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FEBRUARY, 1961 • 25 CENTS
MEMBER E. C. M. A.

THE WISCONSIN ENGINEER

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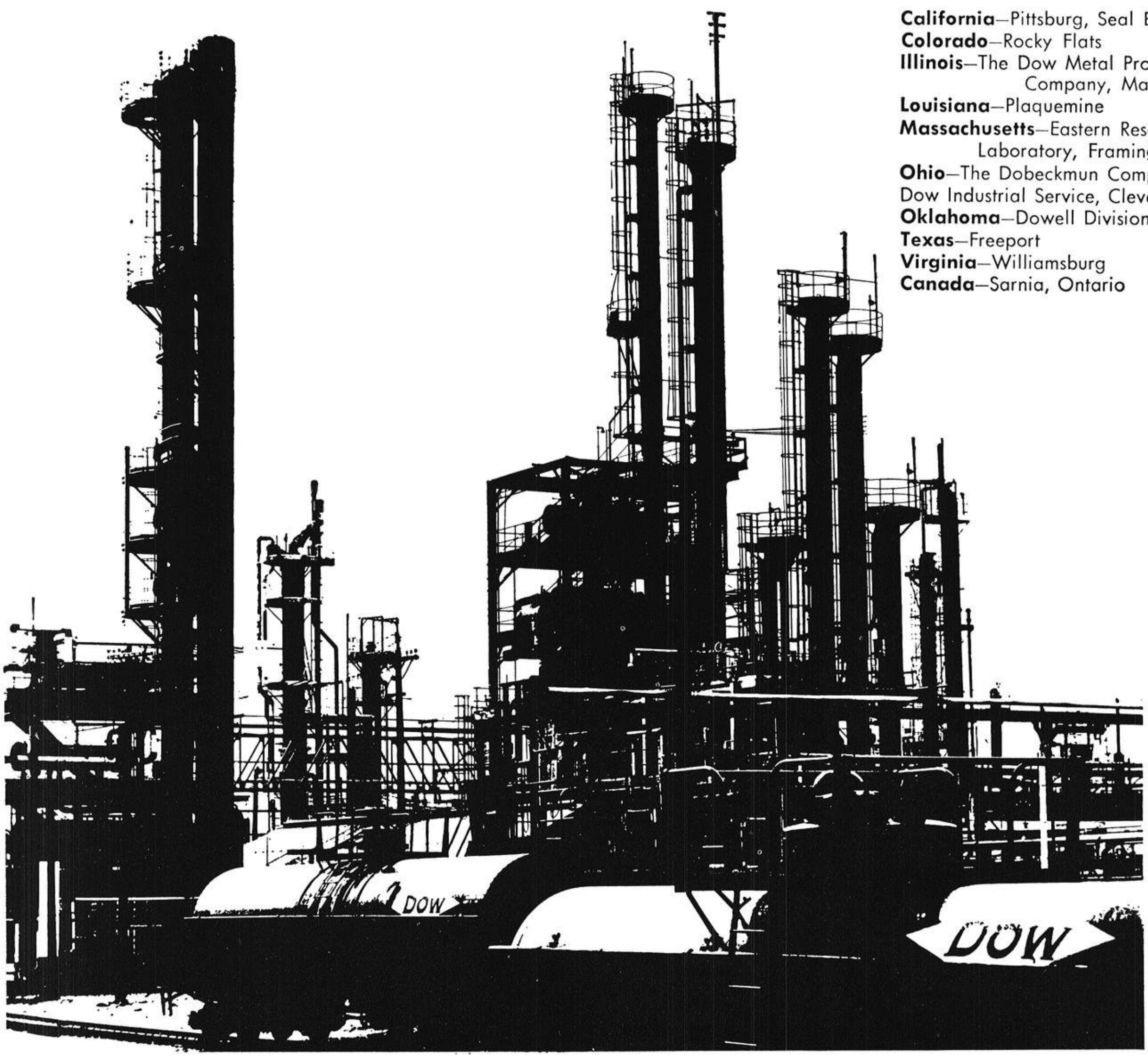

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Page 24

Page 42

HIGH SCHOOL SECTION

DEPARTMENTS

THIS MONTH'S COVER

This artist's concept depicts "Satellite Observatory," termed the initial mission of the Boeing Company's PARSECS program, or Program for Astronomical Research and Scientific Experiments Concerning Space. Courtesy Boeing Airplane Company.

FEBRUARY, 1961

THE WISCONSIN ENGINEER

The Student Engineer's Magazine Founded in 1896

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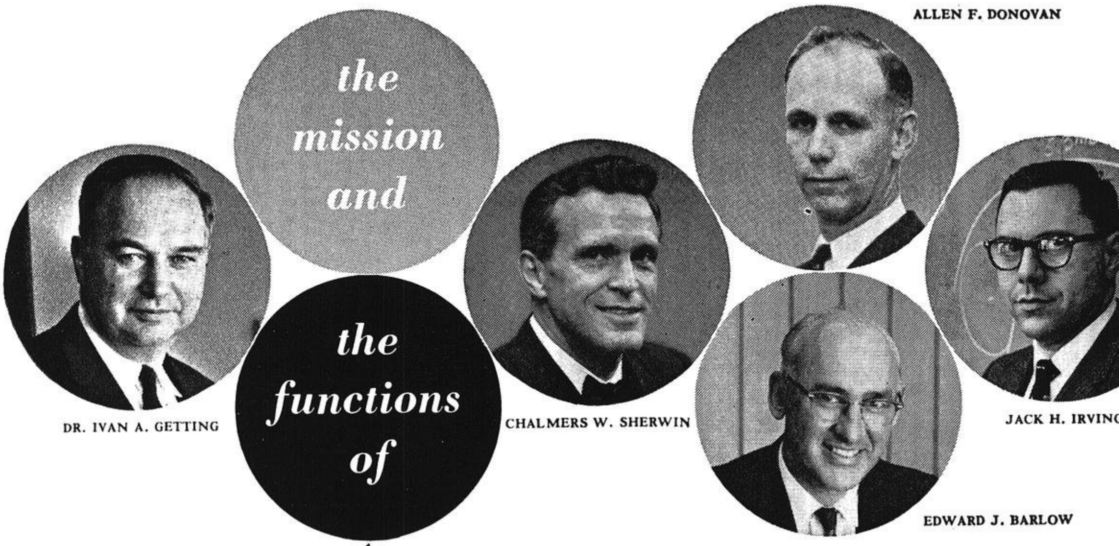

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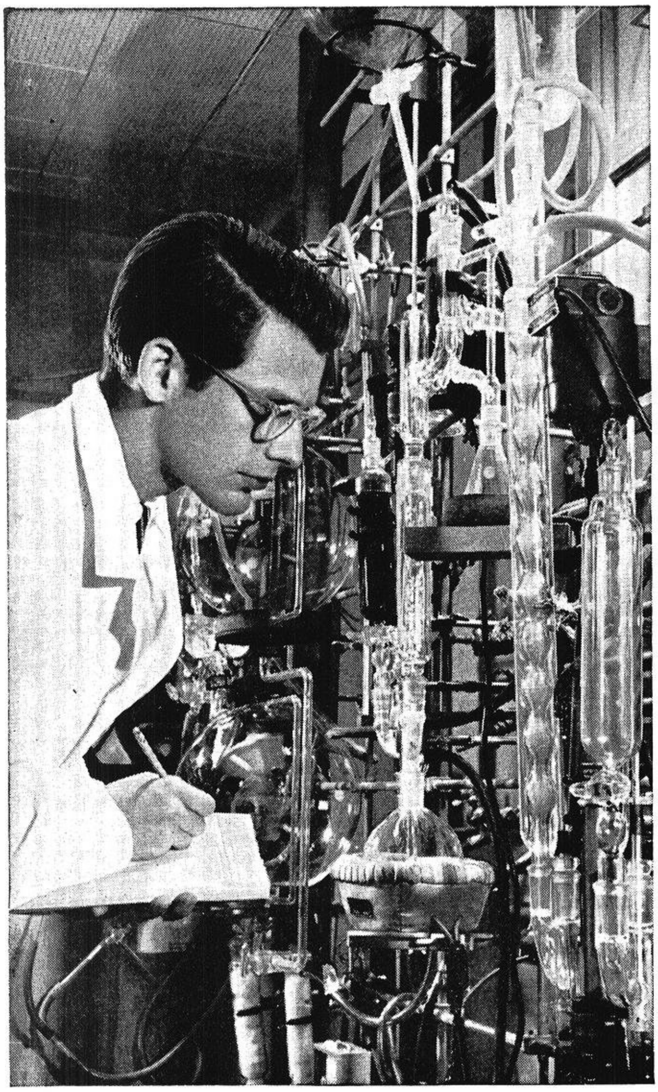

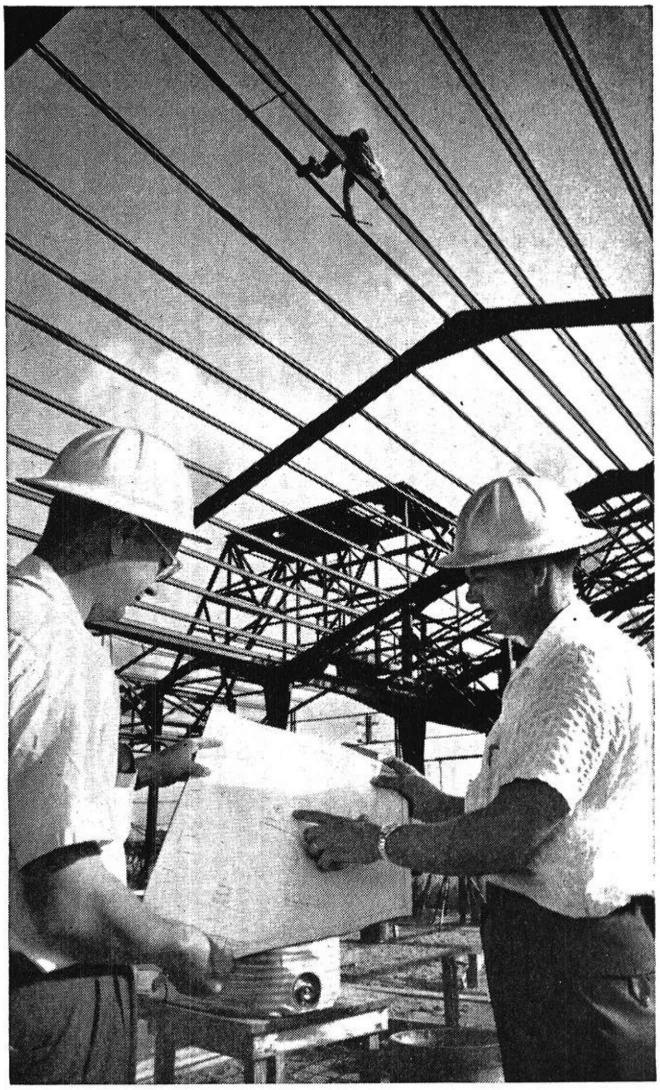

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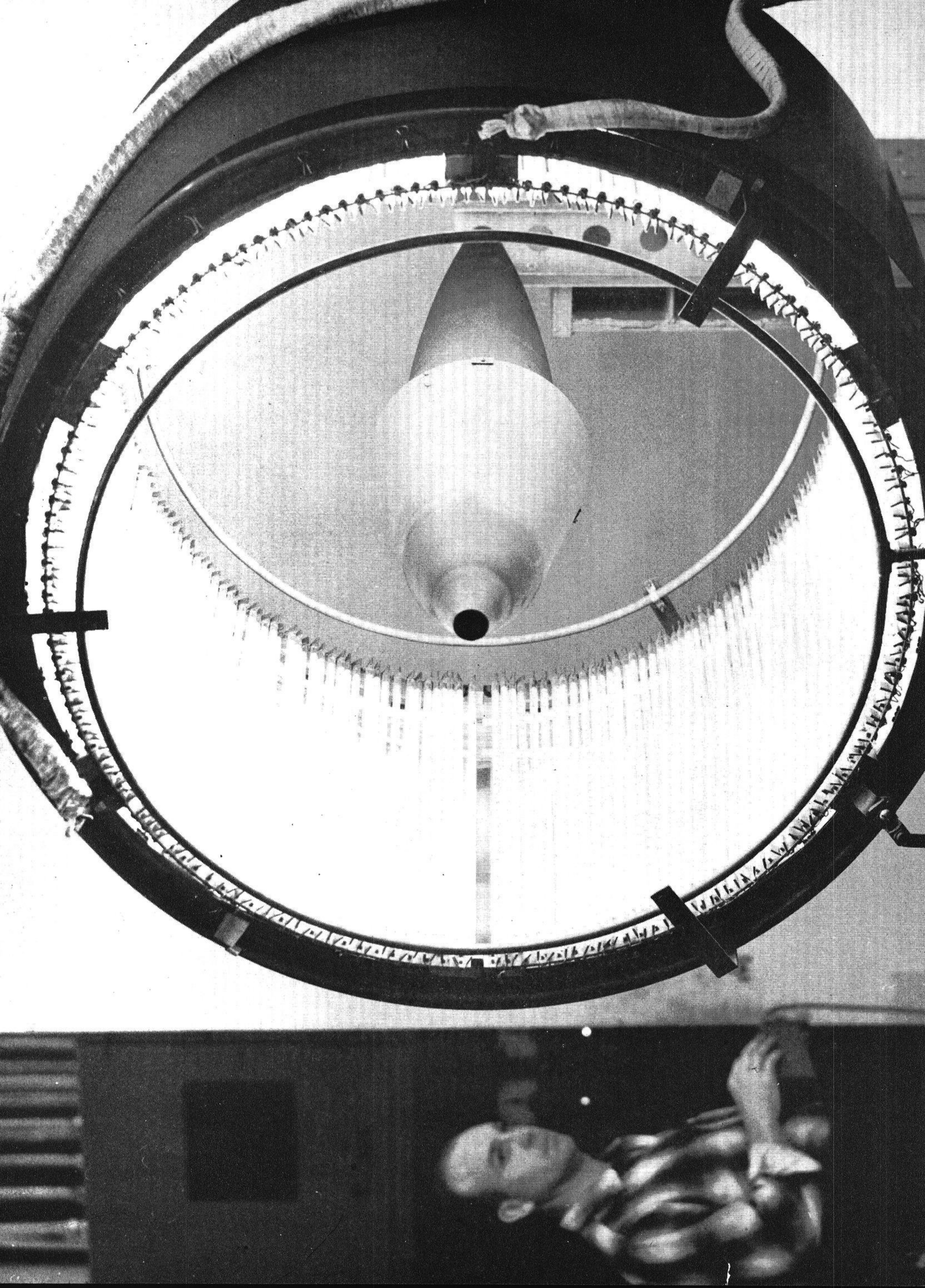


Rambling With The Editor

This edition of the *Wisconsin Engineer* is directed toward high school students, especially to those contemplating an engineering career.

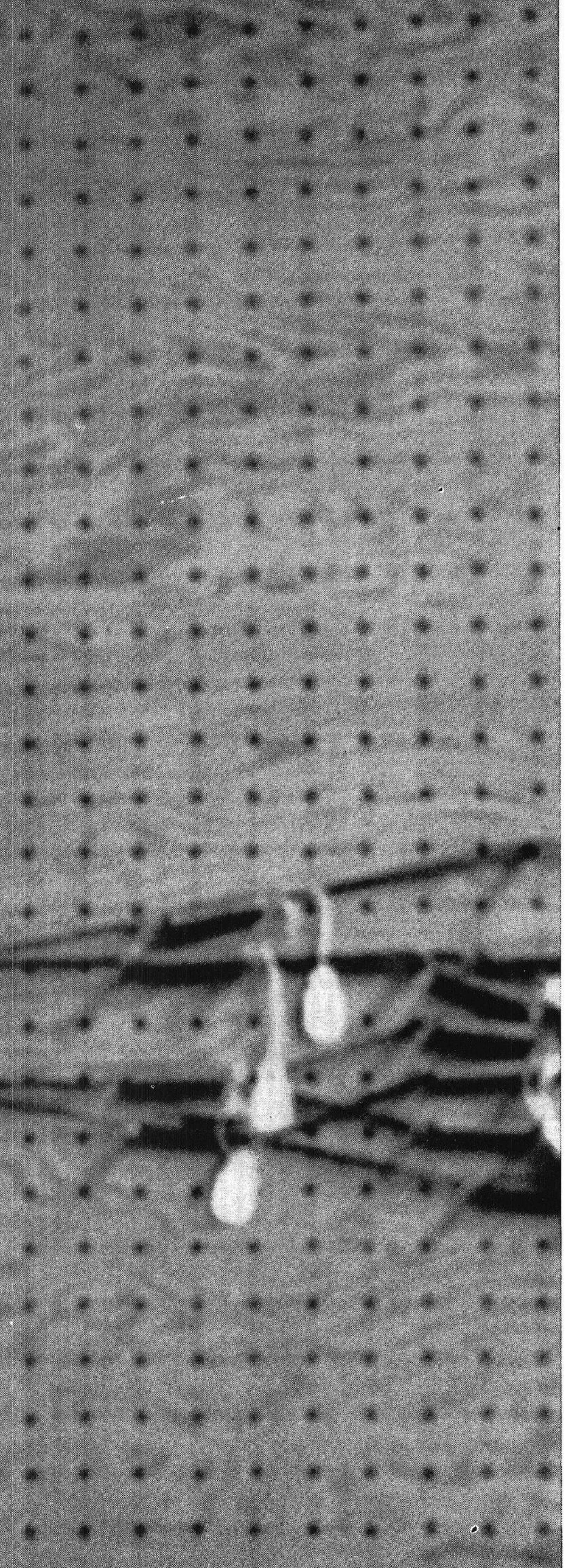
Why choose engineering? There are probably as many reasons as there are engineers. These may range from the somwhat romantic notion that you would like to have a hand in some of the engineering marvels of the day, to the more down to earth idea that it will help you to satisfy your appetite for math and science. It is impossible to say which reason is better and the question is probably an unimportant one since your ideas and goals will change many times with four years of college. The important thing is that you have decided to take a crack at engineering.

A good foundation is necessary for almost every project. An engineering education is no exception. It should begin in high school by taking as many math, science, English, and other academic courses as possible. Not only are these courses prerequisites for engineering, but they are a good background for any field you may enter if you decide that engineering is not for you.

Perhaps the most vital thing one can learn in high school is good study habits. It won't take you long to find out that college is a far cry from high school. Good study habits will get you off on the right track.

You probably have many questions about the various branches of engineering and of course the opportunities that they may lead to. We hope this issue answers these questions. Good luck in your engineering career.—J. C. S.

HOT UNDER THE COLLAR! "Thermal barrier" temperatures are simulated here in this nose cone test at the National Aeronautical and Space Administration's Langley Research Center in Virginia. Heat produced by 225 2500-watt tubular General Electric quartz infrared lamps in the cylindrical radiator reaches 3100° F., about a third as hot as the surface of the sun. Such tests facilitate the nation's efforts to overcome the re-entry problems faced in rocket, missile and space-vehicle programs.



The Electrical Engineering Building.

High School Section

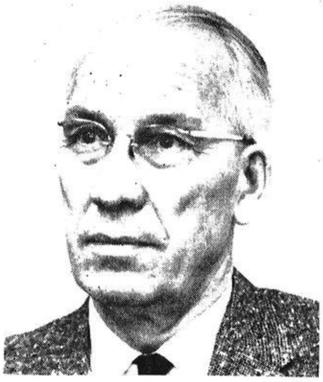
We of the Wisconsin Engineer staff would like to extend our greetings to all high school students, to whom this issue is dedicated. Our hope is that the following pages will inform the prospective college student about the different engineering fields in general, and about engineering at the University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

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

A Career Begins — The Freshman in the College of Engineering

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.

The following outline of registration procedures, and preview of a typical weekly class program for a freshman engineer, is given to help the prospective engineer understand what some of the situations he meets will be like when he registers for and enters the College of Engineering.

TO APPLY for admission to the University of Wisconsin, the student must fill out several forms, and submit a copy of his high school record. He then receives a permit to register. Advance registration is usually accomplished during the summer preceding Fall semester in which the student plans to come to the University. During this advance registration period, the student takes a variety of tests, including a test which measures facility with mathematics, and determines placement in the correct mathematics course. The student discusses with an adviser the field of engineering in which he wishes to enroll, and the course choices open to him. At the end of this period, most students will know exactly what courses they will be taking in the Fall. Occasionally, results of the tests will suggest modifications in course choice, such as taking a more advanced English class or a less advanced mathematics course or carrying a reduced load. Such modifications are made in an attempt to suit the engineering curriculum to individual differences.

On the next page is a sample of a typical work schedule for a freshman in mechanical engineering during his first semester. He is carrying 17 credits, a normal load in the College of Engineering. There are 168 hours in a week. Of these, the freshman spends approximately thirty hours in class. Approximately thirty-five hours should be allotted to out-of-class study. Fifty-six hours are allotted for sleep, twenty-one hours per week for meals, and dressing, and twenty-six hours are allotted for personal activities such as dates, sports, church, and relaxation.

Students who must work for support, who plan to participate in a major sport, or who learn more slowly than their fellows must recognize that the hours for these activities must come from the fixed total of 168 hours per week. If a student needs more time for any of these activities, the time can be gained only through a curtailment of personal activities, or through a reduction of the academic work load. Cutting down on sleep, or missing class, or reducing study time most often leads to disastrous results. Even before coming to College, the student needs to recognize the importance of budgeting time carefully, organizing daily activities, and getting to work immediately, to insure success.

To examine the specifics of the weekly program, we see that our typical freshman begins his day by studying Chemistry. He reads the material to be covered in his lecture and laboratory periods later in the day, and uses this time for review of earlier work. On Friday morning during this first period he attends Chemistry Quiz, a discussion class. On three mornings per week our freshman reports to English class, where he learns principles of composition and gains facility in the use of language. Two mornings per week he attends speech class, where he finds an opportunity to develop skills in public speaking. Following his language courses, our freshman spends two hours, three times a week in drawing class, where he learns to read and write the language used in all engineering work. These skills of communication are considered most important for our would-be engineer.

On Tuesday morning at 9:55, all freshman engineering students attend Freshman Lectures, an orientation program designed to introduce freshmen to key members of the college faculty, and to acquaint them with various aspects of the jobs done by engineers. Two hours per week are spent in physical education class. During the first five weeks of the semester, one hour per week is spent in an ROTC Orientation program, where students are given an opportunity to learn about different reserve training programs and are given the information with which to choose whether or not they wish to pursue a reserve officer training program.

After lunch, our student has some free time three days per week, which he might devote, for example, to the completion of his drawing assignments. Twice weekly he attends Chemistry lecture. As a supplement to these lectures, he spends four hours per week in the chemistry laboratory and one hour in discussion, as noted above. Five days per week he attends mathematics class, to learn the concepts of calculus and analytic geometry, with two hours per week spent in lecture, and three spent in a discussion session where he receives help in applying mathematical theory to the solution of problems. Suggested study time for mathematics outside of class time is ten hours per week, since mathematics is such an important subject in any engineering curriculum. Evening hours are devoted to study, with the hours distributed to insure that no course will be neglected, and utilizing psychological principles of learning. Week-ends offer the most free time, yet some week-end hours must be used for study and review if the minimum of thirty-five study hours is to be realized. College is in reality more time consuming than many "full-time jobs".

The Office of the Freshman Adviser is open at all times for freshman engineers to come for consultation about any special problems which might arise. Students may need and receive help with financial 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

(Continued on page 58)

Hour	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
7:00	Could Sleep Late	Get up, dress, eat, off to classes ---------------					Could Sleep Late
7:45		------------	Study	Chemistry	-----------	Chem 2a	
8:50	Free time	Eng. 1a	Speech 8	Eng. 1a	Speech 8	Eng. 1a	
9:55	Free time	Drawing 12	Freshman Lectures	Drawing 12	ROTC Orient.	Drawing 12	Study English
11:00	Free time		Phy. Ed.		Phy. Ed.		
	--------	--------	--Noon	Meal ------	----------	--------	---------
12:05		Study		Study		Study	
1:20	Free time	Drawing	Chem 2a Lab.	Drawing	Chem 2a Lab.	Drawing	Free time
2:25	Free time	Chem 2a		Chem 2aL		Study	Free time
3:30	Free time	------	--------	Mathematics	60 ----	---------	Free time
4:35	Free time	-------------	Study	Chemistry	--------------------		Free time
6:00	------------- Relax after evening meal ---------------------------						
7:00	--------------- Study Mathematics ---------------					D	
8:00	--------------Study Mathematics ---------------					A	Free
9:00	Study	Study	Study	Study	Study	T	
10:00	Speech	Speech	English	English	English	E	Time
11:00	Hit the Sack ! ---------------------------------						

A typical freshman schedule.

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.

WITHIN the past few years the favorable job market for engineering graduates has remained very stable. Even during the recession in 1958 the job situation for engineering grads was substantially better than for almost any other field. The most noticeable effect has been that the companies are more selective as job openings decreased. Scholastic achievement, extra-curricular activities, personality, character, and all of the factors that employers look for are more critically examined. On the other hand, numerous exhaustive studies by professional, governmental, and business groups all conclude that at least for the next several years, probably for the next decade, the demand for engineers along with other technical and scientific personnel will continue and very likely increase.

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 many cases are increasing. It is not unusual for the graduate engineer to receive a salary of $6,000 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 for many jobs normally considered to be non-engineering 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.

Engineering education, a most vital part of the entire engineering profession, provides excellent opportunities that are often overlooked. The demand for engineers will obviously provide more and more opportunities in the teaching of engineering. 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 Placement Office of the College of Engineering has expanded along with the increased enrollment of engineering students and the need for engineering graduates. The primary purpose of the Placement Office is to provide facilities and information for seniors when they begin looking for a job and give counsel and advice to those who want help.

(Continued on page 60)

The Engineering Profession

by Kurt F. Wendt
Dean, College of Engineering

Dean Wendt received his B.S. degree in Civil Engineering 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 design and production. Today engineers are making major contributions in the fields of nuclear power, rockets, missiles, satellites, and space technology.

During the last five years the discoveries and applications in engineering are increasing at an unprecedented rate and it is the considered opinion of scientists, engineers, and industrialists 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 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?

The profession is divided into five major fields: chemical, civil, electrical, mechanical, and mining and metallurgical engineering, each with many subdivisions. Wisconsin has curricula in all of these fields. A new curriculum in engineering mechanics was recently introduced 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 the areas mentioned. In addition, graduate training is also offered in nuclear engineering.

At the present time electrical and mechanical engineering are about equally popular and together account for about two-thirds of our total enrollment. The demands of industry are high, however, in all areas of engineering and it behooves you to investigate the entire field to determine your special interests before choosing a particular branch.

Manufacturing and processing of substances from raw materials through carefully controlled chemical and physical changes comprise the field of chemical engineering.

Civil engineering, the oldest branch, at one time included all engineering of a non-military character; today the main divisions are structural, sanitary, hydraulic, and transportation engineering.

(Continued on page 58)

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 M.S. from UW and a B.S. from Purdue. 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.

THE University Extension Division is the off-campus arm of The University of Wisconsin. University Extension is most generally thought of as a public service oriented activity of the University. This belief falls short of the truth, for University Extension is *teaching* and *research* as well as *public service*. Therefore, all three great missions of the University are fulfilled through University Extension.

One of the units of the Extension Division is the Department of Engineering. Included among its responsibilities are the programs of undergraduate instruction in engineering at the several University Centers in the state. Centers are located at Kenosha, Racine, Sheboygan, Manitowoc, Marinette, Green Bay, The Fox Cities, and Wausau. Totally new instructional facilities are available at the Wausau Center serving Marathon County and the Fox Cities Center serving Winnebago and Outagamie Counties. New facilities are under construction at Green Bay and Kenosha. 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 University Center System.

It is only fair to mention at this time that The University of Wisconsin-Milwaukee (UW-M) offers considerable 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 distributed throughout Wisconsin. These latter operations are not a part of the University Extension Center system, but a great deal of harmony and accord exists within the entire state-supported system of higher education in Wisconsin.

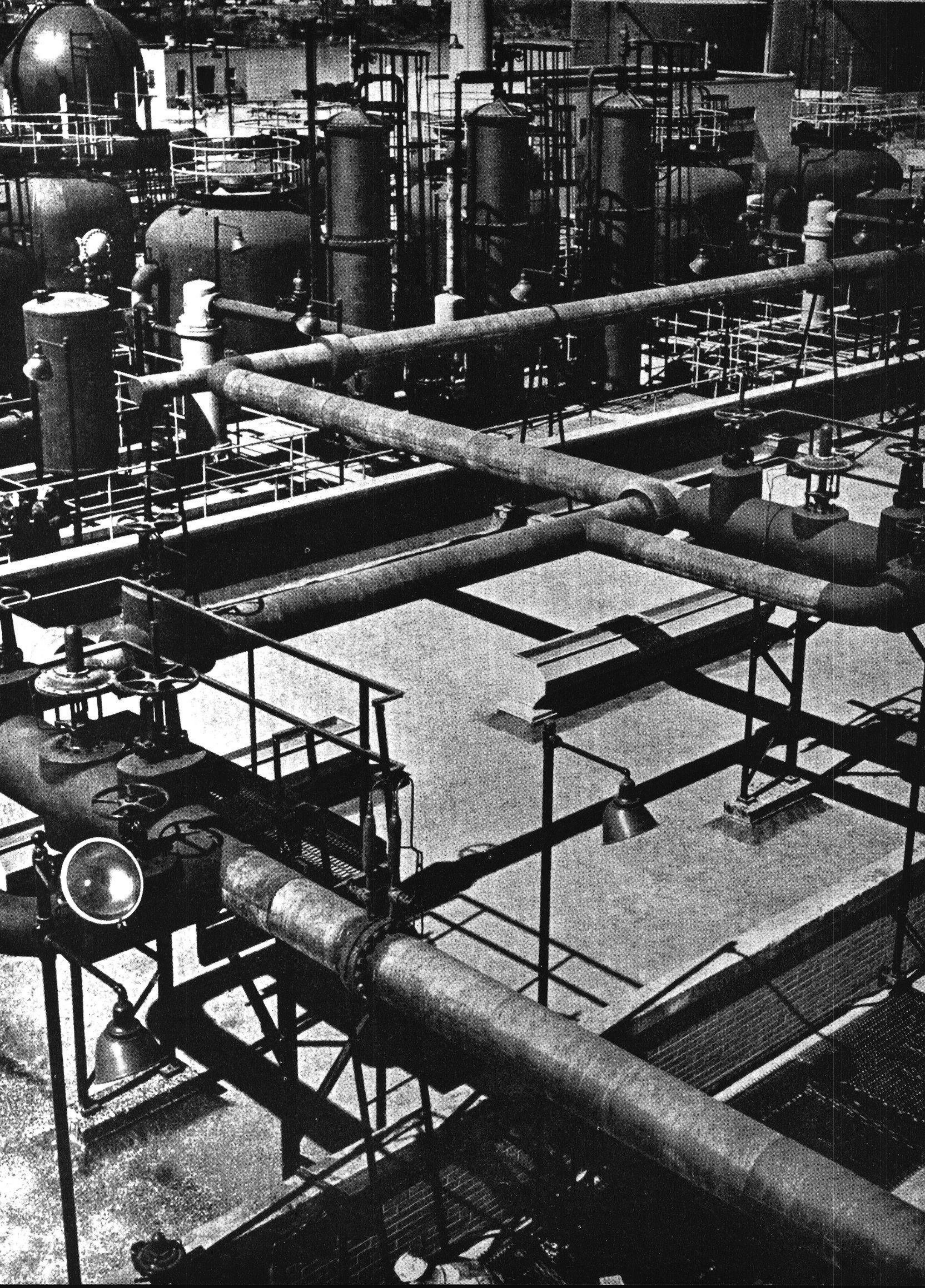
Transfer of Credit

Questions are often asked whether or not an individual is able to obtain "full credit" for work taken in an outlying institution, and whether or not an engineering program can be completed in a normal four years if one starts off campus.

Credits earned at the eight University Extension Centers may be "transferred" to the University at full grade-point value. The quotes on the word "transferred" are purposeful. Actually, University Center 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 student records in Bascom Hall, the main administration building of the University. Transfers from UW-M also are at full grade-point value, although the record card in this instance actually transfers 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

(Continued on page 60)



Chemical Engineering

by Professor R. A. Ragatz
Chairman, Chemical Engineering Department

Professor Ragatz is a true native of Wisconsin, born in Prairie du Sac, receiving his B. S., M. S., and Ph. D. degree at the University, the latter in 1931. He has done some specialty work in plastics, and is joint author of two widely-used texts in chemical engineering.

THE chemical engineer's 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 works 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 design the equipment needed 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 sales 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 manufacture, process measurements and control, applied electrochemistry, plastics, and technical analysis. Facilities for graduate 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.

THE END

◀ View of top of butadiene unit.

The Work of the Civil Engineer

by Professor Arno T. Lenz
Chairman, Department of Civil Engineering

Professor Arno T. Lenz is in his second 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. In addition to his teaching and research, he has spent several summers on engineering work for the Tennessee Valley Authority, the U. S. Bureau of Reclamation and Wisconsin industries, and as a consultant in law suits concerned with water problems.

CIVIL Engineers have built the world in which we live and you men who are entering the profession will build the great new world of the future. Perhaps it would be better to say space of the future because it will be civil engineers who design and construct the space platforms from which we will operate just as those men who have specialized in structures are now designing and building the air frames of the jet planes which streak across the sky and the missile frames and launching devices already in use. The stresses which develop in these frames and their skin plates must be carefully calculated, taking into account the affect of temperature, corrosion and pressure. Such problems will tax the ingenuity of those most mathematically inclined. Design problems in fluid mechanics and hydraulics also require solution in order that maximum pay load may be moved with minimum use of fuel. The fuel system requires burners, turbines, pumps, pipes and valves which are all designed using basic principles of fluid mechanics. To travel in space, man will need water supply and waste disposal problems solved. Sanitary Engineers are already working on these problems. Our space man must also be a navigator using the same knowledge of surveying and measurement as the missile launcher who lines up the frame on the pad.

However, for every civil engineer employed in this new field of glamour, there will be thousands doing equally interesting work planning, designing, and building the civil as well as military works we need for life on this planet. The problems connected with our water resources are but examples of work to be done. While our population is growning and the use of water per person is growing even faster, the fresh clean water supplied by nature remains constant and that is being polluted by man at an ever increasing rate. The civil engineer measures and studies the variations in rainfall and streamflow in order to determine how best to store the flood water for use in time of drought. This water is held in reservoirs which must be surveyed and constructed using dams built by the engineer. He now studies also the conversion of salt water into fresh water to supplement the more usual sources.

The civil engineer plans and builds the cities in which we live. He connects them with interstate highways and cuts into them with expressways so that traffic can move quickly and safely from point to point. He builds bridges to cross rivers, railroads and highways and the buildings in which we live, work and play.

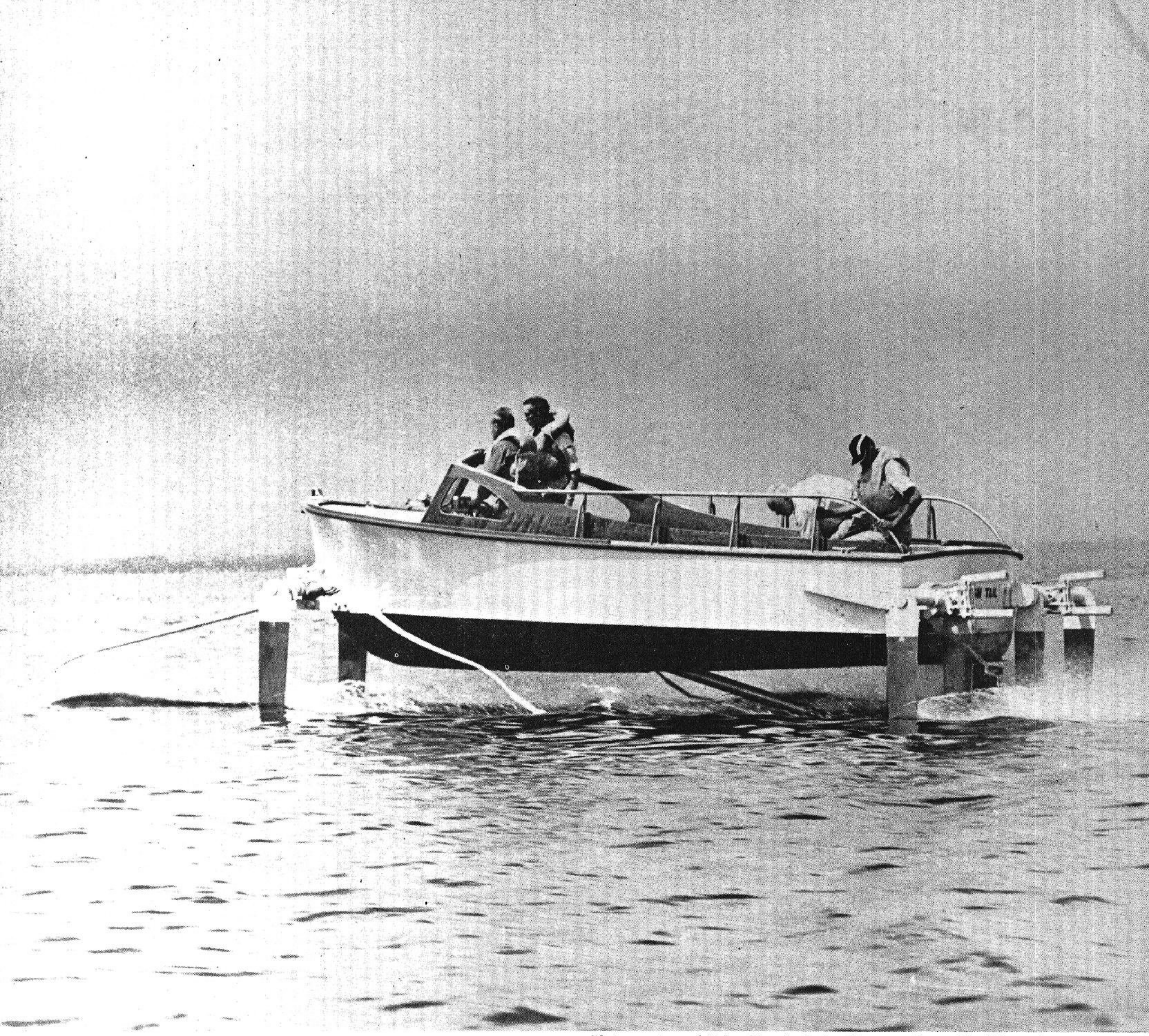
To do these interesting things, he must first collect basic data by measuring land distances, directions and elevations in the field or from aerial photographs. He measures water levels in rivers and wells. He measures flows in rivers and the quantity of water pumped from wells and its effect on adjacent wells. He measures the chemical and bacteriological character of waters and wastes.

From consideration of the loads to be placed on structures and the wind, snow and water pressures involved, the engineer computes the stresses which come on steel, concrete, or wood floors, beams, roofs and walls so that sizes can be selected as necessary to carry the loads and prevent excessive deflection.

The sizes of pipes and pumps and the location of valves and connections must be determined for the municipal water supply in the street as well as the piping in a building. Likewise, pipes must be selected for size, location and grade for storm drainage and sanitary waste removal. Treatment plants using biological or chemical methods to remove offensive materials must be carefully designed.

(Continued on page 56)

Left: View north across Mackinac Bridge from the traffic lane.



—Photo 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.

THE newest undergraduate engineering curriculum at the University of Wisconsin has been started to meet the current need for training in the more fundamental aspects of engineering. It is matched by similar curricula in many of the leading engineering 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—matematics, physics and chemistry—and the various engineering curricula. The mechanics courses 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 new 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, plates, shells, and elastic stability.

Why Was This New 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

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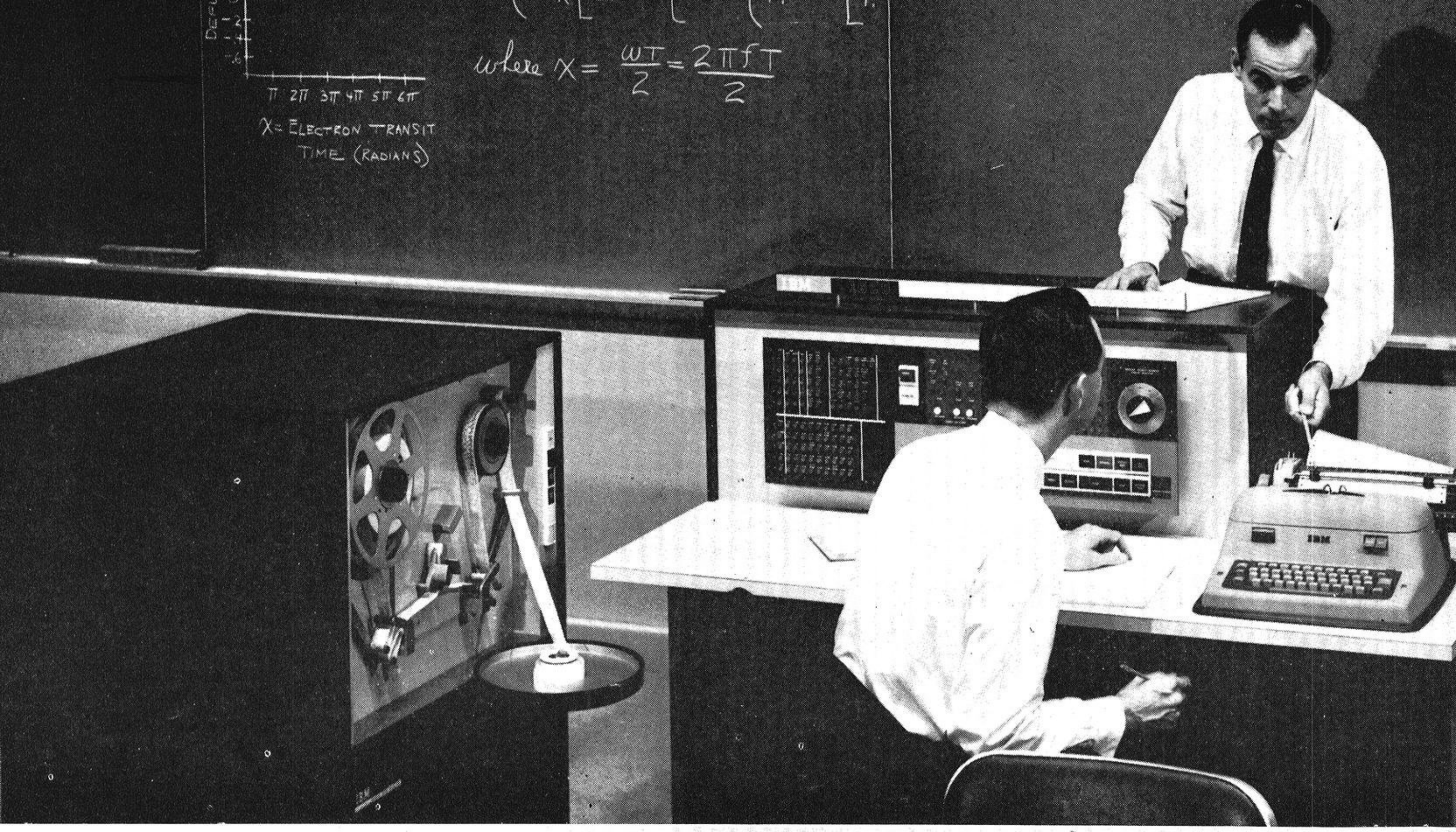
where X = ωT/2 = 2πfT/2
π 2π 3π 4π 5π 6π
X= ELECTRON TRANSIT
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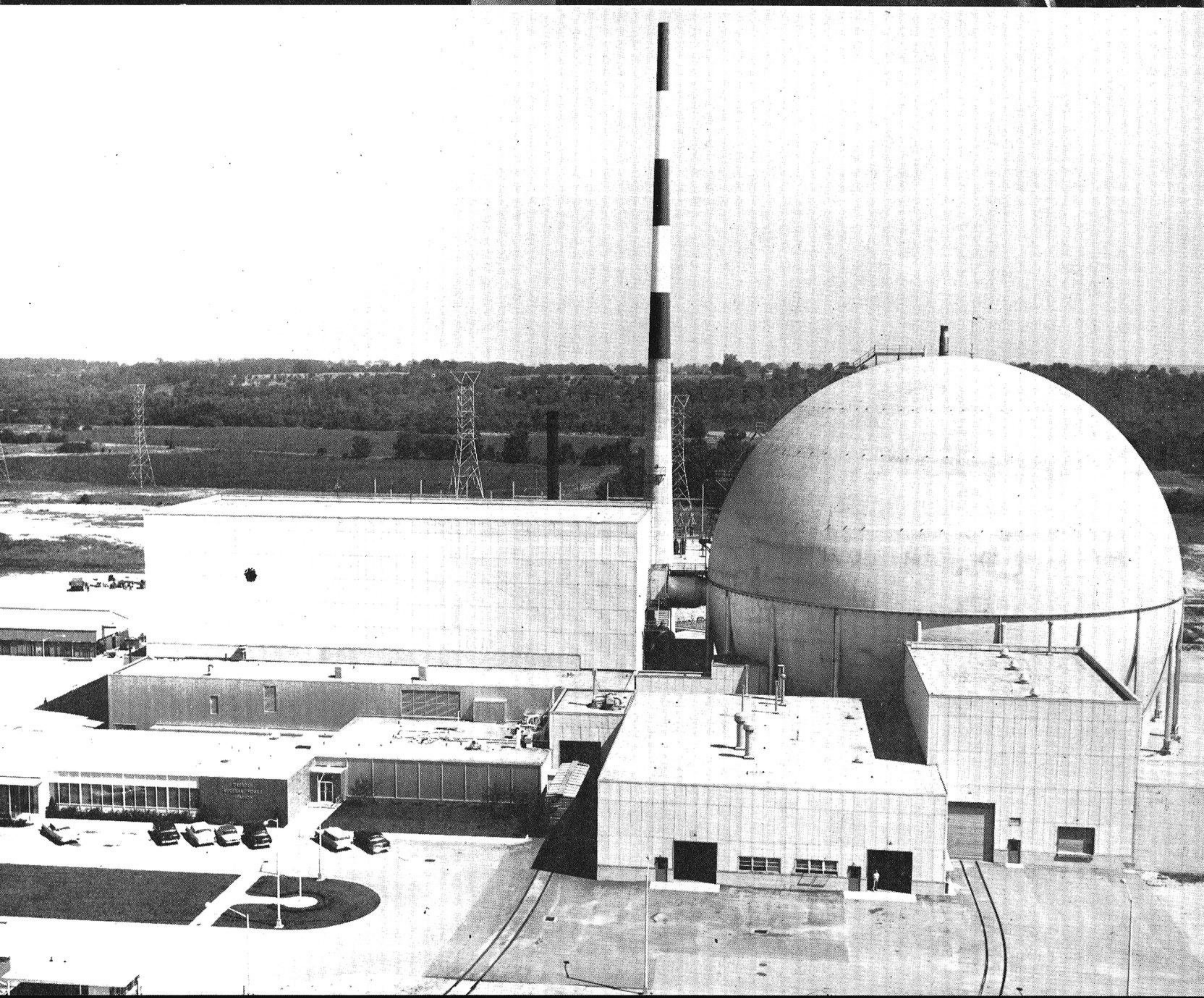


Electrical Engineering

by Professor H. A. Peterson
Chairman, Electrical Engineering Department

Prof. Harold A. Peterson has been Chairman of the Department of Electrical Engineering since 1947. He is from Essex, Iowa, and received his B.S. and M.S. (with high distinction) from the University of Iowa. He is a Fellow in AIEE, a Senior Member of IRE, and a member of several other engineering societies. He also holds eight patents in the field of electrical engineering.

ELECTRICAL Engineering is a young profession. With the characteristic vigor of youth, it is growing and expanding rapidly to meet the challenges of the profession in an era which is characterized by the growing importance of space technology.

Only seventy nine years ago, the first waterwheel driven electric generator in this country was put in operation at Appleton, Wisconsin. Since that time, growth and development of the profession have been phenomenal. Today the American Institute of Electrical Engineers (AIEE) has over 54,000 members, not including student members. In addition, there are approximately 80,000 members of the Institute of Radio Engineers (IRE). The IRE membership is growing rapidly at a rate of about 12 per cent per year. It is one of the fastest growing professional technical societies at the present.

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.

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, nuclear fusion and fission, and many other developments have been basically important in this expansion. The control of guided missiles, and the 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.

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. This new curriculum applies to all those students entering as freshmen in September 1959, and thereafter.

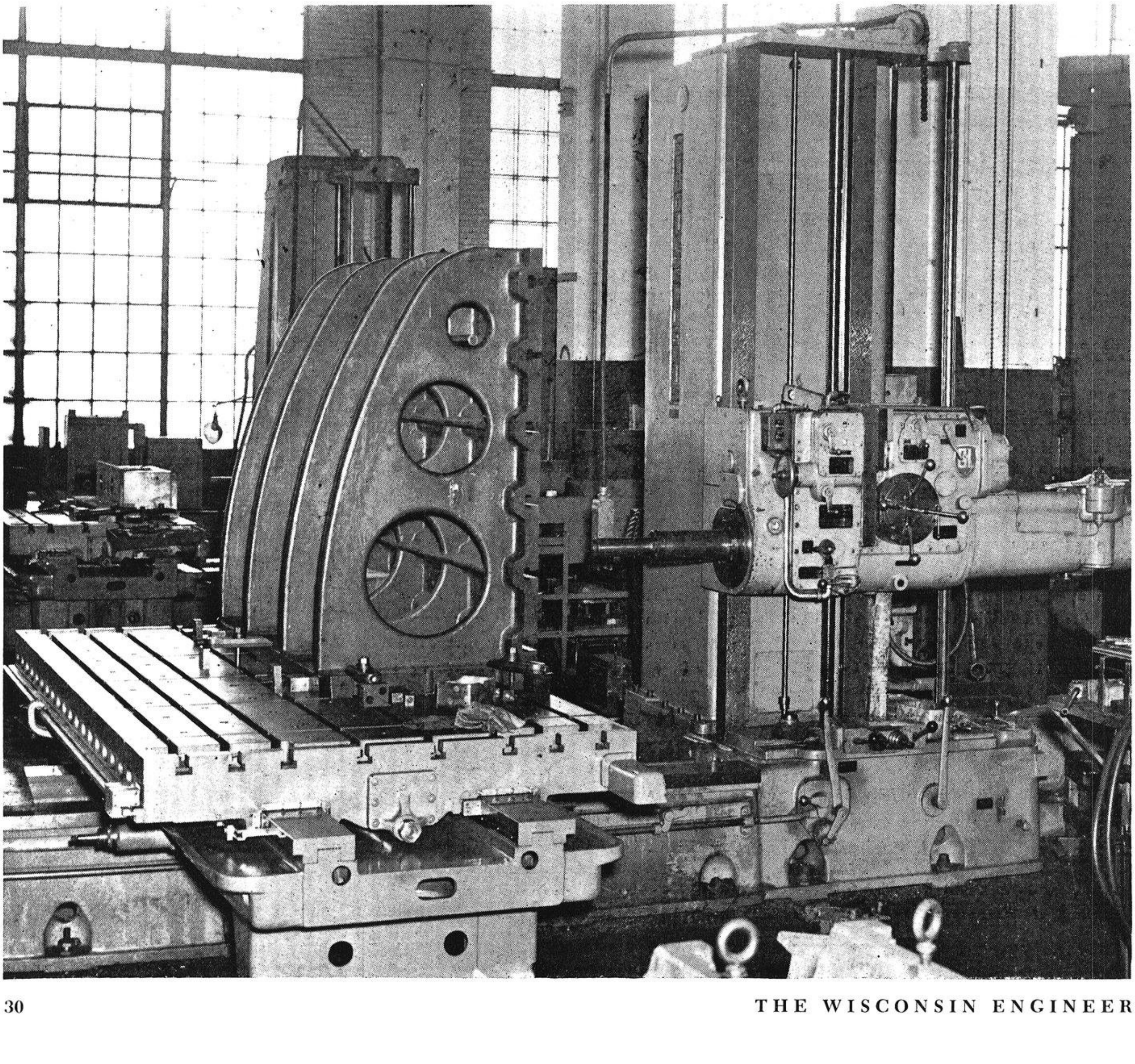
There is a joint student branch of the AIEE–IRE on the campus with a faculty member in charge as branch counselor. This student branch elects its own officers, holds regular meetings, and sponsors activities of interest to student engineers. It affords a means for orienting students with regard to professional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

Top: An IBM 1620 Data Processing System. A new model has been recently installed at Wisconsin School of Engineering.
Bottom: The Dresden Nuclear Power Station.

Above: Four-engine jet transport in flight.

Below: Large horizontal boring mill.



Mechanical Engineering

by Professor Ralph J. Harker
Chairman, Mechanical Engineering Department

Professor Ralph J. Harker is completing his second year as Chairman of the Department of Mechanical Engineering. He is a native of Madison, Wisconsin, and received his B.S. and M.S. from the University of Wisconsin. His field is machine design, with particular interest in vibration and balancing. He has had considerable experience in the aircraft industry, and is vice-chairman of the Rock River Valley Section of the American Society of Mechanical Engineers.

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 development 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-highway 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 tremendous 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 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.

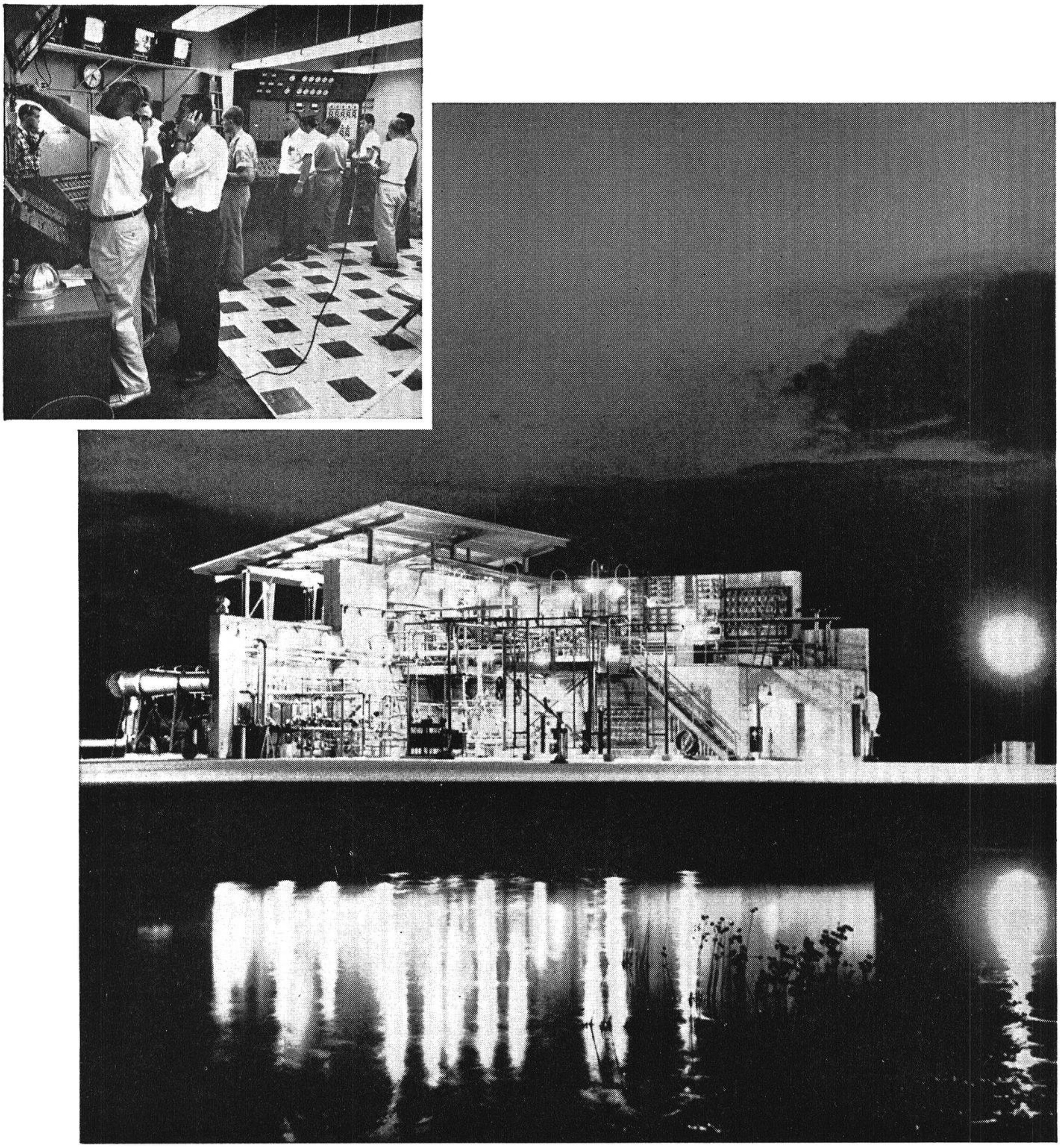
In the heat power field, engineers are interested in the analysis of liquids, gases, and vapors, as they are used in all types of engineering applications. Thus, the internal combustion engine, the steam turbine, the refrigerator, and the rocket engine are but a few examples of equipment requiring this 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 other related subjects.

In the design field, mechanical engineers are called upon to conceive new devices and machines, and to refine and improve existing designs. Perhaps no phase of mechanical engineering places greater demands upon the imagination, ingenuity, and judgment 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, ele-

(Continued on page 56)

What would *YOU* do

as an engineer a



Development testing of liquid hydrogen-fueled rockets is carried out in specially built test stands like this at Pratt & Whitney Aircraft's Florida Research and Development Center. Every phase of an experimental engine test may be controlled by engineers from a remote blockhouse (inset), with closed-circuit television providing a means for visual observation.

ratt & Whitney Aircraft?

Regardless of your specialty, you would work in a favorable engineering atmosphere.

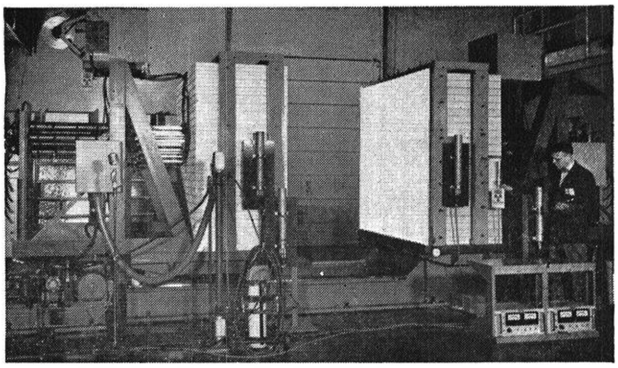
Back in 1925, when Pratt & Whitney Aircraft was designing and developing the first of its family of history-making powerplants, an attitude was born—a recognition that *engineering excellence* was the key to success.

That attitude, that recognition of the prime importance of technical superiority is still predominant at P&WA today.

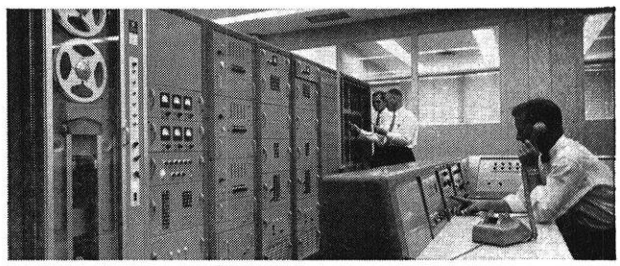
The field, of course, is broader now, the challenge greater. No longer are the company's requirements confined to graduates with degrees in mechanical and aeronautical engineering. Pratt & Whitney Aircraft today is concerned with the development of all forms of flight propulsion systems for the aerospace medium—air breathing, rocket, nuclear and other advanced types. Some are entirely new in concept. To carry out analytical, design, experimental or materials engineering assignments, men with degrees in mechanical, aeronautical, electrical, chemical and nuclear engineering are needed, along with those holding degrees in physics, chemistry and metallurgy.

Specifically, what would *you* do?—*your own engineering talent* provides the best answer. And Pratt & Whitney Aircraft provides the atmosphere in which that talent can flourish.

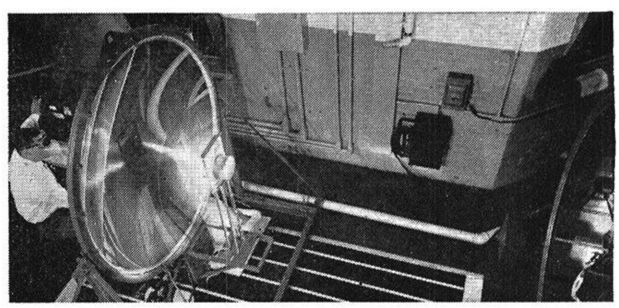
For further information regarding an engineering career at Pratt & Whitney Aircraft, consult your college placement officer or write to Mr. R. P. Azinger, Engineering Department, Pratt & Whitney Aircraft, East Hartford 8, Connecticut.



At P&WA's Connecticut Aircraft Nuclear Engine Laboratory (CANEL) many technical talents are focused on the development of nuclear propulsion systems for future air and space vehicles. With this live mock-up of a reactor, nuclear scientists and engineers can determine critical mass, material reactivity coefficients, control effectiveness and other reactor parameters.



Representative of electronic aids functioning for P&WA engineers is this on-site data recording center which can provide automatically recorded and computed data simultaneously with the testing of an engine. This equipment is capable of recording 1,200 different values per second.



Studies of solar energy collection and liquid and vapor power cycles typify P&WA's research in advanced space auxiliary power systems. Analytical and Experimental Engineers work together in such programs to establish and test basic concepts.

PRATT & WHITNEY AIRCRAFT

Division of United Aircraft Corporation

CONNECTICUT OPERATIONS — East Hartford

FLORIDA RESEARCH AND DEVELOPMENT CENTER — Palm Beach County, Florida

Mining and Metallurgical Engineering

by Professor P. C. Rosenthal
Chairman, Department of Mining and Metallurgy

This is Professor Rosenthal's fifth year as department head. He received his B.S. and M.S. in Metallurgical Engineering from the University of Wisconsin. He has been very active in the AFS and ASM, being chairman of several committees. He was co-author of "Principles of Metal Casting."

IF YOU were to examine a list of the elements and their properties you would find that the majority of them would be classified as metals. Further investigation into the use of these metals would reveal that almost everyone of them has some commercial application in the pure or alloyed form. A more intensive study, such as would be gained in a mining or metallurgical engineering program of courses, would establish that even many of the non-metals such as oxygen, carbon, and phosphorus, play an important part in metal processing and alloying. Thus the mining or metallurgical engineer deals with a wide variety of elements and combinations thereof, and must understand the chemical and physical problems associated with their preparation and use.

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.

Left: Tapping molten aluminum from an electrolytic smelter.

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 beneficiation, mineral dressing or mineral concentration. This field represents the link between mining on the one hand and metallurgy on the other. The *mineral dressing engineer* designs and operates plants for the separation of the valuable minerals from the waste products. This field is becoming increasingly 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 dressing 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 dressing 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 re-

(Continued on page 56)

Women in Engineering

by Barbara Friede ChE'63

Since Barbara is the only sophomore girl in chemical engineering, she wrote this article from an expert's viewpoint. Barb is from Reedsburg, Wisconsin and lives in Chadbourne Hall in Madison. Along with keeping up with her engineering studies, she is circulation manager of the Wisconsin Engineer. *Barb practices what she preaches, especially with regard to maintaining a good sense of humor. Last year she was named honorary co-winner of the bushiest beard contest (artificial division) last St. Patrick's day.*

DURING the first years of high school it is the responsibility of the girls as well as the boys to seriously consider which professions they would like to enter. Today there are more opportunities for women in industry, business, and research than there were a few years ago. Practically every profession known to man has been entered by women. Engineering of all types—chemical, mechanical, civil, electrical, and metallurgical—have suited the interests of some women and they have succeeded in making it their profession.

Not every man or woman can be an engineer. There are four general qualifications which must be considered by every prospective engineer before deciding upon his career.

(1) An aptitude for and preparation in mathematics.
(2) An ability to visualize and work out problems.
(3) A knowledge of mechanical movements and physical principles.
(4) A preference for scientific or mechanical work.

Of course this deciding cannot be done in the last half of one's senior year—but much earlier in high school so the right steps may be taken. If you do decide on Engineering or think you might possibly go into it, certain high school requirements must be met before colleges will accept you. Four years of math and all the sciences you can take are recommended as high school work.

Today there are not many women in Engineering but it is not a brand-new profession for women. Way back in 1886 the first woman engineer opened her office. One woman engineer was Lillian Moller Gilbreth who became famous along with her engineer husband in scientific management. However, since Engineering is considered a man's world, many women do not want to enter the profession even though they are interested in it. But this should not hold them back because we have freedom of opportunity in the United States and that freedom includes job choice. The job openings for women engineers are not as great as for men engineers. In one employment manual there were 300 different companies who would accept men chemical engineers and only 30 who would accept women chemical engineers. But one must take into account that there is about one woman engineer graduating per 1000 men. The types of Engineering jobs for men and women are the same although chief engineer jobs preferably go to men with more lab work reserved for women.

Perhaps you are now wondering what jobs are open to women once they have graduated. The airplane factories around Los Angeles have hired a great many to the extent that Southern California has one of the greatest concentrations of engineers in the country. Bell Telephone, a "highly engineered" industry, is continually looking for women engineers. Firms which manufacture radio, television, and other equipment also employ numbers of women engineers. Quite a few are working for the government. Civil Service does not discriminate against women. Some of the women engineers are teaching in engineering schools. Others have found work in the various branches of the petroleum industry. These are just a few of the many fields in which women engineers are actively engaged today.

It is now being predicted that in the next few years more and more girls will decide to study engineering, for people are finally realizing that women can help satisfy industry's demand for capable engineers. You girls now in high school can be the vanguard of this movement of women into engineering.

One other extra hint from one woman engineer to another; being the only girl with so many boys makes competition with grades a little tougher and the kidding may get a little rough at times. So come prepared with your sense of humor, your eagerness to learn, and your sliderule. **THE END**

Be Active

Develop your natural abilities of working with other people.

by Myron A. Noth
Polygon Board President

Polygon Board is comprised of representatives from the respective branches of the professional engineering societies on campus. It acts as the central organizing group for the common interests of the engineering student body.

MANY high school seniors are choosing engineering as their course of study for the next four years in college. If you are one such student, the natural questions that arise in your mind are: "What will be expected of me?" and, "What can I expect to accomplish in these coming years?"

The purpose of your next four years is to train your mind to cope with problems which will be encountered in the years after college graduation in your expected profession.

How can a college education accomplish this? By taking courses, learning theory and passing exams? It will require more than these accomplishments. You will find that the problems which will be encountered in the classroom are problems which have already been solved in industry. The problems you will encounter after college will be new, unsolved problems. Remember that a college education should train your mind to cope with *future* problems.

There are additional elements, then, to be added to your college education along with your classroom work. One is to learn how to work with other men of your profession in a productive atmosphere. Another is to develop your ability to organize your efforts and the efforts of people around you for the solution of problems or projects.

Unfortunately it is difficult to effectively develop these traits in the classroom. A more direct method of developing these traits is to participate actively in extracurricular activities.

On campus there are student branches of nearly all of the professional engineering societies for all types of engineering, i.e. the American Institute of Electrical Engineers, the American Society of Mechanical Engineers, and others.

Not only do these societies and institutes offer professional association with men in the profession and your fellow students, but they also give the student experience in speaking before audiences, expressing ideas and working with groups.

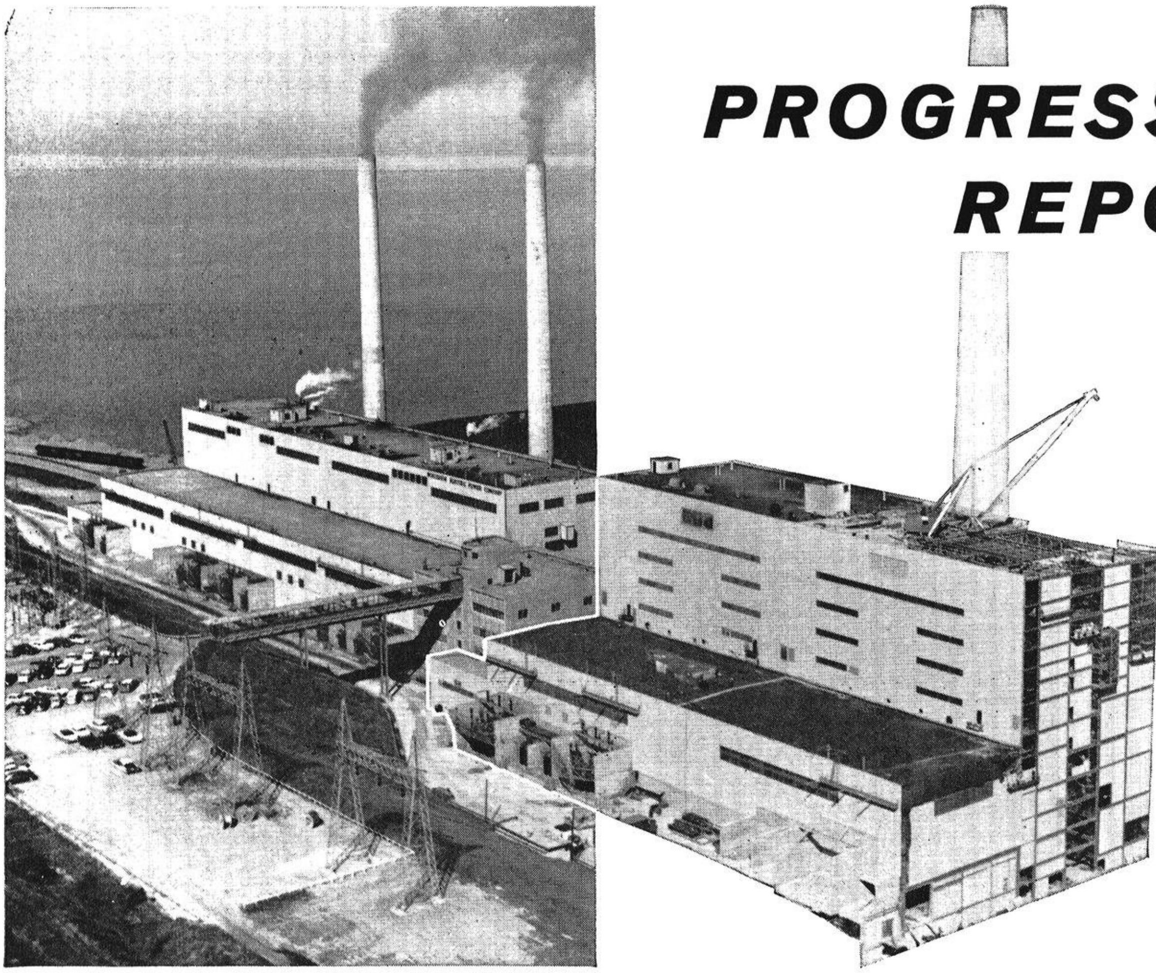
True, activities do take time, but it is apparent from common experience that the active student finds that his study habits, and consequently his grades, improve when he is more active. He learns to budget his time and to study more efficiently. Activities also give a healthy diversion since it is impractical to study continuously.

I do not wish to give the impression that classroom work is not important. A solid knowledge of theory is essential and the calisthenics of doing homework problems will train your mind in approaching problems in analytical manner. I do not suggest that you become active to the point where your classroom work suffers.Rather, I suggest a healthy balance of curular and extra curriculur activity. This is the philosophy of Polygon Board, and we are not alone in this opinion. Great emphasis is placed on activities by most companies interviewing seniors for jobs. The college of Engineering Scholarship committee weighs activities equally as much as grades.

Once you have entered the College of Engineering and get your feet on the ground, *become active*, complete the project of obtaining the best education you can get.* You will be paying good money to go to school. Get the most out of it that you can.

Good luck in your next four, very interesting, years. **THE END**

* Develop your natural abilities of working with other people.



PROGRESS REPORT

OAK CREEK TO PRODUCE 1,050,000 KW

In 1957, Wisconsin Electric Power Company's Oak Creek power plant became the largest power plant in Wisconsin, generating 500,000 kw in the first four units shown to the left of the white line on the photo. Five years later — by the end of 1961 — it will produce 1,050,000 kw.

A growing industry, indeed. The 275,000 kw unit 6 will be housed in the nearly completed structure at the right. Unit 6 will include improvements over its "twin" unit 5, which was placed in service at the end of 1959. Unit 5 is just left of the largest stack. As in all Company operations, design and development work is assigned to Company engineers. The Company is also participating in atomic power research at the Enrico Fermi plant at Monroe, Michigan.

Engineers have abundant opportunities here in all fields for personal progress in power. In addition to a wide diversity of industry, the Company's service area offers a good balance of commercial and farming activities. A good place to work and live.

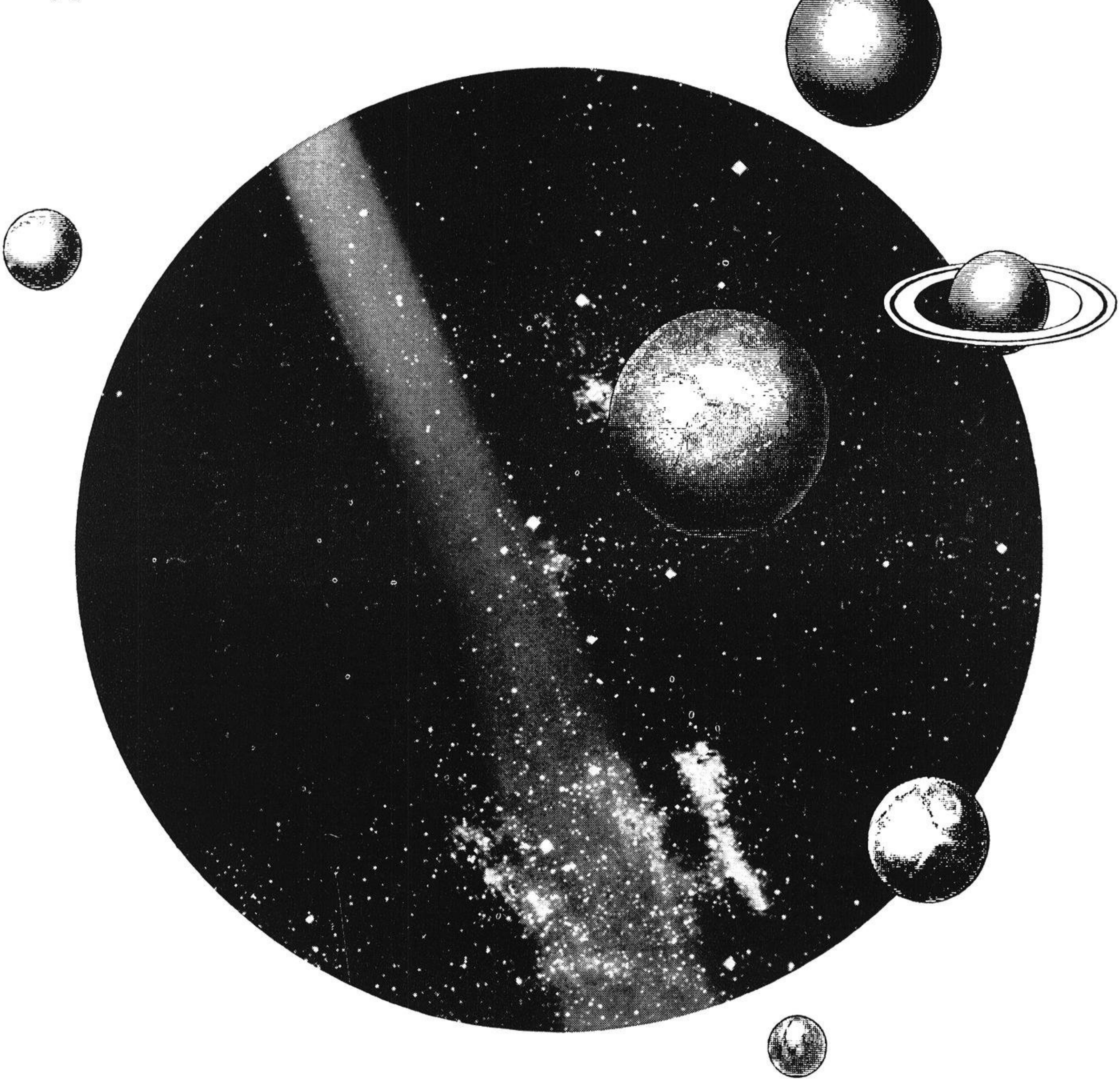
WISCONSIN ELECTRIC POWER COMPANY SYSTEM

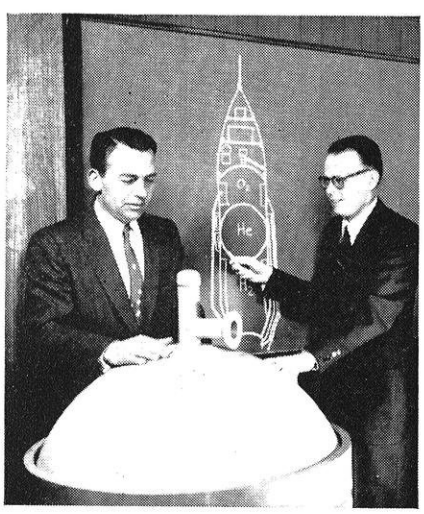
Wisconsin Electric Power Co.
MILWAUKEE, WIS.

Wisconsin Michigan Power Co.
APPLETON, WIS.

Wisconsin Natural Gas Co.
RACINE, WIS.

Biggest thirst in the universe





Each 6,000,000 pound thrust rocket ship now being planned for manned interplanetary exploration will gulp as much propellant as the entire capacity of a 170 passenger DC-8 Jetliner in less than 4 seconds! It will consume 1,140 tons in the rocket's approximately 2 minutes of burning time. Required to carry this vast quantity of propellant will be tanks tall as 8 story buildings, strong enough to withstand tremendous G forces, yet of minimum weight. Douglas is especially qualified to build giant-sized space ships of this type because of familiarity with every structural and environmental problem involved. This has been gained through 18 years of experience in producing missile and space systems. We are seeking qualified engineers and scientists to aid us in these and other projects. Write to C. C. LaVene, Box P-600, Douglas Aircraft Company, Santa Monica, California.

Dr. Henry Ponsford, Chief, Structures Section, discusses valve and fuel flow requirements for space vehicles with Donald W. Douglas, Jr., President of **DOUGLAS**

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...where *a group of outstanding scientists and engineers are conducting both theoretical and applied studies in many aspects of the science of communications*

While our broad concern at Stromberg-Carlson is in the acquisition, transmission, processing, storage and display of communications data, ancilliary investigations—often seemingly remote—are carried on to enhance our basic understanding of the communications field.

TO THE ADVANCED DEGREE CANDIDATE this frequently offers the opportunity, upon completion of his studies, to continue theoretical investigations initiated in thesis preparation.

TO THE MAN WHO HAS RECENTLY RECEIVED HIS BS, it provides varied career choices: to work directly with experts on research projects; to participate in advanced development engineering concerned with the solution of complex systems engineering and equipment problems; to undertake the design of specific hardware which may involve the first practical utilization of new knowledge.

AT ALL LEVELS, the opportunities for professional growth are exceptional, not only through concentration on work in advanced areas but through continual contact with able men trained in other disciplines. Informal consultation between engineers, physicists, mathematicians, psychologists and linguists is available on a day to day basis. Further, with scientists it is the aim of Stromberg-Carlson's technically-trained management to maintain the atmosphere of the academic world, encouraging discussion, publication of papers and participation in technical symposia.

The list below indicates the range of work currently in progress.

FIELDS OF RESEARCH ENDEAVOR
Paramagnetic Resonance
Thin Photoconductor Films
Ferroelectricity
Propagation and Coding
Speech Analysis
Bandwidth Compression
Hydro-Acoustic Transducers
Molecular Electronics
Defect Solid State Physics
Parametric Devices
Tunnel Diode Logic
Scatter Propagation Analysis
Plasma Physics

ADVANCED DEVELOPMENT & ENGINEERING
ICBM Communications
Electronic Switching
Nuclear Instrumentation
High-Speed Digital Data Communications
Electronics Reconnaissance Systems
Single Sideband Communications
Synchronous Data Transmission
ASW Techniques
Machine Tool Automation
Radio Data Links
High Intensity Sound Generators
Air Acoustics
Shaped Beam Display Systems
High-Speed Automatic Missile Check-Out Equipment
Super-Speed Read-Out and Printing Equipment
Electro Acoustics & Transducers
Logic Systems
Sound Systems
RF Equipment
Precision Hi-Fi Components

For further information write to the College Relations Section, Engineering Personnel Department.

STROMBERG-CARLSON
A DIVISION OF **GENERAL DYNAMICS**
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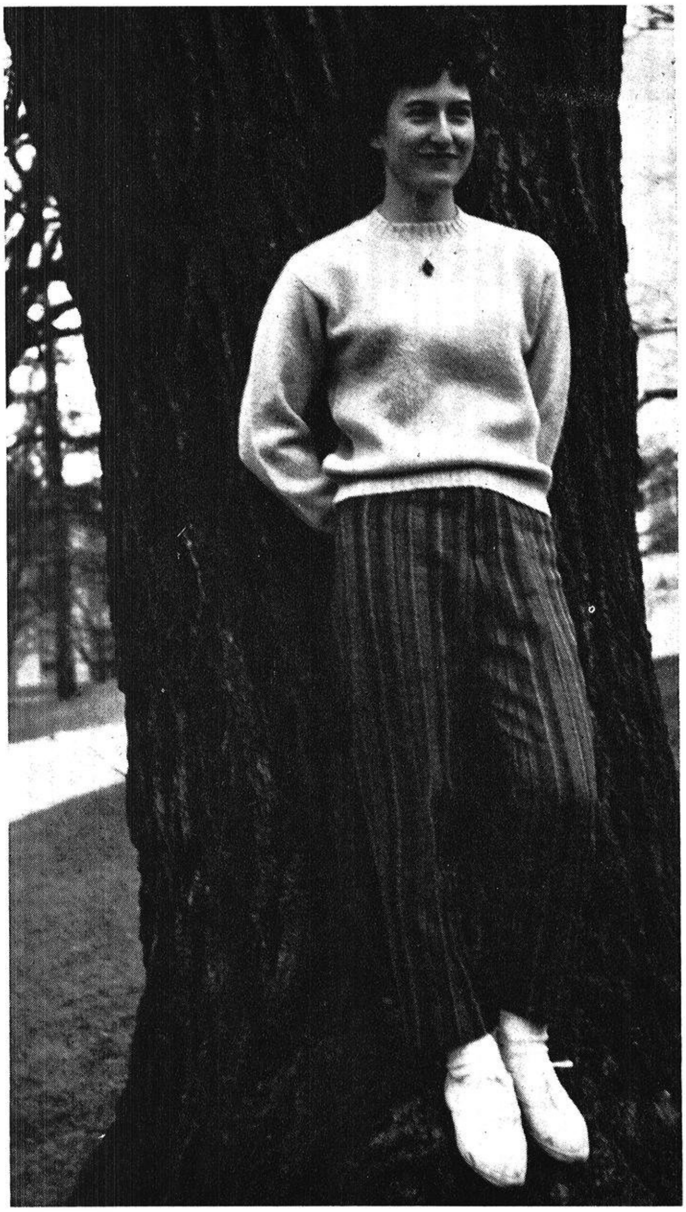

Girl of the Month

JOELLEN FISHER

As a tribute to the girls in the school of engineering we present the best looking "fellow" engineer. Joellen, better known as Jo, is a sophomore in civil engineering.

Often times she has been kidded about studying civil engineering, but her gay smile and quick replies always quell impending embarrassment. Usually the kidder ends up being flustered —ask some of her instructors.

OUT OF THE LABORATORY

Manned space missions of extended flight duration must have a large, continuous, long lasting and reliable source of electrical power. Only a nuclear reactor heat source is compatible with these requirements to provide power for propulsion and to operate all equipment aboard the spacecraft. Advanced nuclear energy conversion systems are now being developed by Garrett's AiResearch divisions to meet these new power requirements.

Besides nuclear and solar power systems for space applications, other project areas at Garrett include: electronic systems, such as flight data computers and solid state transistorized conversion systems for high speed generators; and complete environmental systems for advanced flight vehicles.

This diversification of project areas enables the engineer at Garrett to specialize or diversify according to his interest, not only making work more interesting but increasing the opportunities for responsibility and advancement.

An orientation program lasting a number of months is available for the newly graduated engineer, working on assignments with highly experienced engineers in laboratory, preliminary design and development projects. In this way his most profitable areas of interest can be found.

For further information about a career with The Garrett Corporation, write to Mr. G. D. Bradley in Los Angeles.

THE GARRETT CORPORATION

AiResearch Manufacturing Divisions

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Koppers moves into new research center

Right now, Koppers research scientists are moving into this new $8 million research center located in Monroeville, Pa., a suburban area of Pittsburgh.

This move is typical of Koppers growing emphasis on an aggressive research and development program, in exploratory and applied research, to discover new products and to improve and find new uses for existing ones. Koppers research is identified with a variety of products, including plastics, coal-tar derivatives, wood preservatives, fine chemicals and dyestuffs.

The Exploratory Section of our Research Department enjoys complete academic freedom for the analysis and investigation of new ideas and concepts in fields such as polymer chemistry, general organic chemistry, catalysis, and organometallics.

Koppers Research Department provides opportunities for research assignments in organic, physical, analytical, and polymer chemistry. Scientists will be associated with either the Exploratory or Applied Researches Sections, or the Analytical or Physical Chemistry Laboratories, as warranted by the interests and achievements of the individual.

Learn about the opportunities for *you* at Koppers and at our new Research Center, where research-minded graduates are offered an ideal atmosphere for progressive development. Write the Personnel Manager, Research Department, Koppers Company, Inc., Monroeville, Pennsylvania.

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SCIENCE HIGHLIGHTS

by Dave Cress me'63

BABCOCK & WILCOX BEGINS SHIPMENT OF ATOMIC FUEL FOR N. S. "SAVANNAH," WORLD'S PIONEER NUCLEAR MERCHANTMAN

The initial shipment of $9 million worth of nuclear fuel elements which will power the N. S. "Savannah," world's first atomic merchant vessel, was made by The Babcock & Wilcox Company's nuclear facilities plant here today. The units are en route to Camden, N. J., where the ship is nearing completion.

In all, 36 fuel elements will be delivered to Camden in nine shipments spread over a seven-week period.

Four of the elements will be "spares," while 32 will be assembled as the reactor "core," capable of propelling the "Savannah" 14 times around the globe, or 350,000 miles, without stopping. A ship powered by more conventional means would require 800,000 barrels of fuel oil to travel the same distance.

Each element weighs 760 pounds, and is 92 inches long and 8.5 inches square. A single element contains 164 stainless steel tubes one half inch in diameter, which contain the nuclear fuel in pellet form.

There will be 682,200 uranium oxide pellets in the reactor core, bearing 15,620 pounds of U235 and U238. Of this, 127.6 pounds, or 1.2 per cent of U235, the fissionable isotope, will be consumed before replacement by a new core is necessary. In effect, the "Savannah" will travel on approximately two fuel pellets per mile.

Construction of the ship began when the keel was laid on May 22, 1958, by Mrs. Richard M. Nixon. Built as an experimental government project initiated by President Eisenhower to demonstrate the peaceful applications of atomic energy, the vessel measures 596 feet long, 78 feet in beam, and will cruise at about 20 knots when it begins operating in 1961.

The "Savannah's" nuclear propulsion system, designed and manufactured by The Babcock & Wilcox Company, will be "one of the most advanced, yet conservatively designed atomic power plants in existence," according to the U.S. Atomic Energy Commission and the Maritime Administration.

WESTINGHOUSE BUILDING MOUNTS FOR LARGEST SOLAR TELESCOPE

Mounts for the world's largest solar telescope are now being built in Westinghouse Electric Corporation shops at Sunnyvale, Calif., for installation at Kitt Peak National Observatory, 40 miles southwest of Tucson, Ariz. When the telescope is put into operation, it will allow geophysicists to conduct spectographic analyses of the sun's surface. Eruptions of fast moving gases, radiation, electromagnetic forces and other phenomena that can be studied with the instrument will contribute valuable information to various scientific fields including atomic research, meteorology and communications.

Three large mirrors will be used in the new telescope to focus the sun's rays into a bright image, 34 inches in diameter. The largest mirror, part of an assembly called a heliostat, will have a diameter of 80 inches. It will be rotated on its axes by light-sensitive servo devices so that a reflection of the sun will be transmitted through a 480-foot tunnel to a second mirror, then on to a third mirror, through a 75-foot-long 72-inch-wide vacuum chamber, and on to a spectographic plate for observation. The second mirror is parabolic, 60 inches in diameter; the third is flat, with a diameter of 48 inches.

A heliostat provides an artificial eclipse of the surrounding corona of the sun excluding all but the direct surface to be studied. The heliostat assembly is to be 23 feet wide and 31 feet long. It will rotate at the earth's rotational speed, following the sun all day, each day of the year. In addition, it can move with respect to the second mirror to compensate for temperature changes.

The observatory is equivalent to a 10-story 500-foot-long building situated 300 feet underground and 200 feet above ground. It is located on 6,875-foot-high Summit Ridge inside Papago Indiana Reservation. The telescope building will have an outside skin of copper underlaid by tubes carrying water to keep the building temperature close to that of the outside air. A substantial temperature difference would cause "heat waves" that interfere with observations.

Because its instruments will be capable of photographing 500-mile areas on the sun 93 million miles away, the observatory must be built to critical specifications. For example, the 26-foot-diameter tower on which the heliostat sets cannot move as much as one-thousandth of an inch in a 25-mile wind.

Westinghouse has received a $215,000 contract to build and install the heliostat mounts from the Association of Universities for Research in Astronomy (AURA), which is designing the observatory and will operate it. AURA is made up of astronomers from nine American universities: California, Chicago, Harvard, Indiana, Michigan, Ohio State, Princeton, Wisconsin and Yale. Its president is Dr. C. D. Shane, former director of the University of California's Lick Observatory near San Jose, Calif. Dr. N. U. Mayall, director of Kitt Peak National Observatory, heads the three-phase AURA research mission in solar, stellar and space astronomy. Dr. A. Keith Pierce, associate director, is the astronomer in charge of the solar project.

The Western Knapp Engineering Company of San Francisco will build the observatory to the design of Skidmore, Owings and Merrill of Chicago, architects.

The solar telescope, scheduled for completion early in 1961, is being built with a $4,000,000 grant from the National Science Foundation.

More and better food, flowers and fiber for industry are expected to result from experiments conducted by government scientists in one of the world's most brightly lighted plant growth rooms.

NEW BRIGHTLY LIGHTED ROOM HELPS UNVEIL MYSTERIES OF PLANT GROWTH

At the U. S. Department of Agriculture's research center here is a basement room newly lighted to a higher level than normally is encountered by man except in bright sunshine. It is helping researchers unveil the mysteries of plant growth.

"We don't know how much light is needed for optimum plant growth," said USDA Chief Physiologist Harry A. Borthwick, "but we do know that plants grown in this new room are superior to those grown in our other rooms having lower light levels." Other important factors include the color of light and the length of time plants are exposed to it.

The new 9- by 16-foot room offers plant growth scientists up to three times as much light with which to experiment as exists in other plant growth rooms at the Beltsville Plant Industry Station. In early tests scarlet sage seedlings flowered much faster than in other plant growth rooms and in greenhouses.

To get the high levels of light—initially 5,000 footcandles, or more than 100 times as much as prevails in the average office—government scientists selected as their chief light source General Electric's eight-foot-long Power Groove fluorescent lamps. Sixty-four of the lamps literally blanket the seven-foot-high ceiling. They are operated on a new circuit which assures maximum light output.

The fluorescent tubes are supplemented by forty 100-watt incandescent bulbs. The ratio of incandescent to fluorescent light has a bearing on what a plant will do with respect to growth, according to Dr. Borthwick. He explained that recent experiments with these light sources contributed importantly to the discovery of a light-sensitive compound in all plants which controls their development.

"Installation of plant growth rooms is proceeding at a tremendous rate," Dr. Borthwick said. He pointed out that virtually every college and university, in addition to Department of Agriculture Research and Experiment Stations, is now either operating or planning one or more growth rooms. In some institutions extensive installations (phytotrons) consisting of a number of growth rooms with elaborate controls, are planned or under construction.

In addition, many industries are operating or planning growth rooms to test the growth characteristics of seeds and plants in various environmental conditions, the effectiveness of fertilizers, weed killers, anti-insect chemicals, disease inhibitors, and others.

Besides the larger rooms, thousands of lighted commercial and home-made growth chambers and cabinets are used by organizations and hobbyists.

What is exciting plant physiologists today is the possibility that they now have the key to man's complete control of plant growth from seed germination through plant flowering and fruiting. Discovery of the triggering mechanism for plant development is hailed by the Department of Agriculture as one of the most important research achievements in 25 years.

A light-sensitive substance in plants, determined to be two forms of a blue pigment which exists in plants in amounts of one part in a million, has been found to control plant growth responses.

(Continued on page 60)

562 PROGRAMS, PROJECTS & STUDIES AT HUGHES

THE DIVERSITY OF ELECTRONICS ACTIVITY AT HUGHES PROVIDES AN IDEAL ENVIRONMENT FOR THE GRADUATING ENGINEER OR PHYSICIST. THESE ACTIVITIES INCLUDE:

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- Digital Components and Devices
- Plasma Physics Research
- Polaris Guidance Development
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- Satellite Active Repeater Development
- Wide Band Scanning Antenna Feed Systems
- Microwave Antennas and Radomes
- Guidance and Navigation Computers
- Satellite Communication Systems
- Satellite Reconnaissance Drone
- World-Wide Communications Networks

ELECTRICAL ENGINEERS AND PHYSICISTS

B.S., M.S. and Ph.D. (June and Summer Graduates)

Members of our staff will conduct

CAMPUS INTERVIEWS

March 2, 1961

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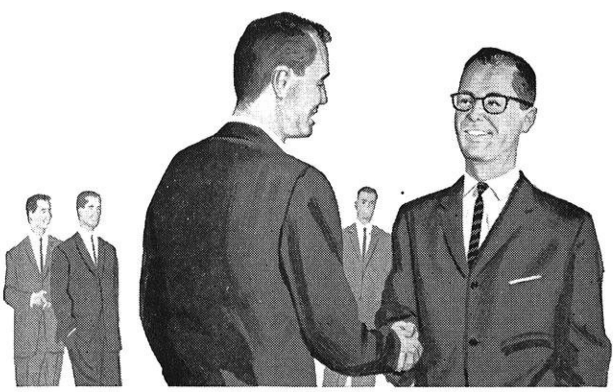
For interview appointment or informational literature consult your College Placement Director. *Or write Hughes College Placement Office, P.O. Box 90515, Los Angeles 45, California.*



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HUGHES

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ELDOR, SOMETIMES I GET THE IDEA THAT COMPANY RECRUITING REPS ARE EXAGGERATING TO US. DON'T YOU FIND IT THUS?

AS YOU KNOW, ALBRECHT, I HAVE ACCEPTED AN ENGINEERING POSITION PRIMARILY ON THE BASIS OF AN HONEST, FORTHRIGHT PRESENTATION.

THEY SAID THAT I WOULD BE WORKING ON NEW UNCHARTED TRAILS THROUGH THE UNIVERSE... WITH THE ONLY LIMITS THOSE IMPOSED BY MY IMAGINATION.

I WILL LIVE IN AN ULTRA-MODERN ALL ELECTRONIC HOME SNUGGLED AMONG THE PINES AT THE EDGE OF A CRYSTAL BLUE LAKE.

WITH MERELY A DOUBLE GARAGE, ONE OF MY SPORTS JOBS WILL HAVE TO SIT OUT IN THE YEAR-ROUND PLEASANT WEATHER.

THEY TOLD ME EXACTLY WHAT MY SALARY WOULD BE, AND I'LL HAVE TO SET ASIDE (TEMPORARILY) MY PLANS FOR AN OCEAN-GOING YACHT.

AND SO YOU'RE JOINING COLLINS?
YES, ALBRECHT, SUCH HONESTY AS THEIRS SHOULD NOT GO UNREWARDED.

Furthermore, Collins is one of the nation's leading growth companies, producing for both government and business. Commercial fields include airline and business aircraft communication and navigation equipment, data transmission, microwave, amateur radio, broadcast and ground communication equipment. Research, development and manufacturing facilities are located in Cedar Rapids, Dallas and Burbank.

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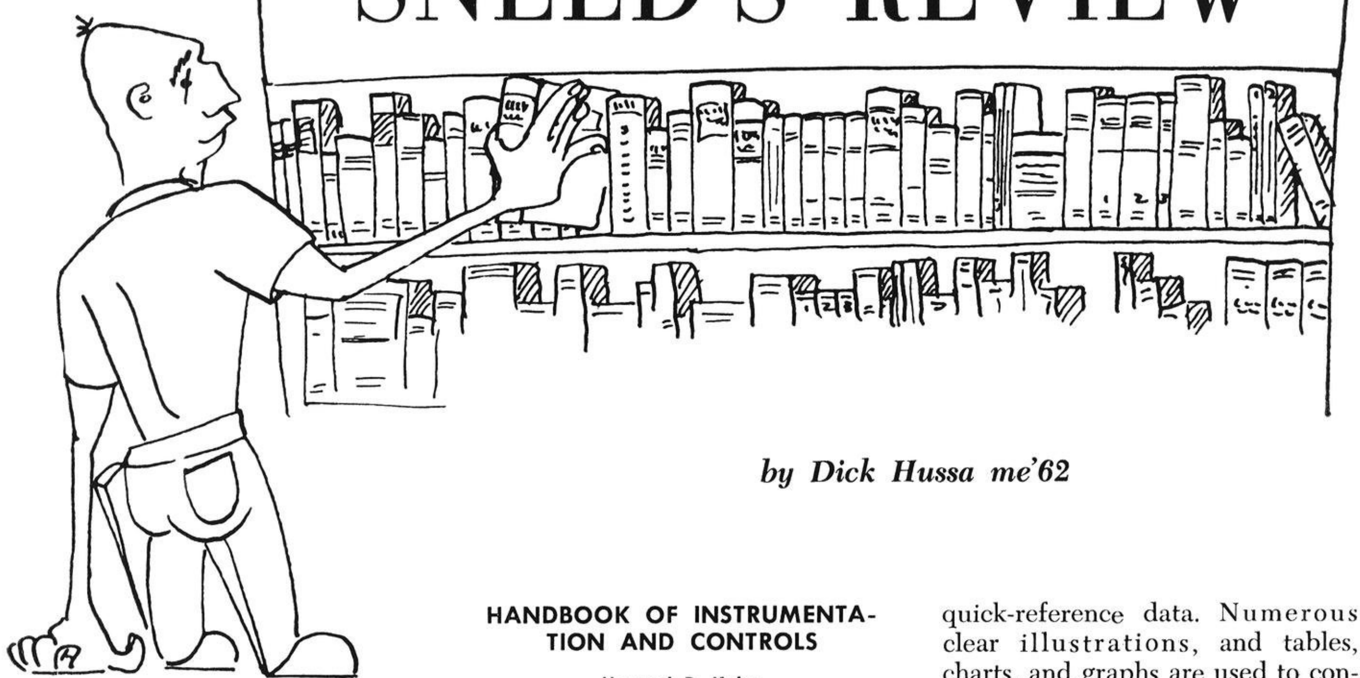
SNEED'S REVIEW



by Dick Hussa me'62

THE PHYSICAL AND THERMODYNAMIC PROPERTIES OF HELIUM

Whittaker Controls

84 Pages, $10.00

The revised edition of "The Physical and Thermodynamics Properties of Helium," a reference book originally published in 1957, summarizes currently available information on the physical and thermodynamic properties of gaseous helium. The information is presented in both tabular and diagrammatic form to facilitate its use by design and test engineers who work with pressurized helium. The reported property values cover the pressure range of 14.7 to 6000 psi and the temperature range of -440° to 600°F, with minor exceptions where data was limited or unavailable. The original publication was compiled by Whittaker Controls engineers who needed helium data in their ICBM valve development programs. Cost of the book covers printing expenses.

"The Physical and Thermodynamic Properties of Helium" is available by contacting Whittaker Controls, 915 North Citrus Ave., Los Angeles 38, Calif.

HANDBOOK OF INSTRUMENTATION AND CONTROLS

Howard P. Kalen

692 pages, $15.00

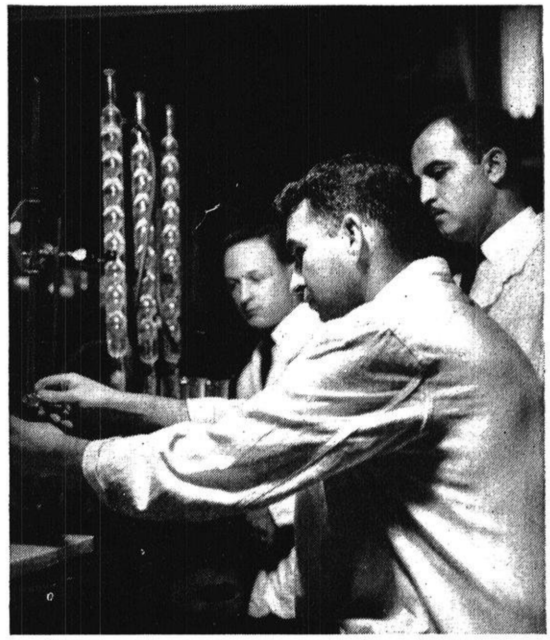
Planned to help the reader determine how to best select and effectively apply instruments and control systems for mechanical services in commercial, institutional, and industrial buildings, this newly published handbook provides a wide range of authoritative and quantitative data. Extending from basic facts on instruments to thorough descriptions of complete control systems, this guide presents important information needed to procure, specify, or design equipment.

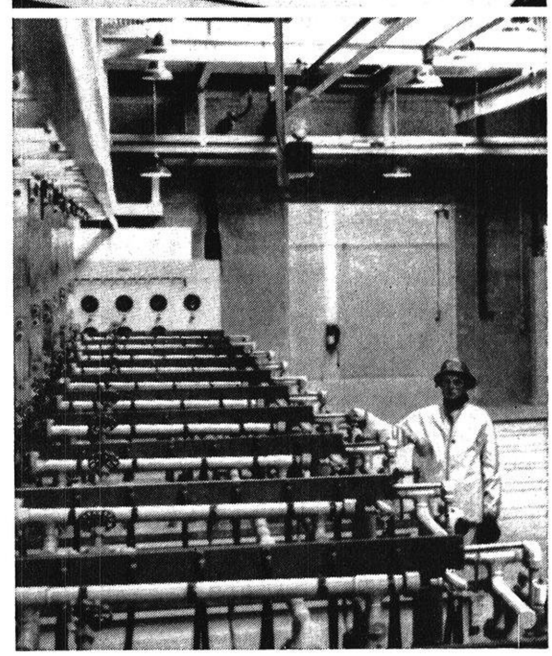
In treating instrumentation for pressure, temperature, flow, liquid level, pH and conductivity, combustion, and boiler controls, the needs of the engineer who designs and develops instruments, as well as the application engineer, were kept in mind. Similar consideration for the practical needs of engineers, technicians, and others is extended in the coverage or turbine-generator, heating system, air-conditioning system, refrigeration, diesel engine, and other controls.

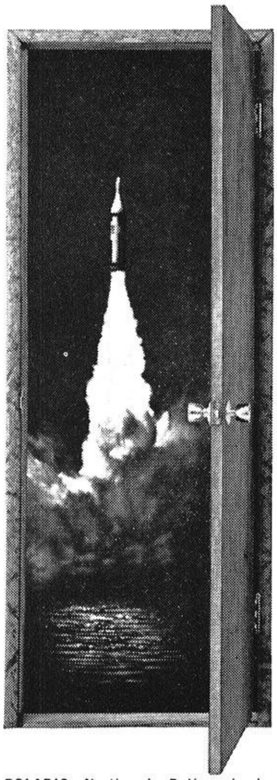
Lengthy, complicated discussions are omitted in favor of many quick-reference data. Numerous clear illustrations, and tables, charts, and graphs are used to convey technical aspects of instrumentation. Of particular interest is the presentation of many control systems that are completely illustrated to demonstrate modern practice in the field. Typical practical applications of all controls are described.

Specialized phases, including boiler and combustion controls, boiler flame-failure safeguards, and the fundamentals of instrument system design are covered. Also the book includes newer developments such as control systems for high-pressure steam power plants, and controls for large central air-conditioning systems found in office buildings, hospitals, schools, and other commercial and institutional buildings.

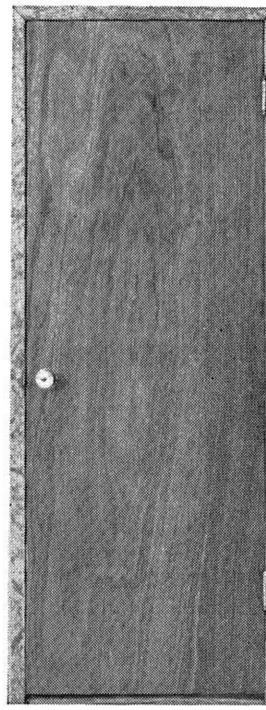
Howard P. Kallen is a partner in Kallen & Lemelson, Consulting Engineers, a firm that specializes in the design of mechanical services systems for commercial, industrial, and institutional buildings. Formerly, he was Chief Mechanical Engineer for Frederic R. Harris, Consulting Engineers, and an Associate Editor of *Power*. He is a member of the American Society of Mechanical Engineers and the Instrument Society of America.



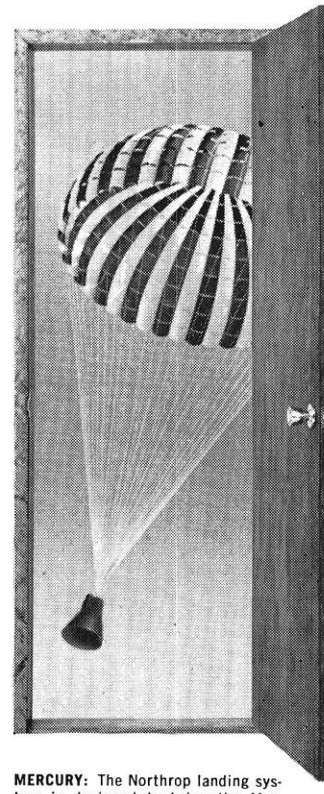




POLARIS: Northrop's Datico checks out Polaris at all levels of maintenance and operation.

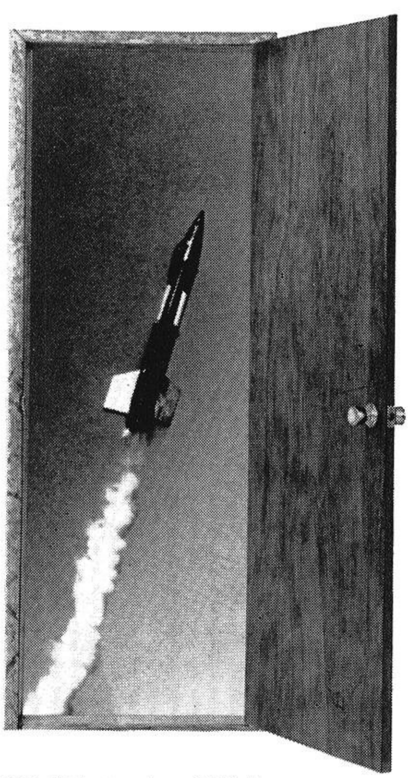


SKYBOLT: Guidance and navigation systems are being developed by Northrop for this new and highly secret air-launched ballistic missile.

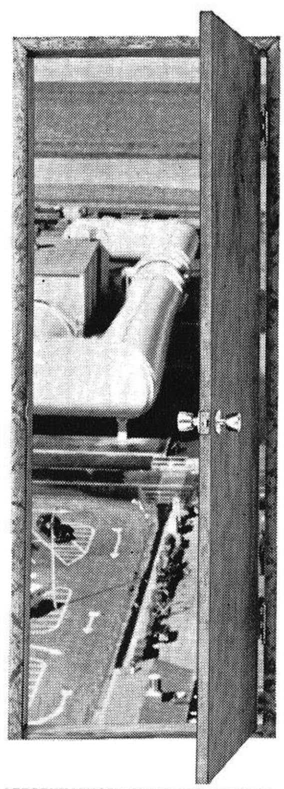


MERCURY: The Northrop landing system is designed to bring the Mercury astronaut down safely.

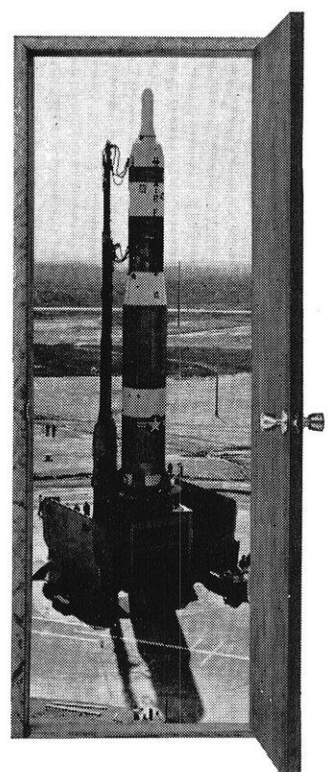
Northrop is now active in more



X-15: Northrop produces Q-Ball, the flight angle sensor for safe re-entry of X-15 and other aerospace vehicles.



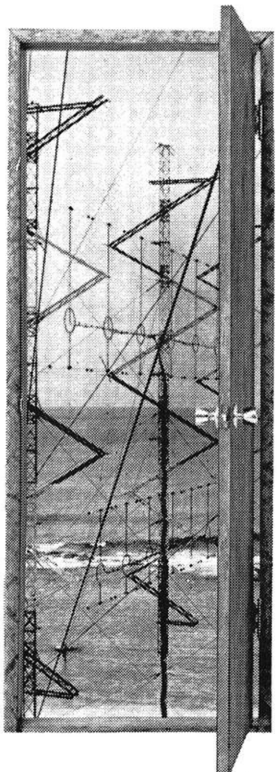
AERODYNAMICS: Northrop's Laminar Flow Control technique is designed to greatly increase aircraft range, flexibility, cargo and passenger capacity.



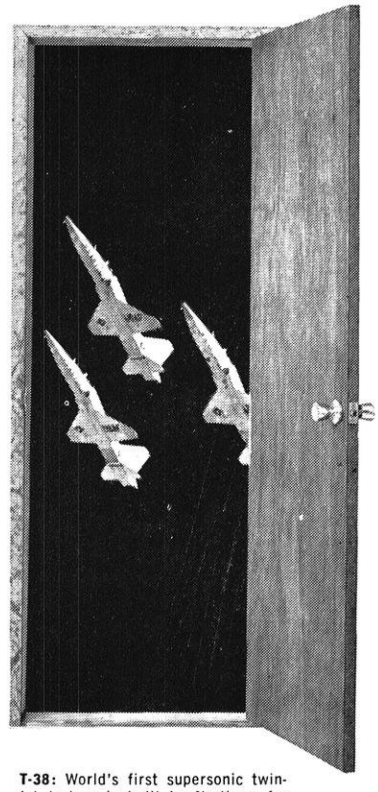
TITAN: Northrop supplies complete technical and industrial management to activate the T-2 Titan missile base.

For work on these advanced programs, we seek exceptional engineers, scientists and mathematicians.

HAWK: Northrop produces airframe components, ground handling and launching equipment for this air defense missile.

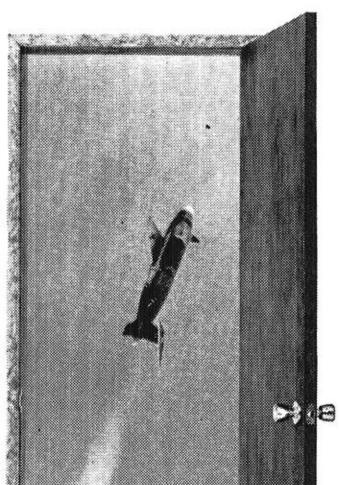


COMMUNICATIONS: Northrop designs the trans-Pacific Scatter Communications Network and other worldwide communication systems for U.S. and free world governments.

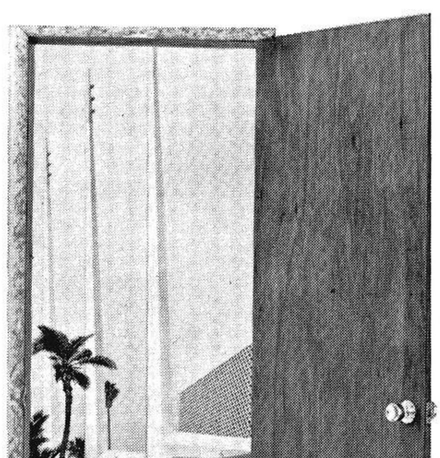


T-38: World's first supersonic twin-jet trainer is built by Northrop for the United States Air Force.

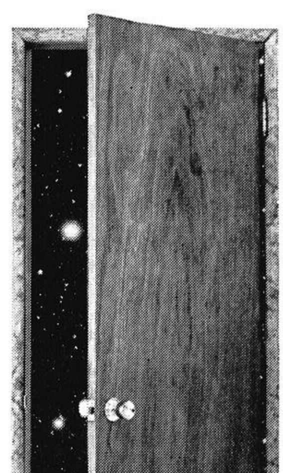
than 70 important programs



TARGET MISSILES: Northrop has produced more than 50,000 electronically-controlled aerial targets, and surveillance drones.



COMMERCIAL METAL PRODUCTS: Northrop produces aluminum architectural shapes for many important industrial and commercial buildings.



SPACE RESEARCH: Northrop's accelerated space research programs reach into such advanced areas as maneuverability, rendezvous, space vehicle maintenance, space probes, and the survival of men in space.

rite Northrop Corporation, Box 1525, Beverly Hills, California. Divisions: Norair, Nortronics, Radioplane.

Civil Engineer

(Continued from page 25)

The civil engineer not only plans the highways and streets, he also computes the grades at which they will be placed, computes the excavation and fill required, lays out the work for the contractor, inspects and measures the work done and certifies the contractor shall be paid.

It becomes evident that with increased experience and knowledge, the civil engineer quickly moves to positions of increased responsibility in supervision of design or construction. Many then become consulting engineers or contractors owning their own firms, some of which are very large doing work all over the world. Others prefer to rise to great responsibilitity in governmental agencies at the local, state, or national level or with established corporations from the very smallest to the very largest.

Through good times and bad, through war and peace, there is always work for the civil engineer who builds for the future.

Engineering Mechanics

(Continued from page 27)

a science, some fields are based largely upon empirical data and 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.

What are the Opportunities Open to Graduates to the Engineering Mechanics Curriculum?

This curriculum is designed to prepare engineers for graduate work and for careers in research, industrial product and process development, and teaching in engineering colleges and universities. Publications such as CAREER which list job opportunities indicate special requests from such companies as Aerojet-General Engineering Corporation, Astronautics Systems, Inc., Bell Aircraft, Chrysler Engineering, Chrysler Guided Missiles, Lockheed Missile Systems, Northrop Aircraft, Inc., Ramo-Wooldridge, and Space Technology Laboratories. In the Government, opportunities exist in such organizations as the U. S. Atomic Energy Commission, National Bureau of Standards, and the Naval Ordnance Laboratory.

Mechanical Engineering

(Continued from page 31)

ments, 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 that 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.

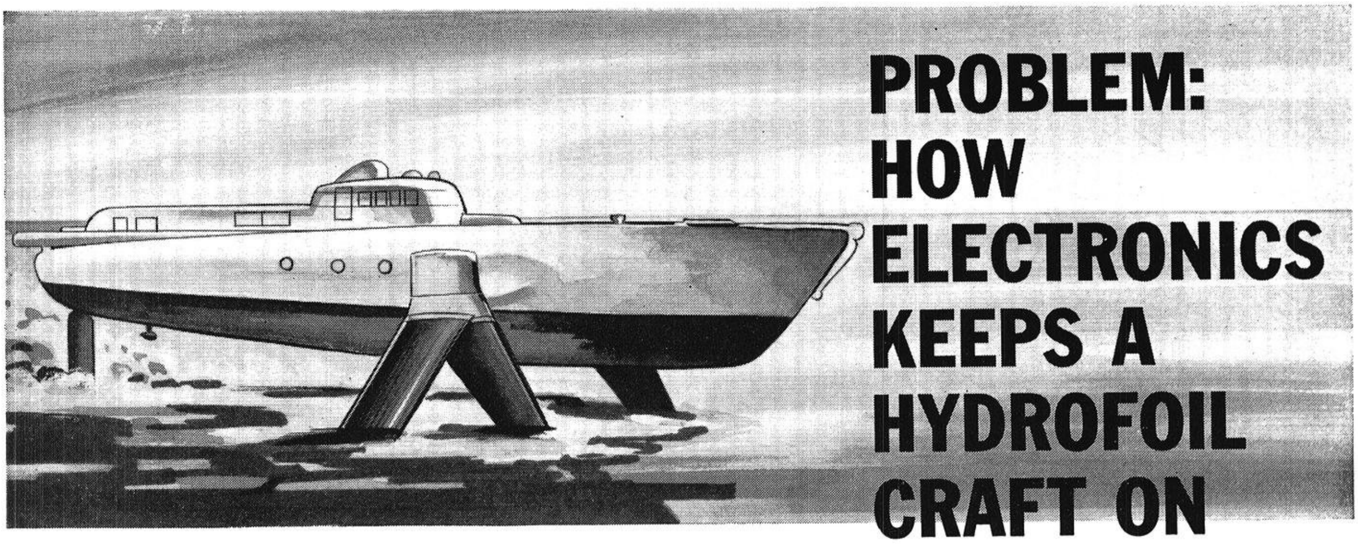
Mining and Metallurgical

(Continued from page 33)

actions, 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* 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 suc-

(Continued on page 58)

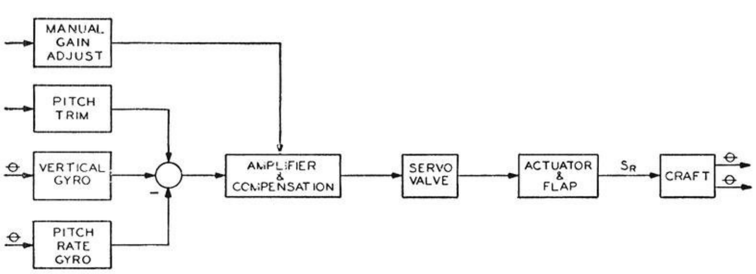


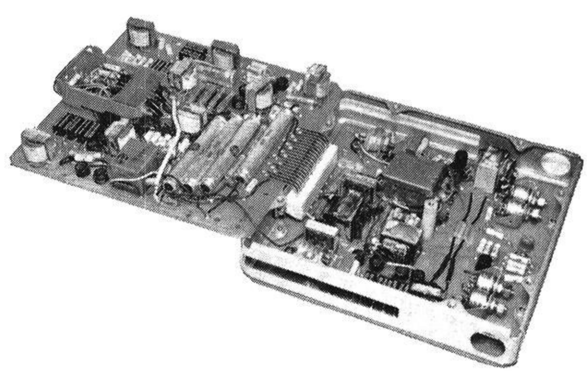
PROBLEM: HOW ELECTRONICS KEEPS A HYDROFOIL CRAFT ON ITS TOES

Hamilton Standard's Electronics Department is currently developing the automatic stabilization system for Grumman Aircraft's exciting hydrofoil boat. This all-aluminum, 80-ton test design is expected to reach speeds of 60 to 80 knots by means of reducing its drag through the automatically controlled "lift" of hydrofoils. For peak efficiency, the incidence of these foils must be continuously controlled so that the center of gravity will remain steady as wave height and direction of flow change . . . through every kind of sea.

As you can see, the engineering requirements implicit in designing an automatic control system for such a craft created a variety of problems. Engineers had to consider automatic pitch stability augmentation during take-off, cruise and landing; manually adjustable trim control devices to allow the pilot to set desired trim in pitch attitude; pitch trim control from level to eight degrees bow-up and within ± .25 degrees of reference. In addition, the control, which will require 115 ± 10V RMS at 400 ± 20 CPS, had to be designed so that open or short circuit failure of any one component would not put large reference voltages in circuit areas resulting in large control surface displacements.

Making use of its experience acquired in engineering the Automatic Stabilization Equipment for helicopters such as Sikorsky's S-61 the Electronics Department developed the lightweight, highly transistorized gear shown below incorporating the latest state-of-the-art packaging and circuitry techniques. The block diagram on the left below shows the breakdown of the major parts of the system—amplifier and compensation, vertical gyro package and rate gyro. Space prevents detailed explanations of its operations but if you would like to work on similar challenging undertakings talk with our campus representative about your career aspirations. Write for your copy of our brochure, ENGINEERING FOR YOU AND YOUR FUTURE, to Mr. R. J. Harding.





HAMILTON STANDARD DIVISION

an organization dedicated to *Scientific and Engineering Excellence*

UNITED AIRCRAFT CORPORATION

WINDSOR LOCKS, CONNECTICUT

Mining and Metallurgical

(Continued from page 56)

ceeded 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 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 or 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.

The Engineering Profession

(Continued from page 19)

Electrical engineering has two main divisions: power engineering, which is concerned with the generation, transportation, and application of electrical energy; and the broad field of communications and electronics which includes telegraph, telephone, radio, radar, television and control.

The mechanical engineer deals chiefly with the design and construction of machines for the generation or transformation of power, the design and production of machine tools, and industrial planning and management.

The mining engineer searches for and extracts all classes of minerals from the earth; the field naturally divides itself into mining geology, mining engineering, and mineral dressing.

The metallurgical engineer extracts metals from their ores and subsequently refines and combines metals to produce alloys possessing special properties.

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.

It should also 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 at the expense of informational and application courses.

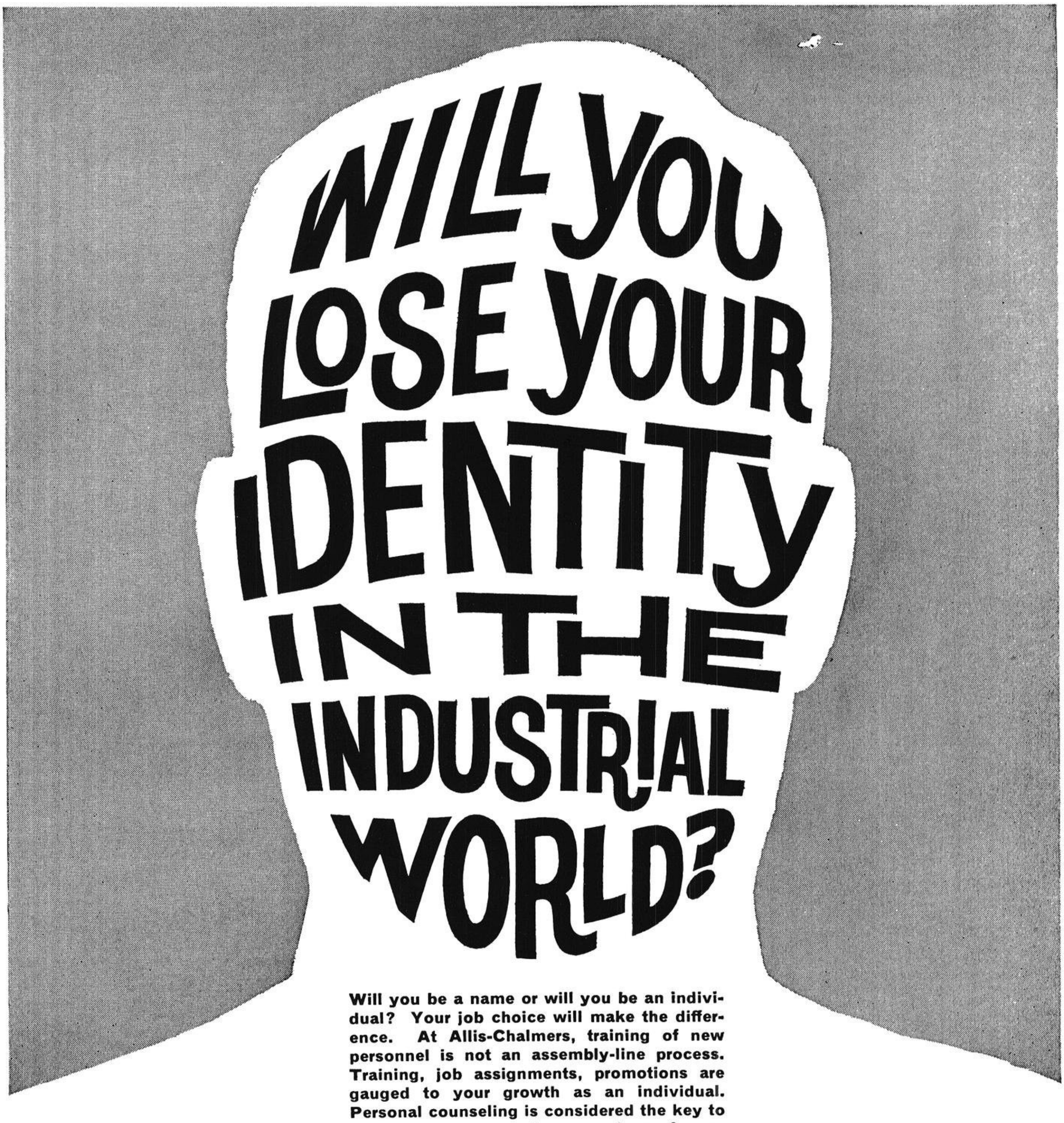
Every profession demands of its members integrity, industry, perseverence, courtesy and good personality. Success in engineering requires all of these and, in addition, a strong aptitude for mathematics, the sciences, and written and oral expression. If you possess these qualities and apitudes you can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

A Career Begins

(Continued from page 17)

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.



Will you be a name or will you be an individual? Your job choice will make the difference. At Allis-Chalmers, training of new personnel is not an assembly-line process. Training, job assignments, promotions are gauged to your growth as an individual. Personal counseling is considered the key to your success . . . various members of management meet with you to help you tailor a training program in keeping with your background, interests and future plans.

Career opportunities exist with electrical and mechanical equipment serving a wide variety of industry. Check with your placement counselor for detailed information. For a personal copy of Bulletin 25B6085, "Where Do You Go From Here?" giving facts on our company and our training program, write Mr. C. M. Rawles, Manager, Recruitment and Placement, Graduate Training Department, Allis-Chalmers, Milwaukee 1, Wisconsin.

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Career Opportunities

(Continued from page 18)

Each semester up to five hundred representatives from companies throughout Wisconsin and all over the country visit the campus to interview 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 sometimes 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 in industry. And he may discover special interests in a particular phase of engineering and tailor his selection of courses accordingly. As a result, he will be better prepared to continue his career after graduation.

University Extension

(Continued from page 20)

program of particular interest. Grade points, however, are entered on the same basis as transfers between any pair of neighboring 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.

Full applicability of credits available for transfer towards the requirements of the particular degree in mind requires wise selection of program within the offering of any outlying institution in which you may enroll. Student counsellors are generally very well informed on matters of local course selections 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 engineering is that the engineering programs at Wisconsin vary from 146 to 152 semester credits. This means that you will have to earn an average 18 hours per semester just to stay abreast of the schedule. If 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, shop, mechanics,* you stand a good chance of maintaining pace with your contemporaries in Madison. An excess of credits in *music, sociology, philosophy,* will simply mean that your total credits upon graduation will exceed the numbers spelled out above by virtue of courses taken outside of the rather rigid engineering requirements. 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 a third course in 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 the Extension Centers. Returning then to the typical degree requirement of 146 to 152 credits, the average 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 on the average. The opportunity to effect some overall economies by two to four semesters' study close at home where living costs are lower and parttime 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 Extension Centers of the State Colleges. If you do, there is every reason to believe that time will bear out the overall wisdom of your selection.

Science Highlights

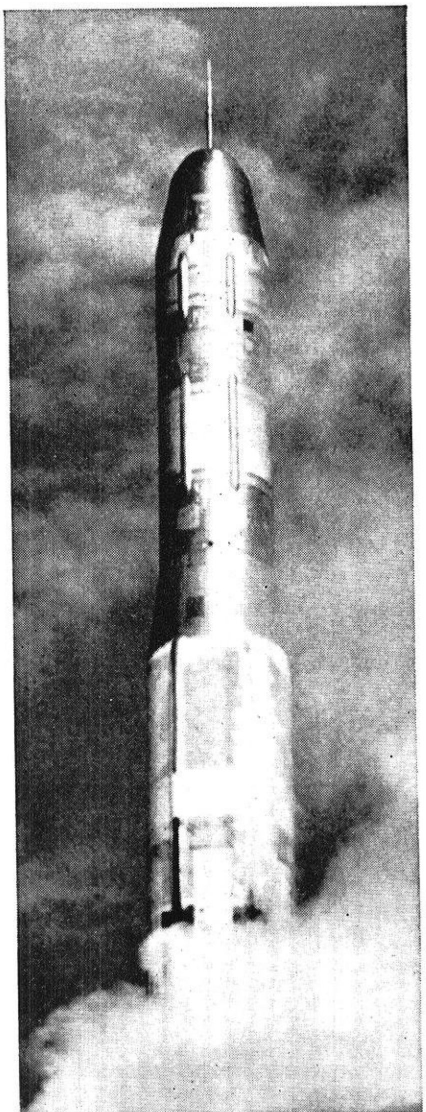
(Continued from page 49)

The two forms of the pigment act as valves which open or close according to the kind of light they receive. Further research will be aimed at isolating, purifying and identifying the growth-triggering substances.

Scientists first determined the presence of such a compound when they studied the effect of different colors of light on plant responses. They found that red light prevents flowering of some kinds of plants, promotes flowering of others, and reduces stem elongation. It also promotes the germination of seeds and production of red coloring in plant parts.

Each effect of the red light, however, is nullified or reversed by exposure to "far-red" light. Far-red is the short wavelength of the infrared spectrum. It immediately adjoins the red part of the visible

(Continued on page 62)



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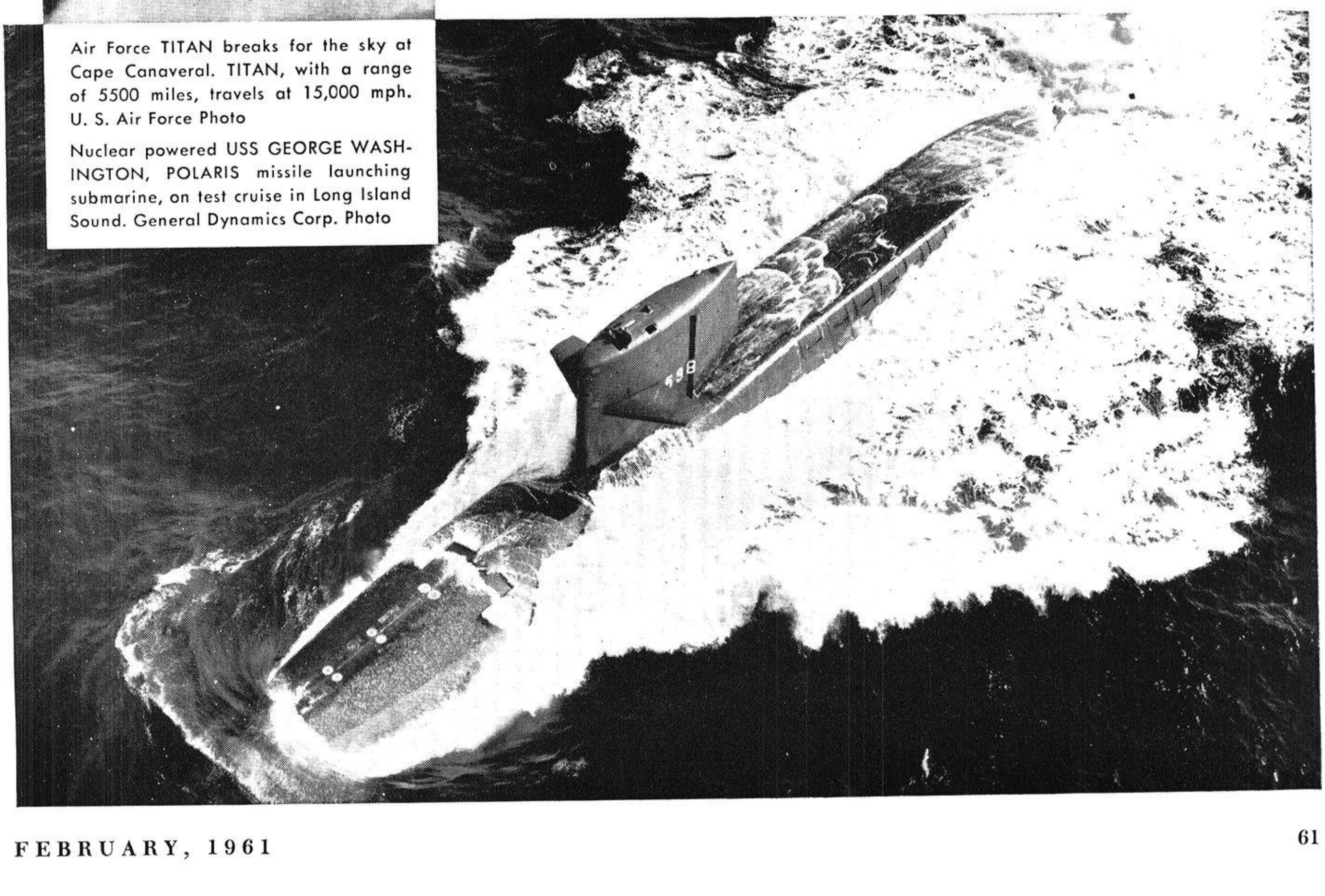


Air Force TITAN breaks for the sky at Cape Canaveral. TITAN, with a range of 5500 miles, travels at 15,000 mph. U. S. Air Force Photo

Nuclear powered USS GEORGE WASHINGTON, POLARIS missile launching submarine, on test cruise in Long Island Sound. General Dynamics Corp. Photo

Science Highlights

(*Continued from page 60*)

spectrum. Incandescent lamps emit far-red light in large quantities.

The scientists verified the presence of the pigment by examining plant juice under a spectrophotometer. After the extract was first irradiated with red the spectrophotometer indicated high absorption in the far-red, and after strong irradiation with far-red the region of absorption shifted back to the red.

Exposures of seeds, fruit, and plants to red and far-red light in plant growth chambers have caused responses as follows:

Germination: Exposure of lettuce seeds to far-red light for 16 minutes inhibited germination, but irradiation with red light caused rapid germination.

Coloring: Apples kept in the dark remained green, but those exposed to fluorescent light, which contains a red component, became bright red.

Elongation: Three bean plants received eight hours of daylight each day. One which also received a five-minute daily exposure to elongation-promoting far-red light just after the beginning of each dark period far outstripped the other two in growth. One of these received no artificial light, and the other five minutes of far-red light followed by a five-minute exposure to elongation-suppressing red light, which counteracted the effect of the far-red.

Flowering: Eight hours of daylight were received each day by three petunias. One which got eight additional hours of incandescent light (a mixture of red and far-red) flowered, while that which was given an additional eight hours of fluorescent (red) light developed buds which flowered only after considerable delay. The plant which got only eight hours of daylight showed the least development.

The period of time a plant is exposed to light has an important effect on its growth response. Lobolly pine trees, for example, grow six times as fast as normally when exposed to light 24 hours a day. On the other hand, only one ten-thousandth of a second of light causes lettuce seeds to germinate.

It's the duration of darkness rather than light that controls flowering. Some plants, such as poinsettia, hemp, millet, and chrysanthemum, need long daily dark periods for flowering. Short-night plants, such as wheat, barley, rye, beet, spinach, and certain summer-flowering weeds, can flower only when daily dark periods are short.

Ordinarily, the day-length of a region can't be changed to fit the needs of a field crop. However, experiments in plant growth rooms have helped in the selection of the proper crop or crop variety to fit the region. For example, nine distinct groups of soybeans are used in this country, each adapted to a cross-country belt about 100 miles wide. The Biloxi variety thrives along the Gulf Coast, but doesn't do so well 300 miles farther north in Arkansas.

In breeding a new variety of plant it must be carried through several generations. Because a plant growth room provides freedom from day-night and seasonal cycles, scientists are able to grow as many as six generations of some kinds of plants yearly, thus speeding up the development of special strains. This is in contrast to one generation in nature.

Best-known use of light to control flowering is that employed by the chrysanthemum industry. Chrysanthemums normally flower in the late summer, but their flowering often is delayed intentionally by growers who provide a few hours of light during the night. Similar techniques are used by growers of poinsettia plants, which respond to only a few minutes of light.

Beltsville scientists are not adverse to giving helpful advice to those requesting it. A visitor to the research center asked how he could get his chrysanthemums to bloom before those of his neighbors. He was told to place a box over them each day when he got home from work and to take off the box when he left home in the morning. By thus prolonging the plants' exposure to darkness he was able to stimulate flowering many days before the plants of his neighbors.

SAFETY PAYS

Employees of a New Jersey company are finding silver dollars in their pay envelopes if their plant group completes the month without a lost time accident or doctor's case requiring three visits. The group leader gets $5; the safety leader $4; group members $2 each. In the first two months of operation, there were no lost-time accidents and minor accidents were cut 80 percent.

AIRPORT TRAFFIC LIGHTS

Traffic lights on either side of a runway enable smooth earth-moving and airport operations in Tulsa, Okla., reveals Construction Methods and Equipment, McGraw-Hill publication. A veteran radio operator mans a special radio control tower, monitors the airport's control tower operations, and flashes a red light on signals whenever aircraft are about to use the runway.

SATELLITE LUBRICANTS

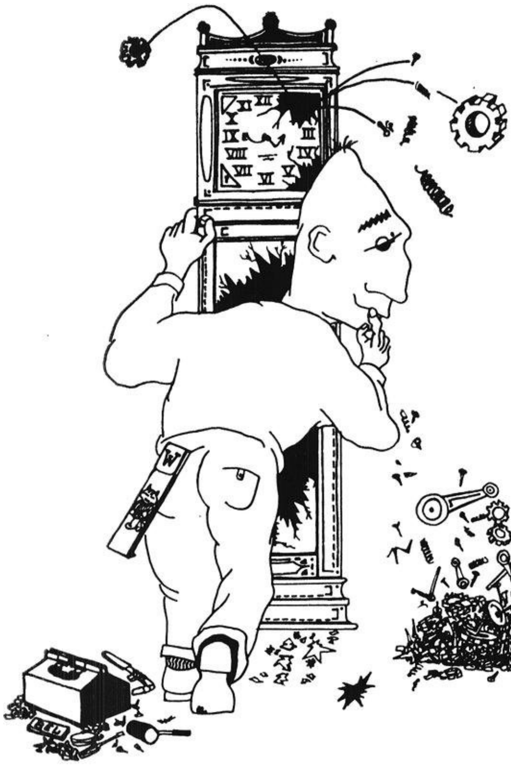
Liquid metals and gases are being considered by the Air Force as long-lasting lubricants for satellites and space vehicles to substitute for grease and oil, Petroleum Week, McGraw-Hill publication, reveals.

RADAR MAY FREE OIL

Deep-penetration radar beams may provide the necessary heat to unlock oil reserves trapped in rock thousands of feet beneath the earth's surface. An electronics firm is packaging 5,000 to 10,000 watts of microwave power into a capsule six inches in diameter. Oil is expected to rise to the surface after the capsule—lowered down a wellbore—provides heat needed to raise the temperature of molasses-like oil some 20 degrees.

TOLL COLLECTORS' SHIELD

A shaped Plexiglas shield protects toll collectors on the Garden State Parkway in New Jersey during inclement weather. The shield is said to have cut in half the number of heaters required in 28 toll booths and measurably reduced operator colds, dry skin and other ailments caused by standing in drafts.



STRIPPED GEARS

edited by William S. Huebner

Millionaire: "Marry my daughter on an engineers salary? Ha? Young man, you couldn't keep her in underwear."

Engineer: "There are times, sir, when you don't do so well yourself."

Not long ago, one of our city-bred engineering graduates was making a trip through the country. As he passed a fertile field he spied an unusual sight—a farmer helping a calving. Now our engineer didn't have the slightest idea what was happening, and he stopped his car to watch the spectacle. He could tell that the farmer was having an awful time assisting the cow.

Presently he got out of the car approached the farmer, and said, "Want some help?" And so sweating and straining, he assisted the farmer at the difficult task. Then at last, the calf was born.

Gratefully, the farmer accompanied the engineer to his automobile to see him off. But hesitating, as he wiped the sweat from his brow, the engineer looked up and said, "Say, mister, just how fast was the calf going, when it hit the cow?"

If it hangs where it's supposed to, a gal's locket is bound to be in the groove.

An attractive young lady lay on a bed in the receiving ward of a Roanoke hospital, covered only with a large sheet. Two young gentlemen passed by and were struck by the young lady's lovely features. One stopped, drew back the sheet, and carefully examined the patient from head to foot.

"Do you think you will have to operate?" the girl asked anxiously, after a few minutes.

"Oh, you'll have to ask one of the doctors," said one of the young men cheerily, "we're engineers."

Coed: "My, what slim, expressive hands you have. They belong on a girl."

C.E.: "You win, baby."

When you put on your cute rayon scanties
Do they crackle electrical chanties
Don't worry, my dear,
The reason is clear,
It's just that you have amps in your panties.

At roll call in a Russian regiment, it is reported that an officer sneezed and four men promptly answered "Here."

Drunk in telephone booth: "Number, hell. I want my peanuts."

Once upon a time there lived in the South a man who worked all day in a stove factory, making stoves. He was, in fact, a stover, i.e., one who makes stoves. Now, this stover's boss not only ran the stove factory, but also (this was in pre-Civil War days) picked up loose change by trading in the slave market. He kept his spare slaves in the basement of the stove factory, right under where the stover worked.

One day the boss brought in a slave who was sick — had a high temperature (106°F) and was delirious. The slave kept shouting and ranting all day, which made it very hard for the stover to work. So when he, the stover, went home that night, his wife said, "My dear, you look tired."

"So would you look tired," he replied, "if you had been stoving over a hot slave all day."

A woman was appearing before the court for a divorce. The judge inquired on what grounds she was asking for the divorce, and she told him.

She was granted the decree and given the custody of three minor children when she informed the judge that her husband had spoken to her only three times in ten years.

A girdle is an elastic supplement to a stearn reality.

A young man is at the in-between age in life when he knows why a strapless evening gown is held up, but he doesn't know how.

A couple of officials were walking by Oak Ridge, when they discovered a strange unidentified object lying on the ground. They decided to take it up in an airplane and drop it to see what would happen. They flew over some woodland in the South and dropped it. When it hit the ground it blew up. Just then a long bearded old man wearing a Confederate uniform and shouldering a musket came running out of the woods. As he looked up and saw the atomic mushroom he said, "I don't know what Lee's going to do, but I'm going to surrender."

Why is a man eating soup with a fork like another kissing his sweetheart?
Do you give up?
Because it takes so long to get enough of it.

The sting of a bee is one thirty-second of an inch long—the other six inches are imagination.

"Surveying the landscape again, Gloucester?"

An old Southern colonel was making a trip through Turkey and one day hired a guide to take him on a personal trip through a Sultan's harem. While wandering through the halls he recognized a burly black attendant as a former hand on his southern plantation.

"Well, Sam," exclaimed the surprised colonel, "What on earth are you doing away over here?"

"Well, suh boss," replied the grinning Negro, "Ah'll tell you. Ah has de best job in de worl'. Every day ah sits heah in front o' dis yeah doorway. Ah has a bowl o' watah in mah han' an' when dat long line o' beautiful gals wat belongs to de Sultan passes by, ah dips mah fingahs in de watah an' trows it on 'em. When ah finds one dat sizzles-ah is don fo' de day."

It was at a sultry foreign picture in a small art theatre. The hero and heroine, after some minor plot preliminaries, went into a terrific clinch. For fully five minutes they remained wrapped up in each other. Suddenly a small childish voice piped up from the audience: "Mommy, is this when he puts the pollen on her?"

A group of ministers and the AIChE organization were holding conventions in the same hotel. The catering department had to work at top speed to serve dinners to both.

The ChE's were having spiked watermelon for dessert but the harrassed chef served it to the ministers by mistake.

"Quick!" he commanded a waiter. "If they haven't eaten the watermelon bring it back and we'll give it to the ChE's.

The waiter returned and reported it was too late—the ministers were eating the dessert.

"Well," demanded the excited chef. "What did they say? How did they like it?"

"Don't know how they liked it," replied the waiter, "but they are putting the seeds in their pockets."

A soldier, just in from a tiny isle, was passing a big rooming house when he noticed the letters "B-B-B" on the front door. He stopped and tried to figure it out, but found it impossible. He though the best way to find out what the three "B's" stood for was to go to the door and inquire.

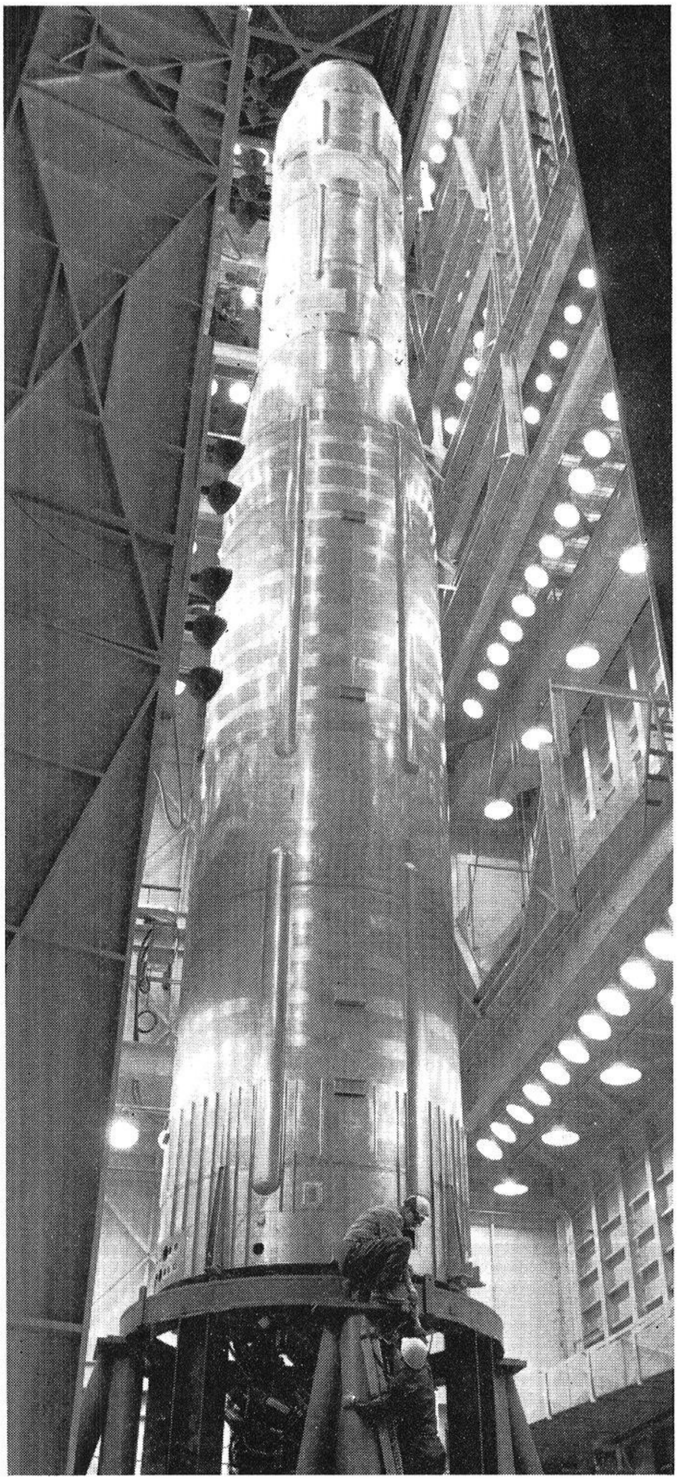
He knocked and a good-looking blonde, clad only in a negligee, answered and asked him what he wanted. He asked her to please explain what the letters stood for.

"Well," she said, "they stand for Blondes, Brunettes, and Beer." The soldier thanked her and started to walk away. He was deep in thought and feeling the money he had in his pocket he hurried back to the house and knocked on the door again. The same blonde came to the door and with a come-hither look in her eye, asked him what he wanted.

He replied by asking, "Say, is that draught or bottled beer?"

If your sights are set 

on outer space—



U.S. Air Force I.C.B.M. "Titan" shown in the vertical test laboratory at the Martin Company, Denver, Colorado.

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Kodak TRADEMARK

*One of a series**

Interview with General Electric's W. Scott Hill Manager—Engineering Recruiting

Qualities I Look For When Recruiting Engineers

Q. Mr. Hill, what can I do to get the most out of my job interviews?

A. You know, we have the same question. I would recommend that you have some information on what the company does and why you believe you have a contribution to make. Looking over company information in your placement office is helpful. Have in mind some of the things you would like to ask and try to anticipate questions that may refer to your specific interests.

Q. What information do you try to get during your interviews?

A. This is where we must fill in between the lines of the personnel forms. I try to find out why particular study programs have been followed, in order to learn basic motivations. I also try to find particular abilities in fields of science, or mathematics, or alternatively in the more practical courses, since these might not be apparent from personnel records. Throughout the interview we try to judge clarity of thinking since this also gives us some indication of ability and ultimate progress. One good way to judge a person, I find, is to ask myself: Would he be easy to work with and would I like to have him as my close associate?

Q. What part do first impressions play in your evaluation of people?

A. I think we all form a first impression when we meet anyone. Therefore, if a generally neat appearance is presented, I think it helps. It would indicate that you considered this important to yourself and had some pride in the way the interviewer might size you up.

Q. With only academic training as a background, how long will it be before I'll be handling responsible work?

A. Not long at all. If a man joins a training program, or is placed directly on an operating job, he gets assignments which let him work up to more responsible jobs. We are hiring people with definite consideration for their potential in either technical work or the management field, but their initial jobs will be important and responsible.

Q. How will the fact that I've had to work hard in my engineering studies, with no time for a lot of outside activities, affect my employment possibilities?

A. You're concerned, I'd guess, with all the talk of the quest for "well-rounded men." We do look for this characteristic, but being president of the student council isn't the only indication of this trait. Through talking with your professors, for example, we can determine who takes the active role in group projects and gets along well with other students in the class. This can be equally important in our judgment.

Q. How important are high scholastic grades in your decision to hire a man?

A. At G.E. we must have men who are technically competent. Your grades give us a pretty good indication of this and are also a measure of the way you have applied yourself. When we find someone whose grades are lower than might be expected from his other characteristics, we look into it to find out if there are circumstances which may have contributed.

Q. What consideration do you give work experience gained prior to graduation?

A. Often a man with summer work experience in his chosen academic field has a much better idea of what he wants to do. This helps us decide where he would be most likely to succeed or where he should start his career. Many students have had to work hard during college or summers, to support themselves. These men obviously have a motivating desire to become engineers that we find highly desirable.

Q. Do you feel that a man must know exactly what he wants to do when he is being interviewed?

A. No, I don't. It is helpful if he has thought enough about his interests to be able to discuss some general directions he is considering. For example, he might know whether he wants product engineering work, or the marketing of technical products, or the engineering associated with manufacturing. On G-E training programs, rotating assignments are designed to help men find out more about their true interests before they make their final choice.

Q. How do military commitments affect your recruiting?

A. Many young men today have military commitments when they graduate. We feel it is to their advantage and ours to accept employment after graduation and then fulfill their obligations. *We have a limited number of copies of a Department of Defense booklet describing, in detail, the many ways in which the latter can be done. Just write to Engineering Personnel, Bldg. 36, 5th Floor, General Electric Company, Schenectady 5, N. Y.* 959-8

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