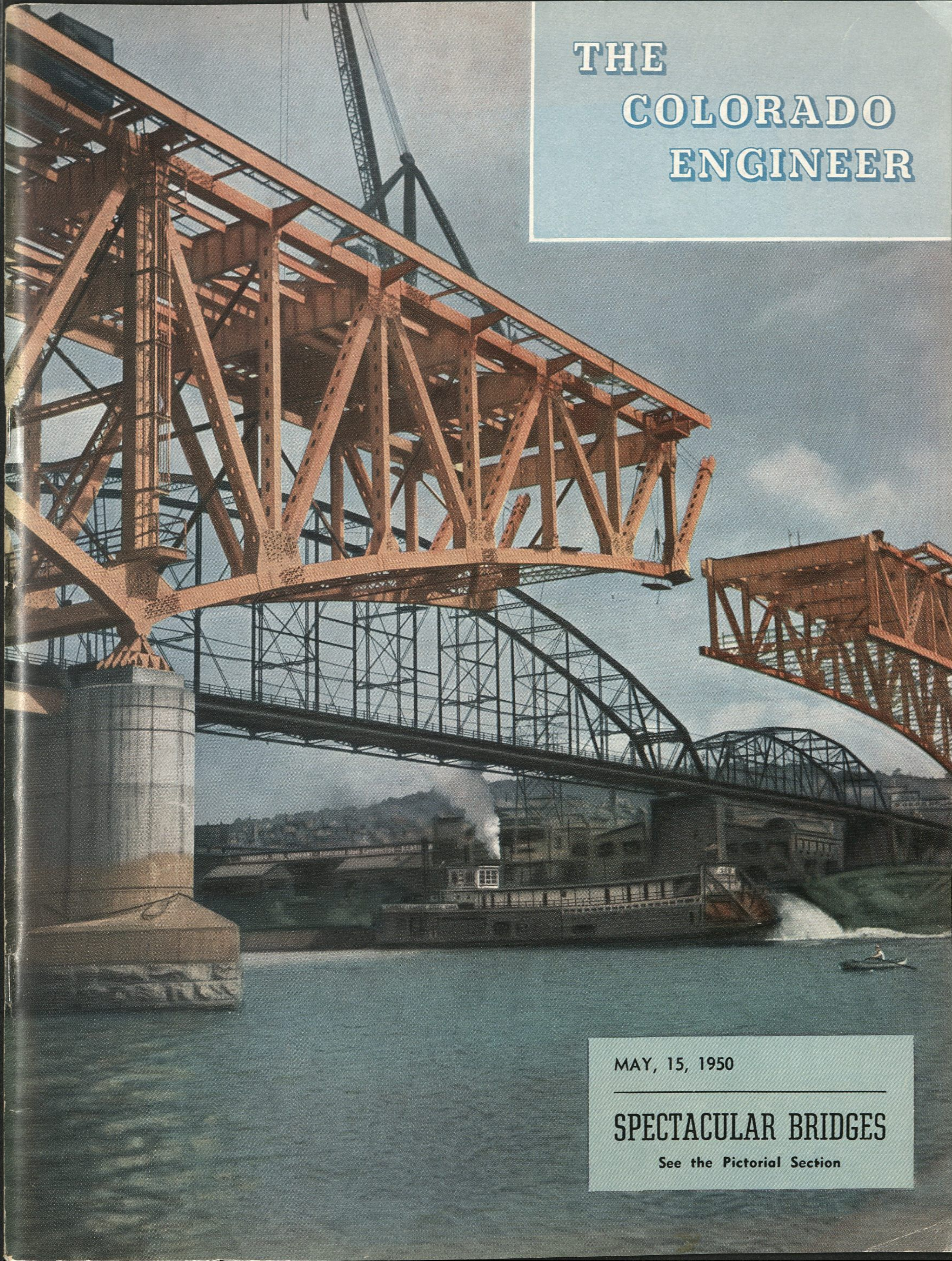
THE COLORADO ENGINEER



MAY, 15, 1950

SPECTACULAR BRIDGES

See the Pictorial Section

RESEARCH--*A Problem*

by DAVID M. RADUZINER, E.E. and Bus. '51

Scientific research—a vital prerequisite for the advancement of mankind. This article is concerned with the problems facing universities who have research laboratories.

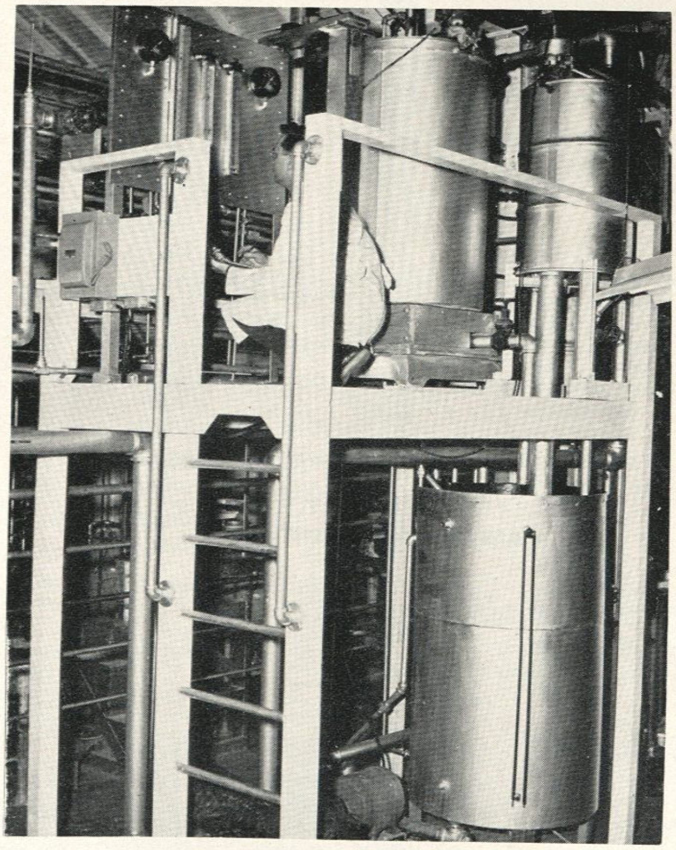
Dave, a senior in the Department of Electrical Engineering, has been a member of the staff of the **Colorado Engineer** for over two years. He was the recipient of a **Colorado Engineer** Scholarship in 1948. Claiming Denver as his home town, Dave is twenty-one years old. Activities: Pi Mu Epsilon, A.I.E.E., and President of Beta Sigma Tau social fraternity.

We have all noticed the ease and swiftness with which a child will learn the rules of a new game. In much the same manner colleges and universities have quickly learned the rules which permit them to participate in a new game – the game of applied research.

Early research in institutions of higher learning was almost entirely directed toward uncovering fundamental truths of science; however, an increasing number of specialized problems was presented to the colleges by industry. There was much early opposition to schools handling applied research since it was feared that investigation of basic science would suffer.

Difficulties

It was feared that research workers would find developmental projects more interesting than basic investigations since applied research offers a reward of a feeling of satisfaction and accomplishment to the inventor of a new process or gadget. It was also anticipated by the opponents to applied research in technical schools that researchers might be attracted by the quick commercial benefits that are derived from applied research.



The properties of materials in suspension are studied by R. F. Heckman as the solutions are passed through the apparatus.

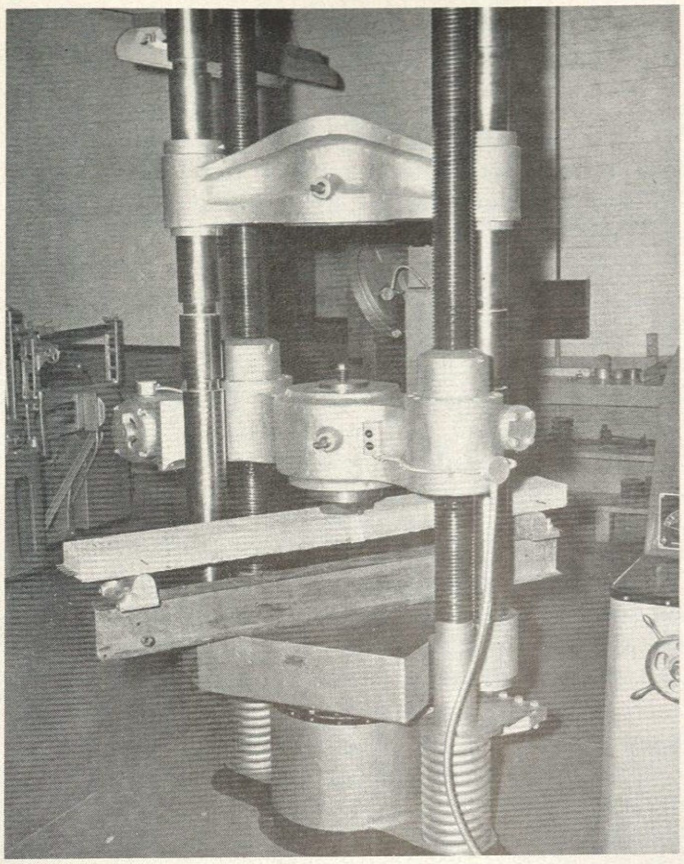
The research laboratory was always a medium of free exchange of ideas among associates as well as a tool for finding new data. Here was another problem presented by the introduction of applied research for it was feared that the possibilities of patents would put an end to the atmosphere of open discussion and cooperation. It was realized that the free exchange of ideas among research workers is a key to advancement and cannot be sacrificed.

Although there was an abrupt difference of opinion among researchers as to the merits of technical schools conducting applied research, the division between basic and applied investigations is sometimes difficult to make. For example, in the basic study of rheoloicgal properties of multiphase systems (a study of the movement of suspended particles in complex closed systems) currently being conducted by R. F. Heckman of the Chemical Engineering Department here at the University of Colorado, it was necessary to develop a special type of rotational viscometer. Here a specialized development, the new meter, grew out of a primarily basic study. The opposite case is also common; a basic study is often evolved from a pure development project. It can be seen that this relationship between the two types of technical study presented another problem.

Also many other problems had to be solved. What was the academic status of the research worker to be? Would developmental work be recognized for graduate degrees? Who would benefit from the patents–the inventor of the institution or the sponsoring company? It was important that a solution be found, because industry was in need of the research facilities of the nation's universities and colleges.

Importance of Research

The importance of applied research can be demon-



A thin, pre-stressed concrete beam in which the reinforcing steel was held under a tension of 120,000 psi. while the concrete was formed.

strated by its magnitude. Although industry and government dominate the field, colleges and universities are playing an ever increasing part.

In the past quarter century the amount of work put into investigation of basic ideas has been overshadowed by the amount of work done in applying the findings of pure research. Although we need more basic research, especially in the fields of neuclar physics and biochemistry, it seems that the trend is away from basic studies and toward the utilization of the information which we now possess.

To demonstrate this fact, consider 1940 as an example of a typical year before the direct influence of the war. In that year, according to a government report on scientific research, a total of about $40 million was spent for pure research by universities, government, and industry in this country; while $312 million was being spent for applied research by the same three groups.

During the war years the situation was altered, and now the ratio of basic to applied research has begun to return to its former level.

Solution to Research Problems

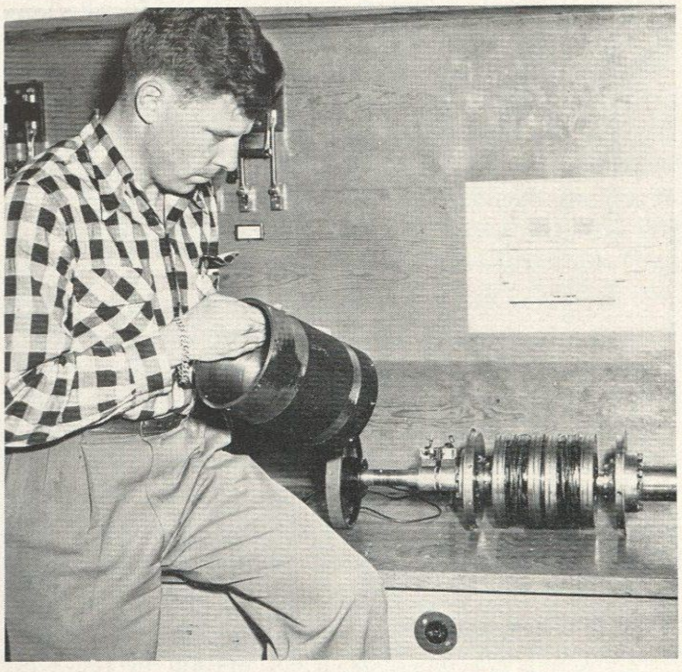
The roll played in applied research has been made possible by the use of three mediums of handling the research. These mediums have been: 1) private non-profit organizations, 2) organizations that are loosely affiliated with colleges and universities, and 3) organizations directly under the control of the universities and colleges.

First, let us consider the non-profit private organizations. An outstanding example of this group is the New York Research Corporation, which was begun in 1912 when Dr. F. G. Cottrell donated his patent rights on electrostratic precipitation. This process is widely used today for removing dust from factory smoke.

This non-profit organization was established to build an effective business unit to promote commercially the electrostatic precipitation process and other patents that might be donated to the Corporation by public-spirited inventors. From its net gains on patents it was to support further scientific research. It hoped to set an example for patent management in the public interest.

The achievement of its expressed purposes is demonstrated by the fact that up to 1948 the Corporation had given about $1¼ million to fifty-two universities for pure scientific research. In the five years following the war it expects to give grants totaling $2½ million for more research in basis science.

The Research Corporation also offers its facilities to universities for handling their patent administration. Massachusetts Institute of Technology, Columbia University, Princeton University, University of California and University of Arizona have almost all of their patent management handled by the Research Corporation. About ten other schools use the Corporation's patent facilities to lesser extents. The New York Research Corporation and other private, non-profit organizations sponsored for the benefit of the general public and private industry have been the solution to the management of patents for some schools. Some of the private organizations that handle problems of research management in a similar manner to the Research Corporation are the Bartol Research Foundation of the Franklin Institute, Carnegie Institute of Washington,



A magnetic fluid clutch developed by James P. Roach, a graduate student in eletcrical engineering. It can transmit 100 horsepower with an input of only 16 watts.

and the Mellon Institute of Industrial Research. About twenty separate research foundations are developing patents in the United States today.

Organizations that are loosely affiliated with their resepective universities comprise a second group that helps manage the research problems. Few schools before 1930 held patents and developed them for income. The two exceptions were the University of Toronto, the holder of patents on the process of making Insulin; and the University of Wisconsin, which holds patents on Vitamin D manufacture. The Toronto patents are managed by separate committees appointed by the University; the Wisconsin patents are managed by an alumni foundation. Since the problems of the two schools were similar, let us look at the Wisconsin solution as an example.

In 1925 a process of manfacturing Vitamin D was developed at the University of Wisconsin. For protection of the quality of the product to insure the safety and health of the public, a control over the manufacture was needed. From previous experience gained by the handling of Vitamin A developments, it was obvious that the existing University administrative machinery was too cumbersome to acquire and manage the patents required for public protection. As a result the Wisconsin Alumni Research Foundation was established. Its secondary purpose, as expressed, was to commercialize the Vitamin D and other patents that it might acquire and to set up an endowment principal to advance research in any field at the University.

By 1940 about $7½ million had been received from the Vitamin D patents alone. All of this has been or will be reinvested in research except for about 15 per cent which is earmarked for the inventor. All University of Wisconsin patents are handled in this manner.

Today there are over 60 schools in the United States that have separate or loosely affiliated foundations to supplement or relieve their regular staffs of patent management. This is about one-fifth of the total number of schools doing scientific research. However, there are over 200 universities and colleges directly interested in patents. So it can be seen that the largest number of schools handle their own patent procedures. It is this group to which the University of Colorado belongs and which will be discussed next.

According to J. E. Hobson, Director of Stanford Research Institute, a university "must have a separate research organization, independent of educational activities." This organization "should be self-supporting and should not be expected to supply additional funds for other university activities."

However, at the University of Colorado the prime purpose of research is to aid academic instruction and to advance the knowledge of the faculty members in their respective fields.

Why Is An Engineering Experiment Station Formed?

The Engineering Experiment Station of the University of Colorado was created in this era of increasing demands on the Rocky Mountains Area's technical facilities. It is to supplement the Area's technical research facilities, but not to compete with them.

What is the function of a Station?

The function and purpose of a Station as stated by Florida University are three-fold: to conduct research on natural resources of the area, to develop new industries, and to aid the present industries in the area.

The University of Colorado Experiment Station was created in 1941 because the Board of Regents "felt the Engineering College of the University of Colorado should make greater contributions to our fundamental knowledge of engineering principles; should aid in industrial development and utilization of our natural resources; and should serve as an engineering research agency for regional industry."

How Is an Experiment Station Organized?

The Colorado Station is organized under a Director and an Executive Staff composed of the Deans of the College of Engineering and the Graduate School and heads of the departments of the College of Engineering. A staff of full-time research associates, graduate research assistants, and special technicians is employed.

An example of graduate research is a project of developing a high power magnetic fluid clutch. The present working model is said to be able to transmit 100 horsepower with an energizing power of only 16 watts needed. James P. Roach, graduate student in electrical engineering, is performing the work on the clutch for his masters thesis.

Personnel and equipment of the eight departments of the College of Engineering are made available to the Station's needs.

From What Sources Does an Engineering Experiment Station Receive Its Funds?

Some schools receive funds from: 1) their respective state governments, 2) outside foundations and alumni organizations, and from 3) special contracts with industry and federal government agencies.

The University of Colorado has received about $41,000 for research in all fields from the state since June, 1947. Grants for research by the Station from the Navy, Army, Air Force and the public has amounted to about $950,000 since June, 1947. Since the same date about $125,000 has been received from industry through special contracts.

Some funds are made available for unsponsored projects by the University's Council on Graduate Research. A project receiving such aid is the study of thin pre-stressed concrete beams in which particular interest is taken in observing the bond between the highly stressed wire and concrete. The project is under the direction of M. L. Mass, of the Civil Engineering Department.

To illustrate the growth of the Colorado Experiment Station, about $95,000 was spent in the year 1947-48; about $250,000 in 1948-49; and it is estimated by F. A. Rohrman, Dircetor of the Station, that over $300,000 will have been spent in the year 1949-50.

(Continued on page 40)

The Search for Oil

by R. L. HYSOM, E.E. '50

The search for oil is an everlasting science. Here is an article on the methods of detecting one of nature's most valuable storehouses.

Under the nickname of Gus, Rollo entered school to study Electrical Engineering in the fall of 1946 after two years Navy duty. Gus is still single, 24 years old, and comes from Fowler, Colorado. This is his first article, but he has been editor of the Oil Can for the past three issues of the **Colorado Engineer.** Besides waiting tables in a cafe, his activities include A. I. E. E. and the Boulder F. O. E.

It has not been too many years ago that the processes by which decisions were reached as to where to drill for oil were, to say the least, haphazard. For the most part, the probable location of a new oil deposit was determined largely from old superstitions or so-called "magic" on the part of those who claimed to be able to find the location of an underground fortune with the aid of a small forked tree branch ornamented with a rawhide bag containing some "magic" material. Most people are aware that such outdated methods are no longer accepted as a basis for investing their hard earned dollars, but many people do not know exactly what methods are used today. It is hoped that the following paragraphs will give a clear picture of the modern scientific approach towards making the important decisions as to where to drill a new well that costs from $30,000 to $50,000.

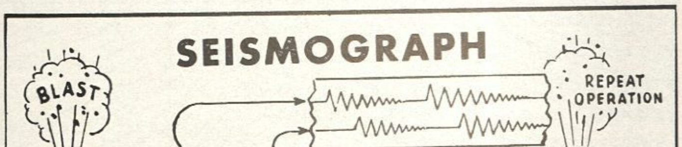
Let it first be stated that even today there is no fool-proof method which can be used to accurately determine where a pool of oil lies hidden beneath the earth's surface except to drill a well into that pool. The closest approach to a predetermination of such a location is an investigation of sub-surface structural conditions which may be conducive to the trapping of oil and/or gas at a certain point. This investigation of structural conditions is performed by means of several methods, known collectively as "geophysical exploration."

In order to understand some of the differences in sub-surface structural formations, refer to Figure 1 and Figure 2. It can be seen in these figures that there is a deep layer of hard basement rock which extends far into the earth, but the cross-sectional views of these two formations differ considerably. These figures show three conditions under which gas and oil would be trapped if they are present. Of course there are many other possible formations which cannot be shown and explained due to the limited scope of this article. The problem of the geophysicist, then, is to locate such "probable" underground traps from tests conducted on top of the earth's surface.

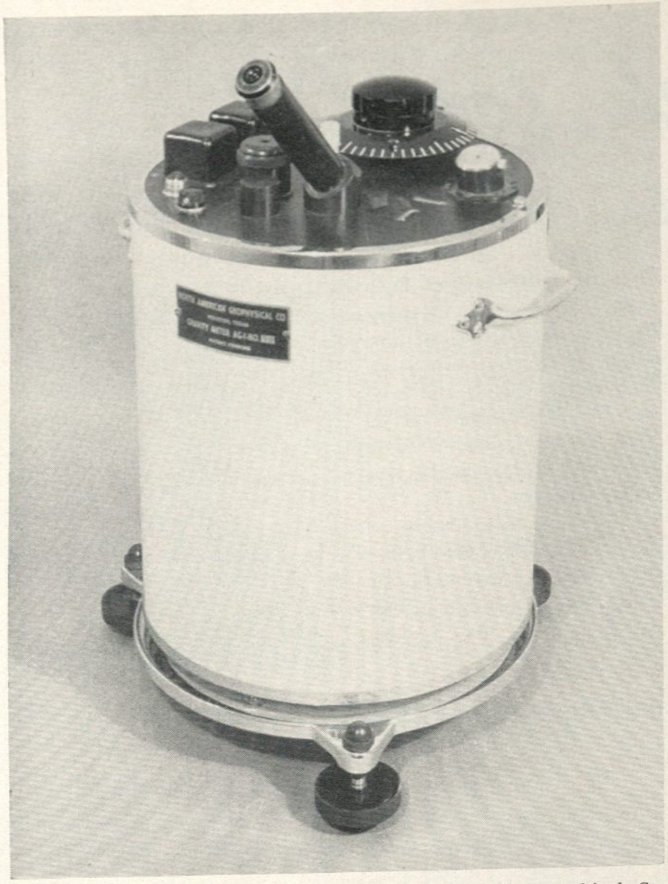
Exploration Methods

The four principal methods used in geophysical exploration are: magnetic surveys, electric-resistivity surveys, seismic surveys, and gravitational surveys. A brief explanation of each of these methods will give an idea of how an indication of the formation of the sub-surface structure is shown. Because of the widespread application of the gravitational method at the present time and in recent years, however, a more complete discussion of that method seems in order.

The magnetic survey depends essentially on the earth's magnetic field of force. The intensity of this magnetic field varies slightly from point to point on the earth's surface because of the magnetic properties of the hard basement rocks under the earth's surface. The magnetic survey is carried out with a magnetometer, an instrument which measures the relative strength of the magnetic field from point to point over the surface of the earth. Since most of the hard basement rocks have magnetic properties which change the intensity of the earth's magnetic field according to the mass of the hard rock strata and its proximity to the surface of



The seismograph is the foremost scientific instrument now in use for the location of hidden earth structures.



—Courtesy North American Geographical Co.

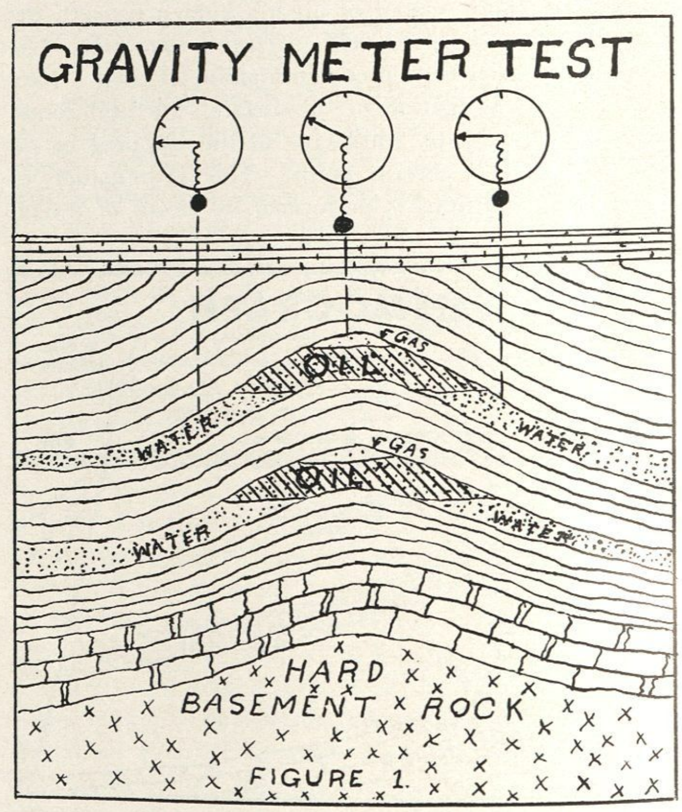
A gravity meter for determining the distance from the earth's surface to basement rock.

the earth, a number of readings taken with the magnetometer over a certain area of the earth's surface will give a fairly good indication as to the probable geological formations underneath. After a few wells have been drilled in a certain vicinity however, the iron and steel pipes used as well-casings have a noticeable effect on the magnetic readings taken thereafter, so that the magnetic survey has it greatest worth only in virgin country.

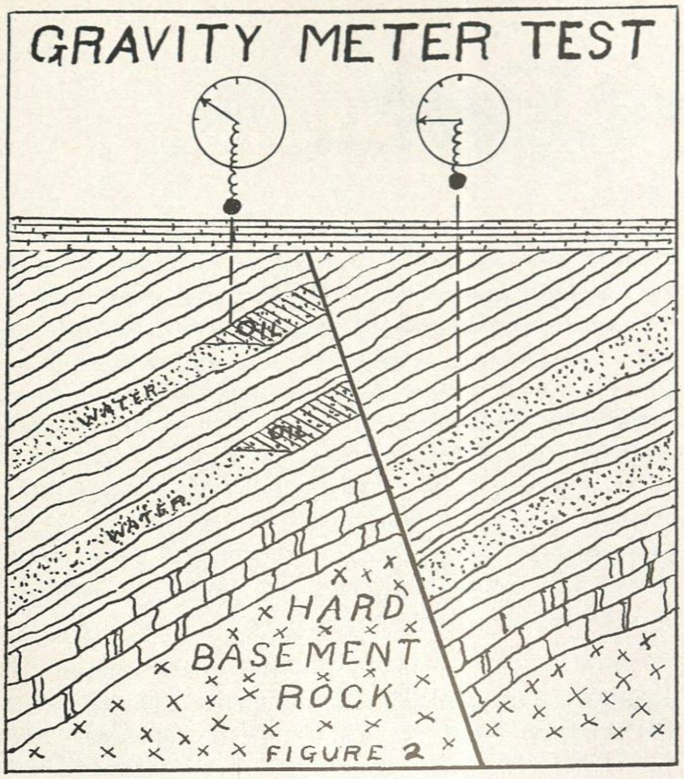
The electric-resistivity test is a test of the resistance of the earth's surface to an electric current. This test is carried out by an instrument which is built to measure the resistance of the earth's surface between the two electrodes connected to it when they are placed in the ground at some distance apart. The resistance of a certain distance corresponds to the resistance of the earth at a depth equal to that distance on the surface. Therefore, if one electrode is placed in the earth as a certain point, and a second electrode is placed in the earth at successively greater distances from the fixed electrode, the readings taken at each position of the second electrode will give an indication of changes in sub-surface strata when compared with the resistance which was calculated assuming no changes in the structural formations. This type of survey has been found to be effective for near-surface formations, but is not readily adaptable for the depths necessary in oil exploration. Another application of the electric-resistivity test which has found wide acceptance in petroleum discovery is that of resistance tests made by lowering the two electrodes into a vertical well that has already been drilled. Very accurate and precise indications of oil deposits in the immediate vicinity of the well have been made in this manner. To a large degree resistance tests are still in the experimental stage.

The seismic-survey is the most precise and accurate of the geophysical surveys, but at the same time it is the most expensive. Because of the time and expense involved in making the seismic survey, it is usually used only to gain greater detail of the structure in a small area which has already been picked by other methods as the most probable oil-trap area.

The seismic-survey is performed with a seismograph which records energy waves on a photographic film. The energy waves are shock waves which are produced by exploding a charge of dynamite in the earth at a short distance from the region under survey. These waves are picked up by detectors which are placed in the earth at various points over the area, changed to electrical impulses by the detectors, and transmitted electrically to the seismograph. The initial shock wave is recorded on the film by a detector set very close to the dynamite explosion. Then, as the waves travel through the earth, they are reflected back to the surface by the rock strata which they encounter, and these reflected waves are picked up by the detectors and recorded. The softer sandstone strata send back reflected waves of much weaker intensity than the waves reflected by the harder rock strata. By means of the intensity of the reflected waves and the time-delay shown on the film between the initial and the reflected waves, a very precise and accur-



An anticline in the basement strata registers on the gravity meter. Oil deposits are often found trapped above.



Faults in the basement rock are traps for oil. The gravitational force between the gold weight of the gravity meter and the basement rock varies in relation to the rock depth.

ate determination of the magnitude and depths of the various rock strata in the formation can be calculated.

The underlying principle of the gravity survey is one of the fundamental principles of physics, that is, the attractive force between two masses is inversely proportional to the square of the distance between them (Newton's Law). This of course means that a mass on, or slightly above, the earth's surface will be attracted to a mass of heavy density under the surface by a force which varies according to the distance between the earth's surface and the underground mass. It follows, then, that if a heavy mass were supported in the air by a helical spring, that the mass would be pulled down towards the earth with a greater force by a hard basement rock structure which was near to the surface than by a similar structure which was deeper, or further away from the earth's surface. If the top of the spring were always held the same distance above the earth's surface, the varying pull on the suspended mass at different points over a certain area would stretch the spring different amounts. The stretch of the spring could be measured at each point, and the relative amounts of stretch would give an indication of the relative depths of the hard basement rock under the surface. However, the stretch on an ordinary spring of convenient practical length would be too small to measure, even with considerable magnification of the reading. For this reason a spring which is, in itself, a unique feat of engineering, is used in the modern gravity meter. The wire of which the spring is formed is stressed to a high tension while being wound into shape, so that when the spring is completed and allowed to remain in an unstretched position, the convolutions of the spring are all touching each other. The result is a spring which, although only a few inches long, has a very great period of vibration, equivalent to an ordinary spring too long to be used in a portable geophysical measuring device. This type of spring is commonly known as a zero length spring because its length is always proportional to the amount of force used to pull it.

In the North American Gravity Meter shown, this spring is supported at one end by the inside of the instrument case while the other end is fastened to the center of gravity of a horizontal lever arm. One end of the lever arm supports a block of solid gold while the other end supports a light aluminum cylinder to compensate for the buoyancy of the air on the mass of gold. The lever arm is fulcrumed, and the end opposite the mass of gold is attached through an intricate spring leaf arrangement to an adjusting screw that is turned by means of a micrometer reading dial. Now, when the meter is set over a certain point, the mass of gold is attracted to the hard basement rock. The micrometer is turned so that the lever arm is adjusted to a horizontal position as shown by an elaborate optical arrangement which magnifies the movement of the lever arm one-hundred fifty times. This setting is used as a base reading, and then, as the meter is moved from point to point over the surface of the earth, the observed variations in the movement of the lever arm show the relative depths of the dense sub-surface structures. The meter is so sensitive that differences of two billionths of a pound of force on the mass of gold can be detected! Since this extreme degree of accuracy is far greater than the accuracy which could be maintained due to error that would be introduced by the thermal expansion of any materials known to engineering science, a high degree of temperature control is maintained inside

(Continued on page 38)

— Courtesy North American Geographical Co.

A helicopter equipped with gravity meter facilitates surveys in wilderness regions.

The Dean's Page

by C. L. ECKEL

This year, colleges of engineering will turn out more graduates than are needed for immediately foreseeable engineering positions. It is believed, however, that graduates, who really should, will find positions with opportunities to achieve success, but more effort on the part of the individual will be required than was necessary last year or the year before.

On other occasions in this space, I have suggested that students and prospective graduates should give serious thought to the field of future work that might hold their interest and to learn about the companies or organizations which are active in the fields of probable interest.

Early in his career, it seems to me, the young engineer should try to determine his long-time goal and then plan a series of steps of short-time goals designed to bring about his major accomplishment. I do not mean that the young engineer should aim to be chief engineer of such and such a company. He can decide, however, that he wants to become a consulting engineer, a teacher, or that he is primarily interested in research, design, sales, or some other field. His short-time goals or projects should be considered as stages and opportunities to acquire experience which may be useful in achieving the major accomplishment. Even if the work at intermediate stages is disagreeable and uninteresting at times, it can and should afford valuable experience.

The young engineering graduate must realize that he is not a finished professional engineer, and therefore not competent to solve any and all problems that might come his way. Obviously he lacks experience and "engineering know-how." It may take years to acquire these prerequisites. And no worthy member of the profession ever "knows it all." Any young engineer can learn much of value by keeping his eyes and ears open and his mouth shut. The need for continued study and professional development, and the means available for these accomplishments have been mentioned in previous articles on this page.

The recent graduate has problems of adjustment. He must make new friends and fit into the stream of his community life. If he has not already done so, he must learn to get along with his associates. He must learn to give and take. It has been said that no one but the lawyers win in a lawsuit but that both parties to a controversy may win if they are willing to sit down and genuinely try to work out an equitable solution. There is much compromise in living, but do not compromise on fundamental principles such as honesty and integrity. It is often desirable, however, to yield on a minor point which may really be relatively unimportant, in order to be in a position to win an item of major importance. It should be remembered than a man must always live with himself and this means no yielding on fundamentals of character.

As a citizen, an engineer should have community interests. Professional men are often charged with "social indifference." This charge is sometimes true but in many instances valuable public service is rendered by engineers with little thought of publicity or even of public recognition. Often this service is not properly appreciated, but if a job needs doing, it should be done. Usually there is enough credit to go around, but accomplishment and not credit is the important thing.

Every new invention makes new opportunities and opens new positions. In choosing a field of activity or a position, ability, interest and compensation are important factors. A man's interest in a particular job is of little value if he does not have the ability to meet the job requirements. Ability without interest in the work is likewise a sorry combination. Hard work will sometimes overcome these difficulties.

The pay one receives for his work is important. Too often, engineers, as a whole are underpaid for the service they render, but on the other hand no engineer or professional man is entitled to his fee unless he renders a service that saves his client more than the amount of his fee.

In his early employment, the young engineer is involved in a continuation of his training. Invariably a period of time—perhaps as much as year—may be required for a recent graduate to really earn his initial salary. Beyond this stage, the best way I know to deserve a raise in salary is to be worth more than the amount of your pay check.

All this relates to monetary pay—which is important and necessary because a man must live and eat and support his family—but the real pay that you will receive is the satisfaction that comes from a job well done and the enjoyment and pleasure that comes from your contribution toward making this a better country in which to live.

A Livable Roundhouse

by W. A. WAHLER, C.E. Graduate Student

Here is a house that has what it takes to solve many housing problems. An air-form house — a concrete construction requiring no wooden forms.

Bill, who claims Boulder as his home, is twenty-four, married, and employed by the Bureau of Reclamation. On educational leave, he is a member of the Graduate School, holding a degree in Civil Engineering with a minor in geology. Bill spent three years as a navigator in the Navy during the war. His activities include membership in A. S. C. E. and the American Concrete Institute.

Cheap, adequate housing has always been a problem of paramount importance throughout the world. In recent years, many improvements have been made in the method of constructing small houses. Many new materials have been developed, and others greatly improved. The use of concrete has become increasingly important due to its resistance to fire and weathering. For many years, concrete has been used only in foundations and floor slabs. Lately concrete has been used for almost all the parts of a house from the roof down. Concrete houses are constructed of pre-cast concrete panels, and by shooting concrete onto forms.

The invention of the gunite machine and the pneumatic form has made possible the balloon, or airform type of construction. This technique is especially adapted for the construction of houses, aircraft hangars, oil and water storage tanks, hospitals, schools, warehouses, grain bins, and storage facilities of all kinds. It is the fastest and most economical of all methods of construction.

Airform building are not constructed in the usual sense, as the word "construct" has a root meaning "to pile on." Conventional construction involves the piling of brick or stone, one on top the other; while the airform method is to place all materials, such as concrete, insulation waterproofing, etc., by blowing or shooting them into place on a form by air pressure. The gunite machine shoots the concrete on the form under pressure, making a dense, strong concrete. The airforms are made of rubber-coated nylon fabric by Goodyear Tire and Rubber Company. They are inflated by a standard blower or compressor to a guage pressure of from eighteen to forty-five pounds per square foot, depending on the size of the airform and the building to be constructed.

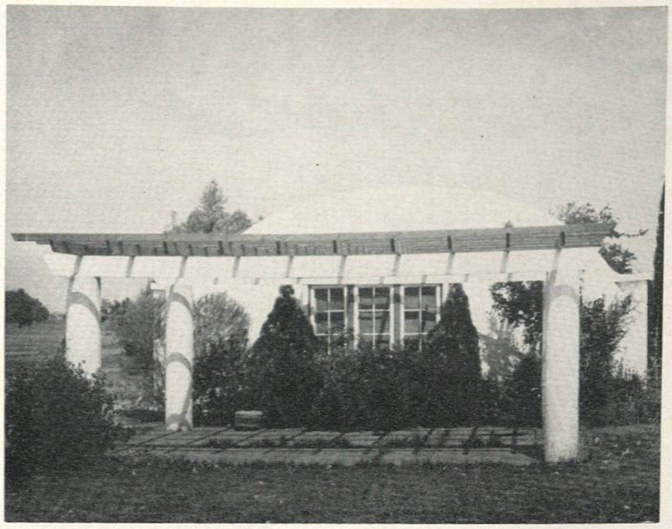
—Courtesy Walter Neff, Los Angeles, Calif.

This modernistic three bedroom home is located in Pasadena, California.

The whole procedure of construction is simple, and consists of laying the floor slab with footings, placing and typing the airform to the floor slab, inflating the airform, and erecting the scaffolding preparatory to placing the concrete on the form. The door and window assemblies are placed in position against the airform and remain as part of the structure. The concrete is then placed on the form by the use of a gunite machine or by hand when the gunite equipment is not available or when building sites are scattered and low cost labor is plentiful. After the concrete has gained sufficient strength to support itself, the form is deflated and removed through a window or doorway. The strength is usually sufficient in twenty-four to forty-eight hours. The airform may be reused several hundred times, making the unit cost of form work relatively low. The scaffolding may be built so that it can be taken down and moved from building to building and used indefinitely.

The first layer of concrete is placed on the top of the form and brought down the sides in circles of even elevation. This layer of concrete is about three-fourths of an inch thick. By placing the concrete from the top down, the side walls tend to widen out and give ample head room around the interior walls.

The buildings are reinforced by using the first coat of material placed on the airform as a base on which to lay reinforcing mesh. A second coat is then placed over the reinforcing mesh to bring the thickness up



—*Courtesy Walter Neff, Los Angeles, Calif.*
Graceful lines are the keynote of this two bedroom house. Its site is in Arizona.

to one inch if insulation is to be used or to one and one-half to two inches if insulation is not used.

In extreme climates insulation may be desired in the structure. To insulate the airform house a shell of one inch thickness is built up and reinforced in the normal manner. The airform is removed and a layer of pumice and foaming agent, or a rock wool blanket is laid over the shell. A second coat of one inch of gunite is then placed over the insulation and finished.

The house would have a minimum of outside wall and ceiling area for a given inside floor area or volume. This would make heating quite simple and economical. When insulation is used, the heat lost to the atmosphere is quite small. In the summer the building would be cool since it would have a fairly high ceiling, and the insulated concrete would resist heat conduction, thus cutting radiation to a minimum.

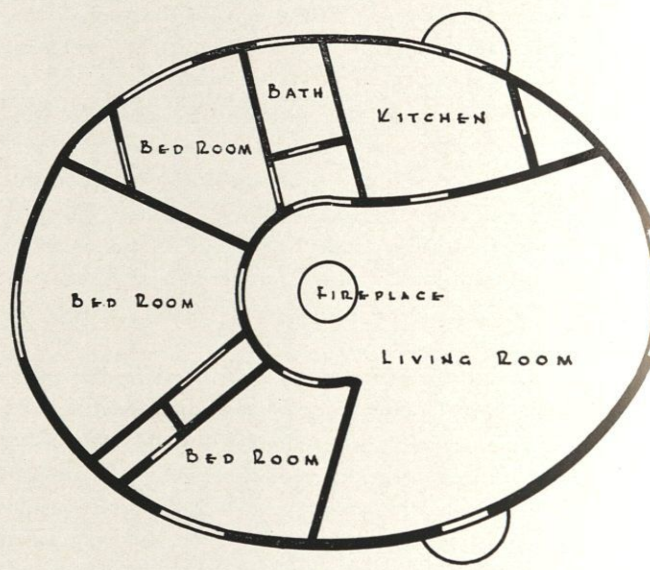
Modern streamlining is economical and natural with this type of construction, since air is one of the basic components of the technique. The design of a structure is no longer limited to rigid lines and angles. Flowing lines and curves may be easily and naturally incorporated in the design of a house. The dome shape may be modified to produce an infinite variety of shapes and forms. The design is simple and modern. New fascinating organic designs heretofore too expensive to contemplate are now possible and available to architects and engineers for use in house design.

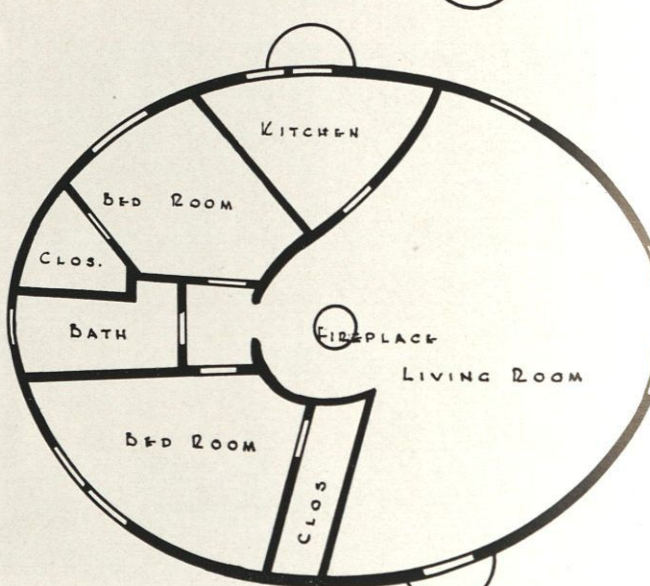
The shape of these houses is basic, and natural. Sea shells, one of the most nearly permanent and durable structures of living organisms, often take the form of an oval dome. The Eskimos use the igloo as their home because its dome shape offers the maximum protection from the elements. Many native huts the world over are circular or dome-shaped. Man and nature developed this structural shape in order to offer its inhabitants the maximum protection from natural and man-made destructive forces.

As it does not require the use of girders, columns, or trusses to support its ceiling, airform construction offers a structure which has a maximum of free space within its walls. The interior of the house has a graceful, clean, uncluttered appearance. It may be divided into rooms in many ways, giving maximum freedom in the utilization of the space. Permanent brick, wood, or composition walls may be erected or screens and curtains used in the space separation.

The exterior appearance of the airform houses may be varied by the use of brick or stone veneer. The veneer may be carried around the building vertically to a point above the door-heads to give it lines of conventional buildings. Wood and asphalt shingles have been used to vary the appearance of the roof lines, so that they may be as conventional or different as is desired. The buildings have the basic cross-sectional shape of an oval or circle. At present the sizes range up to two hundred feet in diameter with a clear ceiling height of forty feet in the center.

Houses made by the airform process are permanent Class "A" structures. They are structurally sound and pleasing in appearance. They are natural looking in





Floor plans for two and three bedroom airform homes. Dimensions: 32′ by 42′ oval, 1083 sq. ft.

— *Courtesy Walter Neff, Los Angeles, Calif.*
The interior of a new Pasadena home combines beauty, luxury, and utility.

almost all locations. Near the sea shore they may be modified to take the appearance of a gigantic sea shell. In the desert they fit in with the erosional patterns of the ground quite well, especially when they have large window areas and are painted a neutral color. In the mountains their shape blends naturally with the rocks and boulders. They may be made to resemble Indian hogans, Eskimo igloos, and many take a variety of natural structural shapes.

Reinforced concrete structures are vermin and termite proof, as well as being fire and weather resistant. The reinforced concrete coupled with the dome shape of the airform produces an earthquake resistant structure.

During a war the shape of the house would make it resistant to bomb concussion and splinters. The reinforced concrete would make thermite and fire bombs ineffective. Earth could easily be piled around and over the house to protect and hide it from the ravages of war. A near miss with a bomb or explosive shell would have a much less damaging effect on this type house than on the conventional vertical walled type.

This type of house is economical to construct because the work is done largely by mechanical means and requires the minimum use of masons, carpenters, and plasterers. The forms and scaffolding sections may be used over and over again producing a low unit cost for this otherwise expensive phase of operations. The materials of construction are non-critical and may be obtained almost anywhere. The reinforcing mesh, the window and window frames, and the door and door frames are prefabricated in large quantities, making them economical to produce. The upkeep on a concrete structure is much lower than on wood, masonry, brick, or stucco.

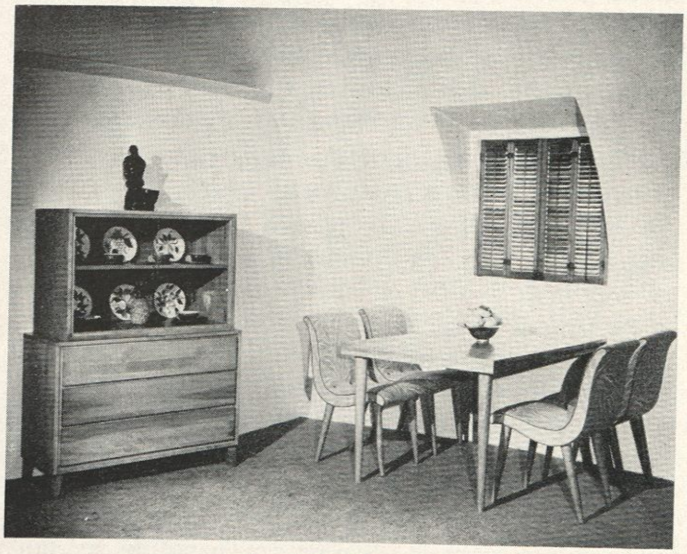
Extensive tests and research work have produced buildings that will not crack, sweat, or leak. Mixtures have been developed for the concrete that reduce expansion and contraction factors to a minimum, thereby eliminating the unsightly cracks which are quite often associated with concrete. The concrete is made of sand, cement, and water. The amount of water is kept to the point where the concrete will just remain where it is placed on the form. The water-cement ratio is a minimum and the slump would be almost zero.

A one inch thick standard shell without reinforcing of any kind, thirty-one feet in diameter, and thirteen feet high was recently tested by the Raymond Osborne Laboratory. A dead load of forty-three thousand pounds was concentrated on the top of the house and no fracturing was developed. There was no appreciable deflection in the structure.

The airform houses have been built in many countries and often in large numbers at one site. They are very adaptable to industrial housing units and commercial cabin developments. They have been built in the better residential areas of some of the more beautiful cities in the United States and also serve as native housing in Africa, Morocco, and India.

Structures of many types may be built with the same general type of equipment and trained personnel. The airforms come in many sizes and shapes and are easily modified so that a great variety of structures may be built with one airform. Gunite is easily applied to any other form work which is used in conjunction with the airform. Doors and windows may be placed where they are desired and two or more airforms may be used in one structure to serve any desired purpose.

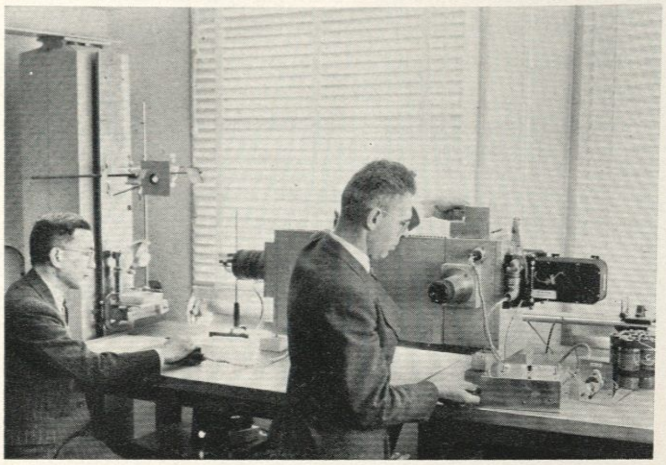
The airform house seems to be the answer to the need for a functional economical house which may be satisfactory under almost all conditions of use and climate. The engineering analysis of reinforced concrete is the same throughout the world and requires no special tests or permits. The materials are generally available, and the cost of construction is low. The houses may be built faster than by any other method and offer a flexible finished structure.



— *Courtesy Walter Neff, Los Angeles, Calif.*
Interior view of a part of Rio de Janeiro project, Brazil.

CAMPUS

High Altitude Observatory



Dr. Ch'ing-Sung Yu (left) and Dr. John W. Evans, assistant supervisor of the observatory, test their co-designed solar flare patrol camera.

A solar flare patrol camera has been designed and built by the High Altitude Observatory on the University of Colorado Campus to take pictures of the sun's image every few minutes. The sun's image is piped into the laboratory by means of a heliostat installed on the outside and which follows the sun across the sky.

The chief purpose of the camera is to record flares on the sun, although other features of the sun's disk also are recorded. A flare is an unusually bright patch on the sun that lasts just a few minutes, but in that time has a marked affect on communications systems, electrical transmission lines, and cosmic ray intensity.

Shown in this picture are Dr. Ch'ing-Sung Yu (left) and Dr. John W. Evans, assistant supervisor of the observatory. Dr. Evans designed the optical system for the camera with the help of Dr. Yu. It includes the finest birefringent filter ever constructed. The filter transmits light four-tenths of an Angstrom unit wide whereas the best photographic filters transmit a band several hundred Angstrom units wide.

"H" Bomb Is For War Only

There will be no peace-time application for the "H" bomb according to Dr. Joseph Harold Rush of the Colorado-Harvard high altitude observatory.

Dr. Rush told the member of the American Society of Mechanical Engineers at the University of Colorado that the "H" bomb would be incapable of control, and therefore useless except for military purposes.

There is a chance, however, that scientists will discover ways to use uranium and plutonium energy for power generation and propulsion.

However, these applications are a long way off because of the dangers involved in handling a "hot" atomic pile. Dr. Rush said that maintenance work would be impossible once the pile was hot. "Overhauling the atomic pile," he said, "has been compared to overhauling an automobile engine by dissolving it in acid, precipitating the iron, and then starting again to build the engine from what's left."

The only method developed so far for using the atomic energy for power is to employ it as a big fireplace to replace the burners in a power plant. The high temperatures required for operation, the heavy shielding needed, and the dangers involved make such an application difficult. Putting such a ponderous unit in mobile form for transportation involves even greater difficulty.

Special Summer Course

"Statistical quality control," called the sharpest management tool to be developed in a half century, will get a thorough going-over this summer at a special ten-day course to be presented by the University of Colorado, College of Engineering.

This ten-day intensive training course, for engineers and management personnel in the Rocky Mountain region, will be given August 14-25. Dr. Lloyd Knowler of Iowa University, Dr. Mason Westcott of Northwestern University, and Prof. John Henry of Illinois University will head up the staff of experts which will be brought to the Boulder campus.

Basis of the new technique is the application of the laws of chance to production or distribution. Its employment reduces rejection, saves machine and man hours, increases tool life, and boosts efficiency. "Inspection fatigue" factors may be eliminated by the use of statistics for inspection.

Industries which are currently using the statistical techniques of quality control to good advantage include pastics, radio equipment, rubber, seeds, candy, textiles, drugs, food, transportation, mail order houses, small arms, and many others. It is applicable to industries making large numbers of small items and small numbers of large items.

Senior Engineer Awarded

F. J. O'Donnell, senior in the architectural engineering department at the University of Colorado, was awarded $100 and major honorable mention for his plans for an 8-family wood, garden-type apartment building. The contest was sponsored by the Timber Engineering Company in conjunction with the National Lumber Manufacturers Association, Washington, D. C. There were more than 2,000 entries in the contest.

O'Donnell is the son of F. J. O'Donnell, 1560 Cornell Drive, Dayton, Ohio.

NEWS

The Dean Travels

Dean Clarence L. Eckel recently returned from an inspection trip which took him through Arizona, New Mexico, California, Utah, and Texas. This trip, made for the Engineering Council for Professional Development, was just a small part of the job that Dean Eckel does as chairman of the council.

He left Boulder, April 15th, for Fresno, California, where he visited the Bureau of Reclamation. He saw many of the Colorado Alums who are working at the Bureau. The Dean left for Los Angeles to see Alumni and to attend the spring meeting of the A.S.C.E. He then went to the U.S. Naval Civil Engineering Research and Evaluation Laboratory at Port Hueneme, California, to see Commander Tyrrell, a graduate of C.U. Dean Eckel then met Professor Beattie in Los Angeles, and they finished the tour of inspection together.

The places inspected on the trip were: Utah State Agricultural College, the College of Engineering and Mines at Arizona University, New Mexico State College of Agriculture and Mechanical Arts, New Mexico University, and the United States Reservation at Las Cruces, New Mexico.

Colorado's Experiment Station To Support Three Fellowships

Fellowships for eligible graduate students throughout the country will soon be available at the University of Colorado in engineering, physics and chemistry.

The Board of Regents of the University recently aprpoved establishment of three fellowships financed by funds from interest on investment and earnings in the Engineering Experiment Station.

The fellowships will be for $750 each with no charge for tuition. Winners will not be required to have duties other than study and research in the stipulated fields. The fellowships will start in the fall of 1950 and run for a nine month period.

Selection of the fellows will be made by the executive committe of the Enginering Experiment Station, with final appointment by the President of the University of Colorado.

Colorado Gets More Money To Study Supersonic Speed

Research on a supersonic speed problem at the University of Colorado received a boost from Wright field, making a total grant of $54,000 for the project.

An extension of $10,000 was given to the aeronautical engineering department for its work on thermoelastic-stress analysis.

The work is directed by H. W. Sibert, head of the department, assisted by Franklin P. Durham, assistant professor of aeronautical engineering, and by B. T. Arnberg, instructor of mechanical engineering. Frank Stevenson, Colorado graduate in mechanical engineering, is employed to work full-time on the project.

The scientists are finding the temperatures and thermostresses caused at speeds from two to six times the speed of sound. Such high velocity produces terrific heat in various sections of airplane wings. Tests are made and analyzed and then verified in the laboratory where aerodynamic heating is simulated by radiant heat.

Work was stated on the contract with Wright field in August, 1947, and will continue through June, 1950.

New Buildings

The Board of Regents of the University of Colorado is asking for bids for the construction of a physics building and the "Sommers" observatory on the Boulder campus. The bids were opened May 2, at 2:00 p.m., in the office of the President of the University.

Combined bids for both the buildings will be considered, or bids for either of the buildings, individually.

The physics building will have the same distinctive architectural style as the other buildings on the campus built in the last 20 years. It will be located east of Norlin library, and together with the engineering administration building to the south and the library to the west, will form a new quadrangle. The new building will be approximately 200 feet long and three-and-a-half stories high.

The "Sommers" observatory will be located on the east edge of the campus. It will house the ten and one-half inch telescope presented the University's high altitude observatory by Bausch and Lomb Optical Company. It also will have a lecture room, office, and space for student research.

Atom Research

Why does an atom nucleus wobble? The Research Corporation of New York granted Dr. John R. Zimmerman, assistant professor of physics at the University of Colorado, $4,500 to continue his research on this problem.

Dr. Zimmerman, who received a Ph.D. degree from Ohio State last year, began his work on "nuclear magnetic resonance absorption by radio frequency methods," while still at Ohio.

The research corporation support, known as a "Frederick Gardner Cottrel Grant" will make it possible for Dr. Zimmerman to continue his project here at the University.

The research involves tiny nuclear particles, which may be thought of as spinning steadily like so many

(Continued on page 49)

The R. F. Mass Spectrometer

by ROBERT POWELL, Eng. Phys. '50

Are you interested in spectrometry? Here is an article on a radio frequency mass spectrometer.

The magnetic deflection mass spectrometer has become a common instrument of modern physics. In this spectrometer a collimated beam of ions is shot through a magnetic field. Because of the charge on the ions, their paths will curve, heavier ions curving less than lighter ions. In this way, ions of different mass are separated. The mass spectrometer has many uses among which are chemical separation, accurate gas analysis, and experimental determination of the mass of atoms. The magnetic deflection spectrometer has high resolution; one being built by the Bureau of Standards will resolve one-thousandth of an atomic mass unit. But, the magnetic deflection spectrometer is bulky, complicated, and very expensive, even with instruments having poor resolution.

These disadvantages in the magnetic deflection mass spectrometer have led to the need for a lighter, simpler, less expensive, and less accurate spectrometer. Mass spectrometers using velocity selection instead of magnetic deflection for separation have been studied since 1932, but with little success until recently. In 1946 Dr. Willard H. Bennett of the Bureau of Standards observed the resolution possible by applying a radio frequency potential to the intermediate grid of a coaxial cylindrical pentode. The tube was first used in the separation of negative ions, but much better resolution was obtained than expected. Because of this, experimentation was begun on the possibility of using velocity selection for mass spectrometers. Radio-frequency, velocity selection spectrometers having the necessary lightness and simplicity have been constructed which will resolve ions to within one atomic mass unit.

Description of a Radio-Frequency Mass Spectrometer

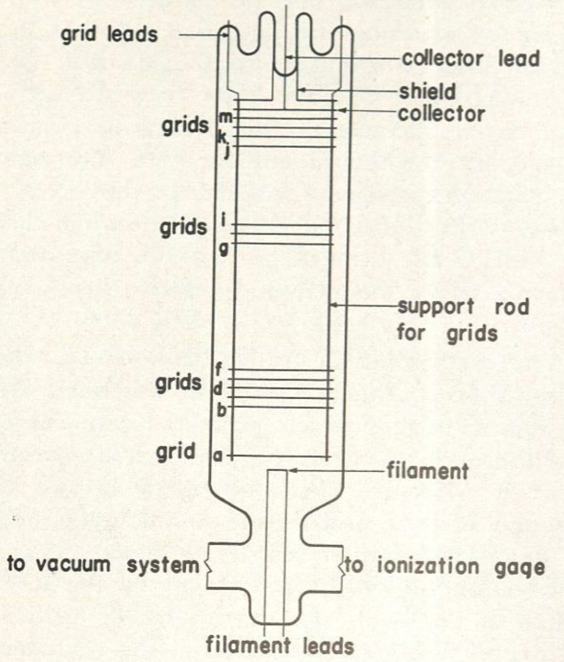
A 7-5 radio-frequency mass spectrometer is shown diagramtically in figure 1. The seven and five refer to the distances between grid groups measured with reference to the time (in cycles of the radio-frequency potential) that it takes for an ion to travel from one grid group to the next. The metallic elements are enclosed in a glass envelope. The tube is approximately 40 centimeters long and is about 7 centimeters in diameter. Near the bottom of the tube are two openings. One opening leads to the vacuum system and the entrance for the tested vapor. The other opening leads to the ionization gages for measuring the pressures in the tube. The filament leads, about 17 centimeters long, which also act as filament supports, are brought through

Bob is a senior in Engineering Physics and an assistant instructor in the Physics Department. Last summer he was a trainee at the Bureau of Standards. A native of Denver, Bob's main recreations are skiing and hiking. He was a squad leader in Rocky Mountain Rescue Squad, was an organizer and first chairman of the Boulder Ski Patrol, and was president of the Ski Club last year. On the campus he is a member of Sigma Tau, Pi Mu Epsilon, and the I. R. E.

the press at the bottom of the tube. The filament is one centimeter long and is straight. The 13 grids are in four groups. There is one grid in the first group; in the second group there are five; in the third, three; and in the fourth, four. The first grid *a* is approximately 6 millimeters from the filament. The grids in each group are separated 4 millimeters by glass spacers. The collector is between the last grid and the shield, and its lead leaves through the center press at the top. Leads to the various grids are brought out of the tube through the seven presses along the rim of the top of the envelope.

Nichrome is used for the grids and grid leads, and tungsten is used for the filament and filament leads. Knitted tungsten wire is used for the grid screen which permits 95% pass. The high pass is necessary because of the large number of grids through which the ion current has to pass. The glass used in the envelope is Pyrex, except at the metallic joints. At those points uranium glass has to be used to prevent separation of the metal from the glass when the temperature is increased from normal. The inter-grid distances have to be very accurate, the tolerance allowable being 0.002 centimeters. After the tube is completed, it is baked while under a vacuum to remove residual gasses from the metallic surfaces.

For the spectrometer to be effective, the mean free path of the ions must be as long as, or preferably longer than, the spectrometer tube. For this condition to hold, the pressure in the tube must be one micron of mercury or less. The working pressure of the 7-5 spectrometer tested during the summer of 1949 at the Bureau of Standards was approximately 1×10^{-6} millimeters of mercury which is equivalent to one-billionth of an atmosphere pressure. The pressure in the tube is first reduced by an oil rotary pump. Pressures in this range are measured with a McLeod gage. After the pressure is reduced by the oil pump, the mercury diffu-



Radio Frequency Mass Spectrometer

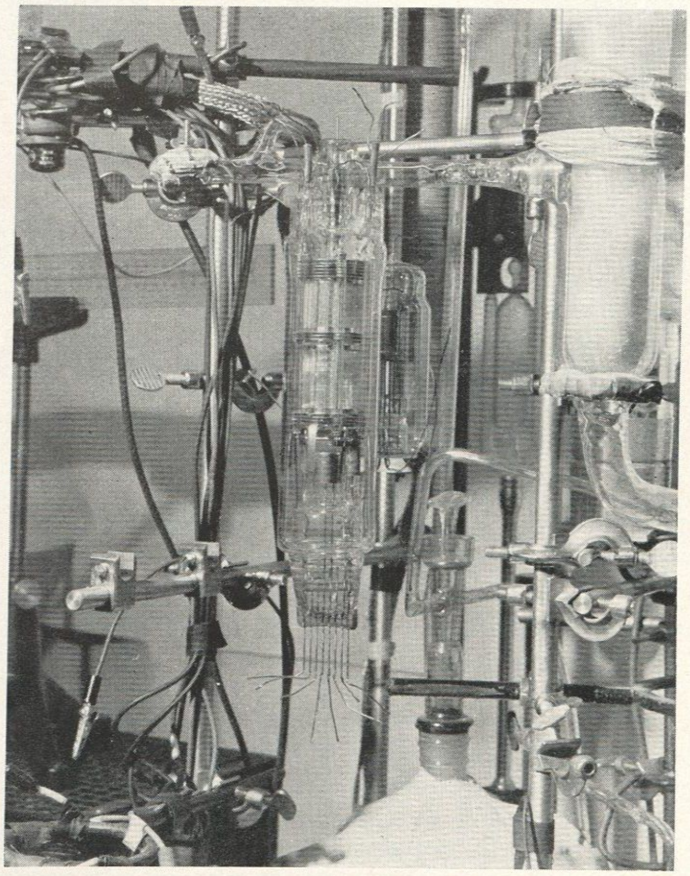
FIGURE I

sion pump is started. A dry-ice trap is placed between the diffusion pump and the source of the substance to be tested. The dry ice condenses any mercury vapor left in the system. The lower pressures are measured by an ionization gage connected directly to the stem of the tube. As the pressure is decreased, the electric current flowing across the ionization gage will increase. From previous calibration, the pressure may be obtained from the current readings. The unknown gas or vapor is admitted to the system by a controlled leak into the tube leading to the vacuum system. A needle valve and a crack in a glass stem have been used as controlled leaks.

A 9-7 mass spectrometer is shown assembled in figure 2. The main differences between this tube and the one previously described are that the vacuum in fig-zation gages are connected to the *top* of the tube and some of the grid leads are brought through the *bottom* of the tube. Six grid leads and the two center filament leads are shown at the bottom of the tube. The filament and the first group of grids are about half way up the tube. At the top of the tube are the last group of grids, the shield, and the collector. The collector lead of stiff tungsten leaves the tube in the top center. Around the rim at the top of the envelope are additional grid leads. The vacuum line leaves the top of the tube and goes to the right. On the far right side of the picture is the dry-ice trap. Just to the right of the spectrometer tube, and about half way up, is an ionization tube gage. Further to the right, and in the background, is the McLeod gage. Leaving the top of the spectrometer towards the left is the line for the ionization gage and the source of the vapor or gas. The source, mercury liquid, is in the far left extremity of the top left tube. In the background at the left is seen the scale for the galvonometer deflections.

General Theory

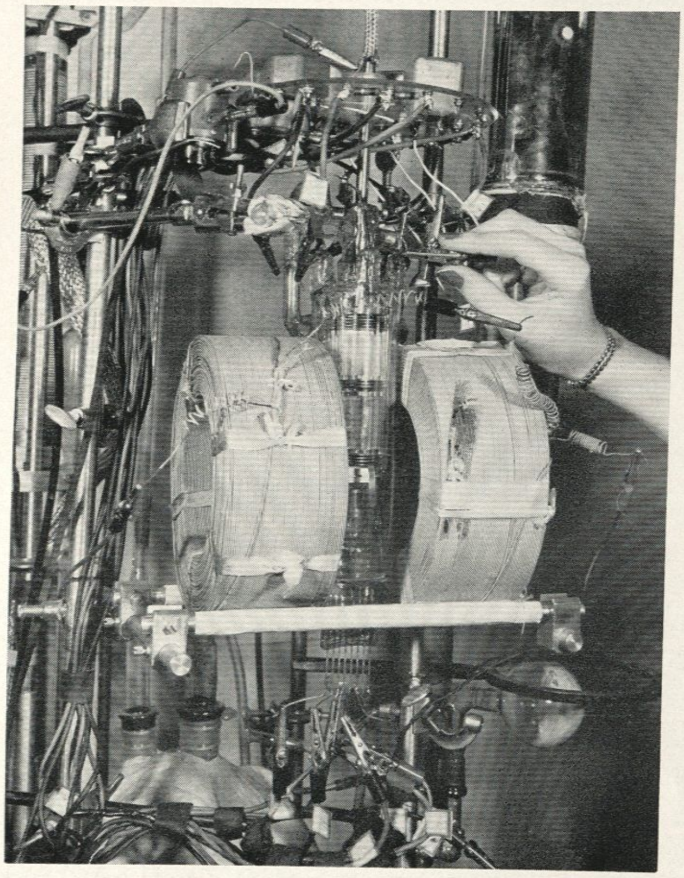
A diagram of the spectrometer tube is shown in figure 1. The pressure in the tube is maintained between the limits of 1×10^{-6} and 1×10^{-4} millimeters of mercury pressure. Atoms or molecules of the vapor being tested enter the tube from the opening to the vacuum system. A direct current flows through the filament, heating it so that electrons are emitted. The filament is kept at a large negative potential, whereas grid *a* is closer to ground potential. For this reason, the electrons from the filament are accelerated toward grid *a*. They acquire sufficient energy to pass through the relatively open structure of grid *a* and collide with molecules of the vapor in the region between grids *a* and *b*. These collisions produce ionization of the unknown vapor. The ions may have either a positive or negative charge, but in this discussion it will be assumed that the ions are positive. Grid *b* is slightly negative with respect to grid *a*. Because of this, electrons will be turned back toward grid *a* and positive ions will be accelerated toward grid *b*. Grids *c* and *d* are held at a large negative potential. The positive ions acquire energy in this field and are accelerated rapidly upward. The ions will have a velocity great enough to travel the remainder of the distance to grid *L*.



—*Courtesy Bureau of Standards*

Figure 2
A 9-7 spectrometer assembled for experimentation on mercury ions.

A small radio frequency potential is applied to grid *e*. The ions are further accelerated by this field *if* the frequency of the potential is adjusted to give an ion of that mass maximum incremental energy. By varying the frequency of the potential, ions of different mass may be given the maximum incremental energy. The exact mathematical relation between the frequency and the optimum mass, M, will be given later. Ions of one particular mass, M, then have a greater velocity when they leave grid *f* than ions of any other mass. The ions travel in a constant field from grid *f* to grid *g*. A radio frequency potential is applied to grid *h* and again only ions of mass M will receive maximum incremental energy. The ions travel in the constant field between grids *i* and *j* until they are again differentiated by the radio-frequency potential on grid *k*. The relatively positive potential on grid *L* is large enough to turn back all positive ions except those which have received the maximum incremental energy in each of the three grid groups. These preferred ions of mass M will then hit the collector which is at ground level. Grid *m* is at a more negative potential than any other grid and will turn back any electrons formed by the ions as they travel through the tube. An electrometer placed in the collector circut measures the current flowing (approximately 1×10^{-11} amperes). As the radio-frequency potential is varied, the electrometer will register peaks in intensity. These intensity peaks allow determination of the mass of the unknown vapors.



—Courtesy Bureau of Standards

Figure 3

A spectrometer assembled with magnets to study negative ions.

Negative ions may also be analyzed by the spectrometer by reversing the potentials. Unless precautions are taken, electrons from the filament register with the negative ions and cause a very large background level. Because of this, two large electromagnets are placed on the sides of the tube. The magnetic field from these magnets will deflect the electrons to the side of the tube, but will not affect the ions because their mass is much greater. A tube with the magnets in place for analyzing negative ions is shown in figure 3.

The exact solution for the motion of a charged ion in a sinusoidal field is difficult. But there are several approximations which make the problem easier, but still give accurate results. The first approximation is that the velocity varies only slightly because of the sinusoidal field applied to the middle grid. This is true because the initial velocity is much greater than the variation in velocity introduced by the RF field. Because of this small variation in speed, there is also a small, but negligible, variation in the transient time between grids. It is assumed that the space charges near the grids have little effect on the motion of the particles, and as usual, the grids are also assumed to be ideal.

In the grid group *d, e, f,* only grid *e* has a radio frequency alternating current applied to it. The force acting on an ion between grids *d* and *e* is

1) $F = Ee \sin (wt + \Theta)$,

where *E* is the maximum RF voltage, *e* is the charge on the ion, *w* is the RF angular frequency, Θ is the phase angle of the field as the ion passes grid *d*, and the time, *t*, is measured from when the ion passes the grid *d*. Similarly the force acting on a particle between grids *e* and *f* is

2) $F' = -Ee \sin (wt + \Theta)$.

The energy that an ion acquires due to the RF field is

3) $dw = V F dt$,

where V is the initial velocity of the ion. Substituting the values for the force *F* from equations 1 and 2, and integrating equation 3 from $t = O$ to $t = 2s/v$, where *s* is the distance between grids in centimeters:

4) $\Delta W =$

$Eev/w [\cos \Theta - 2 \cos (sw/v + \Theta + \cos (2sw/v + \Theta]$.

This equation is a maximum when $\Theta = 46° 26'$, and $sw/v + \Theta = \Pi$

This shows that for maximum incremental energy, the ion should pass grid *d* when the current has the phase angle of 46° 26′ and pass grid *e* as the field changes sign.

It can be shown that the mass of the ion which receives the maximum incremental energy from the grid group will be

5) $M = 0.266 \times 10^{12} \, v / s^2 \, f^2$,

where V is in volts. Since the distance *s* is fixed in any one spectrometer, the determination of the resonant

(Continued on page 48)

This Today, What Tomorrow

A new series of technical radio broadcast services over radio stations WWV, Beltsville, Maryland, and WWVH, Maui, Territory of Hawaii, will be inaugurated on January 1, 1950. Except in certain details, these services of the National Bureau of Standards will not differ greatly from those given in the past.

The revised services from WWV include (1) standard radio frequencies of 2.5, 5, 10, 15, 20, 25, 30, and 35 megacycles, (2) time announcements at 5-minute intervals by voice and International Morse Code, (3) standard time intervals of 1 second, and 1, 4 and 5 minutes, (4) standard audio frequencies of 440 cycles (the standard musical pitch A above middle C) and 600 cycles, (5) radio propagation disturbance warnings by International Morse code consisting of the letters W, U, or N, indicating warning, unstable conditions, or normal, respectively.

* * * *

Scientists can now explore unknown substances with X-rays, and determine in a few minutes what elements the substances contain and how the atoms in them are arranged, by means of a new, automatic instrument.

Called an X-ray spectrogoniometer, the instrument makes its analyses by means of X-rays, and especially sensitive "Geiger counter," and a system of gears machined to the accuracy of those used to guide major astronomical telescopes.

* * * *

The Boeing XB-47, Stratojet, holder of the all-type trans-continental record at an average speed of 607 miles per hour, is now equipped with even more powerful jet engines.

Installation of General Electric J-47 turbojets in one of two experimental XB-47's will service test the new, higher power engines for use in the production of B-47's now being built for the Air Force at Boeing's Wichita, Kans., Division. First flight of the XB-47 with the more powerful engines took place recently.

Use of the new G-E J-47's increases total power of the Stratojet more than 25 per cent. Each of the new engines has a basic thrust rating of 5200 pounds, compared with 4000 pounds of earlier J-35 turbojets.

* * * *

Not to be outdone by human heating comforts, a brood of turkey chicks can roll out of the hay on cold winter mornings, tidy their feathers while standing on an electrically heated floor, and eat a hearty breakfast under cozy infra-red radiant energy.

Poultryman George Ranson, after talking "cold turkey" to General Electric Company engineers, recently installed a heating system in the floor of his poultry house, and suspended nine 300 watt infra-red lamps from the celing.

He reported that three weeks before his first brood of 2000 turkeys reached maturity, many of the toms weighed more than 40 pounds.

* * * *

Scientists have recovered a portion of the two-stage rocket which set an altitude record of 250 miles last winter and which previously was believed to have disintegrated upon re-entering the earth's atmosphere.

The Army Ordnance Department and the General Electric Company, responsible for firing of the high-flying rocket last February, announced jointly that a badly-smashed tail section had been recovered at the White Sands, N. M., proving ground.

The two-stage rocket, designed "Bumper," consisted of a German V-2 with a 700-pound, American-built "Wac Corporal" rocket attached to the nose. At a height of about 20 miles, the smaller rocket was separated from the mother missile and sped away at a speed of 5,000 miles an hour to an altitude never before attained by a man-made device.

It was part of the "Wac Corporal" tail section that was found near the north end of the 116-mile firing range.

* * * *

Split-second flashes of light, produced when radioactive particles strike a suitably prepared surface may now be measured with great accuracy by an electronic counting system embodying recent developments in phototubes by the RCA Tube Department. Because of its greater sensitivity and flexibility, the instrument, called a scintillation counter, is fast replacing the Geiger counter in many applications involving atomic and nuclear radiation.

The scintillation counter, consists essentially of an extraordinary phototube "eye" and a fluroescent screen or phosphor crystal. When the instrument is exposed to radiation, radioactive particles strike the fluorescent screen and produces flashes of light. The light from each flash is picked up by the phototube and converted into a tremendously amplied electrical signal. The signals are then further amplified and registered on a meter or other device to indicate the presence and strength of radio-activity in the immediate area.

The heart of the scintillation counter is a remarkable electron tube called the multiplier phototube. This photo-electric eye picks up the feeblest phosphorescent flash and converts it into an electrical current which is amplified as much as a million times before it is released to the other circuits of the instrument.

This tube is capable of discriminating or "counting" radioactive particles arriving less than one 100-millionth of a second apart. This counting rate, considerably faster than that of the Geiger counter, greatly enhances the usefulness of the scintillation counter.

EDITORIALLY

Isn't It Worth Trying – Just Once?

In certain quarters on this campus the opinion that students have too much authority in governing themselves prevails. Also some believe that in many instances where students were and are being given responsibility of this nature, they have failed. The cry is, "you were given the chance, but you did an inefficient job and/or you misused your authoritative power."

It is also common belief that while students are treated as relatively mature people by instructors in the classroom and by administrative officials of the University in business relations, they are not yet mature enough to evaluate the type of education they are receiving, much less mature enough to criticize it constructively with those who design and provide it.

Modifications of the preceding views constitute the primary bases for arguments against student participation in matters that deal with the educational curriculum. But are such arguments valid?

Have not specially trained University officials who have administered the government of student affairs and activities to a greater or less degree at various times in the past also made similar mistakes? Does the administration always realize that the student government is handled by a *new* group of students *each* year, and that the seemingly continuous repetition of the same mistakes by many who enjoy the opportunity of assuming responsibility for the first time is due to a lack of experience? And does not the experience gained by these participating students, who are so urgently needed as future leaders in the world of today, overwhelmingly compensate for any errors made?

Where — — where shall tomorrow's citizens equip themselves to occupy the crucial positions in civic, political, business, and industrial affairs if not on these proving grounds? How much better they unjustly accuse a university president in the columns of a student newspaper and be reprimanded accordingly than they blaspheme anyone and everyone in a Senate Committee where they not be subject to censure!

Regressing to the original discussion — have students the ability and should they be permitted to constructively criticize the curriculum and methods of instruction at the University? Or are these latter above reproach? Would it not be feasible and advantageous for all, to have a group of conscientious students discuss in an open-minded atmosphere these topics with a faculty group at least once each year? The students could be chosen by department heads or, better yet, judiciously selected by various honorary organizations.

Surely there is some room for improvement. And certainly the designated students could at least convey to those whom they would represent some of the intricate problems faced by the administration and the reasons why certain questionable contemporary conditions must exist. This would guarantee maximum cooperation between faculty and students at all times. It would be rather naive and pretentious to assume that such is now the case.

Those who have the power to authorize such a plan say that it is impracticable, impossible, and quite out of the question. But isn't it worth trying — just once?? — fjs

SPEAKING . . .

It's Tough, But Not Bleak

"The picture facing this year's graduate is a mixed one." These words by Secretary of Labor, Maurice Tobin, in a recent bulletin are perplexing. The word "mixed" is an on-the-fence word and certainly doesn't give a distinct indication of the employment status confronting the classes of 1950.

A better word would have been "tough", and for a large portion of the graduating students from colleges this June, some emphatic adjectives preceding that word could easily be used.

Stiff competition is expected for jobs in law, journalism, and personnel work. There is an over-supply of graduates in business administration, and a surplus of new graduates has already developed in the field of accounting. In chemistry, competition is keen and probably will be for the next few years, especially for those without graduate training.

In medicine and dentistry, those able to enter and complete training should have good opportunities, however, the competition for admission to professional schools is great. In pharmacy, the supply of new graduates has almost caught up with the demand; the enrollment in pharmacy schools continues to rise so that this field will probably be overcrowed in the near future.

But what about the Nation's third largest profession, engineering? Is the picture as discouraging as it appears to those June graduates who are registered with placement bureaus, and who have written hundreds of letters of application to industrial companies from New York to Timbucktoo? For something concrete to analyze, let's look at some of the figures.

The Bureau of Labor Statistics has figured that the market for engineering graduates will be glutted until about 1956. However, the American Society for Engineering Education has found that not a surplus but of a shortage of engineering graduates is the prospect foreseen. The ASEE Committee reports that there will be fewer graduates from Colleges of Engineering than will be needed from 1954 to 1965, unless the percentage of high school students entering engineering schools is increased. Numerically, last fall's freshman engineering classes were not half that enrolled in 1946. Also, the indicated number of graduates in 1952 will be much smaller than the number actually placed in 1949; and by 1953, engineering graduates are expected to be fewer than the BLS estimates will be needed for actual engineering jobs.

What does all this mean to the 1950 graduate, especially when large companies are now hiring so few engineers? (The American Telephone and Telegraph Company hired *six* engineers from the entire Nation's March graduating class).

It appears to mean that the graduating engineer will have to "shake the bushes" and find a job of some kind, with the thought in mind that he will be on the lookout for a job that suits his taste and one for which he was trained. Whether or not the BLS or the ASEE committees calculated for this possibility is not known; *but* with the Manpower Committee's report that engineering is an expanding profession, with the known fact that more and more professions are becoming scientific, and with more and more executives in non-engineering professions realizing that the engineering education is an excellent background for administrative, sales, or personnel work—the situation is tough but far from bleak. —gmc.

ALUMNI

The Colorado Society of Engineers, which held election of new officers on January 21, 1950, has announced that George M. Hatfield, B.S. (M.E.) 1929, has been elected president for the coming year. Mr. Leslie N. McClellan, who received an honorary degree of Doctor of Engineering at the June commencement of 1949, was elected vice-president and Mr. C. M. Lightburn, ex-1910, was re-elected as secretary. James O. Rose, B.S. (E.E.) 1935, was general chairman of the convention committee and he was assisted by numerous other College of Engineering graduates.

1907

Eugene D. Eby, B.S. (E.E.), formerly consulting engineer with General Electric Company at Pittsfield, Massachusetts, now retired, visited the campus on Febuary 1. He was accompanied by Mrs. Eby and had not been on camus for a number of years. He said that he was pleased with the developments which have taken place on the campus during recent years. Mr. Eby's home address is 100 Holmes, Pittsfield, Massachusetts.

1911

Hary S. Stocker, B.S. (C.E.), is working as an engineer for the firm of James K. Monroe, Architect, in Denver, Colorado.

1912

W. LeRoy Page, B. S. (E.E.), is now employed as engineer with the Colorado State Highway Department. His office is in the State Office Building, Denver, Colorado.

1916

Victor E. Vallet, B.S. (C.E.), is president of the firm of Griffels and Vallet, Inc., Detroit. This company is to be designing engineer on some $6,000,000 worth of hospital buildings for the University of Michigan at Ann Arbor, Michigan.

1918

Charles M. Schloss, B.S. (E.E.), of the firm of Schloss & Shubart in Denver, has recently had a vacation and fishing trip on the Mexican Gulf Coast. "Dock" reports excellent luck and he says that he has certificates to prove his catch of sailfish was the real thing. His son, C. M. Schloss, Jr., is at presently enrolled in the College of Engineering at the University of Colorado.

1920

Gano R. Baker, B.S. (E.E.), who has been with the Westinghouse Electric Company since graduation and has recently been branch manager of the company's Southern California elevator division, has been transferred to New York. His new position will be Eastern District Manager of the elevator division of the Westinghouse Corporation. While in California, Baker served as President of the San Francisco Producer's Council and is a member of the Building Industry Conference Board.

1923

Harold W. Richardson, B.S. (C.E.), visited the campus in February. He also visited his mother, Mrs. Calle Richardson, formerly of the library staff and friend of the faculty. Mr. Richardson is present editor of *Construction Methods,* a McGraw-Hill publication at 330 W. 42nd St., in New York City.

1924

George W. Hoffman, B.S. (C.E.), is a highway engineer with the U. S. Bureau of Public Roads in Columbia, South Carolina. He is charged with the construction and maintenance work in connection with highways under the supervision of the Bureau of Public Roads in the South Carolina area.

1926

Donald S. Walter, B.S. (C.E.), is in charge of Regional Operation and Maintenance at the Regional Office of the Bureau of Reclamation in Boise, Idaho. His address is P.O. Box 937, Reclamation Building, Fair Grounds, Boise, Idaho.

1927

Frederick J. Johnson, B.S. (E.E.) 1927, E.E. (1933), and his wife visited the campus in early March. Johnson is Vice President and Assistant Manager of the Honolulu Rapid Transit Company, Ltd., at 1140 Alapai Street, Honolulu.

Frank M. McEahern, B.S. (C.E.), is an engineer in charge of structural work for the Colorado Fuel and Iron Company at Pueblo, Colorado.

1928

Louis R. Douglas, B.S. (C.E.), is Assistant to the Regional Director, Region III, U. S. Bureau of Reclamation. His address is Administration Building, Boulder City, Nevada.

Vernon J. Duke, V.S. (E.E.), staff engineer for the National Broadcasting Company at Rockefeller Center in New York City, visited the campus on January 24. He is engaged in development work, principally in connection with television circuits. His daughter, Eleanor Jean, is a junior in the College of Arts and Science at the University of Colorado.

1929

George F. Wallis, B.S. (E.E.), is an engineer in charge of electrical work at the Colorado Fuel and Iron Company in Pueblo, Colorado.

Terry Owens, BB.S. (C.E.), is City Engineer for the City and County of Denver and will be in charge of work in Denver's street improvement plans costing approximately $33,000,000.

1930

Harry J. Deines, B.S. (M.E.), has recently joined the Westinghouse Electric Company in a position of great opportunity. He obtained his experience in the advertising field by working for the General Electric

NEWS

Company from 1930 to 1944 and then going into the advertising agency business. His present address is 511 Wood Street, P.O. Box 868, Pittsburgh 30, Pennsylvania.

1931

Russell D. Rudolph, B.S. (C.E.), is now Works Manager for the United States Gypsum Company at Fort Dodge, Iowa.

1932

Frank E. Goehring, B.S. (C.E.), is head construction engineer at the Construction Field Office of the Keyhole Dam in Wyoming. His address is P.O. Box 278, Moorcraft, Wyoming.

Rob Roy Buirgy, B.S. (M.E.), is acting Construction Engineer at the Fort Morgan Field Office, South Platte River District, U.S. Bureau of Reclamation. His address is P.O. Box 152, Fort Morgan, Colorado.

Warren T. Terry, B.S. (E.E.), has recently been elected as general manager of the Home Gas and Electric Company of Fort Collins. His address is 1329 Sixteenth Avenue, Fort Collins, Colorado.

1936

Paul L. Harley, B.S. (C.E.), is Area Engineer of the Lower Platte River Area Office of the U.S. Bureau of Reclamation, His address is P.O. Box 997, Grand Island, Nebraska.

T. Arthur Quine, B.S. (C.E.), visited the campus on January 23 with his wife, the former Dorothy Ann Thomson. Having been with the U.S. Bureau of Reclamation in Denver for some years, he is being transferred to the Missouri Souris district office as an office engineer. The Quines have a daughter, Ann. There new residence will be Bismark, North Dakota.

1938

Percy B. Goss, B.S. (C.E.), who was with the U.S. Bureau of Reclamation, is now an engineer in the office of the City Engineer in Denver, Colorado.

George A. Frohlick, B.S. (C.E.), is now a member of the Frohlick Construction Company. His residence is 4785 East Evans, Denver, Colorado.

R. E. Kennedy, B.S. (C.E.), is with Miles-Cooper, a structural engineering firm in Portland, Oregon.

1939

John J. Brosius, B.S. (E.E.), is an electrical engineer for the Cheyenne Light, Fuel and Power Company at Cheyenne, Wyoming. Brosuis is in charge of electrical distribution.

1940

Royce J. Tipton, B.S. (C.E.), who is a consulting engineer in Denver, Colorado, has recently moved to 610-11 Insurance Building from the First National Bank Building.

1941

Gerald A. Samson, B.S. (A.E.), is Acting Construction Engineer for the U.S. Bureau of Reclamation at the Loveland Field Office in the South Platte River District. His address is P.O. Box 449, Loveland, Colorado.

1943

John Earl Lake, B.S. (C.E.), is now the minister at the Methodist Church in Bingham Canyon, Utah. Lake's address is 337 Main Street, Bingham Canyon, Utah.

1944

John C. Twombly, B.S. (E.E.), who has been an instructor in electrical engineering, but is now taking graduate work toward his master's degree at Stanford University, visited the campus on December 29. Twombly feels that he is obtaining excellent training at Stanford, but looks forward to his return to the University.

John R. Carry, B.S. (M.E.), received his master's degree in mechanical engineering at Purdue University in June, 1949. Carry is now an instructor in mechanical engineering at Purdue. He was in Boulder and visited the campus during the holidays.

Kenneth P. Rice, B.S. (M.E.), received his master's degree in mechanical engineering at Purdue University in June, 1949. Rice is now an engineer with the Boeing Aircraft Company at Seattle, Washington.

1945

Robert G. Look, B.S. (C.E.), is with Hendrie and Bolthoff in Denver, Colorado.

Ewalt P. Anderson, Jr., B.S. (C.E.), is with the Midwestern Construction Company in Tulsa, Oklahoma. Currently, he is engaged in the construction of a gas pipe line in western North Carolina. He came over to Raleigh to attend the Chi Epsilon Conclave which was held at North Carolina State College on February 24 and 25.

1946

Fred A. Reed, B.S. (M.E.) 1946, and LeRoy Patterson, B.S. (M.E.) 1947, have been selected for the new Creative Engineering Program sponsored by General Electric. The persons chosen for this course must go through extensive testing and interviewing before a final decision is made as to their ability for the course. We are proud to see that the College of Engineering of the University of Colorado is well represented and we wish to offer much success to these men in their work.

1948

Edward T. Brink, B.S. (M.E.), with honors, who is in the employ of the General Electric Company at Schenectady, New York, has been designated for the company's training program for supervisors.

George E. M. Stevens, B.S. (M.E.), was killed in an airplane accident at the National Guard Airfield near Golden, Colorado, on Sunday, January 22. He is survived by his wife and three children.

(Continued on page 50)

BOOK REVIEWS

Route Surveys

By Russell R. Skelton, McGraw-Hill, 1949, New York, pp. 531, $4.50.

Reviewed by R. C. Rautenstraus.

This book differs from the conventional book on route surveying in that the entire book is devoted to the application of highway surveys with the exception of a short section on railroad turnouts, frogs, and switches. The book places considerable emphasis upon the economic factors influencing route location, and presents to the student an engineering approach to highway location.

The arc definition and the chord definition of the degree of curve are both simply and clearly described with emphasis upon the basic difference of the two mehods. Earthwork calculations are given to cover the common conditions encountered by the engineer in the field, with clear examples and sample solutions for each. The chapter on earthwork distribution makes an otherwise difficult principle easy to understand by the use of excellent sketches and written description.

Mechanics of Engineering Soils

By P. L. Capper and W. F. Cassie, McGraw-Hill Book Company, New York City, 1949, pp. 262, $4.00.

Capper, of the University of London, and Cassie, of the University of Durham, have presented a lucid treatment of the fundamental problems of soil analysis. There is a brief study of the classification of soil and particle sizes. Numerous factors affecting the compressibility and consolidation of soils and methods of measuring and computing these are surveyed. The shearing resistance of soils is treated by Coulomb's Law and Mohr's Circle. Direct and indirect methods of measuring sear resistance are also shown. Calculation of the active pressure of cohensionless soil is demonstrated by means of Rankine's method, the wedge theory of Coulomb, and Mohr's Circle. Both Rebhann's and Culmann's constructions are illustrated. The active pressure of cohesive soil and the resistance of soils are also treated by a number of different methods. Mohr's Circle is extensively used throughout the book. A good study of foundations and related problems and pile foundations is given. Briefly studied are roads, runways, compaction, pavements, drainage problems and seepage, ground water, site investigations and soil testing.

Vapor Adsorption: Industrial Applications and Competing Processes

By Edward Ledoux, Chemical Publishing Company, 1945, pp. 360.

Reviewed by H. F. Walton.

This is a book on the statics, dynamics and thermodynamics of gas adsorption, with particular reference to processes of technical importance, such as the adsorption of water vapor or solvent vapors on carbon and silica gel. The adsorbed material is treated as a condensed liquid phase subject to an adsorption potential caused partly by van der Waals attractions and partly by capillarity. The book consists of four parts, entitled: Static Adsorption, Saturation of Air, Dynamic Adsorption, Industrial Applications. The first part is the longest and the most fundamental, and includes a useful discussion of the effects of an external force on phase equilibria. The last part, nearly as long, treats air conditioning, drying of gases, drying hygroscopic materials, solvent recovery and other topics. Each part is introduced by a short preliminary discussion.

The book is concerned less with the physical structure of adsorbents than with adsorption and desorption processes under conditions of high saturation. Nevertheless, the reviewer thinks some mention might have been made of the recent techniques for measuring surface area and effective particle size of adsorbents by low temperature gas adsorption, small angle X-ray diffraction, and the electron microscope.

Proceedings of the Engineering Drawing Division Summer School

Edited by H. P. Hoelscher and Justus Rising, McGraw-Hill Book Company, New York City, 1949, pp. 634, $7.00.

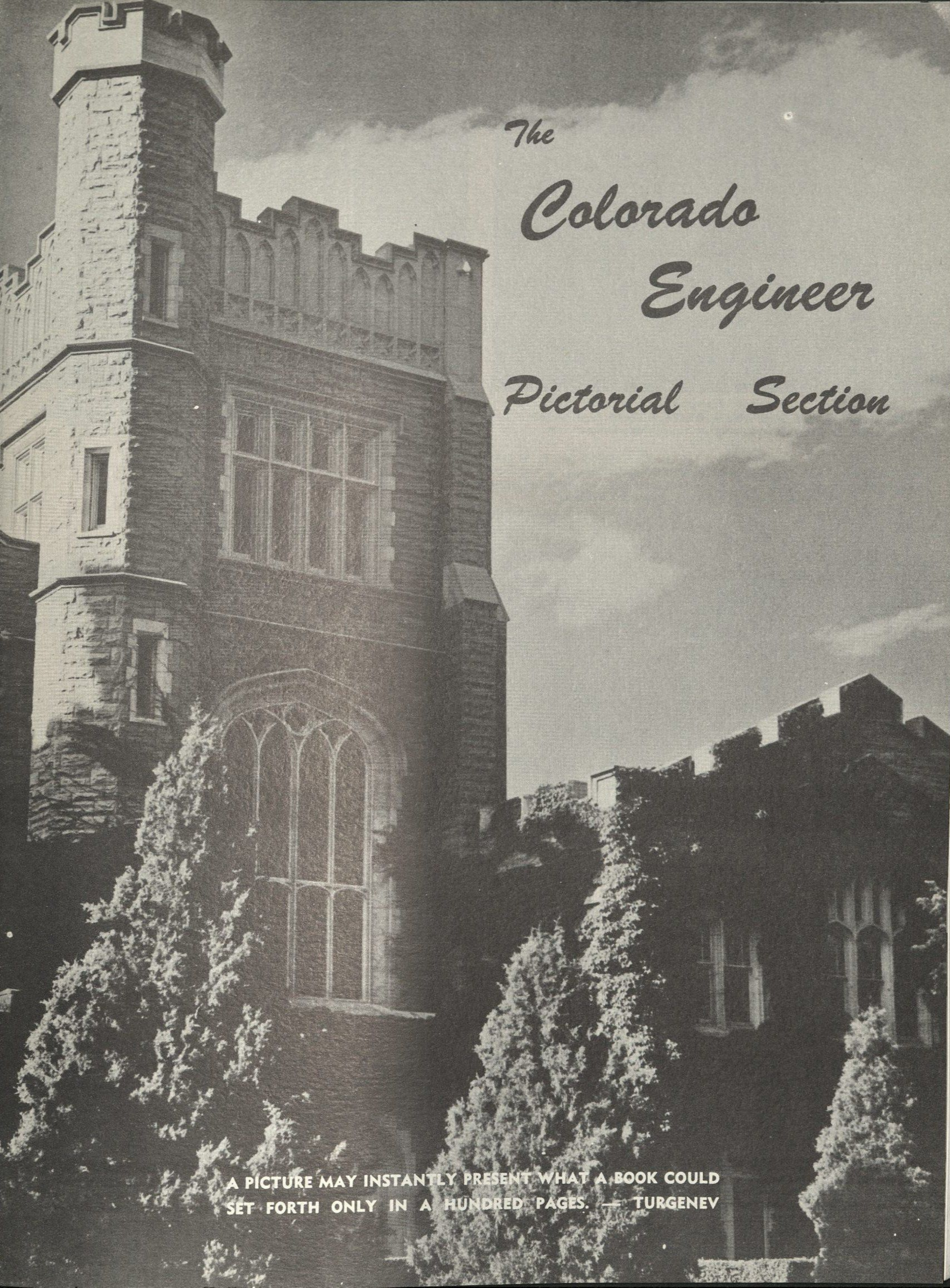
This book is a compendium of the papers presented in June of 1949 before the American Society of Engineering Educators, Drawing division. Noted authorities on various aspects of engineering drawing, graphics, descriptive geometry, teaching methods, equipment, and examinations presented papers which were then analyzed by competent discussion panels.

This book will be primarily of interest to educators.

Water Supply Engineering

Fouth Edition, by Harold E. Babbit and James I. Doland, McGraw-Hill, 1949, New York City, pp. 593, $6.50

Previous editions of this text have earned for it a good name. In line with contemporary trends, this edition includes a new treatment of the important aspects of public relations. There is a rather thorough study of financial methods for both public and private enterprises. A completely revised chapter on electrical equipment brings the information up-to-date, and several new chapters have been added on aqueducts, pipelines, and intakes. The treament of the necessary hydraulics is very good. There is a worthwhile chapter dealing with the demands placed on water supply systems; this is particularly important in view of the extensions presently contemplated for water works systems that are maintained at capacity. The great importance of maintaining complete and accurate records is discussed and methods of so doing are outlined.


The
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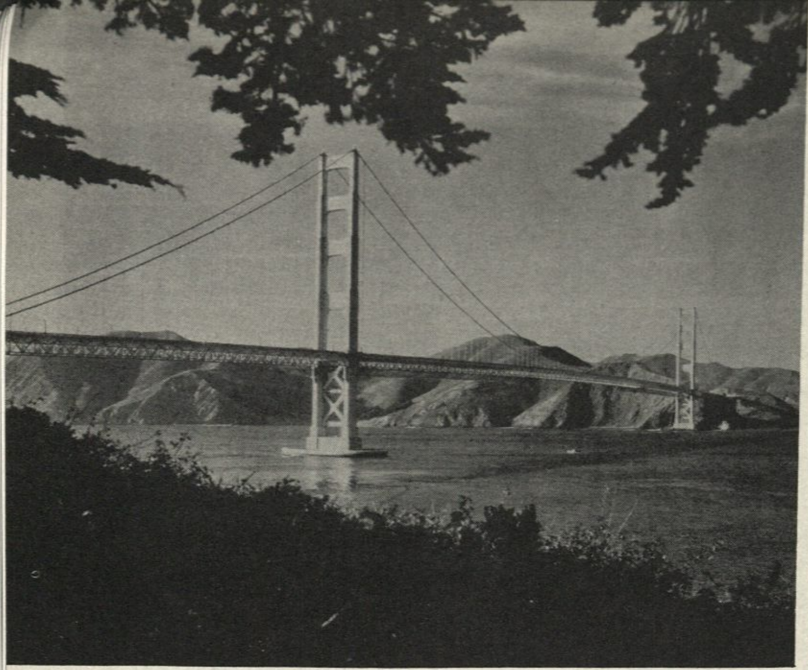
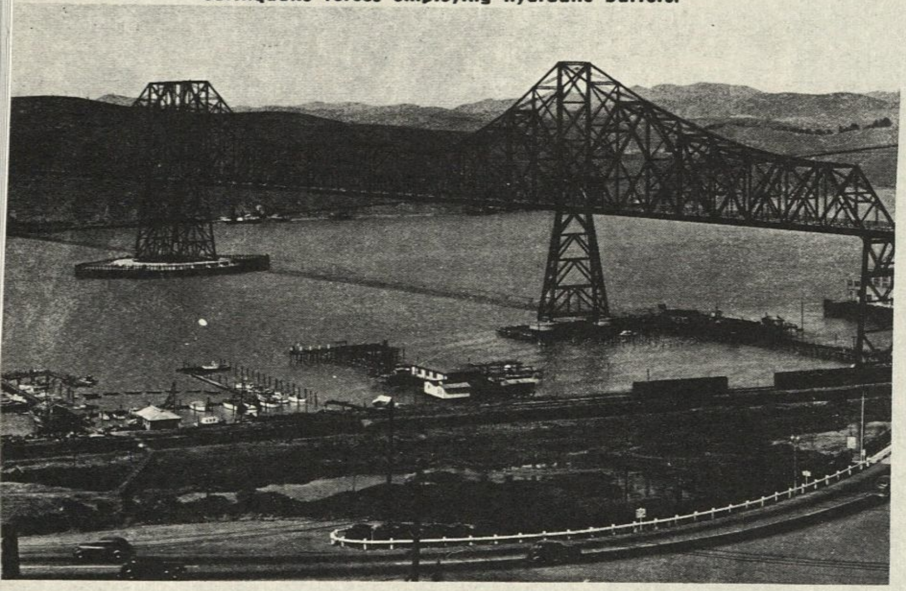
Engineer
Pictorial Section
A PICTURE MAY INSTANTLY PRESENT WHAT A BOOK COULD
SET FORTH ONLY IN A HUNDRED PAGES. — TURGENEV



—*Courtesy American Inst. of Steel Const.*
The famous Golden Gate Bridge. Of the vehicular type, it is perhaps the best known suspension bridge in use.

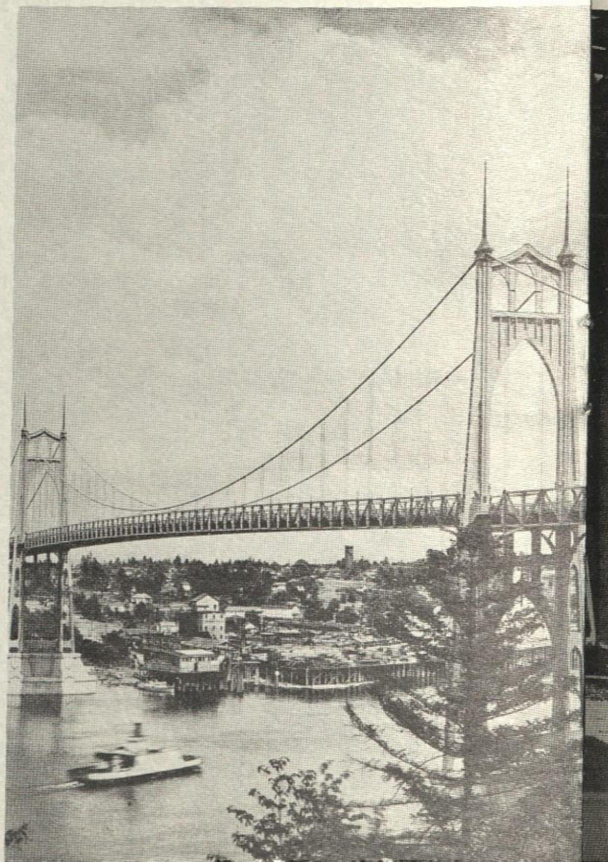
—*Courtesy American Inst. of Steel Const.*
The O. K. Allen Bridge, Louisiana. An example of the through cantilever type structure.

—*Courtesy D. B. Steinman*
Constructed in 1927, the Carquines Strait Bridge, California, is the largest cantilever bridge in the U. S. It is the first structure ever designed against earthquake forces employing hydraulic buffers.

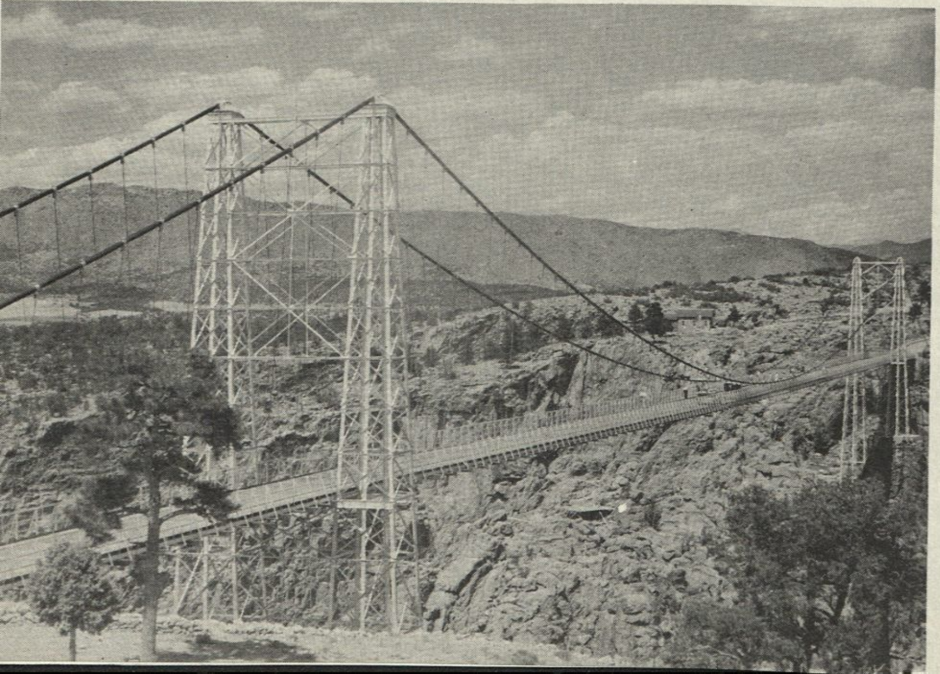


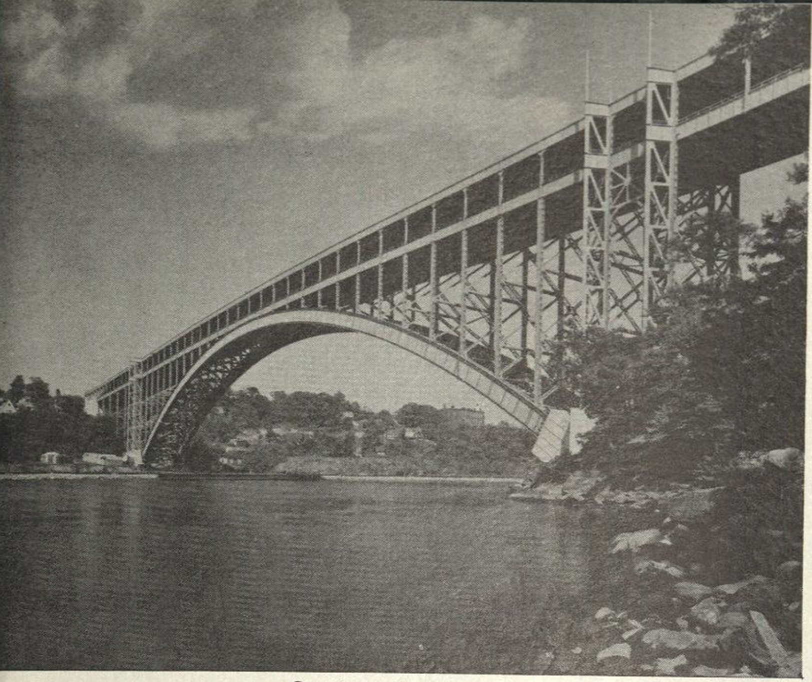
Spectacular

—*Courtesy D. B. Steinman*
One of the most beautiful suspension bridges, the St. Johns bridge across the Columbia River carries traffic 135 feet above the river.

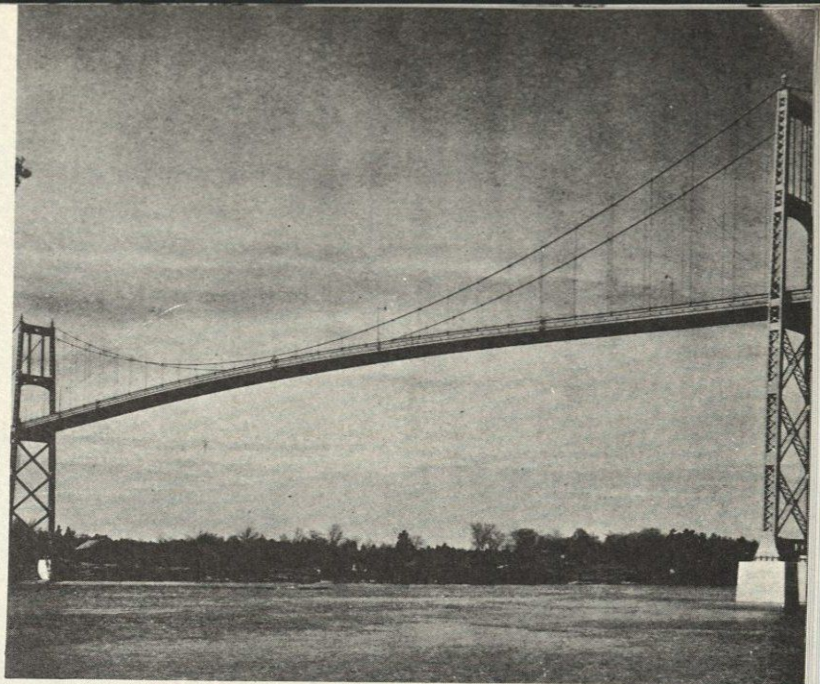


—*Courtesy Royal Gorge Bridge Co.*
Erected in 1929, the world's highest bridge spans the Grand Canyon of the Arkansas river in Colorado. It is 1,260 feet in length and 1,053 feet above the river.





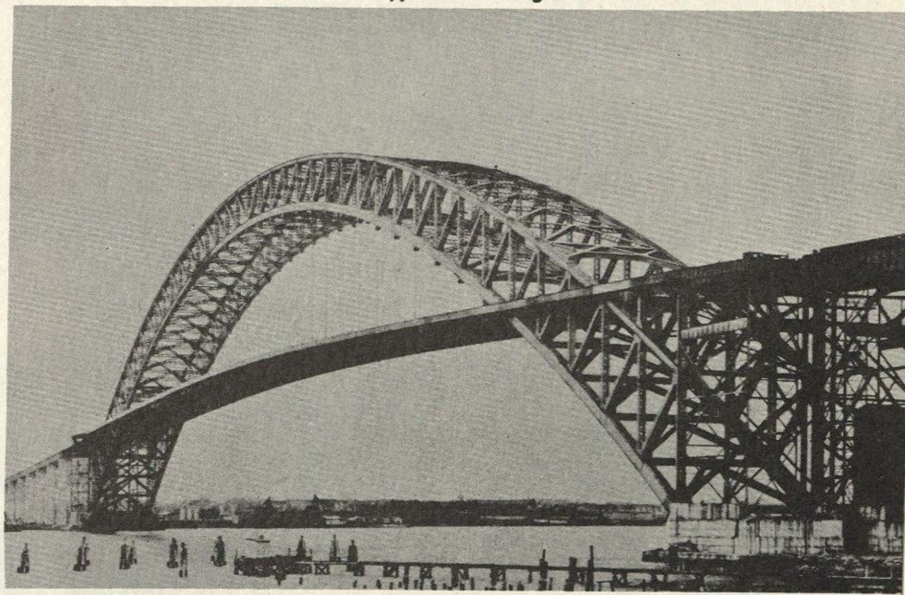
—Courtesy American Inst. of Steel Const.
With a span length of 800 feet, the Henry Hudson Bridge in New York City is of the plate girder arch span type.



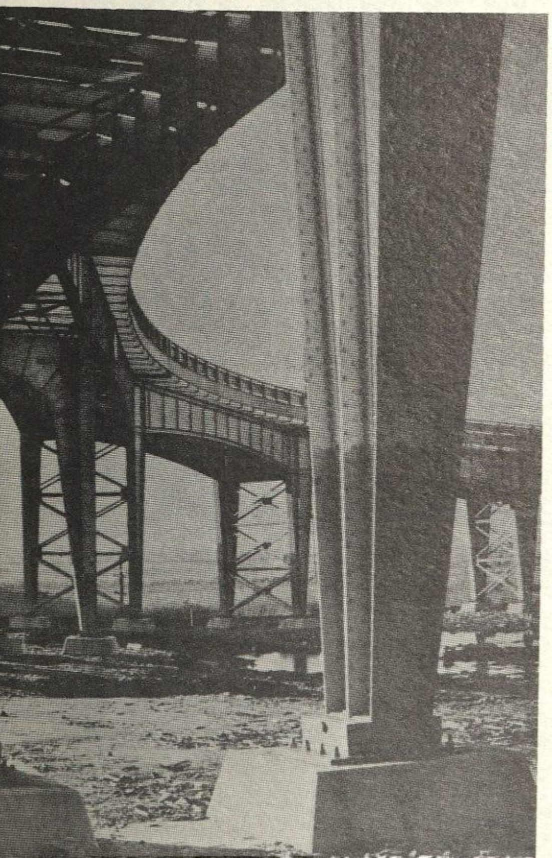
—Courtesy D. B. Steinman
Connecting the U. S. Mainland to Wells Island, Canada, is this spectacular suspension bridge with a main span of 800 feet.

Spans

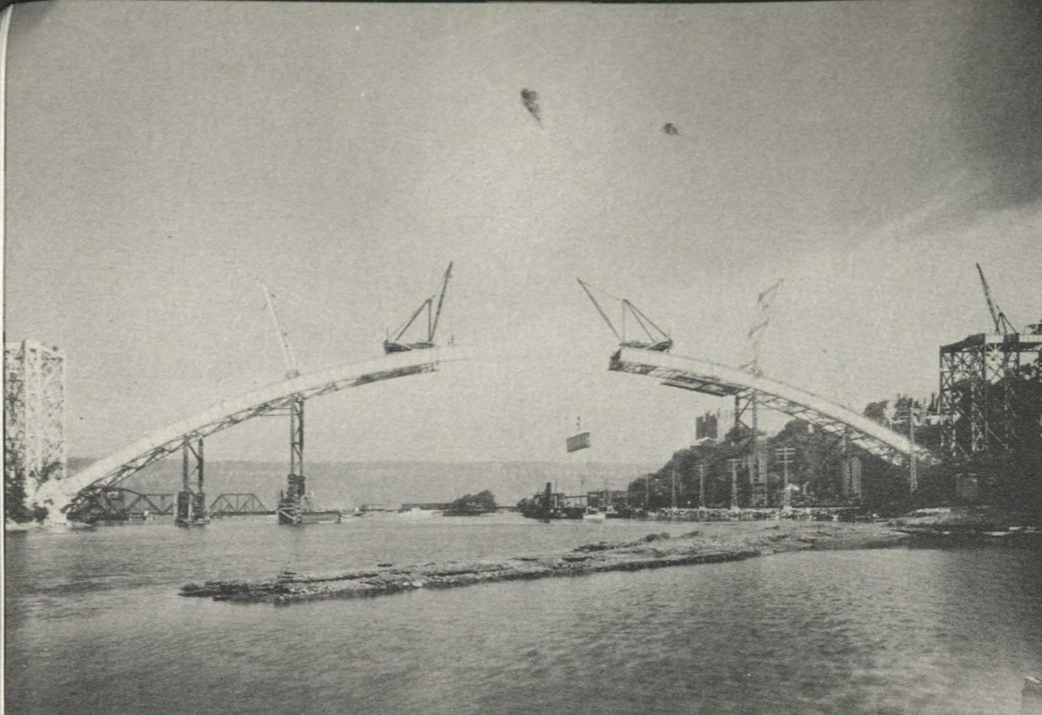
—Courtesy American Inst. of Steel Const.
The Bayonne Bridge, New Jersey, is an example of the two-hinged, through type arch bridge.



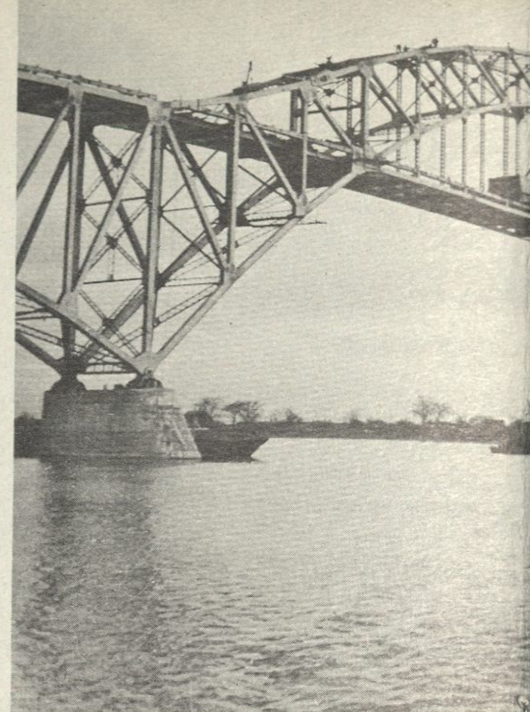
—Courtesy American Inst. of Steel Const.
View of sturdy plate girder viaduct. Tapered steel columns support the curved structure.



—Courtesy American Inst. of Steel Const.
This pedestrian bridge, Burnham Park, Chicago, Ill., is an arched girder bridge of singular beauty.



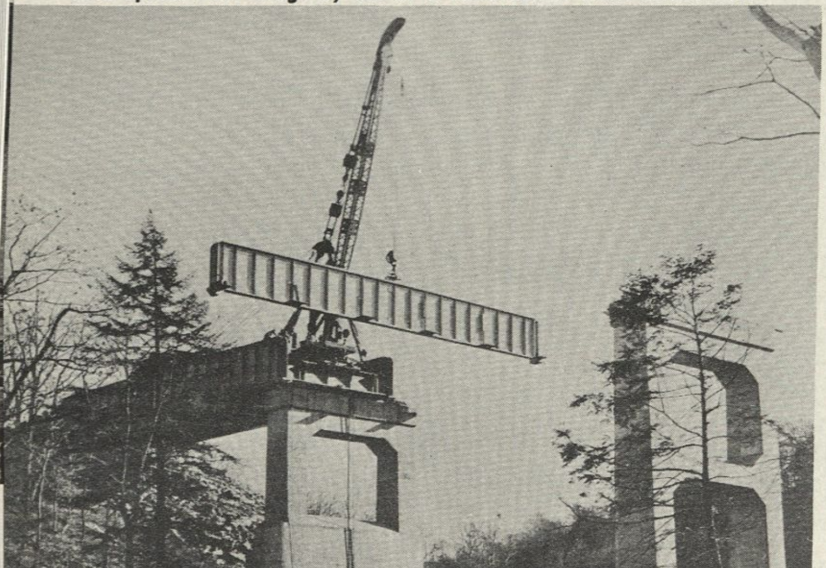
—Courtesy American Bridge Co.
Traveling derricks lift plate girder segments into position on the 800-foot highway arch span Henry Hudson Bridge. The two halves of the span are supported by toggle bents and tie-backs on top and falsework erection bents below.



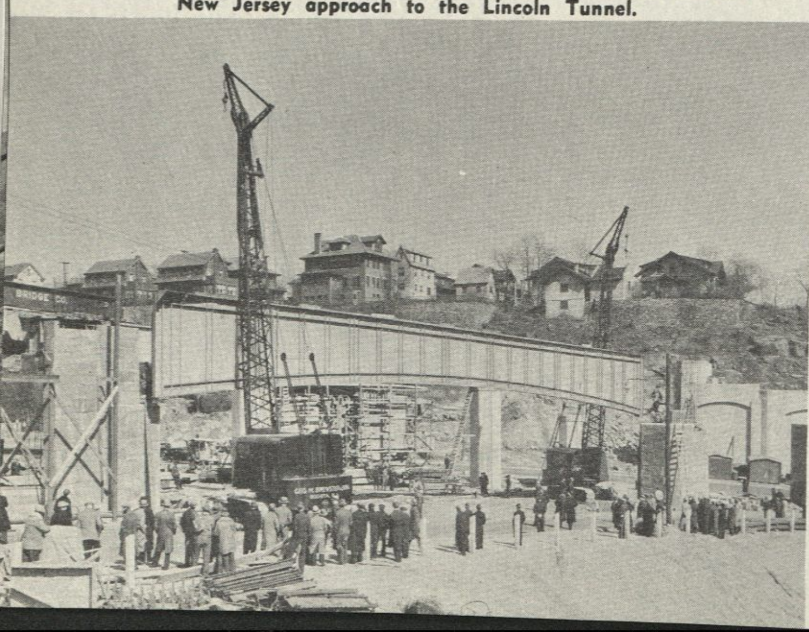
Final stages in the erection of the center arch ... leg derrick lifts girder segments to ...

Bridge Co

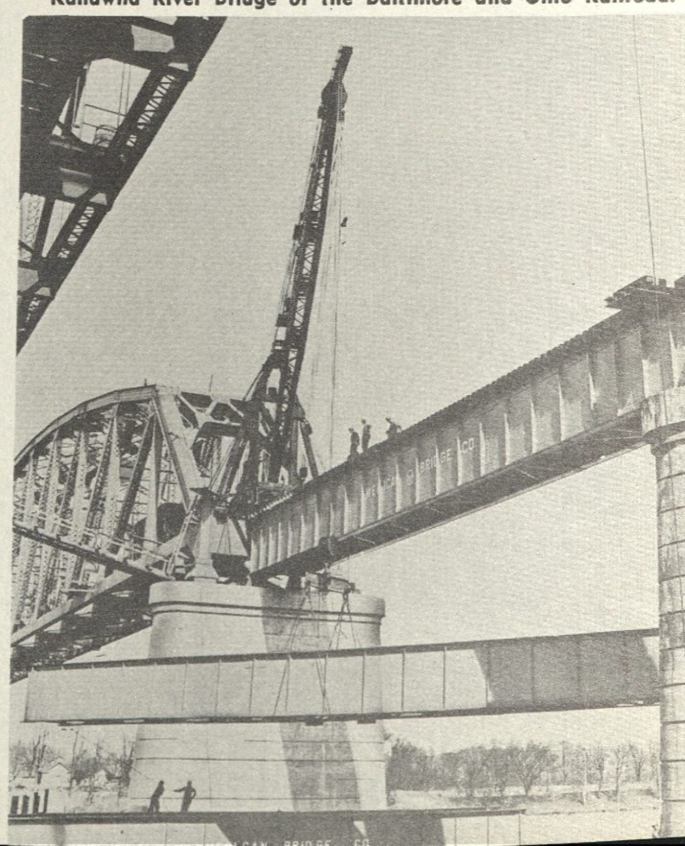
—Courtesy American Bridge Co.
A hundred foot, 85-ton girder is placed in position in one of the three double track, through girder spans of the Pennsylvania Railroad Spruce Run Bridge by use of a combination crane-derrick car.

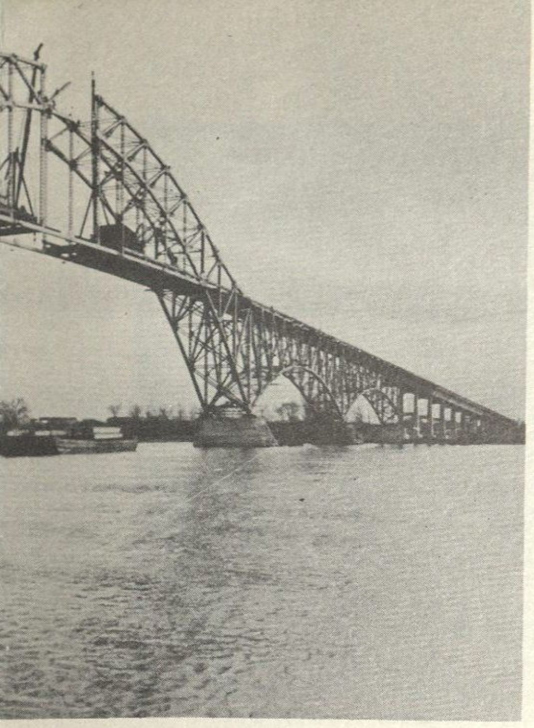


—Courtesy American Inst. of Steel Construction
Cranes lift huge 140-foot girder onto permanent abutments at the New Jersey approach to the Lincoln Tunnel.

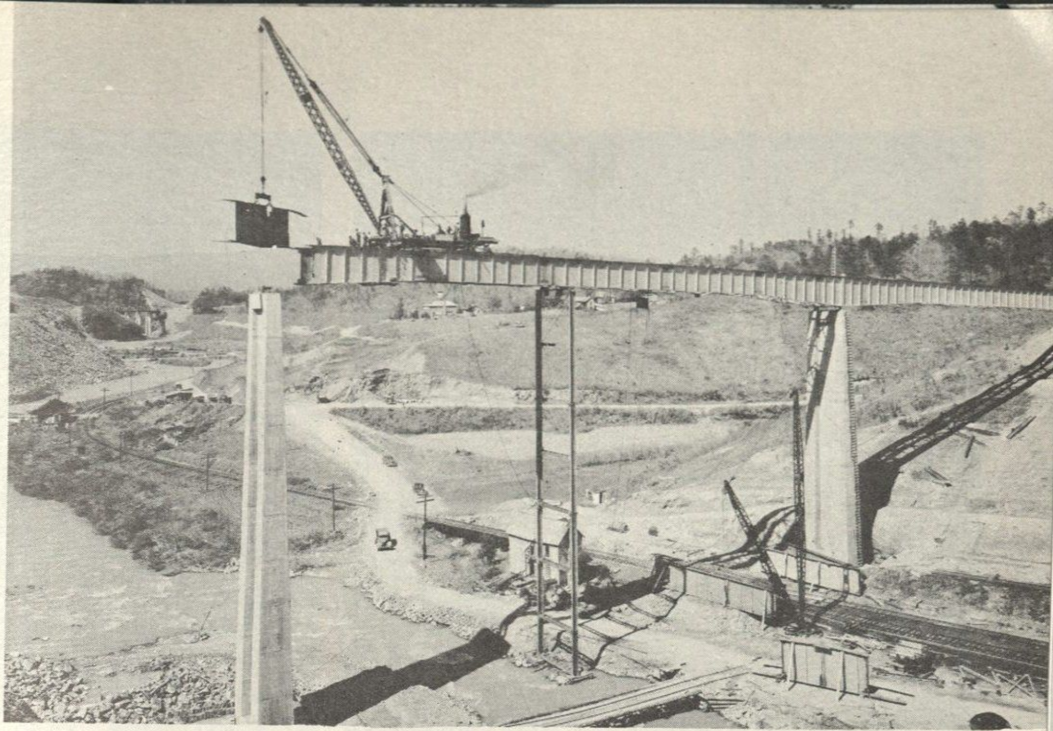


—Courtesy American Bridge Co.
An 80-ton-capacity combination crane-derrick hoists a 62-ton, single track deck girder span from railroad cars on the Great Kanawha River Bridge of the Baltimore and Ohio Railroad.





—Courtesy American Inst. of Steel Construction
f the South Grand Island Bridge. A traveling, stiff- he top of the towering channel span.

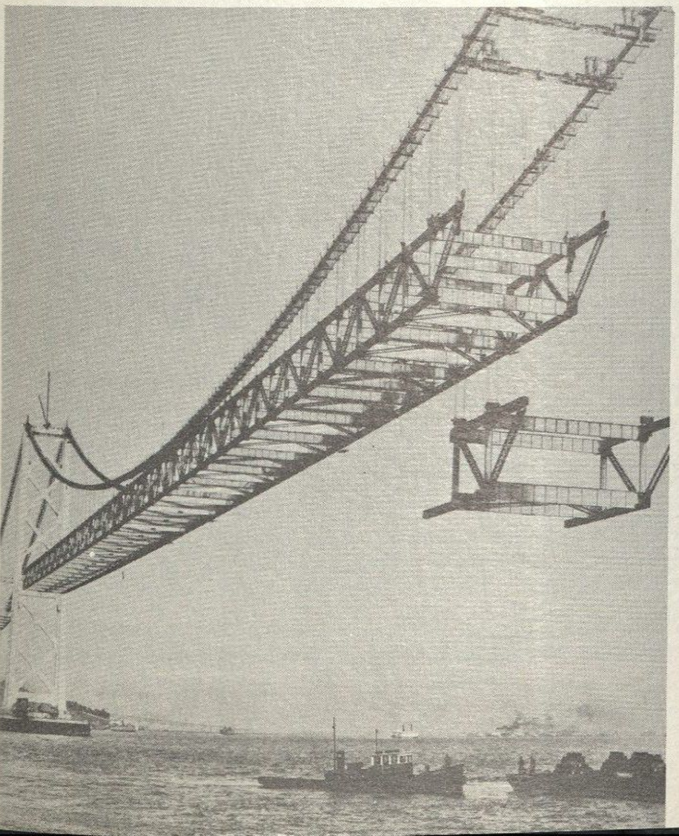


—Courtesy American Inst. of Steel Construction
A deck girder span is hoisted on the T.V.A. authorized Nantahala River Bridge near Bryson City, N. C. Permanent reinforced columns and falsework erection bent support the erected spans.

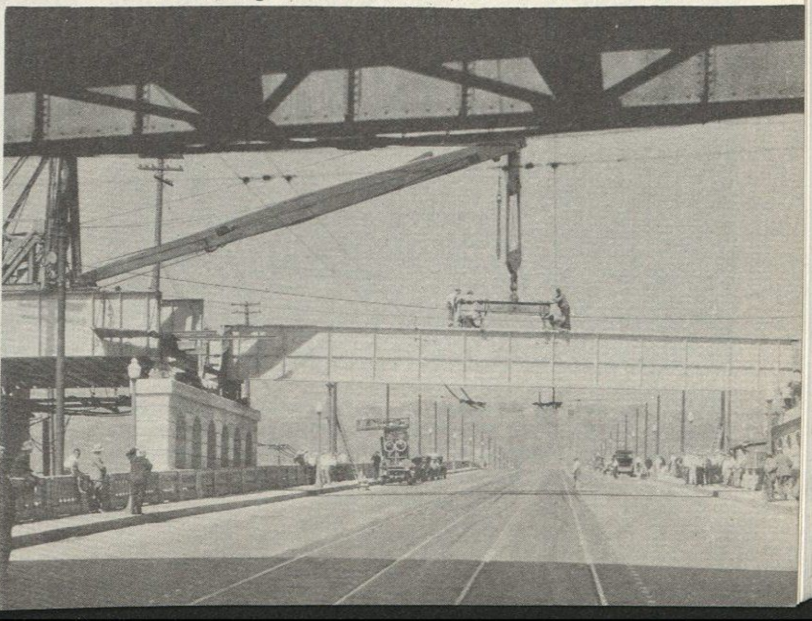
onstruction

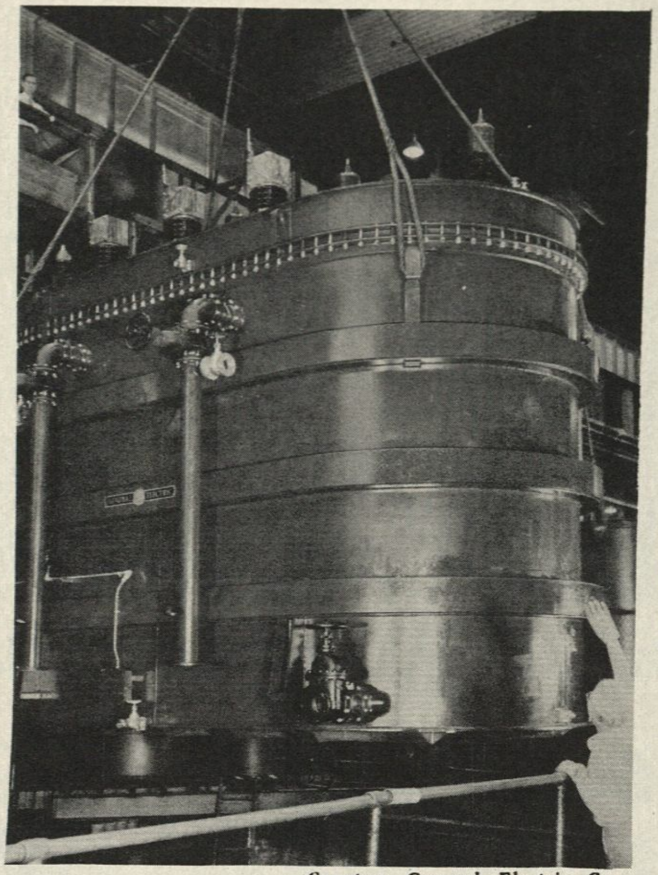
—Courtesy American Inst. of Steel Construction
Construction view of the Pennsylvania Turnpike Dunnings Creek Bridge, consisting of six skewed Continuous Deck Plate Girder Spans. Its overall length is 480 feet, its width, 60 feet.

—Courtesy American Bridge Co.
A huge stiffening truss unit is raised into place from a barge to one of the two main suspended spans of the double deck, twin suspension San Francisco-Oakland Bay Bridge.



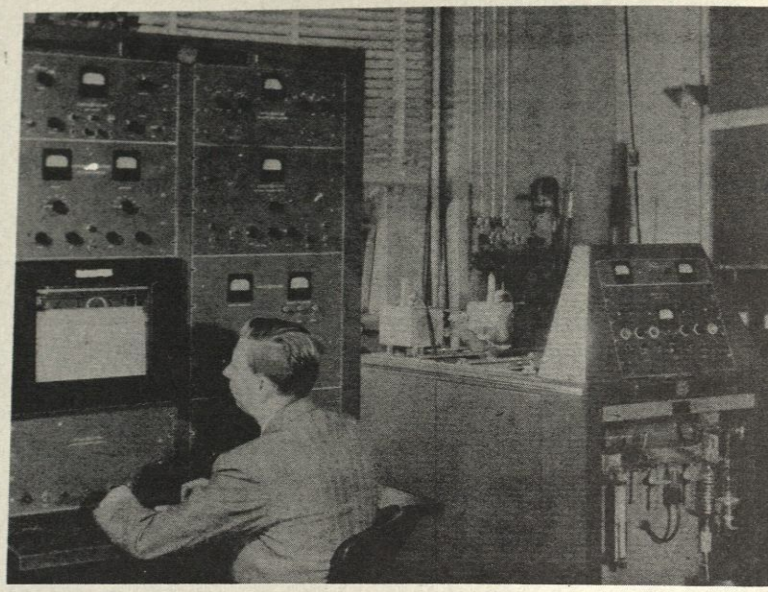
—Courtesy American Inst. of Steel Construction
Placing a deck girder span on permanent abutments performed by a traveling derrick near Cincinnati Union Terminal.





—*Courtesy General Electric Co.*

POWER. Giant 150-ton transformer, among the most powerful ever built, will raise 15,000 volts to 135,000 volts. Rated at 145,000 kilovolt-amperes, it will handle enough power for a city of 150,000.

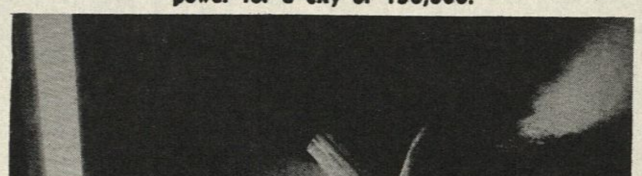


—*Courtesy General Electric Co.*

RESEARCH. Gasses of the upper atmosphere are separated according to their weights by the new analytical mass spectrometer. Gas is introduced into the electronic tube rack (right) and the weight of its molecules recorded on graph (left).

What's

Science and

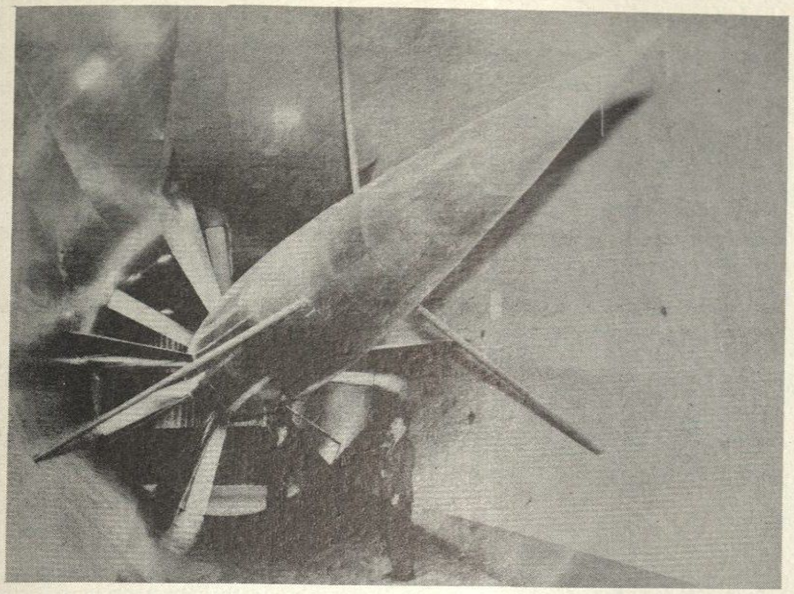


—*Courtesy General Electric Co.*

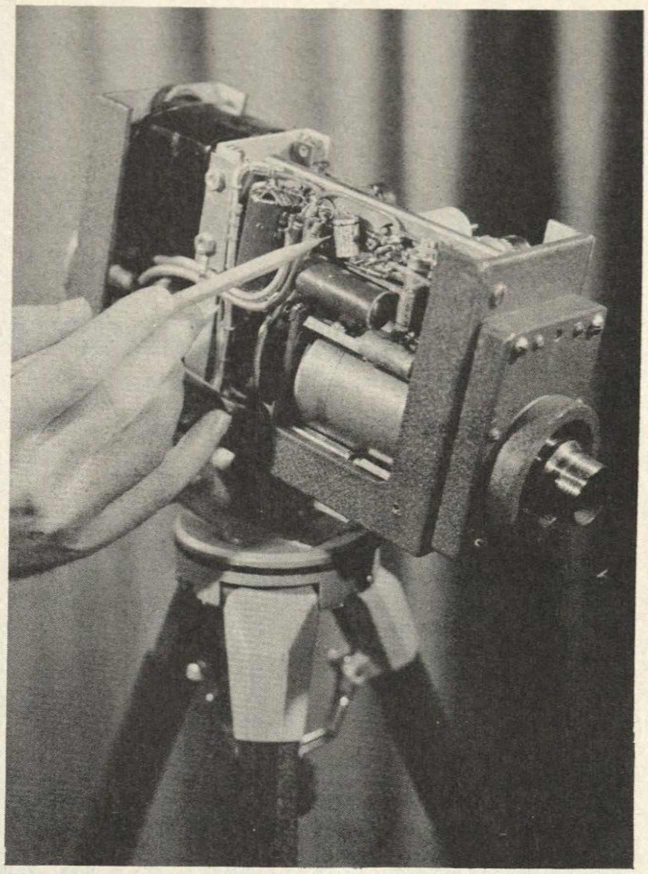
TESTING. Radically modern jet fighter model is subjected to high speed flight conditions in subsonic wind tunnel. The many functions of the assimilated flight are recorded for study.

—*Courtesy General Motors Corp.*

MACHINES. The "Bushwacker," new pre-construction work horse fells a tree. The machine also shreds the trees and clears everything in its path to ground level.



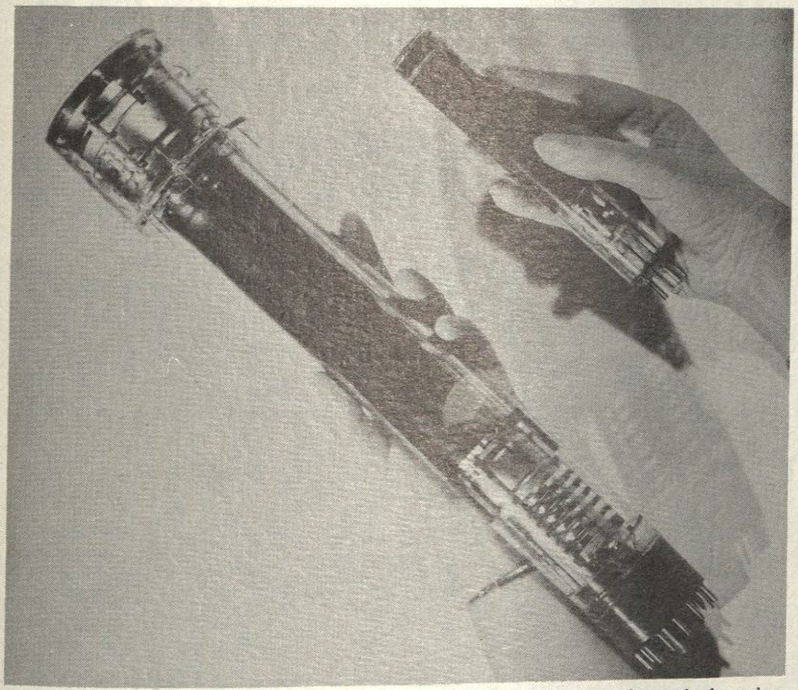
—*Courtesy General Electric Co.*
ENGINEERING. University of Maryland giant wind tunnel develops three hundred mph wind conditions. A seven-bladed propeller, driven by huge 2,250 horsepower motor, produces the blasts.



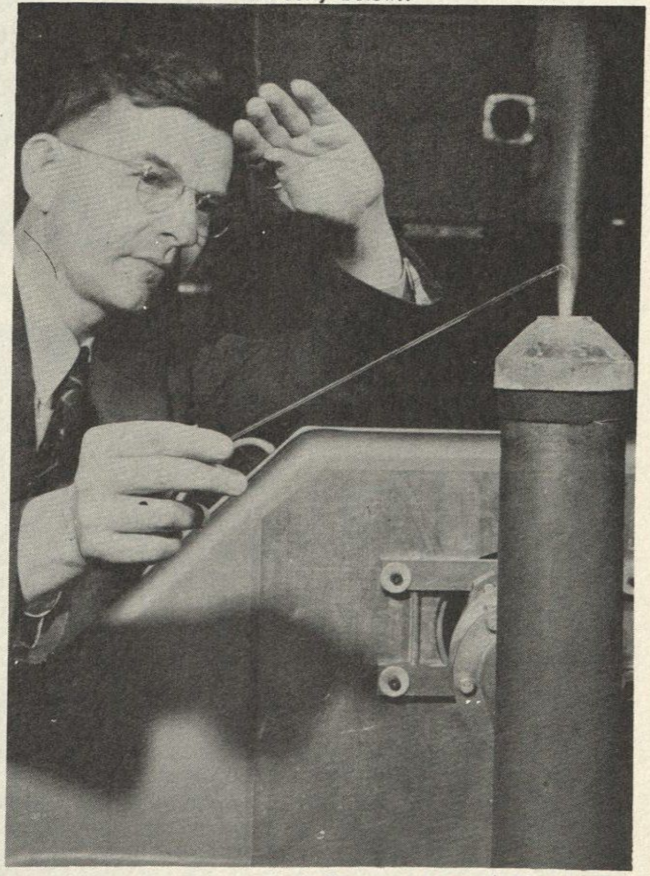
—*Courtesy Radio Corporation of America*
PHOTOGRAPHY. New camera for RCA industrial television system, showing tiny video amplifier (pointed out) and cylinder containing focusing coil and vidicon pickup tube (directly below).

New

Engineering

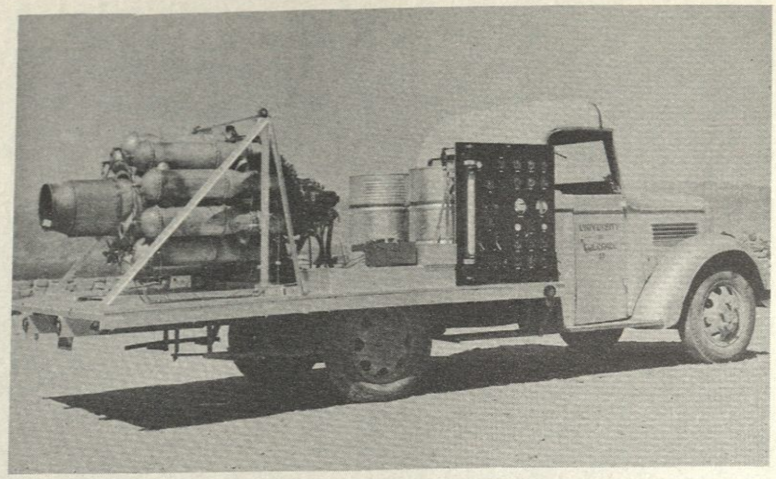


—*Courtesy Radio Corporation of America*
TELEVISION. The new, tiny Vidicon pickup tube recently developea for industrial television is shown in comparison with generally used image orthicon tube.

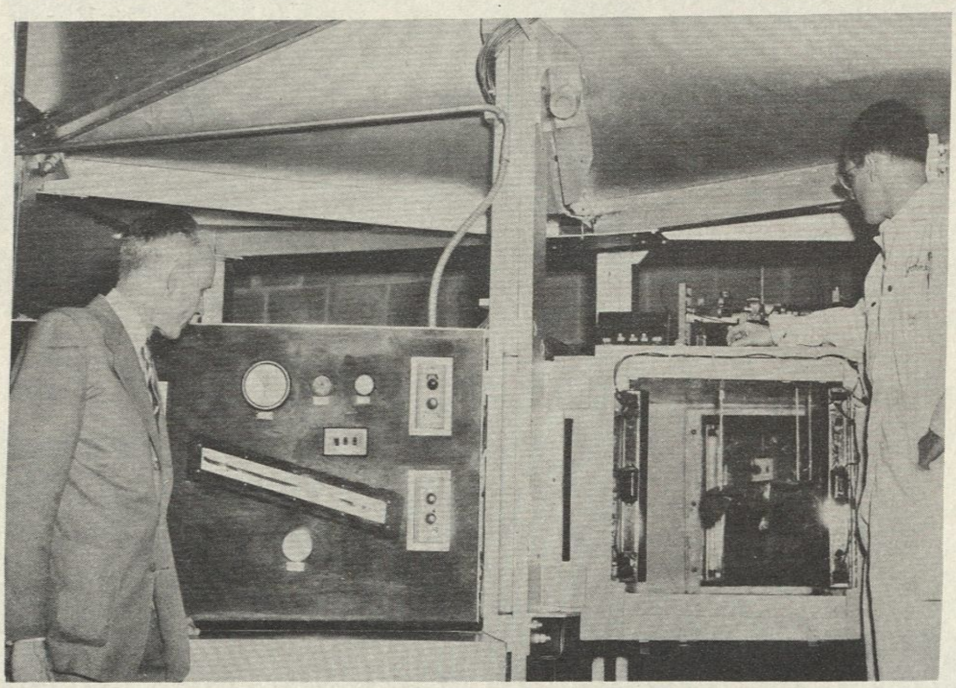


—*Courtesy General Electric Co.*
INDUSTRY. This recently developed electronic torch produces temperatures too high for modern temperature measurement. Quartz (shown), firebrick, and even tungsten melt in the flame consisting of nitrogen passed through a high frequency arc.

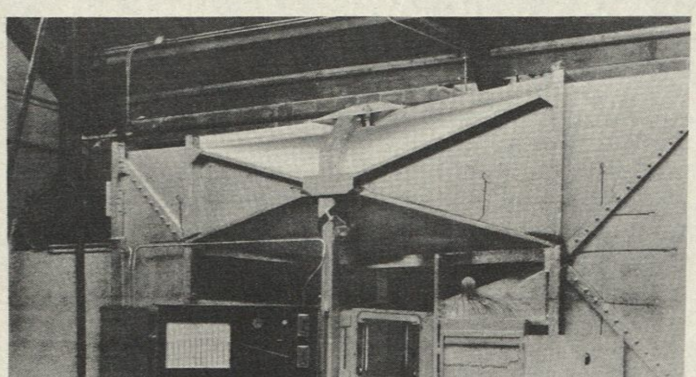
Aeronautical Laboratories



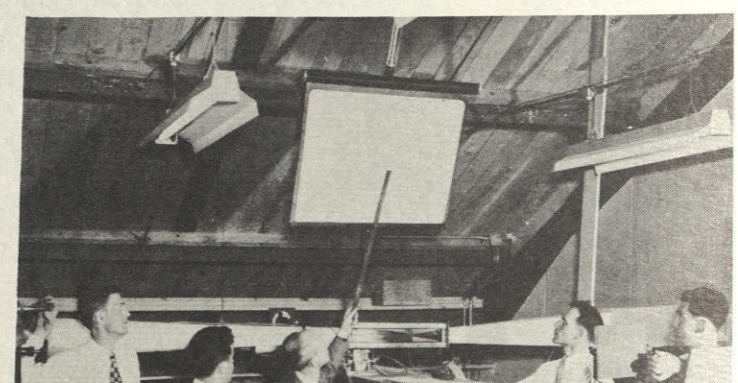
Ready for operation, this jet engine mounted on test stand makes it possible to study engine flight performance on the ground. The engine was tested on Mt. Evans, Colorado.



Head of department K. D. Wood and John Edgar test a model for flying ability in subsonic wind tunnel.



Hundreds of scale models of all shapes are tested in the subsonic wind tunnel. Models are mounted in an inverted position and lift is registered on panel.



Functions of the supersonic wind tunnel with Schlerin optical system for observation of shock waves are explained here by Professor Wood. Wood, who is presently on leave to the University of Michigan, will return to Colorado next year.

The Field of Sales Engineering

TAU BETA PI THEME by WILLIAM MULDROW, JR.

Statisticians inform us that the field of engineering is rapidly becoming overcrowed due to the large influx of engineering graduates since the war. The field of sales engineering, however, still offers unlimited opportunities to the graduate with a B.S. degree in engineering. More and more, manufacturers and distributors of engineering equipment are realizing that the ordinary salesman, with his limited technical knowledge, cannot satisfy the demands of the customer with regard to their products.

In many instances the product being sold must be manufactured according to the plans and specifications designed to meet the prospective customer's needs. Two examples of such products would be power plant equipment and air conditioning systems. These items sell with a high unit cost. The sales engineer must be able to speak with technical men and show them what types of equipment would best meet their needs at a minimum cost. The prospective buyer is not going to purchase a unit which he needs for a particular installation simply because the salesman has a good sales talk about the quality and desirability of his product.

Additional training is usually required before an engineer can enter into this field. Many of the larger companies, such as Standard Oil, have an extensive training program designed for employees who are to become sales engineers. Business training is also of great value in this profession. This is probably why the combined business and engineering degree, offered in many colleges, is becoming increasingly popular.

A competent sales engineer must have various abilities, personality characteristics, and interests not ordinarily required of other engineers. He must be interested in people and their problems, and have a high mental capacity for fast and accurate thinking. He must know how to get along with people, be self-confident, and, of course, have an interest in the field of salesmanship along with his interest in engineering.

In spite of the many advantages which sales engineering offers there are also some disadvantages. In many instances the sales engineer must do a considerable amount of traveling to reach his prospects. This, of course, would necessitate his spending much time away from home—a probable disadvantage for the married man. Higher salaries, sales commissions, expense accounts and company-furnished cars are usually adequate compensation for such a disadvantage. Travel is no drawback to many who welcome the chance to escape the routine of an office job.

Promotional opportunities are exceptionally good for engineers with a good sales record and few customer complaints. Many important managerial positions are filled by sales engineers who have been successful.

Key to the Societies

PI MU EPSILON

At the last winter quarter meeting of Pi Mu Epsilon, national mathematics honorary, the officers for next year were elected. The new office-holders are as follows: President, Raymond Adams; Vice President, Albert Clark; Treasurer, Robert Christopher; Chapter Secretary, Morton Burt; Corresponding Secretary, Carolyn Howe; Historian, Betty Jean Thomas.

The winter quarter initiation banquet was held at Blanchards Lodge on February 26, at which time twenty-three pledges were accorded active membership. The new initiates are: Steven Achtenhagen, Raymond Adams, Robert Braddock, Earl Chandler, David Chase, Robert Christopher, Albert Clark, William Cooper, Edward Corcovan, Donald Hagerman, Dallas Hampton, Dick Harrison, Carolyn Howe, Mike Kelton, William Muldrow, William Neuschaefer, Lydick Ostwald, David Raduziner, Lennard Smith, Betty Jean Thomas, Virginia Van Scoy, and Frederick Wawrose.

The speaker for the initiation banquet was Dr. Burton W. Jones, of the Mathematics Department, in the College of Arts and Sciences, who spoke on the subject, "Tautology."

A. I. Ch. E.

Instituting for the first time a policy of collecting dues during registration, the American Institute of Chemical Engineers started the spring quarter with a record paid-up membership of ninety-two. Further membership registration is expected to swell the total over the one hundred mark.

Serving A.I.Ch.E. through the spring and summer quarters are the following officers who were elected at the close of the winter quarter: Edward D. Thomas, president; Wilbur D. Kittinger, vice-president; Joseph E. Easter, secretary; Allan M. Haven, treasurer, and Carl S. Morris, program chairman.

Representing the University of Colorado at an A.I.Ch.E. meeting in Miniature held in Denver last February 25, were Lyle Gross, who presented his paper, "The Safflower, A New Colorado Industry," in the undergraduate division, and John Pringle, whose graduate dicision entry was entitled, "Pulp and Paper Making Prospects in Colorado."

Widespread plans are underway for the annual A.I.Ch.E. spring picnic. Traditionally, "the event" for the year for the Chemicals, the picnic is tentatively set for the early part of May.

SIGMA PI SIGMA

Sigma Pi Sigma, national phsysics honor society, serves to award distinction to students having high scholarship and promise of achievement in physics, to promote student interest in research and advance study, and to encourage a professional spirit and friendship among those who have displayed marked ability in physics.

For the spring quarter, the society is laying plans for the reception of new members from the ranks of the junior, senior and graduate classes in Physics and Engineering Physics. An election of officers for the coming school year is also on the program for the quarter. As was done last year, Sigma Pi Sigma has undertaken the job of obtaining and disseminating literature and information of a scientific nature for United Nations Week.

PHYSICS CLUB

The University Physics Club was organized in the fall of 1948. Since that time it has grown rapidly, until today it comprises almost all of the advanced physics majors and physics engineers, with many other persons in regular attendance at the meetings. The objects of the organization are: to afford an opportunity for the members of the physics classes to become acquainted, to promote a spirit of congeniality among them, to acquaint them with topics of interest through the medium of addresses by competent speakers, and to foster the development of a professional spirit.

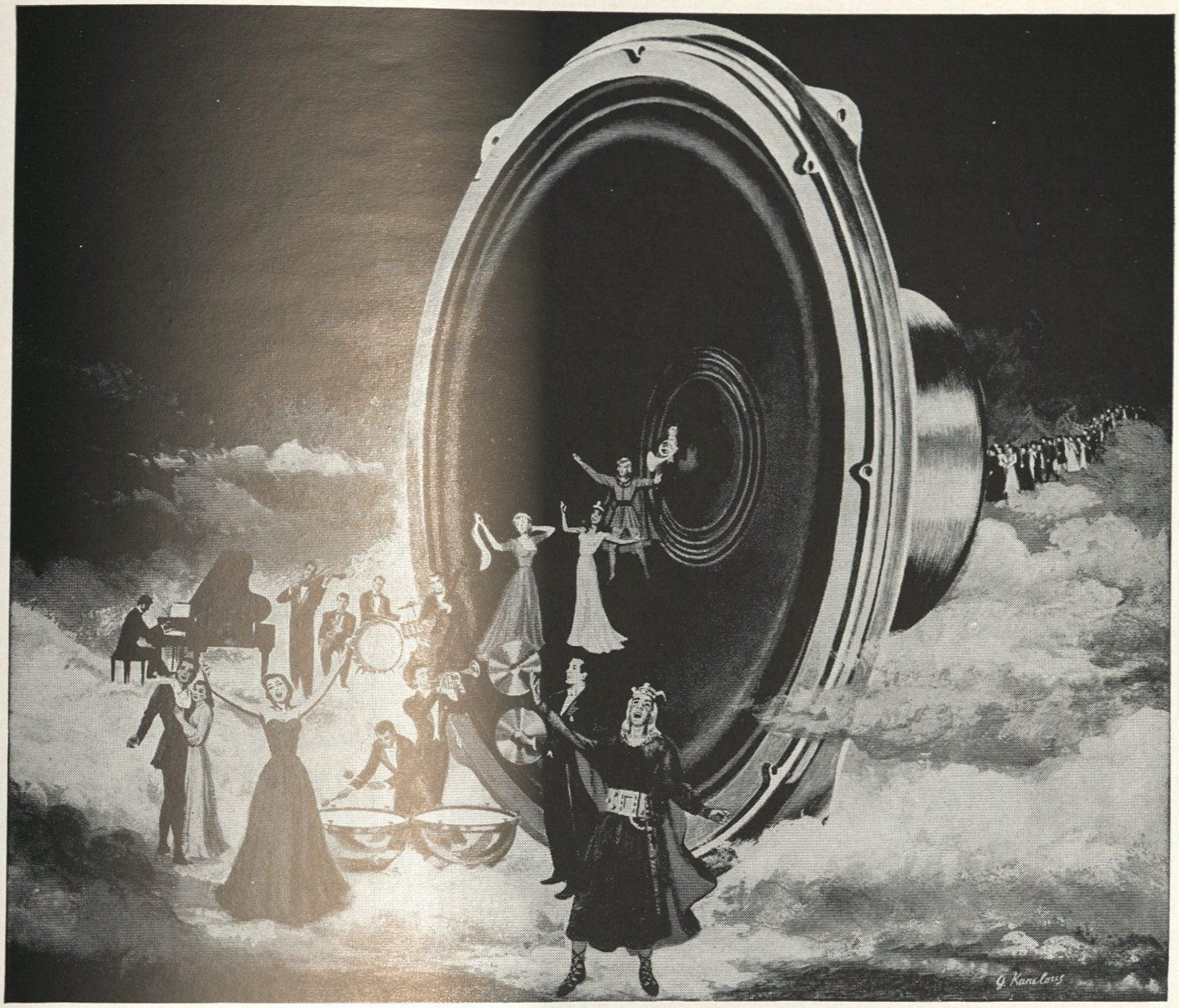
During the year the Physics Club has presented many open meetings designed to appeal to all those of scientific interest. Outstanding programs of the past year have been talks on: "Newton's Laws, Truths or Definitions?" by David Hawkins of the Philsophy Department; "Applications of Polarized Light Theories to Astrophysics" by Dr. William Rense of the Physics Department; and "Solar Variability and Weather" by James Jackson, research physicist.

The Physics Club plans to hold an important business meeting early in the quarter to lay plans for the election of new officers, to discuss proposed activities during Engineers' Day, and to consider the prospect of a combined meeting with Sigma Pi Sigma.

A. S. M. E.

The student branch of the A.S.M.E. was honored to hear Mr. C. E. Davies, National Secretary of the A.S.M.E., at its meeting on March 12. Mr. Davies stressed the importance of continuing study after graduation and obtaining a professional engineer's license.

On April 19 the Bureau of Mines presented its illustrated program on the "Magic of Fire" to the student members, their wives and dates. This meeting proved to be on the most outstanding of the year.



New Duo-Cone loudspeaker, developed at RCA Laboratories, achieves the illusion of "living presence."

The University was represented at the regional meeting, held at Las Cruces, New Mexico on April 24 and 25, by 15 members. Two students, Dick Jahnke and Sam Jacobs, presented papers which received many compliments.

A dinner meeting with the Rocky Mountain section on May 11, included election of officers and some very unusual entertainment.

The student branch entertained Colonel Meisick of the United States Army. The Colonel, who has worked in all phases of jet propulsion, preesnted a summary on the "Military Applications of Jet Propulsion."

With a total membership of over two hundred members, the A.S.M.E. winds up another year's activities on the University campus. We wish to extend our best wishes to all graduating seniors; may you meet with every success. We hope you will return and visit us often.

I. A. S.

The last meeting of I.A.S. for the winter quarter was an interesting one. Mr. McDonald, C.A.A. Airport Engineer, delivered an address on the "Planning and Construction of an Airport." He presented a construction plan for an airport to be be built in Boulder as a typical problem in planning and construction. Mr. McDonald brought with him actual planning designs of the Boulder Airport and discussed the possibilities of its expansion.

The spring quarter will include a variety of interesting talks by both local and distant speakers for the Institute of the Aeronautical Sciences. Plans have been made for talks on helicopters, guided missiles and thermal stresses of high speed airfoils. Dr. Sibert, professor in the Aeornautical Engineering Department, will present a talk on the Department's thermal stresses project.

A meeting this quarter will be devoted to the election of new officers of I.A.S for the coming year.

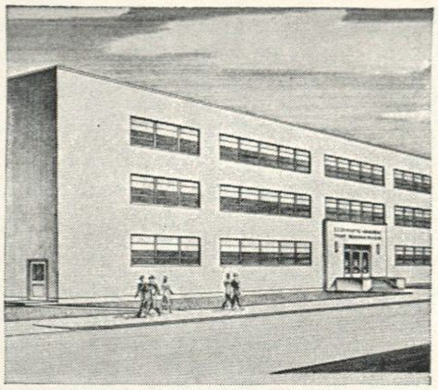
The annual I.A.S. picnic on Flagstaff will wind up the past year's activities.

A. I. E. E. - I. R. E.

The University of Colorado joint student branch has been steadily growing until it is now one of the largest in the country. Membership totals about two hundred.

The district convention of student branches of A.I.E.E. was held at Colorado A&M at Fort Collins this year. All schools in district six which have student branches of A.I.E.E. were in attendance at the conference. Six schools were represented: Colorado A&M, University of Colorado, Denver University, University of Nebraska, South Dakota School of Mines and Technology, and the University of Wyoming. Feature event of the conference was the presentation of student papers. Each school was allowed to present not more than two papers and prizes were

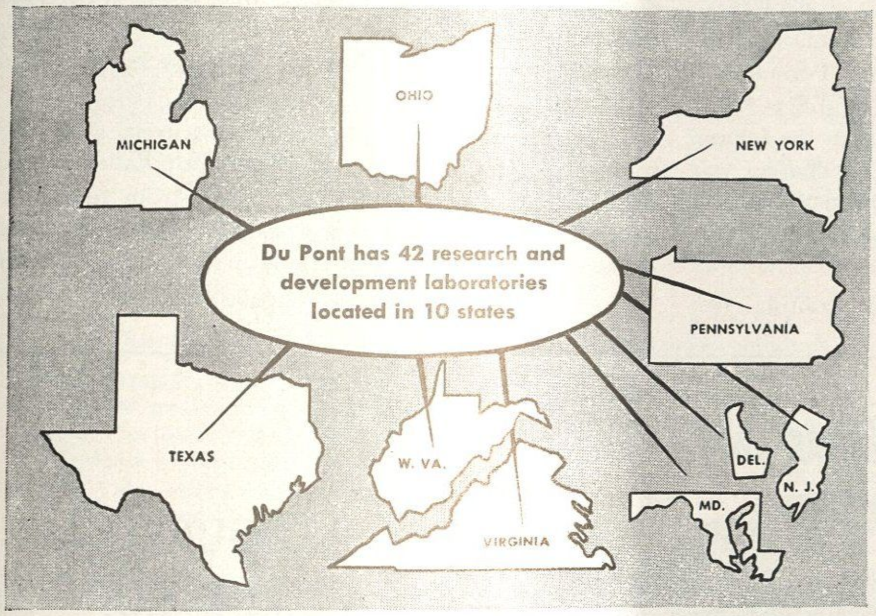
THE DU PONT DIGEST



Artist's drawing of the Marshall Laboratory, new Du Pont laboratory for research on finishes. Under construction at Philadelphia, it should be ready for occupancy by late 1950.

RESEARCH DECENTRALIZED

Du Pont scientists pursue their studies from Buffalo, N. Y., to Orange, Texas



THE DU PONT COMPANY is a large company. Its many manufacturing plants are now located from Maine to California. Likewise, the Company's research activities are spread over a wide area. From the Founder's informal scientific experiments on the Brandywine have sprung 42 research and development laboratories in ten states.

Each manufacturing department* has its own research director and maintains facilities for studies in its specialized fields. Thus, research having to do with dyes, neoprene and fine chemicals is centered at Deepwater, N. J.; research on cellophane and other transparent wrapping films at Buffalo, N. Y.; research on viscose rayon at Richmond, Va.; and research on coated and impregnated fabrics at Newburgh, N. Y. These are only a few of the places where Du Pont scientists are now at work. Each manufacturing department does fundamental research as well as applied research on new processes and products.

Many types of training

At any one time, many hundreds of different projects are under way in these laboratories. Though a relatively large number of Du Pont technical people are chemists and chemical engineers, other fields of training are strongly represented.

Among the scientists working with Du Pont are mechanical, electrical, civil, industrial, mining, petroleum, textile, architectural and safety engineers, physicists, metallurgists, biologists and mathematicians. About 30% of these men and women who are engaged in technical activities at Du Pont hold doctor's degrees.

Interchange of thinking

All manufacturing departments may draw on the services of the chemical, engineering and toxicological laboratories of the company in Wilmington. In addition, the Chemical Department's library at the Wilmington Experimental Station circulates reference material, conducts literature and patent searches and issues a weekly abstract of pertinent articles found in the important chemical journals of the world. This supplements normal work of this kind done by the various manufacturing departments.

No matter where a Du Pont research man may work, he has every opportunity to use his best talents, to advance as his abilities develop, and to profit by interchange of thinking with scientists whose minds complement his own.

**There are ten Du Pont manufacturing departments—each conducting research: Electrochemicals; Explosives; Fabrics & Finishes; Film; Grasselli Chemicals; Organic Chemicals; Photo Products; Pigments; Polychemicals; Rayon.*

★ ★ ★

SEND FOR "This Is Du Pont," 52 pages of information on Du Pont's methods, products, facilities, geography. Fully illustrated. For your free copy, write to the Du Pont Company, 2503 Nemours Building, Wilmington, Delaware.

DU PONT

REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING

... THROUGH CHEMISTRY

Great Dramatic Entertainment—Tune in "Cavalcade of America" Tuesday Nights, NBC Coast to Coast awarded to the top three in the field. The winner of first place will receive an expense-paid trip to the National A.I.E.E. Convention in Pasadena, California, next summer.

The last meeting of the local branch in the winter quarter found us viewing two movies, "Laying Another Submarine Cable" and "Story of Copper." At the meeting of April 5, a film was shown portraying methods of radio frequency heating. In addition Bill Luebke presented a student paper, "A New Long Range Navigational Device." His paper was the one presented at the district competition.

On May 17, the student branch will play host to the Denver section of I.R.E. for he first time since the formation of the joint branch.

A. S. C. E.

The February activities of the A.S.C.E. student chapter consisted primarily of competitive presentation of student papers. John Houston's paper on "Permafrost" and Bob Davis' paper on "Rubber Highways" were selected to be read in the regional conference competition. Our chapter was proud to announce that John Houston's paper was selected to represent the Colorado region at the Los Angeles Spring Convention.

In March the new officers for the coming year were elected. They are: President, Jim Hillock; Vice-President, Gene Goley; Secretary, George Marshall; Treasurer, John Houston.

The activity program for the spring quarter consists of three meetings with a speaker at each; the regional A.S.C.E. meeting in Denver, which will include a field trip; the A.S.C.E. picnic; and the annual Ketchum Award Dinner.

ALPHA CHI SIGMA

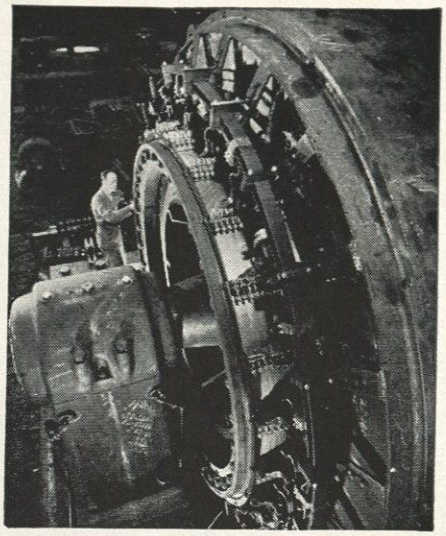
The winter initiation of Eta Chapter of Alpha Chi Sigma was held February 18, 1950. The following chemists and chemical engineers were initiated: Gerald Alm, William Brayton, Dale Croley, Fred Debbrecht, Conrad Jacobson, Lester Krohn, Duncan Orr, Don Sullenger, Don Tabler, Edward D. Thomas, Jack Trevithick, William Turnley, and James Vavra. The initiation was followed by a banquet at Blanchards Lodge and a short talk on the electron-microscope was presented by one of Eta's most faithful members, Mr. Ken Wise.

A delegate, Robert Parker, has been chosen to represent Eta Chapter at the Twentieth Biennial Conclave to be held in Washington, D. C., from June 21 to June 25. This conclave is a national affair of prime importance and several of Eta's members are planning

(Continued on page 44)

BOTTLENECKS

Have No Place in Production— or in Your Future Progress!



Assembling big direct-current blooming mill motor for test—last step in the manufacturing process before shipment and final installation.

by CHESTER E. MEYER
Superintendent, Production Scheduling
General Machinery Division
ALLIS-CHALMERS MANUFACTURING COMPANY
(Graduate Training Course 1938)

PRODUCTION CONTROL in a big plant like the Allis-Chalmers West Allis Works is a constant campaign to prevent bottlenecks and keep orders moving along smoothly to meet scheduled shipping dates.

CHESTER E. MEYER

Most men face much the same kind of personal problem when they get out of engineering school and plan a program of graduate training and experience leading to a firm position in the work they want to do. They can't afford to risk bottlenecks and blind alleys in that program, either.

Big Opportunity

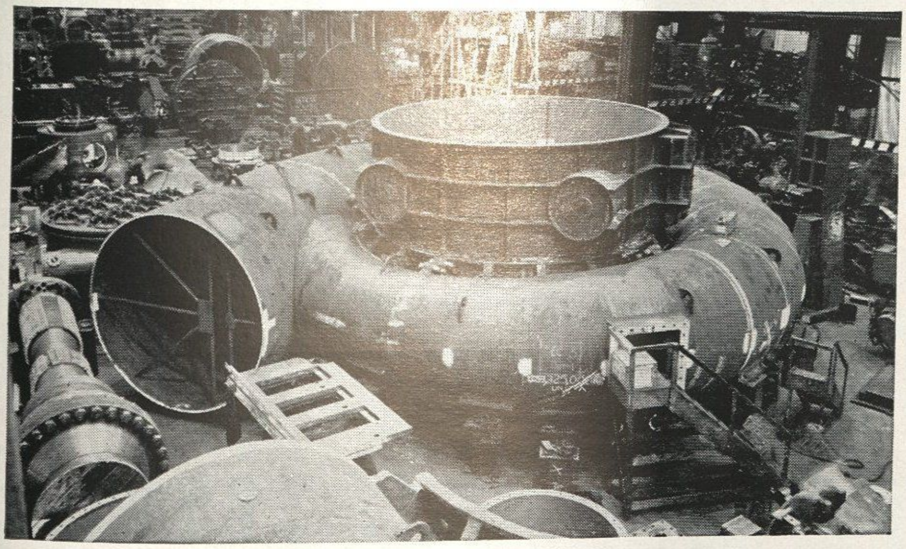
I had this in mind when I graduated from MIT in 1936 and enrolled in the Allis-Chalmers Graduate Training Course. I'd been particularly interested in production and sales. I was looking for practical training, experience and opportunity. And I got them.

First assignment was in Steam Turbine erection. Then I went to the Centrifugal Pump Department, and worked on cost analysis. This job gave me a chance to study plant layout and manufacturing methods, and put me in contact with the Time Study and Planning Department. I liked the work, and finished up the course in that department. I've stayed in the same type of work ever since.

Here in Production Scheduling we pick up each job after the Planning Department has established the routing. It's up to us to set a shipping date, and then work out dates when the job is to be completed in the various shops through which it must go. This requires a thorough knowledge of methods, shop capacities and work loads throughout the entire plant.

Great Diversity of Products

To give some idea of the extent of this operation, here are a few facts about the West Allis Works: The floor area of the buildings is more than 160 acres. There are 14 miles of railway and 4 miles of roads within the plant, and the shops contain more than 30,000 power tools, from small precision machines to the great 40-foot boring mill. It requires 208 traveling cranes to handle materials and equipment. There are twelve great machine, assembly and erection shops, three foundries, pattern shop, tank and plate shop, forge shop, mill shop and many miscellaneous buildings used in manufacturing.



Completed parts flow on a planned master schedule from all parts of the great West Allis Works as this large turbine unit takes form. This is a general view of a part of the vast erection shop.

Some of the big jobs going through now include a 107,000 kw steam turbine unit for a midwest utility and two complete new hydraulic turbine and generator units for Hoover Dam. There's an order for six 22,000 hp pumping motors for a West Coast irrigation project, and another for one of the largest power transformers ever built. Rotary kilns up to 400 ft. in length, gyratory crushers weighing 500 tons and 22 million volt Betatrons are all products of these shops. So are delicate electronic and control devices.

Allis-Chalmers designs and builds basic machines for every major industry: steam and hydraulic turbine generators, transformers and other equipment for the electric power industries; crushers, grinding mills, rotary kilns, screens and other machines for mining, ore processing, cement and rock products; flour mills and oil extraction plants; electronic equipment; big pumps, motors, drives . . . to name just a few.

Widest Choice

As you can see, Graduate Training Course engineers at A-C can move in just about any direction they choose—any industry, any type of work from machine design, research and product engineering to manufacturing, selling and installation.

The course is set up to allow students plenty of chance to gain training and experience in the work they choose. There's no reason to run into bottlenecks or dead-end streets—for students help plan their own courses, and are free to change their plans as new interests, new opportunities, present themselves.

ALLIS-CHALMERS

Allis-Chalmers Manufacturing Company, Milwaukee 1, Wisconsin

OIL . . . .

(Continued from page 11)

all parts of the instrument case at all times to prevent temperature changes.

As can be seen from the foregoing discussion, the North American Gravity Meter contains an extremely delicate and finely adjusted mechanism, yet, the complete meter itself is unusually rugged since the most easily damaged parts can be readily adjusted and clamped in a safe position during transportation from point to point. The most widely used method of transportation for the meter in recent years has been the war-developed Jeep. In fact, it is largely due to this four-wheel drive vehicle that oil exporation has reached into some of the remote regions of the world which were heretofore considered impractical or impossible to reach for a geophysical survey.

The helicoptor brought in another possibility of transportation which has not been overlooked in the rush to locate new oil fields. As can be seen in the picture accompanying this article, the helicopter with pontoons is being used for a gravity survey over swampland. The gravity meter can be seen in front of the man in the plane who is closest to the reader. Motorboats have also been used extensively in gravity surveys over the surface of the Gulf of Mexico. The only external equipment necessary for continued operation of the meter is a six volt storage battery to maintain the constant temperature inside the instrument case, so it remains to be seen what new methods of transportation of the meter for gravity surveys may yet be introduced.

Although the various methods of determining the relative depths of the sub-surface have been explained, it is obvious that such a set of readings, in themselves, is of little value. In order to get a clear, meaningful picture of the underground terrain, it is most necessary that a geophysical map be drawn from these readings. In order to draw a map, therefore, it is necessary to run a horizontal control with a transit and a vertical control with a level over the surface of the prospected area to obtain accurate location and elevations of points observed by the gravity meter. Latitude and elevation corrections can then be made by the computed. After these calculations have been completed, all computed readings that are identical are connected together on the map (called contouring) resulting in a plot very similar in appearance to a topographic or structural geology map. A careful study of the map—a result of an application of the laws of physics—combined with the knowledge of facts and assumptions of geology which have been accumulated and accepted after many years of study of the earth's structure, gives a final geo-physical interpretation as to the most probable location of a new oil supply to fill the ever-growing demand of our modern civilization.

RESEARCH . . . .

(Continued from page 8)

What Are the Patent Policies of the Universities?

One of the chief problems of an Experiment Station is dividing the equities of the invention among the inventors, the sponsors, and the university.

There are five large schools that are opposed to receiving profits for patents. They are the University of Pennsylvania, Chicago, Harvard, Yale, and John Hopkins. These are the exception since most schools gladly use the revenue from patents they control or fostered.

An early Station was set up by the University of Illinois in 1913. It is significant to note that much of its work was paid for by outside industry, but it was the policy that the results of experiments paid for from University funds belong to the University. The rights expressed by Illinois are similar to the relationship of an employer to developments of his employees in industry. However Illinois' policy on developments sponsored by outside industry was different. In this case the patent rights belonged to the sponsor. Most land-grant colleges have followed Illinois' example on patent policies.

Some schools leave the patent responsibilities solely to the inventor and claim no rights for themselves. However, they encourage the inventor to assign the patents to the university or its agent for management. The Universities of Wisconsin, Minnesota, Columbia, Ohio State, and California Institute of Technology follow this policy.

A blanket policy that all rights belong to the inventor is followed by California, Syracuse, Louisiana State and Texas Universities. Very few schools have no definite policies for internally developed patents.

Sound patent policies of the universities toward sponsored developments are all-important for receiving the goodwill and sponsorship of industry. The types of patent policies for sponsored research can be classified as follows:

1) special treatment of each case
2) full patent rights to inventor
3) full patent rights to sponsor
4) part of rights to sponsor
5) option to sponsor to purchase rights.

There are many variations and combinations of the last two policies that are followed by many schools. The Colorado Experiment Station policies fall into this group. The patent rights remain with the University unless the sponsor wishes to purchase them. He may do so by paying 20 per cent of the total cost of the project, and a $100 inventor's fee. Overhead and administration costs are included in the total cost. Lehigh, Florida, and Michigian Universities, and Texas A. & M. have very similar policies.

It may be interesting to note here that the University of Colorado Engineering Experiment Station ranks twelfth among technical schools' research activities in

(Continued on page 42)

Photo by USAF Air Materiel Command

RESEARCH . . . .

(Continued from page 40)

the amount spent for research. Before the war it ran fifty-third.

What Is the Relation of the Experiment Station To Other Fields of Research?

The entire research program at Colorado University is handled by a single organizational committee. The committee is composed of Deans of the College of Engineering and Graduate School; members of the departments of Social Science, Humanities, and Chemistry; the Director of the Bureau of Business Research; a member of the Medical School Staff; and a legal advisor from the University's administrative staff.

A unique feature about the University's research program is that 10 per cent of the profit made from research in any department or school goes into a central fund from which faculty members are awarded grants for worthy projects. About $10,000 has been made available from this fund so far in this academic year. The Graduate Council on Research, headed by Professor Morris Garnsey, decides which of the many requests for funds for individual and cooperative projects are to be granted.

Another unique device is made available to undergraduate students who have worthy projects in any field. It is the Student Research Council, whose purpose is to stimulate creative thinking among undergraduates. It is believed that Colorado University is the first school in the nation to initiate such a policy for undergraduates.

For an example of research that is being conducted at the University, in fields other than engineering, let us consider the field of pharmacy. Specialized equipment is being developed by staff members and graduate students of the School of Phramacy for the study of the relationship between electrical impulses in muscles and muscle action. Mechanical timers to be used to time muscle impulses were developed by Dr. H. C. Heim of the School of Pharmacy. These instruments are so inexpensive and simple in construction that a large number can be made available for both undergraduate demonstration and graduate investigation in Pharmocology.

Summary

In summary, applied research presented many problems to those colleges and universities that participated. Many of these problems were solved by use of three devices—private research foundations, loosely affiliated foundations, and engineering experiment stations.

Applied research is increasing in volume and importance in the United States and the University of Colorado has prepared itself to take an increasingly active part in that research.

Law Student: "You girls wouldn't care to go with us, would you?"

Arts Student: "Would you girls care to go with us?"

Engineer: "Where do we go, you lucky girls?"

Wayne King, "The Waltz King", is one of America's most popular entertainers. His weekly Standard Oil television show is a delight to see and hear—and it makes him one of Standard Oil's best salesmen.

More than sweet music comes from this horn

Let's assume that Standard Oil researchers and engineers have fully developed and tested a new, outstandingly improved petroleum product. Let's assume that the product has been made and distributed to Standard Oil dealer stations.

What happens then?

That's where Wayne King and all our other salesmen take over. They inform the public about this new product. And when the public buys, there's work for people to do all down the line: work for the service station man, for the refiner, the pipeline man, the driller. The more we sell, the more people we need to make new products. Our present employees become more secure in their jobs, and new jobs open up.

Good salesmanship, you see, is vital to all of us. But good salesmen must have good products to sell —and that is why research and product engineering, as carried on at Standard Oil and other progressive companies, is also vital.

Good products *plus* good salesmanship are an unbeatable combination that helps make our country great and the American standard of living the highest in the world.

Standard Oil Company

(INDIANA)

STANDARD

SOCIETIES . . . .

(Continued from page 36)

to make the trip with our delegate.

The spring initiation will be held on May 20, 1950. All interested chemists and chemical engineers are invited to attend the numerous open meetings during the spring quarter.

SOCIETY OF AUTOMOTIVE ENGINEERS

Since O. H. Stelter, Jr. and Bob Hayward, chairman and vice-chairman respectively, graduated in March, secretary J. J. Lorzing is presently acting in these vacated positions. Election of officers for the coming year will take place before the present quarter closes.

For Engineer's Day, May 12, S.A.E. has planned several displays and demonstrations in an attempt to inform all visitors, members, and prospective members of the organization's activities and nature. Committees are presently being formed for the 1950 Apple Fest. High interest in this activity indicates a highly probable success in this event.

The Student charter applied for in January was accepted April 20 by action of the National Group, S.A.E., and changes the present student club to a student branch entitling the organization to all rights and privileges afforded such a branch.

TO KEEP YOUR TOASTER POPPING..

E. C. M. A.

Excerpts from magazines belonging to Engineering College Magazine Association.

On Local Traffic Conditions

We students of the University of Colorado can understand the traffic problem on the campus of the University of Wisconsin since it parallels the conditions on Broadway here in Boulder before the erection of the safety circles:

"Traffic on University Avenue is extremely heavy, especially during the early morning and late afternoon rush hours. . .Nearly everyone has to cross University Avenue at a point where there is no traffic light or safety island. . .Something will have to be done eventually to handle the problem of getting the student body across this busy street."

The Wisconsin Engineer, Dec., 1949.

On Engineering Curriculum

A new course explaining the profession of engineering to freshmen has been initiated this year at Rose Polytechnic Institute:

"Elements of Engineering has been added to the Freshman curriculum. . .a course designed to give the incoming Freshmen a chance to become acquainted with the engineering profession as a whole and with

COMMENTS

some of the duties and responsibilities of the engineer."

Rose Technic, Dec., 1949.

On Extracurricular Activities

Many engineering students round out their college careers with extracurricular activities. The *Oklahoma State Engineer* commented on the activities of engineering students at Stillwater:

"At college where we are receiving our technical background this trend toward a more active community life is becoming more and more apparent. Our extracurricular activities are an indication of it. Not only are engineers active in the technical societies of their fields but also in social fraternities and other all-campus organizations."

Oklahoma State Engineer, Nov., 1949.

There is a big difference between being just a member of an organization and being a participating members as was mentioned in the *Cornell Engineer.*

"To a mild and proper extent, *be a joiner* and after you join, take an active part in the workings of the group. I am sure you've noticed in many groups or meetings the relatively few who stand out and lead. They have taken my advice—first by joining, and second by doing!. . . You will benefit a hundred-fold from every ounce of energy you put into proper group action."

The Cornell Engineer, Dec., 1949.

SPECTROMETER . . . .

(Continued from page 20)

peak of frequency f will allow the calculation of the mass of the unknown ion.

Conclusion

The radio-frequency spectrometer is small, light, and relatively inexpensive. The instrument stays in adjustment and can be operated by persons unskilled in physical experimentation. These advantages over the larger magnetic deflection spectrometer suggest many uses in both industry and physical research. The spectrometer tube has been used as a leak detector in a vacuum system, and may be used in the testing of gases, even when the impurity or poison in the gas is present to a very small degree. In physical research it will be used to analyze the constituents of the upper atmosphere from a rocket, to study the emission from metallic cathodes, and to study the formation of negative ions. Probably many other uses for the spectrometer will be found as it becomes mode widely known.

A rocket motor which uses liquid hydrogen and oxygen as fuel has been tested at Ohio State University. Liquid hydrogen is the most powerful chemical fuel known to science. It is believed that the liquid hydrogen rocket could provide enough energy to overcome the gravitational pull of the earth.

CAMPUS NEWS . . . .

(Continued from page 17)

tops. If these particles are in the field of a powerful magnet, they develop a "wobble"—the physicists call it "precession"—like a top that is not spinning steadily.

By accurately observing their behavior when another magnet is superimposed in the original magnetic field and made to fluctuate at a rate which is exactly in step with this "wobble" Dr. Zimmerman hopes to get new information on how the tiny nucleus of the atom is made.

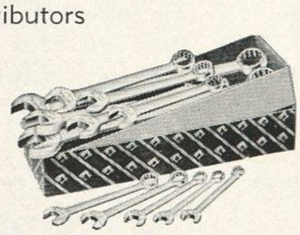
Dr. Zimmerman previously held a Charles A. Coffin fellowship from General Electric Corporation for research and has investigated many problems in electronics. His findings have been published in a number of articles in "American Physical Review," journal for scientists.

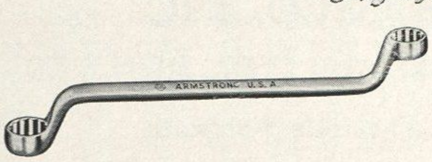
Dr. Zimmerman's home is Eureka, Kansas. He joined the faculty of the department of physics at the University of Colorado last fall.

New Equipment Received

The University of Colorado has recently been given several pieces of equipment for their electrical engineering department. The gifts, valued over $2,000, were presented to the Engineering Electrical department by the Radio Corporation of America.

The equipment includes several signal generators, a dynamic demonstrator, vacuum tube volt-meters, and a five-inch oscilloscope with direct current amplifiers.





ALUMNI NEWS . . . .

(Continued from page 25)

Robert W. Peterman, B.S. (E.E.), is an engineer with the Cheyenne Light, Fuel and Power Company. Peterman is working on engineering problems in the gas field.

Roderick James Downing, B.S. (C.E.), is a sales engineer with the Armo Drainage & Metal Products Company in Denver. Downing is in the Steelbox Sales Division.

Fred Dumler, B.S. (C.E.), is a sales engineer for the Hardesty Division of the Armo Drainage & Metal Products Company, Inc. His residence is 1208 East San Miguel Street, Colorado Springs, Colorado.

Stanley R. Colson, B.S. (Aero. E.), visited the campus recently. Mr. Colson is a research analyst in the plastic group of the Boeing Aircraft Company at Seattle, Washington. During his senior year, Colson was editor of the *Colorado Engineer.*

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Larry Mathis, B.S. (C.E.), Sam Warren, B.S. (C.E.), and Morris Hohnstein, B.S. (C.E.), are with the Inter-American Geodetic Survey in Panama. They can be contacted at P.O. Box, Balboa Heights, Canal Zone.

Paul Lopatin, B.S. (C.E.), is working for the Oregon Highway Department at Salem, Oregon. His present address is 985 Summer Street, Salem.

OIL CAN

THE HONORARY SOCIETY OF LUBRICATION ENGINEERING

**Lubricity shall lack no champion . . .
Friction shall not thrive unopposed**

Spring! Ah spring! The time when a young man's fancy turns to love and an engineer's fancy turns from slipsticks to lipstick. And in the midst of this calm serenity that has settled on our campus a little pest, not unlike the lowly wood-tick, is busily at work injecting his laze-producing venom into the bloodstream of every student. "Spring Fever" has striken the entire engineering school, making the usually creative minds of the engineers lazy and dormant. What other reason can explain the sudden lull of student discoveries? Or is it that young man's mind has turned from engineering fields to fields of wild flowers?

From the "Engineer" office comes our own candidate for the royal order in the person of Ronnie Millard, to whom we award three squirts from the dripping spout. It seems that in kinematic class, Mr. Jòhnson was exhibiting different types of gears for the class to identify. When asked to identify a "herringbone" gear, Ronnie promptly described it as a "tweed" gear.

One of the most unique definitions of an electron ever discovered was found on an anonymous sophomore's physics quiz paper. The result of this engineer's labor was: "An electron is a dot of electricity that speeds very fast backwards from the direction that electricity usually goes, and it loses this sense of direction and gets turned around when the magnetic field is fluxing."

The Oil Can congratulates the Mechanical department for its faithful supply of recruits during the past months. The newest candidate for membership is Richard Corbett, who gave the cracking reply in Manufacturing Operations I, "An advantage of A-C arc welding over D-C welding is that there is less arcing."

Another non-electrial student, S. C. Galing, in E.E. 12b said in his report of an experiment, "Load an alternating generator operating in parallel with a power system by connecting the alternator to a water bucket and then lower the bucket."

At long last one of the "fairer sex" in engineering has come to the rescue of the Oil Can. Miss Helen Means, in an Aircraft Structures report, concluded that the straingage reading was off because there was a permanent set in the wire attached from the gage to the load pan.

In Materials Testing Laboratory, Frank Conrad was recorder. With great care and precision he was quite sure that everything required was on the data sheet. He got the instructor to check it, and started to hand the carbon copies to other members of the squad, only to find that he had inserted the carbon paper incorrectly and the data sheets could only be read by using a mirror. So to Frank we present one pint of non-skid lubricating oil.

Even the electrical engineers sometimes make statements which require a "second" thought to be understood. D. E. Stalling in an E.E. 20 b quiz gave the following answer: "If you tried to short circuit the circuit instantly, the time rate of change of current would be infinite, so the voltage would be infinite. This would not happen because the circuit would throw an arc across where you tried to short-circuit the circuit, and current would continue to flow."

The Architectural Department apparently is banding together. In a "History of Architecture" midterm, Fred Anderson, M. E. Starks, and J. B. Wright, independently, defined "cistercion" as an object for holding or storing water.

Blame spring for this one if you will. The class in Air Conditioning was discussing a group of curves depicting certain values, such as moisture, line, and so forth. Bill Lewis, in describing these lines said, "Now considering that horizontal line sloping upward to the left——!"

Editor's note: Here is a letter from an interested alum.

141 Washington Avenue
Chatham, New Jersey
April 10, 1950.

Mr. Melvin Coleman
Editor, *Colorado Engineer*
University of Colorado
Boulder, Colorado.

Dear Sir:

I have been very much impressed by the recent issues of the *Colorado Engineer* and show them with pride to my associates from other schools. Congratulations.

I suggest that either Robert H. Head or the *Colorado Engineer* or both receive an Oil Can citation for the former's original definition of refridgeration in the March issue. On Page 20 it is stated that refridgeration is the "controlled removal of heat from a desired body." This explanation should greatly increase the enrollment in refridgeration classes.

David A. McLean
B.S. (Ch.E.) 1929.