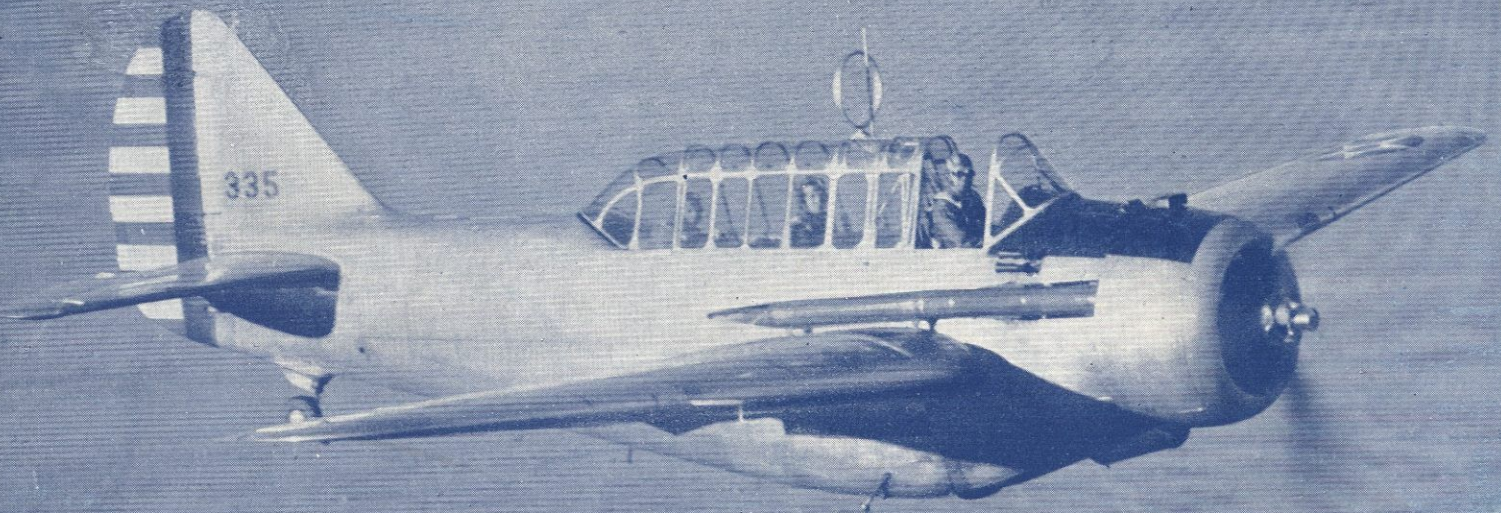


THE COLORADO ENGINEER



UNIVERSITY OF COLORADO
MARCH, 1939

MEMBER OF ENGINEERING
COLLEGE MAGAZINES ASSOCIATED



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of the fence
you're on...

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WILLIAM BAUER
EDITOR

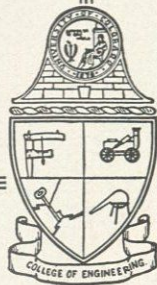
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Photo by Ed Tangen

Out from Under

Colorado's Wings

By Charles L. Carpenter, m. '40

Corporal, 120th Observation Squadron, Colorado National Guard

The Cover—The cover picture for this issue was taken especially for the COLORADO ENGINEER by the 120th Observation Squadron, Colorado National Guard, from another ship of the squadron. The ship in the picture is a North American O-47A observation airplane. Directly below the plane the campus of the University of Colorado is visible.

THE 120th Observation Squadron, Colorado National Guard, is a federally recognized unit in the National Guard of the United States and has been organized since 1923. From the date of organization until early in 1928, the squadron operated from the original Lowry Field, which has since been condemned for use by Army aircraft. The unit now operates from a newly constructed hangar at the Denver Municipal airport. *Lowry Field* has been retained as the name for the flying field of the Air Corps Technical School to perpetuate the name of the first Denver flier killed in the World War. The squadron is operated and governed according to strict Army regulations, and all equipment is furnished by the Army Air Corps according to the tactical needs of the squadron.

The squadron is divided into "sections" for the facilitation of the many tasks that it is called upon to perform; there are three main sections and five subordinate sections.

The engineering section is concerned with the major repairing and troubleshooting on the airplanes. The flight section does all of the routine inspections and minor repairing. The photographic section does the photographing, developing, and printing of pictures as they are needed. The minor sections are armament, radio, headquarters, parachute, and medical, all of which explain their functions in their names. The personnel of the squadron consists of about one hundred and ten men, of which about one-third is officers and the remainder enlisted men.

Since the origin of the squadron, it has been equipped with many different types of aircraft. The first ships were the well-known war-time training ships, the Curtiss JN-4D. From those old "Jennies"

the planes have ranged through deHaviland, Consolidated, Douglas, Thomas-Morse, and now North American. The horsepower has increased from 90 in 1923 to 975 in 1939, while the speeds have increased about three times from the 80 miles per hour of 1923.

The O-47A pictured is the latest type of observation plane in use by either the Army or the National Guard. It is a high-speed, mid-wing monoplane of all-metal construction, using a Wright *Cyclone* air-cooled engine of 975 horsepower. The performance data is still restricted because of military regulations, but the cruising speed of more than 200 miles per hour may give some idea of its capabilities. The propeller is a three-blade, constant-speed, Hamilton-Standard propeller, in which the pitch angle of the blades is changed in flight by oil pressure and counter-weights so that the engine speed remains at a predetermined constant, regardless of whether the airplane is climbing or diving. The landing gear and landing flaps are hydraulically operated by either the engine or hand pump. The landing gear retracts outwardly into the wells in the wings which may be seen in the smaller illustrations. Small control tabs that are adjustable in flight are provided on the elevators, rudder, and one aileron to care for the different flying qualities of the ship that arise due to changing of load, etc., for example, when part of the load of gasoline is used.

The airplane is constructed for a crew of three, a pilot, observer, and a gunner. The pilot's station is in the front cockpit; the observer's, in the center of the ship where he is able to remain in the upper portion of the ship or descend into the "belly" to take pictures or operate the radio equipment. The gunner's position is in the rear cockpit where he is able to protect the tail of the ship with a "flexible" machine gun. Forward armament amounts to one fixed machine gun mounted outside of the propeller disc in the leading edge of the wing. Complete radio equipment consisting of transmitter, receiver, and interphone is provided for the maximum efficiency during military missions.

Because of military restrictions regarding publication of specific data and the complexity of an airplane, this article can not describe each and every part of the ship, but the foregoing description will give some idea of the equipment of modern Army aircraft, of which the O-47A is a good representative type.





A striking example of the use of glass brick in factory construction.

Courtesy Pittsburgh Corning Corporation

Glass of '39

By William F. Gross, ch, '39

Present-day uses of glass have digressed so widely that they now range from the finest fabrics to structural beams. In fact, the following twelve hundred words can only sketch this varied utility of the "sands of the seas."

AS YOU turned the corner you saw her, standing upon a platform, arms thrown downward and outward, head tilted backward—beautiful, naked, and transparent. For she was the glass anatomical girl exhibited at the Chicago Century of Progress Exposition.

Among other things, she illustrates the fairly recent development whereby various objects are constructed in glass so that their internal working parts may be viewed while actually functioning. Glass cylinders in small steam engines and glass fractionating columns where the process taking place on each plate is clearly visible thus find a welcome in laboratories.

The poor girl's nakedness suggests clothing, and what could be more appropriate than glass cloth? As Dante remarked six centuries ago, "All things may be woven, even the sands of the sea." At that time, a pretty figure of speech, but now, in one plant, enough glass fiber is drawn every day to reach to the sun and back.

Glass cloth is one of those inventions mothered by necessity, for its discovery, albeit in the form of glass wool, was made in Germany during the time of the World War when their supply of asbestos was curtailed. It was the close similarity between this crude glass wool and uncarded cotton that suggested the possibility of weaving it into cloth.

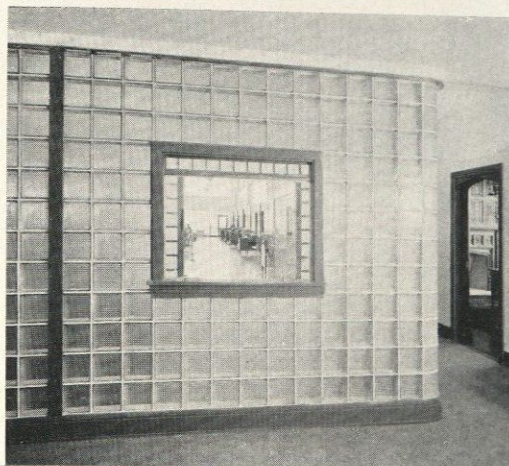
To overcome the many difficulties encountered, too numerous to mention, there has recently been developed the successful thread-producing unit, which is in size and appearance much like the modern electric stove. It is in reality a small electric furnace to which glass marbles of almost optical quality are automatically added one by one. The bottom of the furnace is formed by a bushing of very hard corrosion-resisting alloy containing 102 orifices through which the molten glass flows. The diameter of the orifice needed in producing a filament of glass fine enough to be woven is so minute—0.002 inches—that the bushing must be electrically heated to facilitate the flow of glass.

If a silken thread is wanted, these 102 filaments are merely gathered into a strand and attached to a wheel which is revolved as fast as possible. The usual speed at which the filament is drawn from the orifice is now sixty miles per hour, and strands 10,000 miles long are not uncommon. One glass marble will make a filament over 100 miles long. Two strands are then twisted to form a thread slightly larger than a human hair, which is then woven on standard textile looms into a soft, lustrous, sheer fabric.

On the other hand, if a cottony material is wanted, the filament as it emerges from the orifice is pulled and torn into 10-inch lengths by a jet of high pressure steam. These fibers are then carded, threaded, and

Courtesy Standard Register Company and Architectural Record

The sound-proofing qualities, as well as the translucency of glass brick, make it well adapted for interior walls and decorative effects.



woven on the same machines in the same manner as the organic fibers. It is interesting to note that only the length of the fiber, other factors remaining the same, determines the appearance of the final thread.

We thus have a cloth that is sheer or cottony as desired, and yet retains nearly all the properties of glass—incombustibility, stability, high resistance to moisture, acids, salts, and vermin, and a high dielectric constant—and none of the undesirable properties of brittleness, rigidity, and transparency. Color? That's easy; just use colored marbles, and the resulting colored threads are guaranteed washable and sun-proof.

By reading over again the properties of glass fabric, many industrial applications are at once apparent. Glass filter cloth, having the appearance of canvas, resists three to four times the temperature and pressure of ordinary filter cloth, lasts over twice as long in harder service, and because of its stability, may be used to filter otherwise unfilterable corrosive materials. In the form of tape, glass cloth is an improved electric insulator which, due to its high dielectric constant, high tensile strength (greater than steel, fiber for fiber), and light weight, takes up much less space than usual insulating materials. Used as a domestic fabric, who knows? It may some day surmount the opposing interests of the other textile industries.

Our miss, now fully clothed, is ready to return home—to her glass house, of course! In her glass house she has made full use of the many new architectural developments of glass. Glass bricks are gaining ever-increasing popularity as architects and home and factory owners are realizing their possibilities of beauty and economy.

The brick is usually made of two halves which are fused together at high temperatures, thereby leaving a partial vacuum in its interior. This dead air space results in the low thermal conductivity and sound insulating properties characteristic of the brick. Bonding surfaces are coated with a water and alkali resisting plastic, to increase the bond strength between mortar and glass.

That the glass brick wall is weather proof has been proved from tests conducted by the Pittsburgh Corning Corporation. They found that ten-square-foot panels safely carried an even load of 80 pounds per square foot, equivalent to a 160 mile per hour gale. Rain proofing was shown by a sample remaining watertight after eight hours of a 15-mile per hour spray, followed by sixteen hours of spray with no wind. The panel next successfully withstood alternate heating, spraying, and cooling to minus 30° F. The glass brick wall is desirable under conditions of varying humidity, since the panel remained dry under the extreme conditions of an outside temperature of 0° F. with a 65 per cent relative humidity and 70° F. inside temperature. Since it transmits anywhere up to 80 per cent of the light incident upon it, this and the above men-

tioned properties indicate its wide adaptability for homes, schools, offices, and factories.

Two recent innovations are a nailable glass developed in England, and *Thermolux* from Italy. The English product can be sawed and nailed just like a board since it is multicellular—composed of countless minute bubbles separated in layers by sheets of thin glass. *Thermolux* is composed of a central lamina of spun silk threads regularly arranged between two sheets of clear glass whose edges are sealed air-tight. This glass thus transmits a well-diffused light, but little heat.

For insulation in this glass house, we will, of course, use the efficient glass wool. This is produced in a matting of fluffy glass fibers, a few inches thick, a few feet wide, and as long as you please. Two fiber lengths are necessary, long fibers for structural strength, and



Courtesy Industrial and Engineering Chemistry

Glass thread is successfully woven on ordinary commercial looms to resemble almost any product of cotton or silk.

short ones for high interfelting properties. Unlike other insulators, it will not mat down under vibrations, and thus it finds extensive use as an insulator on ships and in refrigerators. Its vermin and fire-proof properties are further reasons for its widespread use in home and industry.

Further developments which our Lady of Glass will come in contact with are mirrors or tinted glass panels for walls, or clear glass panels for wind breaks in gardens; glass coated with a one or two molecule layer of aluminum, which eliminates interference due to reflected light, thus becoming completely transparent; jet-black rough-ground sheets of plate glass which make excellent black-boards; and a great variety of glasses which are light filters, or are heat, shatter, or bullet proof.

The Position and Training of a Flight Officer

By Jess Anders Smith, c, '32
Flight Officer, United Air Lines

THE air transportation business has advanced to such an extent that the pilot is no longer merely a person who can fly an airplane skillfully. His position requires much more knowledge and technique than in the old "barnstorming" days, and it entails a great deal of responsibility. To correspond with this change, most major airlines in scheduled operation now designate their pilot personnel as flight officers. The great responsibility and skill required of a flight officer makes an extensive and intensive training necessary.

To get a better idea of the position of a flight officer in the present-day scheme of air transportation, let us glance at the development of the industry. Today, air transportation, that is, the carrying of mail, passengers, and express in scheduled operation, is a major business. There are six or seven large airlines in this country, and many others of varying sizes. These major companies employ several thousand workers and operate over thousands of miles of airways. This is a remarkable growth when we realize that the first man-carrying flight ever made occurred only thirty-five years ago, on December 17, 1903, when Orville and Wilbur Wright succeeded in getting their flying "contraption" off the ground by its own power for four successive "hops" at Kitty Hawk, North Carolina.

From this meager beginning, air transportation has grown to its present importance. Large, fast transport airplanes, which carry from ten to twenty-five passengers, now fly from coast to coast in little more than fifteen hours. And this seems only the beginning, for right now actual tests are being conducted on a new four-motored land plane designed to carry forty or more passengers, and on a four-motored flying boat which will carry seventy-two passengers.

The crew of the present bi-motored transport airplane consists

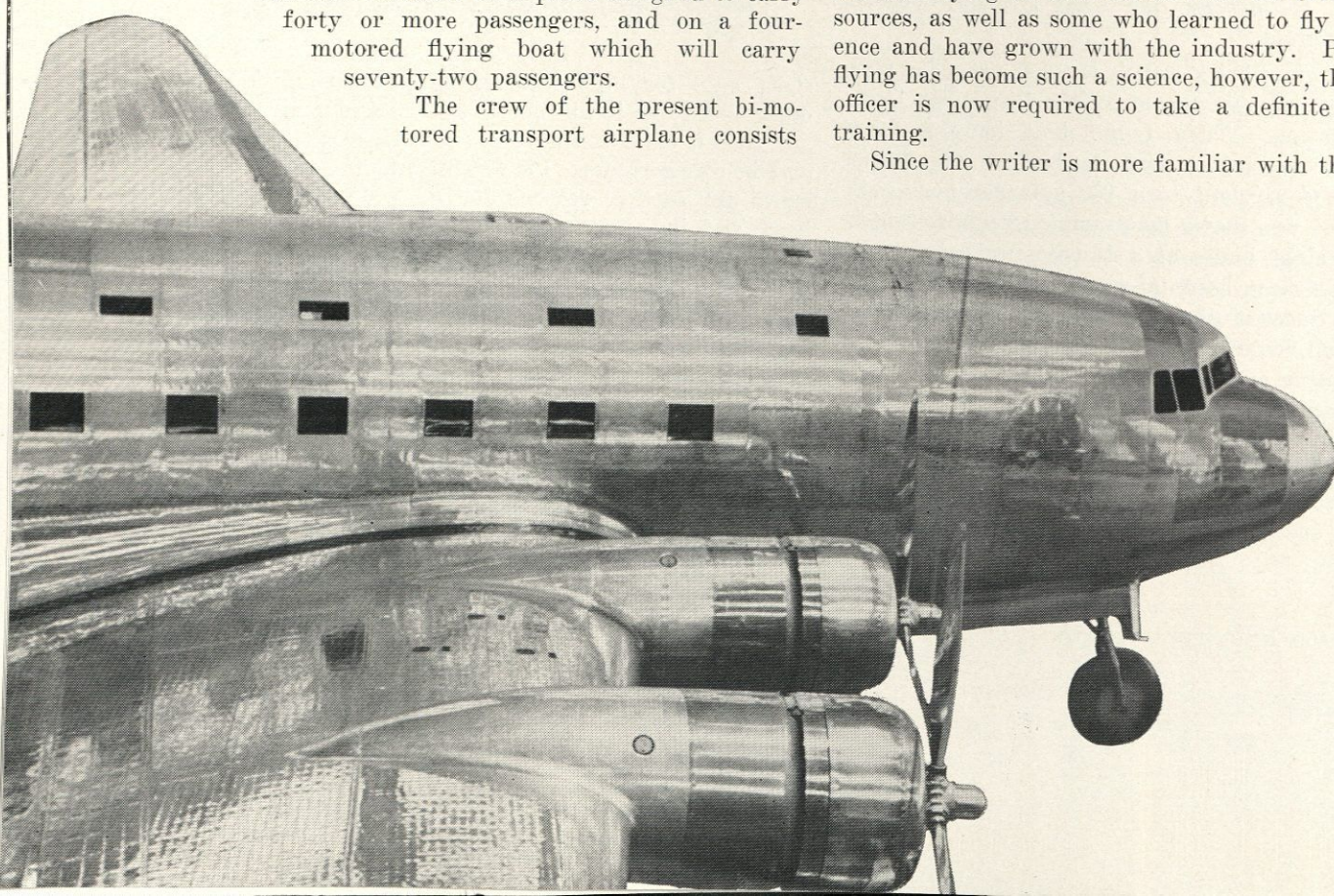
of two flight officers, the captain and first officer, and a stewardess who is a registered nurse. The four-motored airplane will probably require a crew of five. There will be a captain in charge of the airplane, two other flight officers who will manipulate the controls under the supervision and direction of the captain, a steward, and a stewardess.

As the captain of a transport airplane, a flight officer is the direct representative of the company before the public. He is responsible for the safety of the flight, the comfort of the passengers, and the supervision of the crew members with him. He must be an executive as well as a pilot, a navigator, an engineer, a meteorologist, and a radio operator. Qualification in all these phases of the work requires study, special training, and experience.

The technical nature of flying makes it almost essential for the flight officer to have an engineering foundation, and so a man with a degree in engineering is preferred. The operation of the motors, automatic pilot, instruments, navigation equipment, and radios, and the study of the theory of flight are much more easily understood if the basic principles of engineering are already known.

To get the special training and experience necessary for employment on an airline, the prospective flight officer has three alternatives at the present time. He can either go to the Flying School of the Navy, the Flying School of the Air Corps, or to one of the commercial flying schools approved by the Aeronautics Branch of the Department of Commerce. Today there are men flying on the airlines from all three of these sources, as well as some who learned to fly by experience and have grown with the industry. Present-day flying has become such a science, however, that a flight officer is now required to take a definite course of training.

Since the writer is more familiar with the training



at the Air Corps Flying School near San Antonio, Texas, it will be discussed here. This does not imply that training in this way is superior to other courses, although it is one of the best in the world.

The first requirement of any flight officer is good health and normal eyesight, and all pilots are given frequent physical examinations. After passing a rigid physical examination and the entrance requirements, which are a minimum of two years of college—or the equivalent—and good moral character, the prospective flight officer reports as a "Flying Cadet" to Randolph Field, located near San Antonio. Here he gets eight months' training of the one-year course.

The training throughout the year consists of classroom work and flight training. Courses in radio, navigation, theory of flight, airplane engines and instruments, maps, and meteorology are given. The primary flight training naturally consists of the fundamentals of level flight, turns, glides, tail spins, takeoffs, and landings.

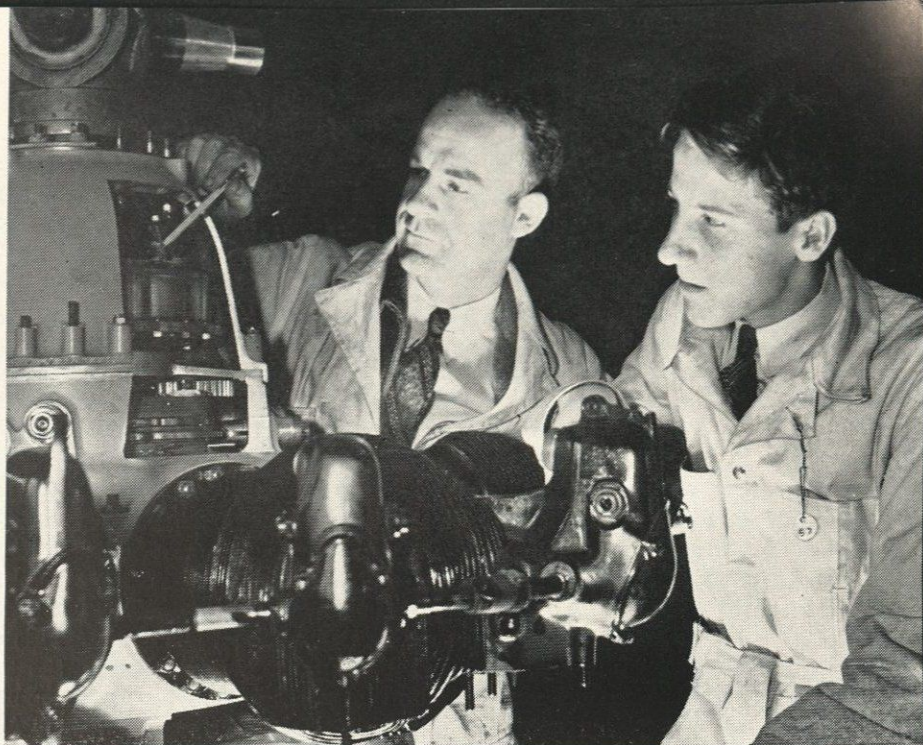
After the cadet has mastered these fundamentals to the satisfaction of his instructor, he is allowed to "solo" or fly without the instructor in the airplane. The average cadet makes his solo flight after seven to ten hours of instruction. However, he continues to receive "dual time" or instruction throughout the entire year. He learns to handle the airplane in any position and under many conditions.

As the training advances, cross-country trips are made wherein the cadet learns to apply his study of navigation and actually to conduct the airplane from point to point over the surface of the earth. The first trips are very short, but successive ones are made longer as experience is gained, until the final trip before graduation is about fifteen hundred miles.

In the latter half of the training at Randolph Field, night flying and instrument flying are introduced to the student. These require additional instruments and switches in the cockpit where the pilot sits. Larger and more complicated equipment is used as each new phase of training is presented. The first airplane the cadet flies probably has a half dozen instruments. From these few, our prospective flight officer will eventually advance to the one hundred and fifty or so instruments, switches, and controls in a modern bi-motored transport airplane.

After learning to take off and land at night, the cadet makes cross-country trips at night as well as in the day time. On cross-country trips he becomes familiar with the use of the radio in navigation and with the beacon lights established along the regular airways by the Department of Commerce. He also learns the Civil Air Regulations which govern airplanes in flight and at airports. Even though in the military service, the cadet must obey the Civil Air Regulations when flying over the airways or into commercial airports.

Instrument training is given to the student while he is in a closed cockpit and unable to see the ground



Cuts Courtesy Popular Aviation

"The technical nature of flying makes it almost essential for the flight officer to have an engineering foundation, and so a man with a degree in engineering is preferred."

or sky. The flying is done solely by reference to the flight instruments. This phase of flying is becoming more and more important in both commercial and military aviation. It permits navigation through clouds or storms when the pilot cannot see the ground, by the utilization of radio beams.

At the end of the eight months' training, if he has been fortunate enough to get that far, the cadet has approximately two hundred hours of flying. Only about forty to fifty per cent of the cadets reporting to Randolph Field are graduated. Most of those who fail are eliminated within the first four months. We will assume here that our prospective flight officer has been one of the fortunate cadets and is now ready for the advanced course at Kelly Field, which is also near San Antonio.

Up to this time, the training has been the same for all cadets, but at Kelly Field specialization is possible. Here each cadet is trained in one of the four branches of military aviation, namely, bombardment, observation, pursuit, and attack. Since these are of importance only to military flying, they will not be considered here; however, the cadet continues to make cross-country trips, to practice instrument flying, and to fly at night in addition to the specialized training.

All through the year of training, as progress is made, new types of airplanes are flown, and thus the cadet learns the characteristics of different designs and motors. Upon completion of the course, he is graduated with about three hundred and fifty hours of flying, mainly in single-motored airplanes. A small amount of bi-motored time is given each student.

Although our prospective flight officer now has three hundred and fifty flying hours and has been graduated, he is not yet ready for employment as a first officer on a commercial airline. These companies ordinarily require from six hundred to one thousand hours; there-

fore, he must spend another year or two in active military service to obtain the necessary experience.

After going to work for an airline, a flight officer must fly thousands of miles as a first officer or co-pilot before he is eligible to be a captain with a definite "run" or route. This period is far from being a dull and monotonous one, however, for the first officer is not merely "marking time." He is an active partner of the captain and actually does much of the flying on a trip. He must learn more about the Civil Air Regulations as they apply to scheduled air transportation and keep informed on changes and additions made to meet advancements in the industry. He also gets a broader knowledge of weather conditions from actual experience with them, and can thus make use of the theory of his meteorology. He learns the procedure of dispatching airplanes from the various terminals along the route and to make flight plans that will provide the safest, quickest, and most comfortable ride for the passengers.

In addition to all this, the flight officer must practice instrument flying until it becomes almost automatic. Definite procedures are followed at each airport for approaching and coming down through the clouds during fog or storm conditions. At the present time, there must be a definite "ceiling" or distance

from the ground to the base of the clouds before a landing can be made. Thus the pilot is able to see the ground before the actual landing. But in the near future "blind landings" will be a standard part of scheduled flying. A blind landing is one made with the aid of instruments and radio but without visual reference to the ground. Actual tests on blind landings under simulated conditions of zero ceiling and visibility are now being conducted and have proved such landings feasible and practical.

The Department of Commerce has definite rules regarding the working hours of a flight officer. He may not fly more than one hundred hours per month, and not more than a total of one thousand hours per year. Under ordinary circumstances, the average scheduled time is about eighty-five hours per month. This is the actual time in the air and does not include the time spent preparing flight plans and making out reports.

After a flight officer has become a captain, his training still goes on, for he must fly new equipment when the airplanes now in service become obsolete. Thus, it is a constant process of "keeping up" with advancements in air transportation, and this is no small job in an industry which is growing as rapidly as aviation.

At Last ... Colorado Trained Pilots

JUST before the first of the year, President Roosevelt announced as a part of his defense program, a student pilot training program designed to build up a huge reserve of men capable of handling airplanes. In time of war, men so trained would have a good background for advanced training in combat flying.

The President's program provides for the training of 20,000 men annually in several hundred of the nation's colleges and universities. This training is to be fundamental in nature. With no combat instruction given, the emphasis will be placed on civilian aspects. Each student will receive 50 hours of dual instruction and solo flying—more than enough to qualify for a private pilot's certificate. Applicants for the training will have to meet the age requirement of 18 to 25 years. They must be able to pass the physical requirements necessary for a commercial pilot's certificate. At the end of the training period, the majority of trained men will remain as civilian pilots, a small percentage being admitted into the army and navy reserve.

The University of Colorado has definitely been selected as one of the nation's schools which will include the student pilot training course in their curricula, providing congress approves a \$10,000,000 instructions program, announced Norman A. Parker, assistant professor of mechanical engineering upon his return from Washington, D. C., last month.

It is the present plan of the university to obtain their planes from the Ray Wilson Flying School in Denver. The training planes will be small Curtis and Cessna ships. Only five students will be allowed to

each plane. It will probably be necessary to use the present municipal field in Boulder as the site of the training field. However, before this field can be used it must be enlarged and modernized. It is believed that the work of enlarging the airport will be done either by the city of Boulder or by a WPA grant under the supervision of the Civil Aeronautics Authority.

It will be necessary for the men who take the training course to take about 360 hours of ground school instruction. This work will start with a review course in mathematics, and will include courses in theory and laboratory work on airplanes and the theory of flight, aeronautical engines and instruments, meteorology, navigation and maps, and the use and care of the parachute. Each of the students will carry a \$3,000 insurance policy, to be paid for in their fees to the university. Through the efforts of the CAA, insurance rates for the students have been reduced from \$11 to \$5 per \$1,000.

Contrary to popular belief, the course will not be restricted to engineering students, but will be extended to take in any other students who can pass the necessary qualifications. A certain quota of high school graduates who are not attending the university will also be included in the program. Another course will be given in Denver at the Ray Wilson Flying School by the University Extension Division.

Inclusion of the University of Colorado in this program was largely due to the excellent co-operation of the Denver Chamber of Commerce, Capt. Ray Wilson, and the congressmen from the mountain sector with the representatives from the university.

Engineering . . .

In an effort to be of some assistance to the engineering students, we have undertaken the following experiment. One of the more outstanding alumni of each major engineering department has been asked to write on the engineering profession as he sees it. The results of their efforts and ours are immediately following. By reading this series of articles, the freshmen, we hope, may be able to extract some guidance in choosing their specialized field of engineering. Upperclassmen, we believe, will gain reassurance in their choice of engineering as a career, or at least as a training. At any rate, the time of reading will be time well spent.

As a chemical engineer sees it . . .

By Dr. Harry A. Curtis, ch. '08

Dean, College of Engineering, University of Missouri
Formerly Chief Chemical Engineer, Tennessee Valley Authority

THE ART of chemical manufacturing came into existence a long time ago. Some of the earliest written records describe chemical processes which were already well developed and had evidently been in use for a long period. No one knows just when glass was first made, or natural dyes prepared for use, or metals first extracted from their ores by chemical processes, or beverages prepared by controlled processes of fermentation.

Chemical plants of a primitive type were planned, built, and operated hundreds of years ago. There can be no doubt that the men who engaged in these enterprises created ingenious contrivances, just as engineers do today. Modern chemical engineering differs from the early art practiced by manufacturers of chemical products primarily in two respects. First, empirical knowledge of materials and of ways of processing materials has enormously increased. This empirical knowledge has been recorded and arranged in orderly fashion so as to be readily available and easily used. Second, the older sciences have been advanced greatly, and new sciences have been developed. Through application of the data and principles of such sciences as mathematics, chemistry, physics, etc., chemical processing can now be controlled more accurately and equipment for such processing contrived with more assurance as to practical performance. Modern engineering of every sort is based on the sciences and on empirical knowledge accumulated out of the experience of the past. No engineering enterprise can be accomplished without drawing on both sources.

Any brief definition of a profession or a field of

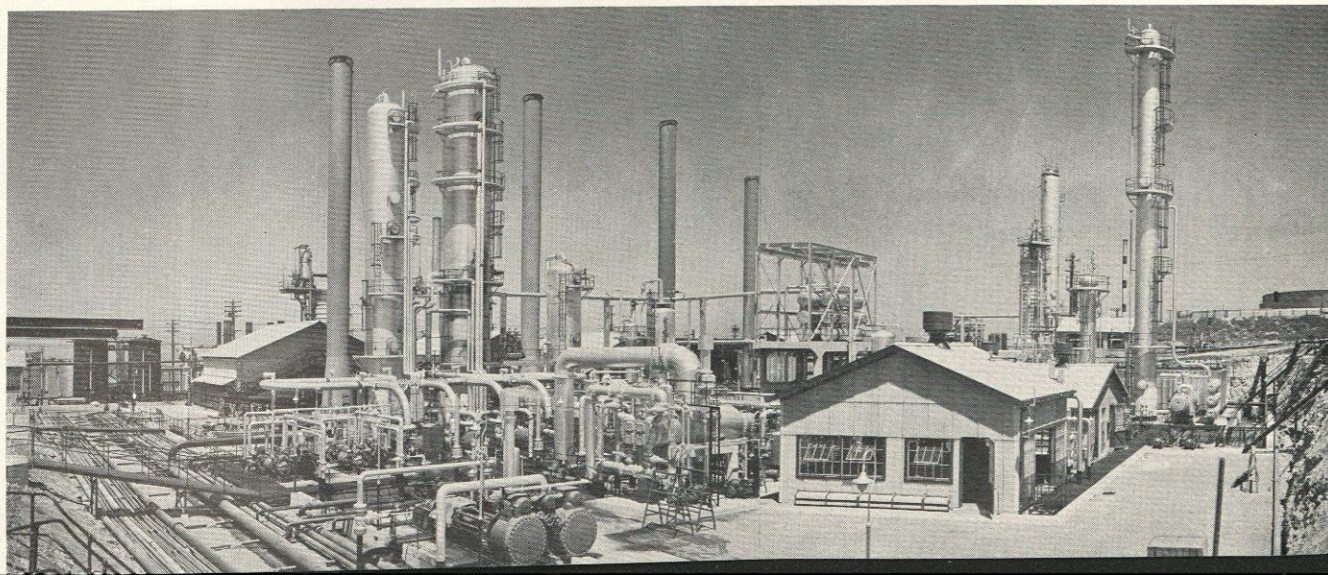
engineering must necessarily be incomplete and therefore somewhat unsatisfactory. Many such definitions of chemical engineering have been attempted. The following is a fair sample:

Chemical engineering is that branch of engineering concerned with the development of chemical processes and with the design, construction, and economical operation of chemical plants and equipment. Chemistry, physics and mathematics are its underlying sciences, and economics its guide in practice.

The chemistry of what may eventually become a chemical manufacturing process is developed in a chemistry laboratory. Chemical engineers may, and sometimes do, spend their days in a chemical laboratory, but it is not their natural environment. The chemical engineering curriculum properly includes a liberal amount of chemistry, but the chemical engineer who elects to compete with the chemist in the chemist's field should recognize the fact that he labors under a handicap. Between the chemical laboratory work on a proposed process and a successful plant applying the process is a very broad field wherein the chemical engineer may exercise his talents and find his career. Of course, no profession can be fenced in and posted against trespassers. Chemical engineers do follow chemistry, while chemists pick up enough engineering to become fairly competent chemical engineers; and either may become an insurance agent by choice or necessity.

Chemists and chemical engineers working together in mutual good will in the development of a process

*Courtesy
Steel*



create an ideal arrangement. The chemist, left to his own devices, will seldom develop all the information the chemical engineer needs. For instance, the chemist will note that a reaction is exothermic. Immediately the chemical engineer wants to know how much heat is liberated per unit mass of reactants, for only with such information can he design a suitable reaction vessel. The chemist will note that a reaction gives "a good" yield of product. The chemical engineer, knowing that eventually he must manufacture and sell the product, wants to know "just how good." The needs of the chemical engineer for quantitative data are, therefore, a guide in the chemical laboratory.

The chemical engineering development laboratory is quite different from the chemical laboratory. Glassware is replaced by steel and alloys and ceramic materials. Filtering is no longer done in a funnel, and stirring is no longer done with a glass rod. The scale of operation is larger, grams become pounds, not because there is merit in handling pounds or tons as against grams, but because engineering equipment is better suited for the handling of larger quantities. The chemical engineering laboratory uses what is called semi-works scale equipment and sets up semi-works scale or pilot plants. The objective of the chemical engineering laboratory is to develop information on which a full scale plant may be designed. As someone has rightly said, the chemical engineering development laboratory enables the chemical engineer to make his mistakes on a small and therefore inexpensive scale.

Chemical plant design is a field in which the chemical engineer may find interesting work. Ordinarily the chemical engineer will not design buildings and will not often design such things as gears, motors, internal combustion engines, or any of the hundreds of so-called standard pieces of equipment available on the market. His design starts with the so-called "flow-sheet", wherein the sequence of manufacturing oper-

ations is represented diagrammatically. The quantities of material to be handled by each piece of equipment are calculated, the heat effects at various points in the process considered. Then comes the selection of standard equipment such as, for instance, pumps of the proper characteristics and constructed of suitable materials. Every motor, still, evaporator, dryer, grinder, conveyor, etc., has to be selected with reference to the particular service required. And in practically every chemical manufacturing plant there are special pieces of equipment required which must be designed completely.

A new chemical manufacturing plant seldom operates precisely as its designer expected. The chemical engineer is particularly qualified to iron out the difficulties almost inevitably encountered in a new plant, not only to bring each particular piece of equipment up to smooth and effective operation, but to determine the optimum conditions of operation from an economic standpoint.

A discussion of chemical engineering would not be adequate if the economic phase were not emphasized. This is not alone a matter of raw material costs, markets, plant location, competition, labor, and all those items that ordinarily come under consideration in planning and managing an enterprise, but economic considerations are given weight in all the technical phases of chemical engineering. The ultimate criterion by which every arrangement in a plant is made and every piece of equipment selected and every schedule of operation decided is that of cost. The industrial world is a competitive one and a ruthless one in which the uneconomical process is inevitably eliminated.

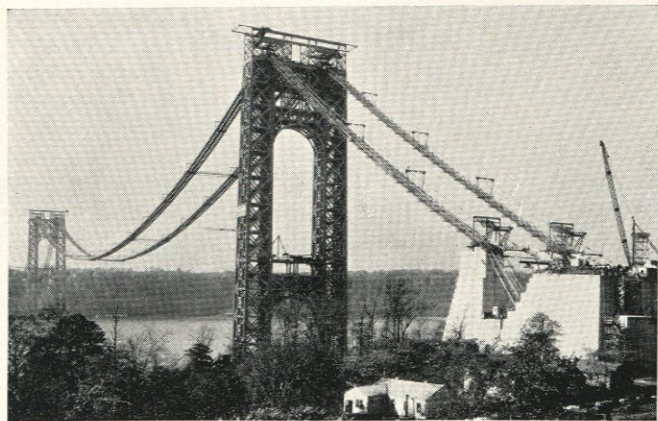
Chemical manufacturing enterprises require management, and in this field the chemical engineer has been notably successful. And, finally, some chemical engineers elect to teach. As one uncharitable "wag" put it, "them as can, do; the others teach."

As a civil engineer sees it . . .

By Ivan C. Crawford, c. '12

Dean, School of Engineering and Architecture, University of Kansas

AS a vocation, civil engineering antedates all other engineering professions with the exception of the military branch, which in itself has been and is largely



the application of civil engineering principles to the art of war. So great, however, has been the advance of scientific and technical knowledge, that several new and quite distinct engineering vocations have come into being and then developed into separate professions. To the general public, the latest development is always the most publicized and, consequently, the most popular, although older branches continue to expand and to be as fundamentally important and as interesting as ever.

BREADTH OF FIELD

Civil engineering, as we know it today, is usually considered to embrace the subdivisions of structural (steel, concrete, wood), sanitary (water supply and water disposal), hydraulic (including irrigation and water power), transportation (railway and highway), river and harbor, and municipal engineering. Geodetic surveying, the precise location of points on the earth's

surface, is another member of the family and one frequently overlooked. Also, wherever structures of any kind are built, the contractor is a most important person, and usually—today—we find that he is a man with civil engineering training and is frequently a well qualified member of the profession.

Individuals of various occupational preferences may find congenial work within this field because of its breadth and the diversity of the component specialties. As one may infer from the subdivisions enumerated above, employment is found in many different types of organizations, such as the United States Geological Survey, the War Department, Bureau of Reclamation, in state highway departments, with railroads, structural steel companies, manufacturing companies, petroleum companies, with firms of consulting engineers, and with contractors' organizations.

Considering now types of work, the civil engineer may find employment to his liking in research departments, in the selling of equipment and materials, in the design of structures, in construction work, in the operation of various types of public utilities, in management, and occasionally in conducting an engineering business by himself or in association with other engineers.

Just as other engineering graduates, the civil engineer frequently finds enjoyable employment in managerial work and thus becomes somewhat removed from the strictly technical phases of his profession. Such positions are generally secured because of demonstrated proficiency in technical work and the possession of the necessary characteristics. On account of the rather broad nature of the civil engineering curriculum, graduates who so desire, frequently uncover opportunities in other occupations more to their liking, and find it quite possible to use their college training to great advantage.

OPPORTUNITIES

Are the opportunities as plentiful now as they were thirty years ago? I think the answer to this question must be in the affirmative, although I know that there are those who will disagree. With the exception of one or two years in the depth of the present depression, civil engineering graduates have been more easily placed in recent years than in the period 1910-1917. Furthermore, the financial rewards for the young engineer—his real wages—are somewhat greater than they were thirty years ago.

Where will these students, recent graduates, be



Courtesy Technology Review and The Reclamation Era

twenty-five years from now? If the past is of any value in forecasting the future, we will find them in responsible positions, the larger percentage—perhaps sixty per cent—in work closely connected with the course pursued in college, a total of say seventy per cent in engineering, and probably twenty or twenty-five per cent in something entirely outside the engineering field. But very few will be rich. Practically all will have been able to raise and educate a small family according to fairly comfortable standards.

PREREQUISITES FOR SUCCESS

But what does the profession demand of its members? In the first place, we must recognize that the attainment of success in any vocation demands close application to duty and continual study outside of the routine of the day's problems. Having received a thorough training in fundamental principles, the young civil engineer must pass through a period of training and experience gained in subordinate positions during the first few years. He must read his technical journals so as to keep pace with current developments; in addition, he must broaden and improve his general education by a carefully prepared reading plan. He should remember that by close observation and study he will gain more from his technical experience. Further, he should ally himself with his major technical society. While many of us may believe more or less in our "lucky stars," figures show that progress is usually made by those who are *prepared* to take the next step.

Civil engineering has experienced the mellowing influence of age; yet it has maintained all of its virility and every day witnesses a broadening of the field. To the young engineer, enterprising, well trained, and with the capacity to develop and absorb further training, the future holds as much promise as at any other time in the history of the profession.

As an electrical engineer sees it . . .

By Frank M. Starr, e, '28

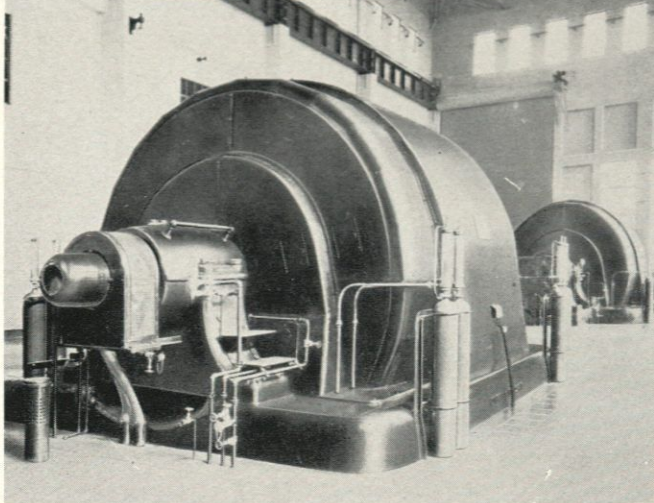
Selected as America's outstanding young electrical engineer of 1936. Mr. Starr is employed in the research department of the General Electric Company.

GREEN PASTURES

THIS question of green pastures is eternally with us. The budding student asks himself, "Shall I be a doctor, a lawyer, or an engineer, or something else?" After receiving considerable advice from many unqualified sources and analyzing his own interests,

abilities, and aptitudes with varying degrees of precision, he probably chooses the one field in which he thinks he can make the most money.

Suppose he has decided on the "lucrative" field of engineering. After about a year of study he may find it necessary to rationalize himself right out of



engineering into something else, but if he sticks, he again must make a decision, this time on the branch of engineering he is to follow, and still later, on the specialty of that branch, and so on. These sequential decisions can never be one hundred per cent right, subject as they are to so many uncontrollable influences. Yet they are important because they largely determine a man's whole career and his ultimate success or failure.

For Brother John to decide on being a lawyer because he happens to know of a lawyer who earns \$100,000 a year and doesn't recall knowing any engineers in that class, is, we all know, pure folly. Nevertheless, it must be recognized that all fields do not offer uniform opportunities at any one time. All pastures do not continue to be equally green. But, fortunately, most human beings have a sufficient range in talents to allow them some degree of choice. They are not necessarily doomed to disaster because they happen to have been born in the wrong era.

And now, you ask, "What about the verdure of the engineering pasture?" Mr. L. W. W. Morrow in the November, 1938, issue of *Electrical Engineering* gives a good answer to this. He states, "When the industry looks over its records to find the type of man to train, the answer is unmistakably the young college graduate in engineering. These men have proved versatile enough to fill all technical and administrative positions. They may not be perfect, but experience indicates that they are the best available. Data on fifty-four thousand officers of some five hundred typical industries showed that the average college man is seven times more likely to be an official than the non-college man, and that the engineering graduate is thirty times more likely to be an officer than the graduate of a non-engineering college. This advantage of the engineering graduate over the non-engineering graduate applies to all positions. He has twelve times the chance to become president, five times the chance to be treasurer, thirty times the chance to hold positions in production, 174 times the chance in engineering, and twenty-four times the chance in sales." This ought to be thoroughly encouraging to the individual who feels he qualifies with some degree of engineering talent.

But the opportunities of the engineer in the future are going to be much broader and his responsibilities greater than has been the case in the past.

Our business and industrial life have become extremely complex. Moreover, our economic and social affairs have become chaotic and confused. The many complex problems of business, industry, and government no longer lend themselves to diplomatic or legal solution. If these problems are to be solved, it must be by thorough and unbiased analysis, and by men who know how to think and think clearly. Who, by the very nature of his training, is better suited to solve the many problems of today than the engineer?

In December, 1936, Dr. Nicholas Murray Butler, President of Columbia University, in addressing the Society for the Promotion of Engineering Education, said, "The key men to whom society will turn for the next century or two for the solution of the gravest series of problems the world has faced in two thousand years will be the engineer broadly trained in the social as well as technical sciences. The lawyers can do nothing for us now. All other careers are partial and special, and it is to the engineers we must look for guidance."

And now you ask, "In this unusually fertile engineering pasture, which patch is the greenest?" That is carrying things a little too far—and, anyway, maybe I am prejudiced; but just as a footnote, let me slip in a bit of enthusiasm for the electricals.

We have good evidence of an expanding electrical industry. The week ending in December 17, 1938, established an all-time record high electric output in this country of 2,333 million kilowatt-hours, which was broken again the following week with 2,363 million kilowatt hours. This increase in power usage means that our engineers have continued to find more new uses for electricity. Moreover, good statistical data indicate that by 1948 the electrical power output in this country will have further increased fifty per cent. Think of the research, design, and construction involved in introducing an additional one billion kilowatt hours to the power consumption of this country, and think of the associated opportunities for electrical engineers.

Last week I attended the Winter Convention of the A. I. E. E. At this meeting were presented some eighty-eight technical papers—perhaps the largest number ever presented at any one meeting. These, in addition to about one hundred others presented at other meetings during the year, represent in part at least all of the phases of technical development in the electrical industry for 1938. I am not going to attempt to even outline the progress in electrical art in 1938, but let me assure you it was amazing. The year 1938 saw the first high-speed turbine-electric locomotive put in service; it saw television introduced on a commercial basis; and it saw the fluorescent mazda lamp introduced. Many other important developments could be enumerated.

It is significant that a great industry which continues to produce ever-increasing new developments is not dead. It is alive and growing and is a fertile field for able engineers.

As a mechanical engineer sees it . . .

By Garwood C. Andresen, m, '34

Branch Manager of the York Ice Machinery Corporation, Farmington, Connecticut

ENGINEERING IS ALSO A GAME

CHESS playing is a game of planning. The first move is made only after a scheme of final play has been mentally pictured. If we correlate engineering with chess playing, we find that it is also a game of planning. The rules for each are the same, but there are fewer winners in the engineering game. The reason is that some players start out with no final plan, and others find a stalemate along the way. Then too, there are some who play but never realize that it is a game. Perhaps the greatest mistake has been that some have failed to obtain the necessary information before entering this fascinating game of engineering.

It is generally conceded that the industrial field of engineering belongs to the young, ambitious man. There are, however, the older executive engineers who direct the activities and progress of the plebe engineer. It is the executive position that we eventually have in mind for our own; and the eventuality of this mental desire should be created early, as we shall soon observe.

The high-speed pace of certain industries may require that we prepare ourselves for a responsible position in less than ten years. The question is, how are we going to accomplish this end? Efficient, fast work is the answer. Not only will it be necessary to work many hours beyond the usual day; but also we must shoulder the pressure of the responsibility that goes with it. Work will increase with progress until we believe that it is humanly impossible to accomplish it. This work usually varies in magnitude and occurs in cycles.

Let us assume that two years have elapsed on our first job before a promotion is executed. Immediately, the new position requires efficient, fast work with long hours. This work will be continuous until we have mastered every detail thoroughly. If we have properly prepared ourselves after the two years of work, another promotion will, no doubt, be offered to us. Assuming that we have accepted the new position, we have then contracted for more efficient, fast work during the next two or three years. Again and again this procedure will take place before our executive position is in sight. How many times this must occur will depend entirely upon our ability and the needs of the particular industry in which we are engaged.

The new fields of industry offer responsible jobs to the young man because he is adept at learning the engineering intricacies in a shorter time. When placed in their proper sequence, air conditioning, refrigeration, automatic control, steam specialty, and automotive engineering represent the more recently active fields of mechanical engineering. The first mentioned above is considered the newest field at present, requiring young blood to such an extent that the supply is far below the demand. Hence, progress will always

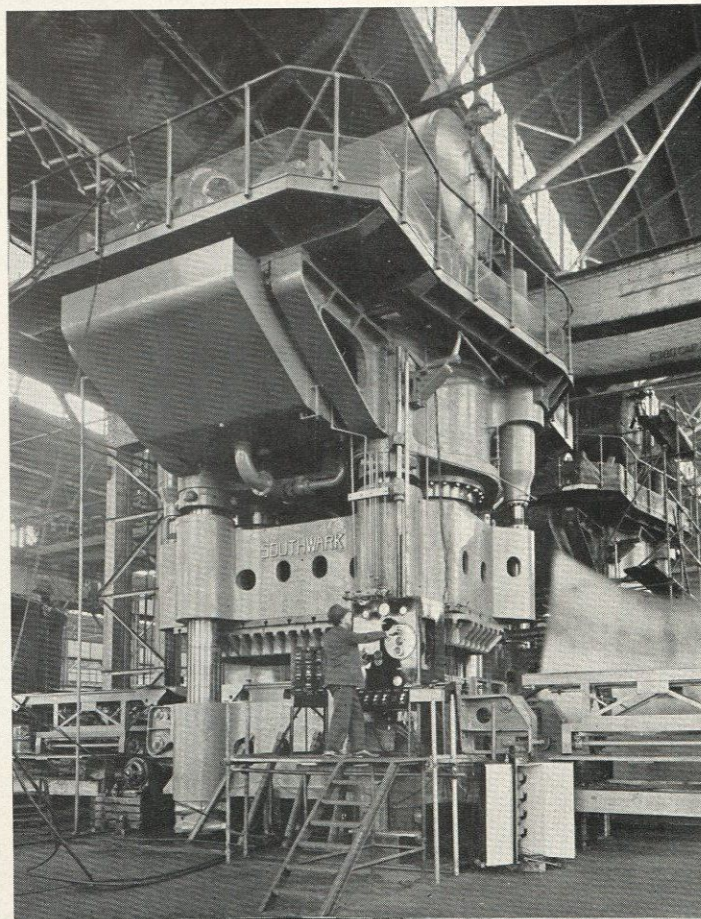
be rapid in the newer fields; and this factor should govern our selection of a vocation.

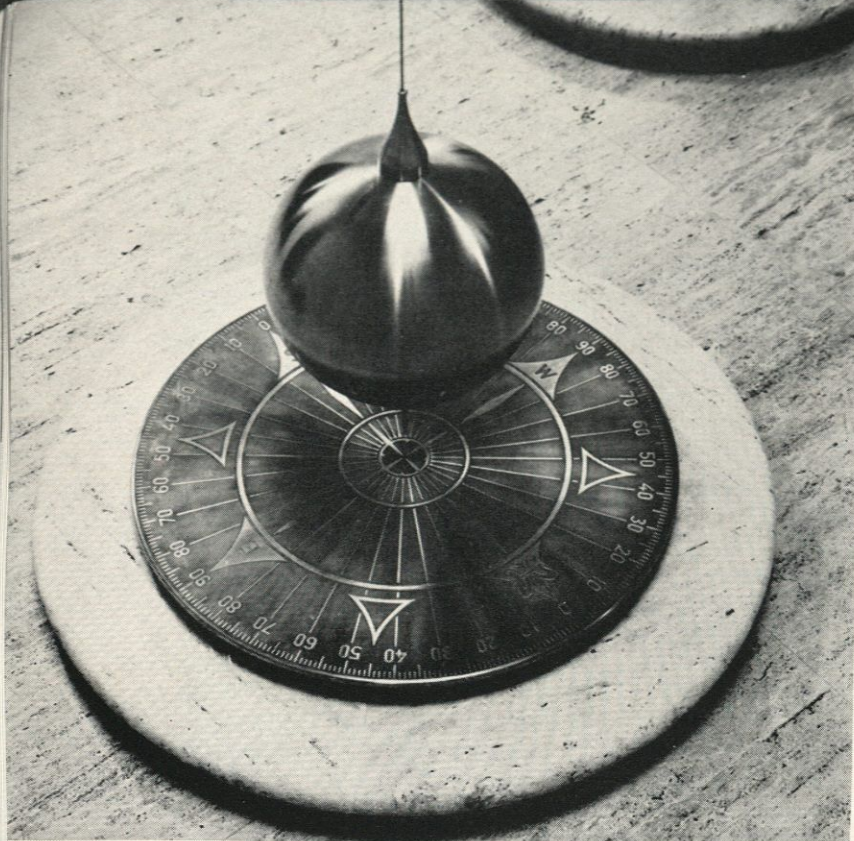
If we choose the suitable field and estimate two years to a promotion, with at least five promotions in all, we will have worked ten years. In that time it would be safe to assume that we have worked five years at more than full pace and five at the normal expected rate. This deduction is worthy of our attention, for it actually occurs in the industrial world today.

We have just investigated the background of the game of engineering. To win in it we must consider two things: time and opportunity. Let us try to choose our first job on the basis of applying our knowledge most effectively. The latter is very important because a "job-changer" very seldom uses his time efficiently, let alone effectively. Next, we must pick out the executive position that we desire, and then estimate the number of moves that it will take to acquire it. Let us assume that the other fellow figures that he will require six promotions in all. If we make a careful study of the situation, estimating the time we are going to allow ourselves for each step, it may be found that by taking advantage of every opportunity, we can make the trip in five moves with less time. We are the winners, then, if we set our pace accordingly and play the game squarely, regardless of the ups and downs.

When we become an expert at the game, it is truly very interesting. Competition is always keen because there are so many skillful players. Remember, too, that the enjoyment comes from our many accomplishments. It is much like all other games; the world recognizes with highest honors a good player; and so with engineering, if we play it well, success and recognition will be ours.

Courtesy Steel



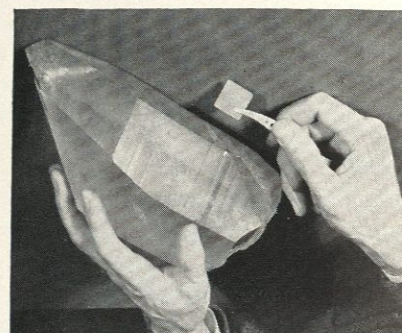


*Courtesy Compressed Air Magazine
Photo by Gladys Muller*

Proves earth turns. Of all exhibits in The Franklin Institute at Philadelphia, Pennsylvania, few attract more attention than the Foucault Pendulum which swings majestically back and forth in its 10-second period in the main stairwell. The sphere weighs almost a ton, and the wire supporting it is 85 feet long. The great ball, in its quiet periodic swing, changes its course considerably in a day's time. In this way the pendulum proves visually that the earth rotates on its axis every day.



NEWS



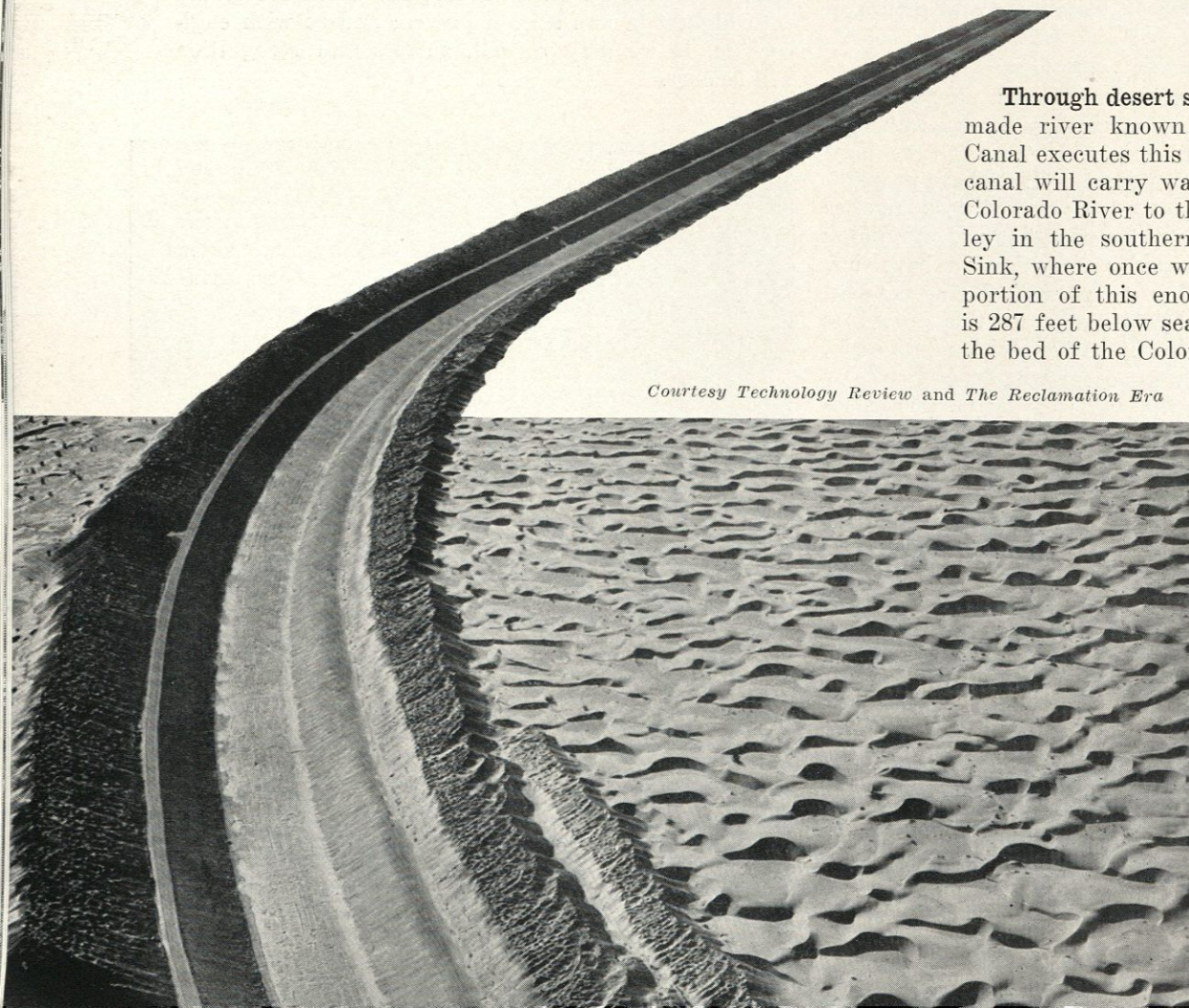
Courtesy General Electric

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Through desert sands. The great man-made river known as the All-American Canal executes this impressive sweep. The canal will carry water diverted from the Colorado River to the great Imperial Valley in the southern part of the Salton Sink, where once was ocean. The lowest portion of this enormously fertile basin is 287 feet below sea level, 300 feet below the bed of the Colorado.

Courtesy Technology Review and The Reclamation Era

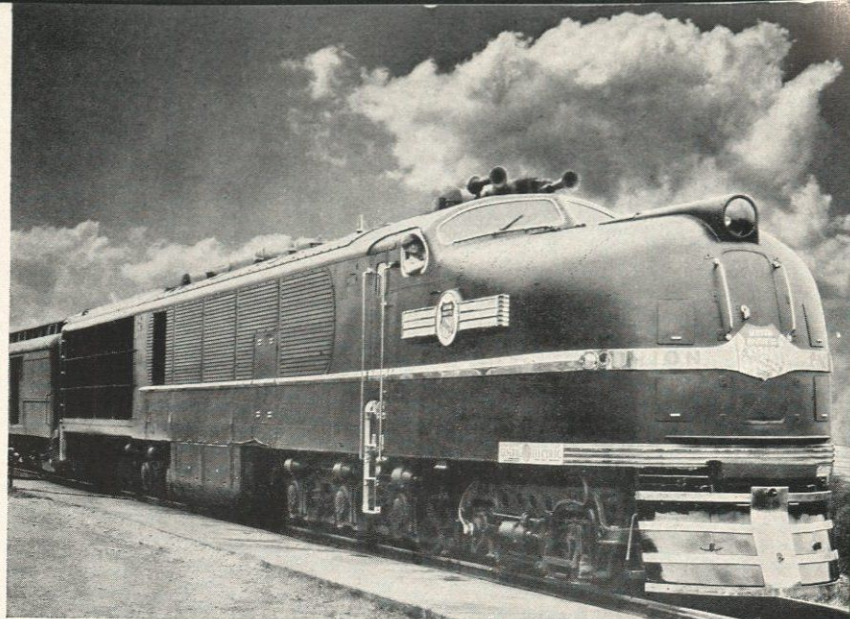


BRIEFS

Speed Demon. Twenty million vibrations and is the phenomenal mechanical speed by a tiny quartz crystal used in a new oscil-
 developed by the General Electric Company for
 constant frequencies in radio transmit-
 e new oscillators enable radio broadcasters
 their transmitters to assigned wave lengths
 g out programs or messages. The crystal
 e is about 15 mils thick and approximately
 square.

enum. Below. Rock drilling in a molybdenum
 t. Flotation cells for molybdenite. The flotation
 own here are of the mechanical agitation type.
 the machine is a rectangular tank divided into
 partments by means of partitions. In each cell
 mpeller which maintains the ore particles in sus-
 the pulp, disseminates the air through the pulp,
 as an emulsifier. The Climax mill treats about
 of crude ore per day and produces about 80 tons
 de molybdenite concentrate.

*Courtesy Industrial and Engineering Chemistry and Climax
 Molybdenum Co.*



Courtesy General Electric

The latest thing on wheels. A new type of stream-
 lined locomotive, carrying its own steam-turbine
 power plant, capable of doing twice the work of the
 conventional locomotive for each pound of fuel, and
 making three times the mileage without stops for
 fuel or water, is a development brought about by
 the General Electric Company in collaboration with
 Union Pacific engineers. The essential features in-
 clude a geared turbine-electric generating unit sup-
 plying electricity for operating six large driving
 motors on each of the two cabs. The locomotive is
 capable of speeds up to 125 miles an hour.



Editorials...

Go East, Young Man

DAY after tomorrow a small group of Colorado's 1939 yield of engineers will be speeding eastward to Chicago, Cleveland, Pittsburgh, and New York. That group, by writing from forty to one hundred letters apiece, has arranged to meet and interview employment supervisors of several important manufacturing companies. They have reason to expect that sometime during their trip each can meet the man who will make possible for them their long-hoped-for job.

The members of this group are thoroughly sold on their scheme of seeking employment directly at the source of activity in their field for several reasons. In the first place, they do not believe that employers hire men by mail. If the tables were turned and they were personnel managers, they most certainly would not risk valuable time and money on a prospective employee who made application from a distance of several hundred miles, when plenty of talent already personally examined was anxiously awaiting call. Employers are perfectly justified in requesting that they see a man first, and hire him afterward.

Then, too, the increased chances of employment far offset the cost of making such a trip. Each member of this traveling group was originally confronted with the problem of financing his expedition. However, when he realized that a job might be awaiting him somewhere along the road to New York, that **\$75 could buy a job**, he found a way to get the necessary funds. A good job is cheap at three or four hundred dollars.

Sometimes engineering graduates give as an excuse for their slowness in going after a job the fact that they don't like living conditions elsewhere. The members of the group think this a poor excuse for young men. A healthy, youthful engineer can easily adjust himself to his surroundings in practically any modern United States city.

Colorado University is somewhat isolated as far as visits by engineering personnel men are concerned; therefore, it is important that Colorado engineers go after their jobs, not wait for the jobs to come after them.

H. E. P. S.

Problem Child

THERE is a new kid on our street. His name is Aviation Industry. He is an awfully nice fellow, always striving to get along with everybody, but up until recently he has had quite a bit of trouble with

his family. His big brother, Automobile Industry, has bullied him all his life, and as a result he is what the other kids call a "runt." His Uncle Sam and even Mother Congress have made little or no effort to shield him from his nefarious brother. However, the other day President Roosevelt announced that he wanted a bill passed which would enable 100,000 students to receive flying instruction within the next five years and which would entail the expenditure of approximately \$50,000,000. It appears virtually certain that this bill will be passed by Mother Congress.

Thus begins a "new deal" for Aviation Industry. This program alone will call for the production of many new planes. Since more men are learning to fly, more men will also be in the market for a plane of their own. It is imperative that a good low-priced ship be placed on the market in the next few years. Following this same line of reasoning, one large manufacturing concern plans to double its research staff next year. This company alone plans to take 250 college-trained men and place them in its research plants before 1940.

We like Uncle Sam's new attitude toward Aviation Industry. It is certainly lamentable that he has not given Aviation some assistance in the past. However, Aviation shows promise of developing rapidly under this impetus and might easily become one of the largest and strongest members of the Industry family within the next decade.

S. A.

Hey, Freshmen—

WITH the next issue, May, 1939, a new staff will assume the responsibility for the publication of the *ENGINEER*. It is, then, a most opportune time for the freshmen—and sophomores—who are interested in publication work and the *ENGINEER* to take steps to become affiliated with the staff.

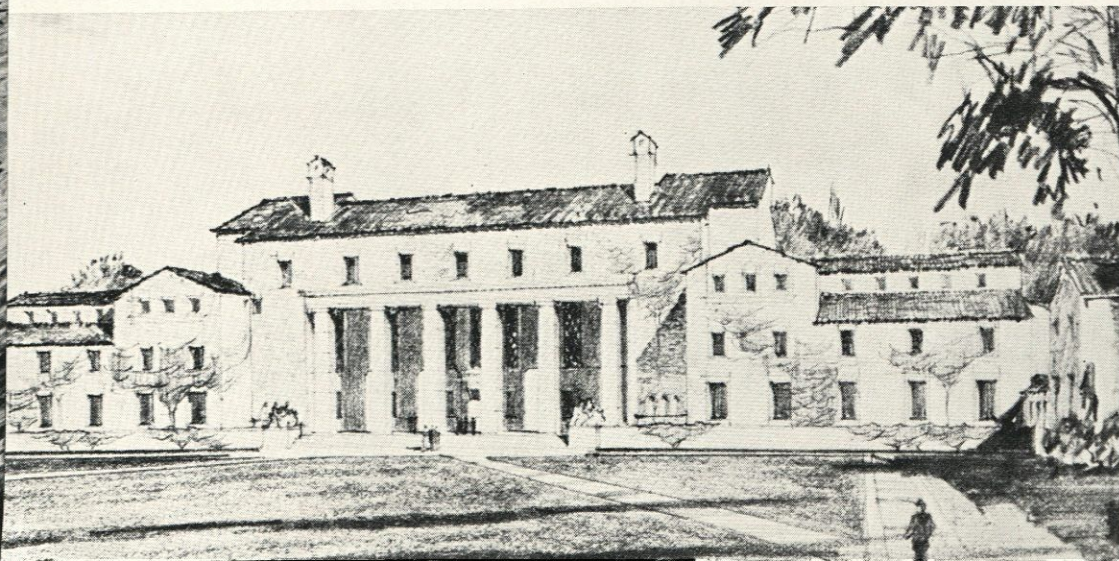
There are no tryouts. To be listed with the staff, one merely signs his name. To stay listed, however, one must show ability, willingness, and co-operation.

We heartily recommend the *ENGINEER* as the most important extra-curricular activity an engineer can enter from the standpoint of benefits received. Not only is the work interesting and instructive, but the experience gained may, as has been the case in the past, be an important factor in determining one's future employment.

So, gentlemen, come in and see us, room 127, Engineering Administration. We need you; how about it?

As a matter of general interest, we here print the architect's drawing of the new \$500,000 library now under construction.

Courtesy the Colorado Alumnus



Building the New York World's Fair

By James H. Lear, c. '39

THE New York World's Fair has as its purpose the commemoration of the one hundred and fiftieth anniversary of the presidential inauguration of George Washington. It is, however, more than the commemoration of a great historical event. It is the "World of Tomorrow" as distinguished architects and engineers have conceived it.

Early in 1936 the idea for such a fair was officially begun through legislation by both the State and City of New York. On October ninth of that year, the plan was first drawn up and published. Since that time it has undergone but few changes. Some idea of its immensity may be gained from the fact that it provides for all the needs except shelter for a city with a population of 800,000.

After the plan was authorized, the first problem encountered was the choice of a suitable building site. Demands on such a site were that it be large enough to accommodate all the structures, and that it be in close proximity to New York City.

In Flushing Meadows, an area already partly owned by the City and intended to be set aside for parks, the engineers found an area which satisfied both demands. The Meadows extend from Forest Hills on the south to Flushing Bay on the north, a distance of about a mile and a half. At Forest Hills they are 2,000 feet wide; at Flushing Bay, about 5,000. In all they encompass an area of 1,200 acres. As to location, the Meadows are located at approximately the geographical as well as population center of New York. It would be difficult to find a more ideal spot on which to build the Fair.

The area was originally a marine swamp with organic clays and silts extending to a depth of sixty to eighty feet. Used as an ash dump, in some places the ashes caused a sinking of thirty to forty feet, with resultant lateral movement in the silts. Prior to any development in the area an extensive soil study was made. Borings were taken at intervals of one thousand feet each way, and results showed that the soil was a mixture of silt and clay of about three parts of water to one part of solid. When disturbed or remolded, the soil was extremely unstable, and even when undisturbed, it had as low a bearing value as that of three hundred pounds per square foot. Further tests showed that all grades had to be limited to three per cent to prevent mud waves. Investigation of existing structures revealed that because of the lateral movement of the earth, the main difficulty was in grading and laying of foundations.

The first step to be taken, both for the Fair and for the development of the future park land to follow, was the filling of low-lying areas. Filling raised them above the water level and insured dry ground for the foundations and the planting of vegetation. From the 50,000,000 cubic yards of ashes that had been dumped there, material needed for filling was drawn. Care had to be taken in laying the fill so as to not

disturb the soil and thereby decrease its bearing value. By laying the fill material in layers not exceeding four feet—the upper layer at no time coming within one hundred feet of the face of the lower level—the bearing value of the fill was preserved. Because of their availability, high salvage value, and less danger of a major breakdown, trucks were chosen to transport the material. After several months of work it was found that a volume of cut was giving less fill than expected. This was due to the porosity of the ash pile, to the occasional hollows where internal fires had burned, and to the compaction of the fill by the heavy trucks. Consequently, some adjustment and additional fill were found necessary. In general, the grading operations proved successful, with no lateral movement except in a few isolated spots.

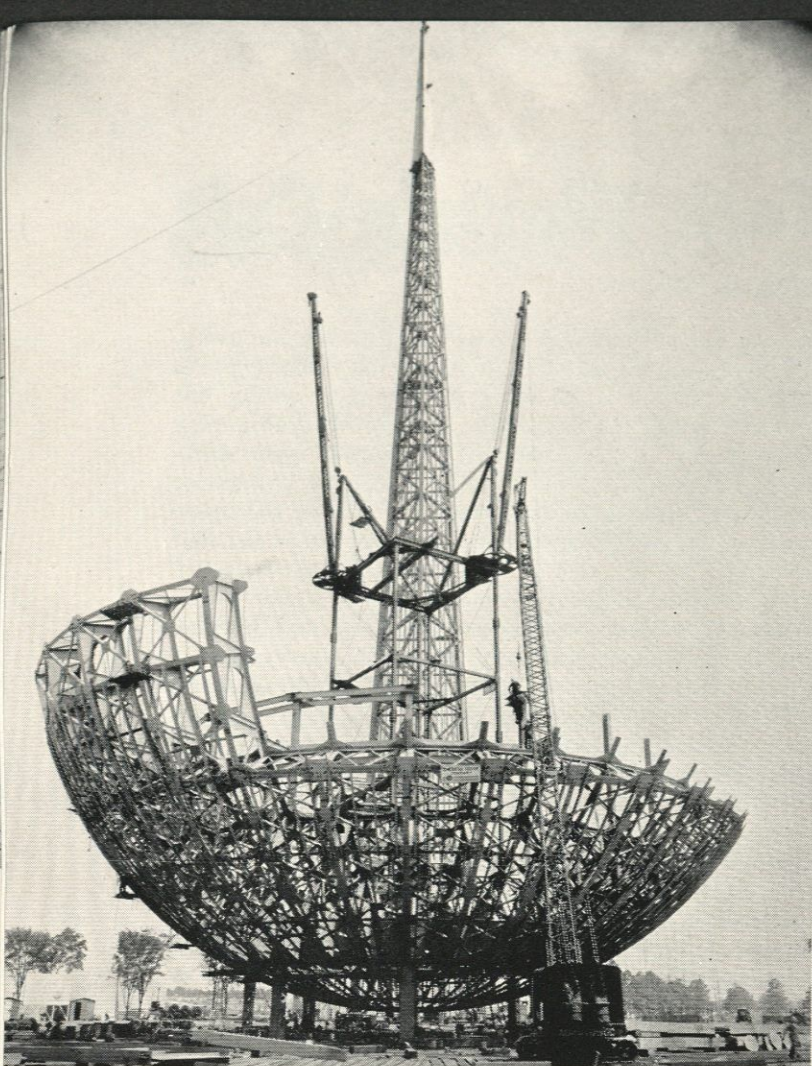
The foundations for the Fair structures are of two types: those used for permanent and semi-permanent structures—structures which are to be used in the park as well as for the Fair—and those used for temporary structures. A complete report of the soil conditions showed that the top seventy feet of the marsh consisted of organic silts and clays, with a bed of sand, gravel, and clay extending to bed-rock about four hundred feet below the surface. In some places it was found that a bed of peat about fifteen feet thick separated the two beds. After the grading operations were completed, investigation showed that on top of the ash-dump there was still a good thickness of ashes—a natural place to build the larger Fair buildings. Studies made in regard to the permanent foundations revealed the following:

1. Timber piles not less than six inches in diameter at the tip, driven to proper bearing, could withstand fifteen tons bearing pressure.
2. Large groups of timber piles had to be placed to distribute the load to the underlying area at an intensity of not over two and one-half tons per square foot.
3. Buildings with basements required sheet piling braces and driven to a proper cut-off in the sand.

During the grading operations a number of settlement plates were placed and from time to time readings taken, showing that, although in some places there were settlements up to $1\frac{3}{4}$ inches per month, no lateral displacement was evident.

The first structure to be erected was the Administration Building. Because it was to be of steel-frame and timber-joint construction and consequently flexible enough to permit differential settlements, both spread and pile footings were used—the spread footings for interior columns, and timber piles for exterior columns. A check of settlements showed a maximum of one inch for the spread footings and one-eighth inch for the piles.

Before the results of the experiment on the Administration Building were known, work on the Communications Building was begun. It presented a



Courtesy Engineering News-Record

Sphere erection was carried out by two types of equipment: a crawler crane placed steel up to the equator while the top structure was erected by stiff-leg derricks on a tower inside the sphere.

peculiar problem in that it had to be erected partly on the cut and partly on the fill. Since differential settlement seemed likely, provisions for jacking up the columns were made. Spread footings were used throughout, and an accurate record was made of the settlements of each column. The settlements were plotted on paper in a parabolic curve to be used in the estimation of future settlements. It was found necessary to raise only one interior column in order to prevent secondary stresses. Otherwise the settlements were quite uniform and presented no difficulties. As a general rule, pile foundations had to be used on buildings located on the filled area, while spread foundations sufficed for the cut area. Permanent structures consisting of a field house, utility building, boat house, and five overpass bridges were constructed on creosoted timber piles.

Throughout, safety, stability, and economy were the three main factors confronting the designers of the World's Fair buildings. It was felt that some central theme should first be originated about which all other buildings could be grouped and co-ordinated. Thus originated the Perisphere and Trylon—a large sphere 180 feet in diameter and a huge three-sided pylon measuring 63 feet at the base, 2 feet at the top, and 610 feet high.

Before the main-exhibit buildings were conceived,

an intensive study was made of the buildings of previous expositions. Results showed that one-story buildings were by far the best for exhibition purposes. Consequently, the Fair was to be a "first-floor" show. It was also found that a typical unit of twenty feet by twenty feet was the best size for a typical show or exhibition place. Those exhibitors desiring extremely large spaces were expected to construct their own buildings. Acting from past experience, no attempt was made to regulate the circulation of visitors but only to indicate a route by which all points of interest might be reached. With these basic facts, several plans were drawn up, resulting in over fifty per cent efficiency in the sale of space. In other words, after deducting space for aisles, concessions, toilets, and storage spaces, it was found from an area of 1,159,000 square feet that 510,000 square feet were available to exhibitors. This exceeded an anticipated value of 450,000 square feet from a gross area of 1,400,000 square feet, or approximately thirty per cent efficiency.

After carefully considering various building types, mainly from the point of view of economy, light steel framing was chosen. By an act of the New York State Legislature, the Fair Corporation was given the power to form its own building code, and in the spring of 1939 a code committee was appointed. They first investigated the codes of previous and current expositions, and finally decided to follow quite closely the provisions of the present Building Code of New York City. Most of the buildings on the grounds were in the class five rating—a fire retarding structure with all structural parts and exterior walls having a fire resistance of one-half hour and the floor three feet above grade. The area of such a building is limited to 80,000 square feet. However, if the resistance to fire is raised to one hour, the area is unlimited. The fire restrictions in the Fair Code are slightly more lenient than those for the permanent buildings of the city, but the requirements for extinguishing apparatus, fire exits, etc., were much more stringent. For the most part, the exterior walls of the Fair buildings are being constructed of wall board and then covered with three layers of stucco. Both the exterior walls and interior walls are being painted. Since the Fair is to last only two years, the paint is applied only for beauty and was chosen as economically as possible.

The many strangely-shaped buildings introduced by the architects involved several interesting engineering problems. By far the most perplexing ones, however, were those in connection with the Trylon and Perisphere, which have been nicknamed the "Needle" and the "Apple." Because of the shortness of time, complete architectural and structural details for the "Needle" and the "Apple" could not be conceived before the awarding of the contract, and so it was necessary for the winner of the contract and the architects to work together more than if the details had been finished first. This was later found by all parties concerned more of an aid than objection. The steel in the Perisphere weighs 2,060 tons and consists of 32 meridian trusses held together at the bottom and the top and braced apart by fifteen girt trusses and a complete system of diagonals. The bottom truss frames

into a ring-box girder $7\frac{1}{2}$ feet deep and 72 feet in diameter supported by 8 steel columns. The inside chords of the meridian trusses form a full circle with a diameter of 162 feet and 7 inches. The outside chords form another circle with a diameter of 178 feet and 7 inches, except at the bottom where it frames horizontally into the girder. The trusses are 5 feet deep at the top and 11 feet deep at the bottom, thus placing the center of the inside chord circle about 3 feet above the center of the outside chord circle, which proved to be another problem during erection. Purlins were placed on both the inside and outside of the sphere to take the covering. To aid in the design of the sphere, a small wooden model 2 feet in diameter was built. This model was also used to good advantage in the drawing and making of templates. The fabrication of the meridian trusses was difficult in that curved trusses are the exception rather than the rule in fabricating shops, and in that 32 trusses had to be made exactly alike. To do this a jig was laid out in the shop big enough to hold one truss. The bottom and the top chords were placed on the jig and made to fit exactly to the curve. The remaining pieces were then assembled and riveted. The practice of fitting and reaming all field connections before each connection left the shop was adopted and found to be very worth while. Because of the bulkiness of the sphere, the erection presented more problems. Its bottom sections were assembled in the shop and connected to the ring girder and drum. The lower half was erected by a twenty-ton crawler crane. The trusses were erected a tier at a time. The top part of the chord was erected and fastened with pins and bolts cantilevering it out. The neighboring section was then erected and held in position in a similar manner. The girt trusses and the diagonals were then put in place. The material above the equator was erected from a ninety foot erection tower. The tower was placed in the center of the sphere and equipped with two 12-ton, stiff-leg derricks, with 97 foot booms at opposite corners. The tower was supported by the meridian trusses inside the ring girder—each corner being held by 3 trusses. Following erection, the rivets were driven. The building of the sphere involved the handling of 6,000 separate pieces and the driving of over 100,000 field rivets. Two revolving platforms are to be placed on the inside of the sphere to enable spectators to get a good view of the City of Tomorrow—a model city built in the center of the sphere. Both the Perisphere and the Trylon are being made permanent structures, for it is expected that public opinion will demand their preservation.

The steel in the Trylon weighs 860 tons. It consists of a braced tower for lower 500 feet, while the upper half is made up entirely of $\frac{3}{8}$ -inch steel plate. Vertical purlins are placed 4 feet and 10 inches apart to hold the covering on the lower half. The main difficulty in the construction of the Trylon was its extreme height and the small size at the top. For the first 90 feet the pylon was erected by a 30-ton crawler crane, with a 100-foot boom. From here to the 425-foot level, a 77-foot basket gin-pole was used. To finish the bracing and to erect the steel plate, a 10-inch gas pipe,

70 feet long was used as a gin-pole. Floors are to be constructed at the 25, 50, and 100-foot levels.

Interesting sidelights on the Fair are its provisions for lighting, drainage, transportation, and the thousands of other things. The fact that the underside of tree leaves become luminous when exposed to mercury vapor light is to be used to advantage in producing an unusual lighting effect. Another outstanding lighting feature will be the star pylon, 132 feet high and finished with polished wood to reflect lights concealed in its recesses. Enough light for a city of 800,000 people is to be provided for the grounds.

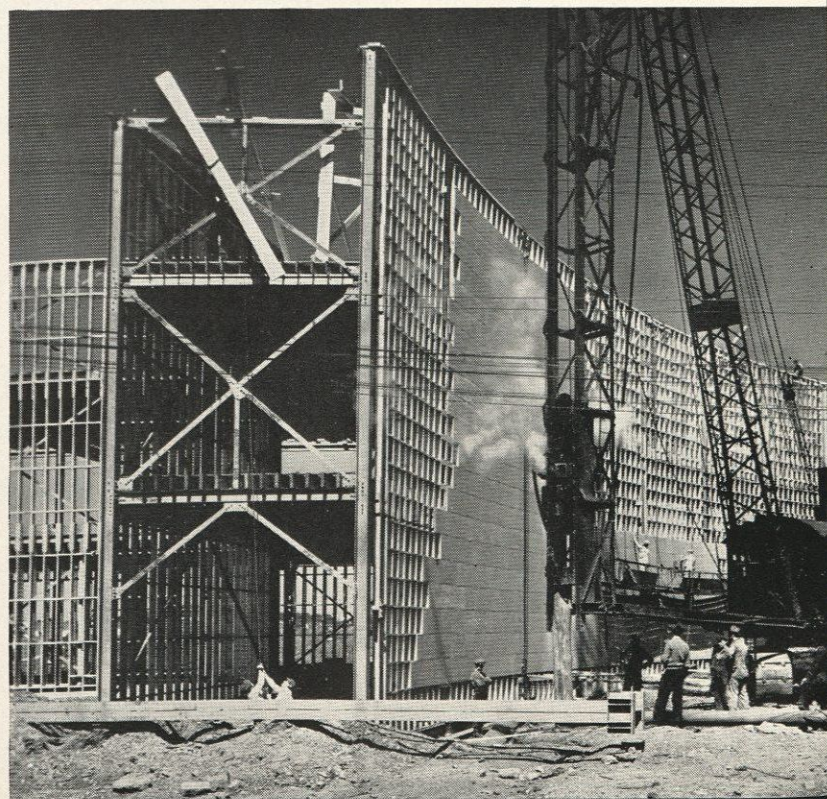
Transportation to and from the fair grounds presents another problem. For an average day the crowd is expected to be 270,000, and for peak days, from 400 to 600 thousand. On peak days, then, more than one million rides will have to be given. All forms of transportation facilities will be provided with specially built depots for arriving and departing. Inside the fair, buses and private chairs will be provided. It is hoped that something in the way of a deluxe motor-driven chair car carrying two or three passengers can be had, taking the place of rikishas and man-pushed chair cars, which do not fit into the futuristic theme of the Fair.

A surprise to most will be the elimination of the "midway", a feature usually present in fairs of all kinds. In place of this there will be a large amusement area where careful check will be kept on the kind of entertainment. There will be no "Streets of Paris," which in the Chicago Fair was allowed to practically dominate the theme. Instead there will be plenty of entertainment for both young and old, but not strong enough to overpower the minds of either.

The New York World's Fair will officially open on April 30, 1939, and will close in November of the following year. It marks an investment of over \$150,000,000 and the expected crowd is over a billion people. Designers have promised something new and different in expositions, and from all signs, that promise will be fulfilled.

Steel framing, timber studding, and asbestos board are the usual form of wall construction on exhibit buildings, stucco being used on exterior surfaces.

Courtesy Engineering News-Record



CAMPUS NEWS

AERONAUTICALS LIST EIGHT NEW COURSES

An enlarged and improved course in aeronautical engineering will be offered to the mechanical engineers next year. New courses to be offered are aerodynamics, airplane design, aviation and meteorology, airplane engines, air transportation, aircraft materials and processes, and aeronautical laboratory.

Aerodynamics will be a study of the aerodynamic theory of airfoils, propellers, parasitic resistance, airplane control, stability and performance, and the theory and operation of essential flight instruments.

Airplane engines, taught during the winter quarter, will be a detailed study of airplane engines from the standpoint of ignition, carburetion, lubrication, construction and control.

The course in aviation and meteorology will be taught during the fall quarter and will include the theory and application of navigation by pilotage, dead reckoning, and observation. The essentials of meteorology, air-mass analysis, weather maps, and a study of the civil airways will be offered.

Airplane design will be taught both the winter and spring quarters. This course will include practical airplane design involving both aerodynamic and structural theory. Stress analysis of principal parts, the design of some details, and the principles of airplane layout to meet a given specification will also be offered.

The course in air transportation, also offered the spring quarter, will include the fundamentals of transportation with regard to international air law, United States government regulations, and economic principles. Location of air lines and their relationship to surface transportation and traffic will be studied.

Aircraft materials and processes will be a critical study of the ferrous, aluminum and miscellaneous materials used in the construction of the modern airplane. Modern methods of processing and fabrication, shot welding, extruding, neoprene sealing, and aluminum riveting are also studied.

Aeronautical laboratory will be taught during the spring quarter. Laboratory work will be done on liquid and air-cooled engines, flight, engine, and navigation instruments, model and full size airplanes, superchargers, magnetos, carburetors and other aircraft equipment.

The laboratory, to be located in Engineering Building II, will contain two Douglas O-2H airplanes, one assembled and one dismantled; two 400 h.p. Liberty twelve cylinder liquid-cooled engines; a 525 h.p. Wright Cyclone engine; a 300 h.p. Pratt and Whitney R-985-36 engine; a 400 h.p. Pratt and Whitney R-1340-D engine; a Boeing wood-and-fabric wing section; a Shipboard Fighter metal wing section; an exhaust driven supercharger; engine starters; gener-

ators; carburetors; magnetos; and a large assortment of instruments including engine gages, tachometers, compasses, and turn and bank indicators.

ELECTRICALS CHECK CORONA LOSSES

Work is progressing in the electrical engineering laboratory on the problem of measuring corona losses on transmission line conductors at high voltage and under high altitude conditions. A short span, three-conductor line made of steel wire has been erected in the laboratory for the purpose, and measurements at high voltage have been obtained. A longer line using standard conductors is now being strung on steel towers outside the laboratory. On this line a voltage of about 60,000 will be impressed in order to more nearly duplicate conditions in actual transmission practice.

The purpose of the investigation is to check the existing formulae used in the calculation of the critical corona voltage and also the corona loss, since power companies operating at this altitude have reason to believe that their corona losses do not check the results of calculations.

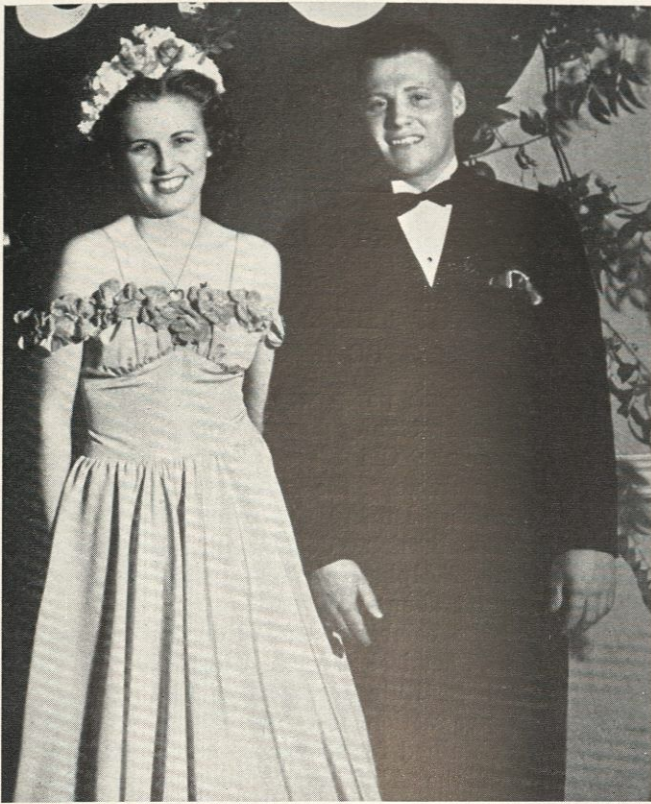
"E HOP" BEST YET

Miss Peggy Layne, one of the more beautiful freshmen lassies, presided graciously as "Queen of the Engineers" at the thirty-ninth annual Engineer's Ball as approximately three hundred couples danced to the smooth music of Lang Thompson and his nationally acclaimed orchestra.

The ballroom was resplendent with green boughs



Committee, et al.



MISS LAYNE

Beauty and the—boss.

MR. ANDERSON

studded with brilliant metallic paper flowers. Programs were in keeping with the theme of the dance in that they were in the shape of a T-square made of alloy metal on which was engraved the seal of the University.

High spots of the evening included the singing of Miss Margie Knapp, Thompson's pretty thirteen year old vocalist, and the presentation of the Queen by John Anderson, chairman of the Engineer's Ball committee.

Guests of honor were President and Mrs. George Norlin, Dean Oliver C. Lester, Dean and Mrs. Jacob Van Ek, Dean and Mrs. Robert L. Stearns, Dean and Mrs. Maurice H. Rees, Dean and Mrs. Harold Benjamin, Dean and Mrs. Homer C. Washburn, Dean and Mrs. Elmore Petersen, Dean and Mrs. Rowland W. Dunham, and Prof. and Mrs. Walter B. Franklin.

Chaperones of the ball included Dean and Mrs. Herbert S. Evans, Dean and Mrs. Harry G. Carlson, Prof. and Mrs. W. C. DuVall, Prof. and Mrs. Clarence L. Eckel, Prof. and Mrs. S. L. Simmering, Dr. and Mrs. C. W. Borgmann, and Dr. and Mrs. William S. Bernard.

Chairman John Anderson and his committee, Robert Lunn, John Philpott, Howard Perry, and Louis Degen, are to be complimented for making the ball a splendid success.

HIGHWAY CONFERENCE

The thirteenth annual Highway Engineering Conference sponsored by the department of Civil Engineering under the direction of Professor C. L. Eckel was held January nineteenth and twentieth in the Gold Room of Memorial Building.

The conference was opened with an address of welcome by Dr. O. C. Lester, dean of the graduate school. The response was made by Mr. O. T. Reedy of the Colorado Highway Department on behalf of Governor Ralph Carr.

Featured topics of the two-day meeting were aerial photography as applied to highway location and design, seismograph exploration in highway construction and bridge location, and design of highway foundations.

The opening session of the conference was presided over by Mr. B. W. Matteson, acting district engineer of the Bureau of Public Roads. Papers presented at the morning session were "Cooperation Between the Engineer and Contractor" by James B. Kenney, secretary of the Colorado Association of Highway Contractors; "Cost Analysis of Construction Equipment" by Ed H. Honnen, president of the Colorado Highway Contractors, and a discussion of the paper by Douglas Stewart, maintenance engineer of the Colorado Highway Department; "Aerial Photography" by J. G. Orwig of the Colorado State Highway Department; and "Seismograph Exploration" by W. L. Eager of the Bureau of Public Roads and Dr. C. A. Heiland of the Colorado School of Mines.

The second session of the conference, with Mr. Arthur Hewitt of the Colorado Highway Department presiding, was opened by the discussion of Colorado traffic surveys by John E. Furlong of the Colorado Highway Department. Other papers presented were "Highway Financing" by P. A. Carmichael, highway economist of the Bureau of Public Roads, and "Rigid Frame Bridges" by A. L. Cerveny, structural engineer of the Colorado Highway Department.

The morning session of January 20 was opened by presiding chairman Roy A. Klein, senior engineer of the Bureau of Public Roads. The papers presented were "Snow Removal" by C. E. Learned of the Bureau of Public Roads and C. E. Shumate of the Colorado Highway Department; "Tests for Asphaltic Mixtures" by A. H. Benedict of the Asphalt Institute; and "Concrete Curing" by R. E. Burnett of the Bureau of Reclamation.

The last session, with Mr. C. F. Seifried of the Wyoming Highway Department presiding, was given to the discussion of construction problems by Dan Ormsbee, construction engineer of the Colorado Highway Department and to design of highway foundations by I. E. Russell of the materials division of the Wyoming Highway Department and Prof. C. M. Duff of the University of Nebraska.

Three hundred and fifteen engineers from New Mexico, Kansas, Nebraska, Wyoming, and Colorado, who represented highway departments, contractors, machinery firms, and the U. S. Bureau of Public Roads attended the conference.

Each year the conference is becoming more important to the western highway engineer because of the discussion of timely topics of construction and maintenance and the presentation of papers on latest research in materials, traffic control, and methods of highway location.

TAU BETA PI



Fourteen men were pledged to Tau Beta Pi on February 12, after each had taken a comprehensive examination in his particular field. Those chosen included the following men: Merrill Teats, Joseph Stepanek, George Imrie, Robert Fishel, John Hodge, Harry Mayor, Billy Shepard, Paul Bock, Douglas Dreier, George Gless, Edward Naylor, Tom Dalby, Robert Lauth, and Robert Scherrer.

SIGMA TAU



Sigma Tau and Tau Beta Pi, honorary engineering fraternities, held their annual banquet before the famed Engineer's Ball at Blanchard's Lodge.

As in previous years, plans have been made to give a gift to the Engineering school in the spring.

Sigma Tau will elect officers during the early part of the spring quarter.

CHI EPSILON



Chi Epsilon, honorary civil engineering fraternity, held its regular dinner meeting on February 1, at Somer's Sunken Gardens. The guests at this gathering were Mr. A. V. Williamson, senior engineer of the United States Bureau of Public Roads, and Mr. A. O. Ridgeway, chief engineer of the Denver and Rio Grande Railroad.

A second meeting was called on February 10, for the purpose of electing officers for the rest of the school year. The following men were elected: Carl Bennett, president; George Brandt, vice president; Rollin Shaw, treasurer; Paul Bock, secretary; and Leo Rosenthal, editor of the *Transit*.

ETA KAPPA NU



The following men have spoken before meetings of Eta Kappa Nu, honorary electrical engineering fraternity, during the past quarter: Mr. G. W. Molis, signal engineer of the Denver and Rio Grande Western Railroad, gave a talk on "Signal Engineering"; Mr. G. S. Spangler took their attention with a talk on "Fluorescent Lighting"; and Mr. A. E. Fleming of the General Electric Company also gave an interesting talk.

PI TAU SIGMA



Pi Tau Sigma, honorary mechanical engineering fraternity, held a short meeting Tuesday, January 24. President Clifford Rockel, who attended the annual national meeting held this year at Oklahoma University, reported to the local members the events and rulings of the meeting. Plans for the installation of an

electric clock in the hall of Engineering Building II were made. A first-aid kit has been donated by the fraternity and has been placed in the machine shop tool room. The officers of Pi Tau Sigma are president, Clifford Rockel; vice president, James Fuller; secretary, Paul Welch, and treasurer, Lowell Shearer.

ALPHA CHI SIGMA

and

AFFILIATES OF THE AMERICAN CHEMICAL SOCIETY



A rush party was held at the Delta Tau Delta fraternity house Sunday, January 22, by Alpha Chi Sigma. After two hours of entertainment, the group was served with ice cream and cake. During this time, Dr. Ronzio, instructor in the chemistry department, and Bruce Gustin, president of Alpha Chi Sigma, spoke a few words to those present about the fraternity.

Through the combined efforts of the Affiliates of the American Chemical Society, Alpha Chi Sigma, and the American Institute of Chemical Engineers, a picture of the production and fabrication of aluminum articles was obtained for showing. Mr. English, a representative of the Aluminum Company of America, was present and answered numerous questions at the close of the meeting.

During the next few weeks the following men were pledged to the fraternity: Berlin Boyd, Arthur Brainerd, Lyle Bray, Vern Dunbar, Tschudy Dungan, John Fleming, Pete Frangos, Richard Germann, Joseph Hobbs, John Hodge, George Kindel, Robert Maul, Tyler Miller, Alexander Milne, Richard Nevius, Walter Prockter, John Suttle, Joseph Watson, Paul Werner, Harry Youngkin, and Robert Ziegler.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS



A large delegation from the local branch of the American Institute of Electrical Engineers plan to attend the district student branch convention to be held at the University of Wyoming during the spring quarter.

Several groups of seniors plan to present papers at the meeting based on experimental work being carried out in the electrical engineering laboratories at the present time.

William Dutton and Howard Perry will base their paper on development of a relay which will protect a polyphase motor against single phase overload. Willis Worcester is doing work on an ignitor type of mercury arc rectifier. An improvement on a type of circuit breaker was the project selected by John Anderson. Measurement of slip in the induction motor by means of a photo-electric cell will be investigated by Burton P. Brown, George Anderson, and Charles Murray.

Professors Palmer and Cassell attended the Winter convention of the Institute held in New York. A

review of their trip and observations is to be presented at an early meeting.

Members, at the meeting of January 25, heard Messrs. Fleming and Spangler of the General Electric Company lecture on the new fluorescent lamp. A demonstration was provided by the installation of several banks of the lamps in one of the new drafting rooms.

Mr. Molis, Signal Engineer of the Denver and Rio Grande Western Railroad Company, gave a lecture-demonstration of new railroad signal equipment at the meeting held on February 1.

AMERICAN SOCIETY OF CIVIL ENGINEERS



Edwin Haak, George Brandt, Raymond Orteiz, William LeFever, George Evans, Russell Kimball, Everard Woodson, and Edward Snyder have given talks before the American Society of Civil Engineers during the quarter.

Mr. Williamson of Denver gave a speech on the organization of the Bureau of Public Roads at one of the meetings.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS



Organization committees were appointed for the spring convention of the district branches of the American Society of Mechanical Engineers by president Robert Simmering at a special meeting held on January 11.

Mr. McClure of the Johnson Supply Company in Denver addressed the society at their second meeting. He showed some slides prepared by the Lincoln Welding Company to demonstrate phases of his talk.

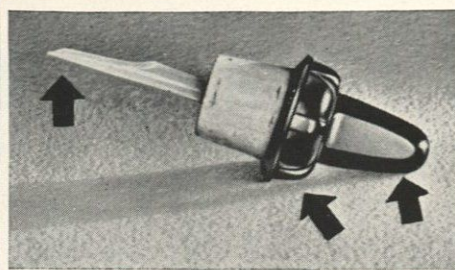
AMERICAN INSTITUTE OF CHEMICAL ENGINEERS



Dr. Gustavson, head of the chemistry department, spoke at a dinner given by the American Institute of Chemical Engineers on the evening of February 1. His talk centered on "The Chemical Aspects of Cancer."

At the next meeting, Dr. Germann spoke on "The Manufacture and Uses of Carbon Dioxide Gas and Dry Ice."

The senior chemical engineers made inspection trips through the Gates Rubber Company plant and the Denver Fire Clay Company plant in Denver.



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ALUMNEWS



1903

JEROME H. FERTIG, e, is employed as division engineer with the United States Bureau of Reclamation at the All-American Canal at Calexico, California.

1909

GEORGE I. GAY, e, is a professor at Stanford University in Palo Alto, California.



ROBERT B. HOUSTON, e, is chief draftsman of the Kansas City Structural Steel Company in Kansas City, Missouri.

1914

GERALD F. GALLOWAY, e, United States deputy mineral surveyor and county surveyor of Park County, Colorado, is living in Alma, Colorado.

1915

CHARLES R. LYNCH, e, is manufacturing representative for the United States Gauge Company, Simpson Electric Company, and General Motors Laboratories, Incorporated, in Los Angeles, California.

1917

HAROLD L. EASTMAN, e, is a consulting engineer with the Cities Service Company in New York City, New York.

JEROME S. MARCUS, ch, sales manager of the Electro-Nite Carbon Company, is residing in Philadelphia, Pennsylvania.

HERMAN G. STRAUSS, e, is president and general manager of Majestic Products Company in Denver, Colorado.

1918

CHARLES R. BURLINGAME, m, is a combustion en-

gineer for the Pittsburgh Coal Company in Pittsburgh, Pennsylvania.

V. P. FRASER, e, of Cleveland, Ohio, is general production engineer for the Ohio Public Service Company.

JOHN D. RANDALL, m, superintendent of the Shoshone hydro plant of the Public Service Company of Colorado, lives in Glenwood Springs, Colorado.

HUBER O. CROFT, m, head of the department of mechanical engineering at the University of Iowa, in Iowa City, Iowa, has written a book entitled, "Thermodynamics, Fluid Flow, and Heat Transmission." Mr. Croft was recently elected President of the Iowa Engineering Society at the annual convention in Des Moines on February 17th.

WALTER THOMPSON MORROW, e, is an engineer for the Public Works Administration in region five, Fort Worth, Texas.

1919

ERHARD A. FROESE, ch, is branch manager of the York Ice Machinery Corporation in Denver, Colorado.

LESTER B. JOHNSON, e, is district representative for the construction materials division of the General Electric Company in Salt Lake City, Utah.

ALVIN J. HOLM, ch, purchasing agent for the city of Los Angeles, lives at 1607 South Hayworth Avenue, Los Angeles, California.

1920

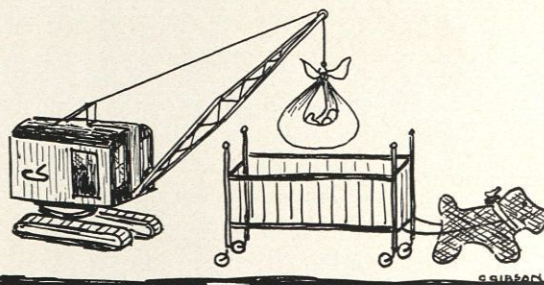
EDWARD M. JONES, ch, is superintendent of the acid department of the Tennessee Copper Company at Copperhill, Tennessee.

HARRY C. MOREHOUSE, m, is vice-president of Wagner-Morehouse Oil Equipment Supply Company in Los Angeles.

RUSSELL LEE WHITNEY, e, is sales manager of the porcelain division of Westinghouse Electric and Manufacturing Company in Greensburg, Pennsylvania.

1928

ROBERT S. WELCH, e, has been promoted to the position of senior engineer of the Works Progress Administration in Denver, Colorado.



JOSEPH A. SETTER, e, announces the birth of a son, Carl Joseph, on October 22. Setter is a sales engineer for the General Electric Company in Fort Wayne, Indiana.

OLIVER E. NELSON, c, is now advertising sales supervisor with the Pacific Telephone and Telegraph Company in San Francisco, California.

1929

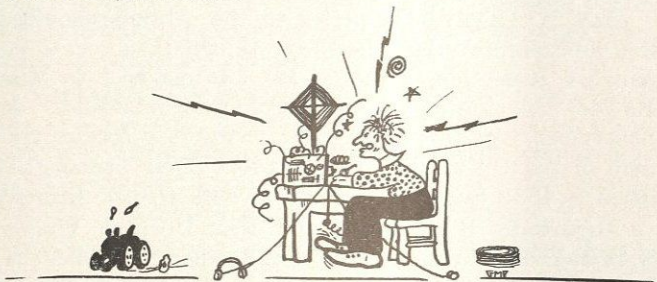
GEORGE M. PHILPOTT, m, and his wife are in Hawaii, where Philpott is transacting business for the Gardner-Denver Company of San Francisco, California. He is a former editor of the COLORADO ENGINEER.

1931

ELDON SMITH, ch, has received an appointment with the British-American Oil Company and has been transferred from Oklahoma City to Grand Falls, Texas. Smith is to serve the company as chief supply clerk in the west Texas district.

JOHN HAYES, ch, assistant superintendent of the National Carbon Company, Niagara Works, Niagara Falls, New York, has moved from Clarksburg, West Virginia, to New York.

WARREN D. MCKELVEY, e, is manager of specialty appliance sales for the General Electric Company in St. Louis, Missouri.

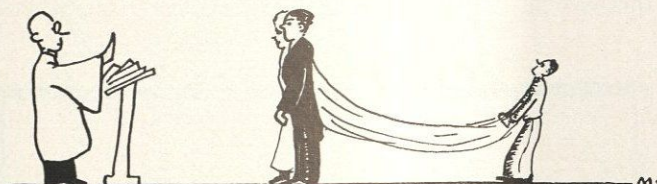


MILTON W. WOODWARD, e, until recently technical director of resident training for First National Television, is now a radio engineering consultant with the Commercial Radio Equipment Company in Kansas City, Missouri.

LEO J. KELLY, m, is an office engineer in the state administration office of the Works Progress Administration in Denver.

1934

GARWOOD C. ANDRESEN, m, engineer for the York Ice Machinery Corporation has changed his residence from Rochester, New York, to Main Street, Farmington, Connecticut.



ROBERT F. BROWN, m, was married November 6, to Miss Constance E. Peake at Dover-Foxcroft, Maine. Brown is employed by the Wright Aeronautical Corporation in Paterson, New Jersey.

J. MARION PAYNE, e, is now employed in the standards department of Swift and Company, Denver, Colorado.

ALAN McDERMITH, c, is assistant engineer for the Bureau of Reclamation in Montrose, Colorado.

1935

O. NEWELL PARKER, e, is located in Seminole, Wyoming, with the United States Bureau of Reclamation. He was formerly employed with the Denver division of the Bureau.



WILLIS E. NEISLER, e, formerly an engineer in the Colorado State Highway department in Canon City, Colorado, is now an assistant engineer for the Public Works Administration projects which will be started at Pueblo, Colorado. These projects include the erection of several new public buildings and the extension of the water system.

1936

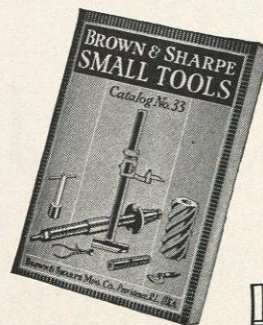
DANIEL L. YOCUM, JR., ch, of Waukegan, Illinois, is associated with the Abbot Laboratories, manufacturing pharmaceutical chemists, in North Chicago, Illinois. His home address is 527 North County Street, Waukegan.

1938

ARVID G. WEDIN, e, has a position with the United States Aircraft Radio Laboratory at Wright Field, Dayton, Ohio.

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Boulder Theater

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Phone 339

GUY C. BURNHAM, m, and CHARLES W. THAXTON, m, have received appointments to the naval air station at Pensacola, Florida, for flight training.

PAUL R. ROOSA, arch, is in Phoenix, Arizona, where he has a position with the United States Bureau of Reclamation.



BRYANT T. CASH, ch, has a position as a chemical engineer with the Phelps-Dodge Corporation in Phoenix, Arizona.

W. TURRELL BARBER, ch, is associated with the Gates Rubber Company in Denver, Colorado.

JAY L. OLVEY, ch, writes to the Alumnews office that he is employed by the Universal Oil Products Company in Riverside, Illinois. He was married to Miss Eleanor Yarrington of Wray, Colorado, in Boulder on September 4 of this year. Mrs. Olvey is a former student of the University of Colorado. Their present address is 4832 Seeley Avenue, Downers Grove, Illinois.

BENJAMIN B. CAMP, c, and Miss Dorothy Walker were married in Denver, Colorado, on November 24. Camp is employed by the Colorado State Highway department in Denver, where the couple are making their home.

MAX SAUNDERS, e, is now employed with the North Platte Municipal Light Plant in North Platte, Nebraska.

VINCENT BAKER, e, recently received a graduate assistantship in the department of electrical engineering at the University of Missouri in Columbia, Missouri.

JOHN BAUER, SAMUEL RIFKIN, and GEORGE BARCUS, graduates of the department of electrical engineering, are employed with the United States Bureau of Reclamation in Denver. They have postponed their work with the General Electric Company until March 1 of this year.

"As the twig is bent..."

Here we have attempted to give an account of some of the alumni who have sons now attending the engineering school of the University of Colorado:

NORMAN HUBERT COIT, c, vice-president and general manager of the South Carolina Electric and Gas Company in Columbia, South Carolina, graduate of 1917, has a son, Hubert, attending this University, a senior in the chemical engineering department.

BEN G. TANDY, e, of the class of 1920, is the father of Riley Tandy, who enrolled as a freshman this year in the engineering school. Ben Tandy is district traffic superintendent of the Mountain States Telephone and Telegraph Company in Pocatello, Idaho.

ALVIN LIST, graduate in electrical engineering in 1913, is an engineer in the General Electric Company in Schenectady, New York, and has sent his son, Alvin, to enter the engineering school as a freshman this year.

WALTER F. MALLORY, m, 1914, professor of mechanical engineering at the University of Colorado, has a son, Warren, who is now in his second year of an electrical engineering course.

GEORGE C. IMRIE, c, 1910, will have a son, also named George C., graduating this June from the University of Colorado with a degree in civil engineering. Imrie, Senior, is an engineer in the United States Bureau of Reclamation in Tracy, California.

EARLE W. DEVALON, e, of the class of 1918, has a son, Earle W., who is a sophomore in the chemical department of the engineering school. Devalon is secretary-manager of the Mountain Clays, Incorporated, in Denver, Colorado.

SIEBELT L. SIMMERING, m, 1910, as head of the department and professor of mechanical engineering at the University of Colorado, has the opportunity of having in his classes his son, Robert, a senior in the mechanical department and assistant editor of the COLORADO ENGINEER.

RODERICK L. DOWNING, c, a graduate of the class of 1914, and associate professor of civil engineering at the University of Colorado, has a son, James, who enrolled in the engineering school as a freshman winter quarter, after attending Texas University at Austin, Texas, for one quarter.

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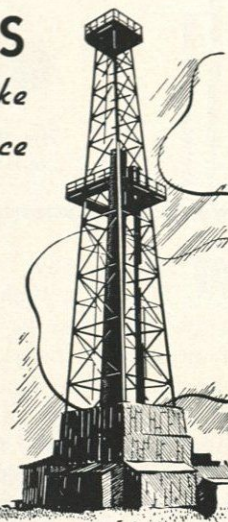
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WRITING this column is akin to playing poker. If one is lucky, he is dealt far more winning hands than losing ones. If, however, he is always given a poor hand, regardless of the fact that he may bluff once in a while, he will, in the end, lose. So it is with the Oilcan. We are sometimes dealt a winning hand, but more often are given a poor deal—not even a pair of jokes. We don't want to go to the extreme of following a suggestion in a recent *Reader's Digest*: "He ended every one of his jokes with an explanation point." Such a procedure is not warranted here, however, for we feel that at least an average number of students understand faintly what this column is all about. This column is primarily concerned with the boners of the students here in school. We have not in the past attempted to borrow from other sources than the students themselves. Does such a procedure meet with your approval?

To start the ball rolling, let us consider George Gleason. George really struck oil with this original method of prolonging a line: "Get two points, take backsight and take foresight, and if the two points line up, why prolong them. Prolong them on foresight, prolong them on backsight, prolong them on foresight and backsight." It doesn't take much "foresight" to see that Gleason was slightly "prolonging" his definition.

Our seeing-eye defective agency has uncovered this bit concerning slips of engineers. It seems that a certain class in electrical engineering was being given its final exam. Everybody was working along very industriously when somebody glanced up at the black board. To his surprise, here was a complete solution to the problems on the exam. The only catch to the entire set-up was that the Professor discovered the problems at the same time. Orchids to Gordon Messmer, who, when running short of scratch paper had worked the problems out on the black-board.

According to John Mayer, reinforced concrete is a special Portland cement concrete in which steel is imbedded in such a manner that the materials act together in resisting a force. Plain concrete does not. We should like a concrete example of the above.

On the subject of hydraulics, let us stop for a moment and consider what Charles Fisher has to offer us. He says, "A suppressed wier is one in which the water level below the wier is higher than the level above." With this veritable gusher, we have

awarded this season's certificate to Mr. Fisher. It will entitle him to sit in at any bull session, anywhere, anytime.

In a class in Statics, Professor Raeder was showing two ways of working a problem. One way involved calculus, and the other way was simple arithmetic. In arriving at the result, one answer seemed to be larger than the other. Bob Maughan made the following remark: "Gee, we ought to do all our power problems by calculus; just think of the extra power we could get that way."

Professor Parker has asked us to assure his class that there is no vertical air load on the rudder in normal flight.

"Ceramic decoration was inlaid figures that had been painted on the tiles and bricks previously to kiln burning." Will someone find the author of above statement and have him come up and see us some time. We'd like to learn how to paint inlaid figures, too.

Looking through our files for suitable material to adorn this page, we came across this short but awe-inspiring study into the mysteries of pre-cast concrete. As Oscar Jacobson says, "A precast concrete pile is one that is poured before setting." Such an idea seems logical. We are going to recommend it to the men building the new library.

A new theory recently developed is that light and color are synonymous terms. Witness Donn Hendricks' story of the Egyptians. "The reason for the use of color as a means of decoration in the temples by the Egyptians was because there was no light in the temples." We hope that Hendricks has since seen the light.

Ray Winger has been finding out strange things about the various types of loads that can be put on a building. He says, "Dead loads are loads that are supported all the time, while live loads are supported only some of the time."

In Economics, the class was studying the Federal Reserve System. It was found that the directors of the banks were appointed to their positions. On a quiz over the subject, the following question was asked: How is the best way to keep the Federal Reserve system democratic? Orrin Watson gave the following answer: "In order to keep the Federal Reserve system democratic, the people must see that a majority of Democrats are appointed."

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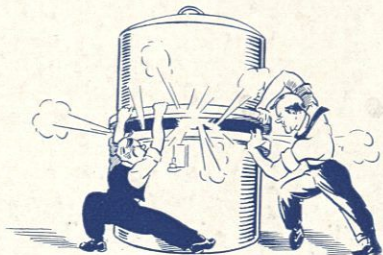
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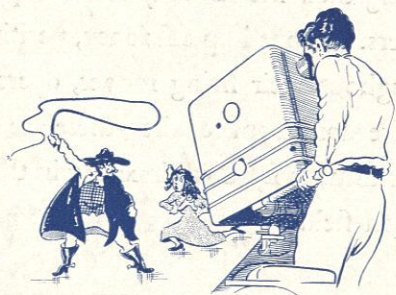
A BIG SQUEEZE

IT TAKES a lot of squeeze to put a 1,000,000-volt x-ray equipment in a container only four feet in diameter and seven feet long, especially when its less-powerful predecessors required a special building 62 feet long, 32 feet wide, and 36 feet high. But recently, G-E scientists applied the necessary squeeze and completed some surprisingly compact x-ray equipment.

Such squeezing naturally involves a few innovations in design. So innovations were introduced. The 11-section x-ray tube was put inside the novel transformer, in the space normally taken by an iron core. Gas having an impressive-sounding name, dichlorodifluoromethane, was used instead of oil as an insulating medium, 100 pounds of this gas doing the work of six tons of conventional oil.

Then the equipment was mounted in the grounded metal container, thereby enclosing the 1,000,000-volt circuit and eliminating the hazard of electric shock. Looking at the apparatus, you note a striking absence of moving parts, for the control of the apparatus is essentially electrical.

The first of the new units will be installed this spring in Memorial Hospital, New York City, providing medical science with another powerful weapon in its constant war on disease.



LIGHTS! ACTION! CAMERA!

IN A specially constructed room alongside the studios of the G-E international short-wave stations, the familiar words, "Lights! Action! Camera!" will soon be heard.

For General Electric's new television station at Schenectady is nearing completion.

The television transmitter, perched atop the Helderberg Hills 12 miles outside the city, will be at least 250 feet higher than the station in the tower of the Empire State building, New York. And, broadcasting with 10,000 watts, it will be the most powerful television station in the United States.

There will be—literally—no strings to the transmitter. C. A. Priest, Maine '22 and an ex-Test man, Engineer of the Radio Transmitter Engineering Department of General Electric, has announced that an ultra-short-wave transmitter will be used instead of the usual cable to relay the images from the Schenectady studios to the main transmitter in the Helderbergs.



THE "HOUSE OF MAGIC" BECOMES TWINS

THE world-famous G-E "House of Magic" show has become twins. It had to, for it was placed in the predicament of having to be in two places at one time—the New York and the San Francisco Fairs.

One twin—directed by R. L. Smallman, Calif. Tech '33 and ex-Test man—is already holding court on San Francisco's Treasure Island, site of the Pageant of the Pacific. The other makes its bow April 30, opening day of the New York World's Fair. Its director is W. A. Gluesing, Wisconsin '23, also an ex-Test man.

The thousands of visitors to these Fairs will see such feats of modern magic as a voice-controlled toy train, a magic carpet, zigzagging pictures of sound. They will see the stroboscope, which makes it possible to see the spokes of a whirling wheel just as if the wheel were motionless. They will see a light beam sawed by the teeth of a comb. However, entertaining as these demonstrations are, they represent far more than mere tricks of modern magic. They symbolize the work in pure science that is constantly taking place in G-E research laboratories—work which is the basis of General Electric's contributions to the world of the future.

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