . aluminum and stainless steels in mufflers, moldings and body fasteners . . . quality baked-enamel finishes—all powerful barriers against rust in Ford-built cars and trucks.

A new process, now in limited test production, is the electrocoating of entire car bodies. This involves electrical attraction between positively charged metal surfaces and negatively charged paint particles. When the body is dipped in an aqueous solution containing the paint particles, a form of "electroplating" occurs, the paint seeking those areas with the least coverage, until a complete and uniform coating is deposited.

More examples of engineering leadership at Ford Motor Company bringing better products to the American Road.

Ford

MOTOR COMPANY

The American Road, Dearborn, Michigan

WHERE ENGINEERING LEADERSHIP BRINGS YOU BETTER-BUILT CARS

Science Highlights

(Continued from page 46)

Now, however, the first mill specifically designed for production of lightweight tinplate has gone into production at the Weirton Steel Company, Weirton, West Virginia, a division of National Steel Corporation.

The new mill is a two-stand tandem cold reduction mill designed and built by Mesta Machine Company. It has 19-inch work rolls and 56-inch backup rolls, and it processes 60,000-pound coils 45 inches wide at 5000 feet a minute. The mill takes steel strip that has been initially cold-reduced by another mill and continuously annealed. It reduces this strip to thin-tinplate gauge from the original cold-rolled thickness.

The entire electric drive and control system for the new mill was supplied by Westinghouse. Each main stand has two 2000-horsepower motors in a twin drive arrangement; total motor rating on the mill is 11,000 horsepower. Variable-voltage control is used, with the main drive motors and generators directly exicted by Trinistor controlled-rectifier regulators.

Close control of product characteristics is provided by an automatic gauge control system, with all-static circuitry, actuated by signals from x-ray thickness gauges. The system has three modes of operation: control of screwdown setting on the first stand, control of tension between the stands, and control of tension between the feed reel and the first stand. These modes can be used independently or in combination, a feature that makes the mill unusually versatile. The operator selects the mode or combination of modes that best suits the material being rolled.

The mill also can be operated without automatic gauge control. In that mode, it is operated either completely manually or with automatic regulation for constant tension between the stands.

LARGER SOLAR CELLS PRODUCED

Solar cells more than 15 times larger than those now in use in orbiting satellites have been developed by the Westinghouse Semiconductor Division. The power from solar cells, which converts the light of the sun directly into electricity, is used to operate the electronic equipment inside an orbiting satellite.

Solar cells in use up until now generally measure one centimeter by two centimeters. The larger area cells were made possible through a Westinghouse development of strip from single crystal silicon made from silicon dendrites.

SUPERCONDUCTING MAGNET SYSTEMS

Superconducting magnets, and complete systems incorporating these new devices, are now being produced and marketed by Union Carbide Corporation's Linde Division. Products being offered include several new design and construction features that significantly increase the usefulness and value of superconducting magnets as research tools, while advancing their use in commercial applications.

Since the temperature of the working volume of the new magnets is not restricted to that of liquid helium (—453°F.), research studies in plasma physics, chemical reactions, and solid state phenomena can now be carried out with superconducting magnets in fields of 50 kilogauss. Magnets of this type are available with working diameters of 1⅜-in. with a working volume thermally isolated from the liquid helium. Magnets with working diameters of 2½-in. are available for liquid helium temperature use. Larger working volumes and higher rated fields are scheduled for the near future.

Modular construction, provides flexibility in field homogeneity, strength and configuration. This technique can provide magnets that have fields with variable intensities, adjustable profiles, and controlled homogeneities. Designs are optimized through the use of analog computers.

In addition, the magnets are designed so that they will not quench (return to the normal resistive mode of operation) under normal operating conditions. Protective circuitry prevents damage if the magnets are intentionally quenched by exceeding the rated field capability. Magnet performance, including protective systems, is fully tested before delivery.

The work being undertaken emphasizes complete systems, rather than a standard line of magnets, and encompasses the following areas of activity:

1. Hot-hole and cold-hole magnets; including solenoids, Helmholtz pairs and multicoil magnets.
2. Special superconducting devices and systems such as delay lines, voltage tuned resonant circuits and shields.
3. Accessory equipment such as cryogenic containers, filling and indicating systems, magnet power supplies and devices for measuring and indicating magnetic fields.
4. Superconducting materials and cryogenic fluids.
5. Design and engineering services for superconducting systems.

Cryogenic equipment is providing new compact dewars which allow easy access into the working volume of the magnet, while still maintaining the lowest possible helium boil-off rate. To accomplish this, Linde is using special low conductivity materials, Super Insulations, and new insulating techniques.

Fill in Your Own Lines

(Continued from page 48)

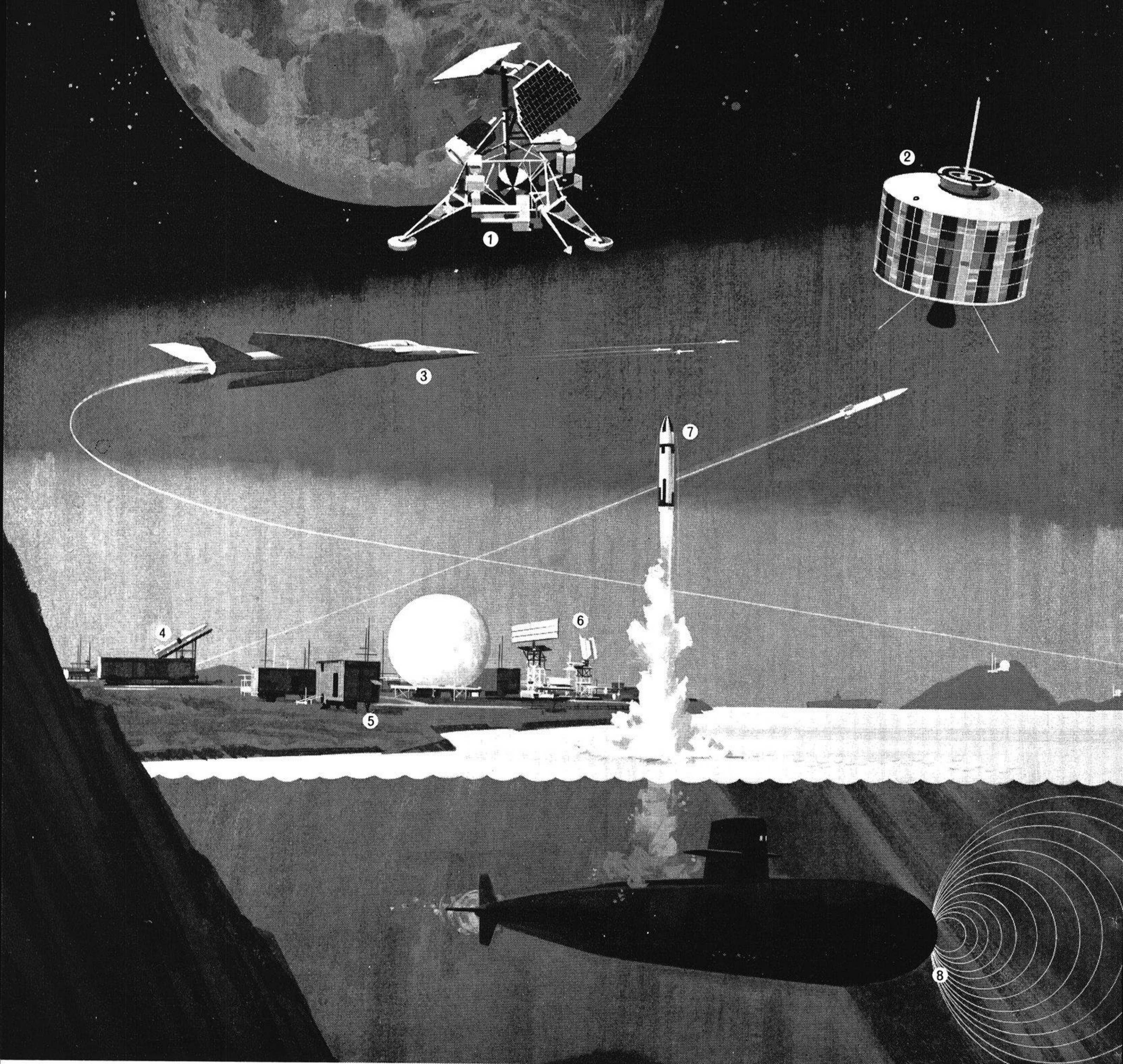
New cocktail for the tense executive: Take one jigger of Vodka, then fill up the glass with milk of magnesia. It's called a phillips screwdriver!

* * *

A pessimistic fellow read his horoscope, which said: "Make three new friends and see what happens." He went out and made three new friends, and nothing happened. Now he complains he's stuck with three new friends.

* * *

A quick-thinking student came up with a new one when the professor demanded, "How come you are sleeping in my class?" "Heavens," replied the sophomore, "can't a fellow close his eyes for a moment of prayer?"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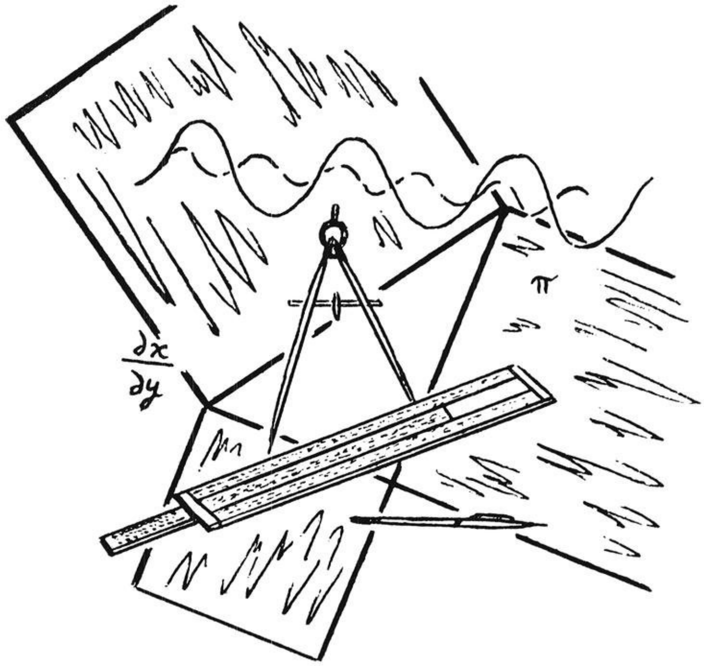
THE

MENTAL MAZE



By Clifton Fonstad, Jr., EE'65

IT SEEMS appropriate in this the annual high school issue, since many of our younger Mental Mazers are potential engineers, to dig into the engineering archives and bring forth a little known fact from the history of engineering. Before we enter the maze then, let's pause for a short lesson—about an early clock. It seems, so the tale goes, that Alexander the Great developed (for use by his soldiers) the first wristwatch. It was a chemically treated rag that changed color with the hours and that was worn as a band around the forearm. Thus, to tell time, all the soldiers needed to know was a simple color code. It was a great success and to this day it is still known as Alexander's rag timeband.

Now, let's get started on the first puzzle—the first turn in this month's Mental Maze.

1. It doesn't seem possible that a logie puzzle hasn't come up yet in the Mental Maze, but one hasn't. As a beginning then let's try a short puzzle.

A says, "B lies."

B says, "C lies."

C says, "A and B both lie."

Is there anyone who is telling the truth?

2. Now let's tackle a first semester relatively problem. Professor Karbunkle has a family of sons and daughters. Each daughter had an equal number of brothers and sisters, but each son had twice as many sisters as brothers. How many boys and girls are there in the family?

3. One of the prides of Tioga Tech is a beautifully landscaped mall of terraces and gardens. Resting on a marble pedestal in the middle of one of the terraces is a large glass bottle. In the bottle a plumb bob is suspended by a thread which is attached to a cork in the bottle's neck. Now, with a minimum of props, can you separate the plumb bob from the thread without disturbing the bottle?

4. As has been stated previously, the majority of problems in the "Mental Maze" can be worked with very little advanced preparation. That policy has not changed but for this puzzle you may need extra help. Page 3093 in the Handbook of Chemistry and Physics should have the necessary information. The problem is to tell us how much dirt is in a hole 2 feet deep, 3 feet wide, and $7\frac{1}{2}$ feet long.

5. Last summer a Karting Club was holding a meet on a small dual track. During one race a proud father remarked, "That's my boy Johnny in the blue helmet."

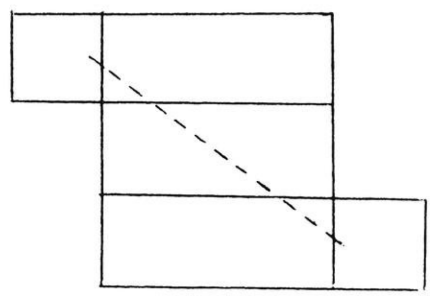
"I see," said a fan next to him, "and how many karts are in the race?"

"One-third of the karts in front of Johnny plus three-fourths of the ones behind will give you the answer."

Does it give you the answer?

ANSWERS: Last month's answers are:

1. 17
2. 0
3. Put 7 each in 3 pens and one pen around those 3 pens
5. 15 weeks behind
6. Just over 40 feet.



Keep those answers coming in. It's too late for you to be history's first Maze Master but this month there's another five dollars so hurry. The announcement of last month's winner will be in next month's Mental Maze. Don't forget, the address to send your entries to is Clifton Fonstad, Jr., ℅ Wisconsin Engineer, 333 Mechanical Engineering. Bldg., University of Wisconsin, Madison 10, Wis. One more thing, you don't necessarily need all the answers right to win so even if you have trouble send your results in.

Production Superintendent Carl W. Yost, B.S. Chemical Engineering, U. of Alabama, is now supervising Glycols and Polyols Production, Organics Division.

Assistant to Vice President Thomas E. Watson, B.A., Earlham College, is currently helping to run Brass Sales, Metals Division.

Senior Research Scientist Malcolm H. Von Saltza, Ph.D., U. of Wisconsin, is currently working at the Squibb Institute for Medical Research, Squibb Division.

They started with Olin 5 years ago.

These men, and a great many of their colleagues, have come a long way in 5 years. And they can expect to go a great deal further. Because at Olin, how well a man does depends entirely on his own character and abilities, not on age or politics or length of company service. (That's one of the reasons these men and others came to Olin in the first place.)

These men think a great deal; they wonder, they explore, they try. When they succeed, they're rewarded. When an idea doesn't pan out, they're encouraged to try and try again. Because here at Olin we believe that trial and failure are integral parts of every important success.

These are the kind of men we need, and we're more than willing to go a long way to get them. If you're our kind of man, the same goes for you. Can we talk about it? Say when.

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