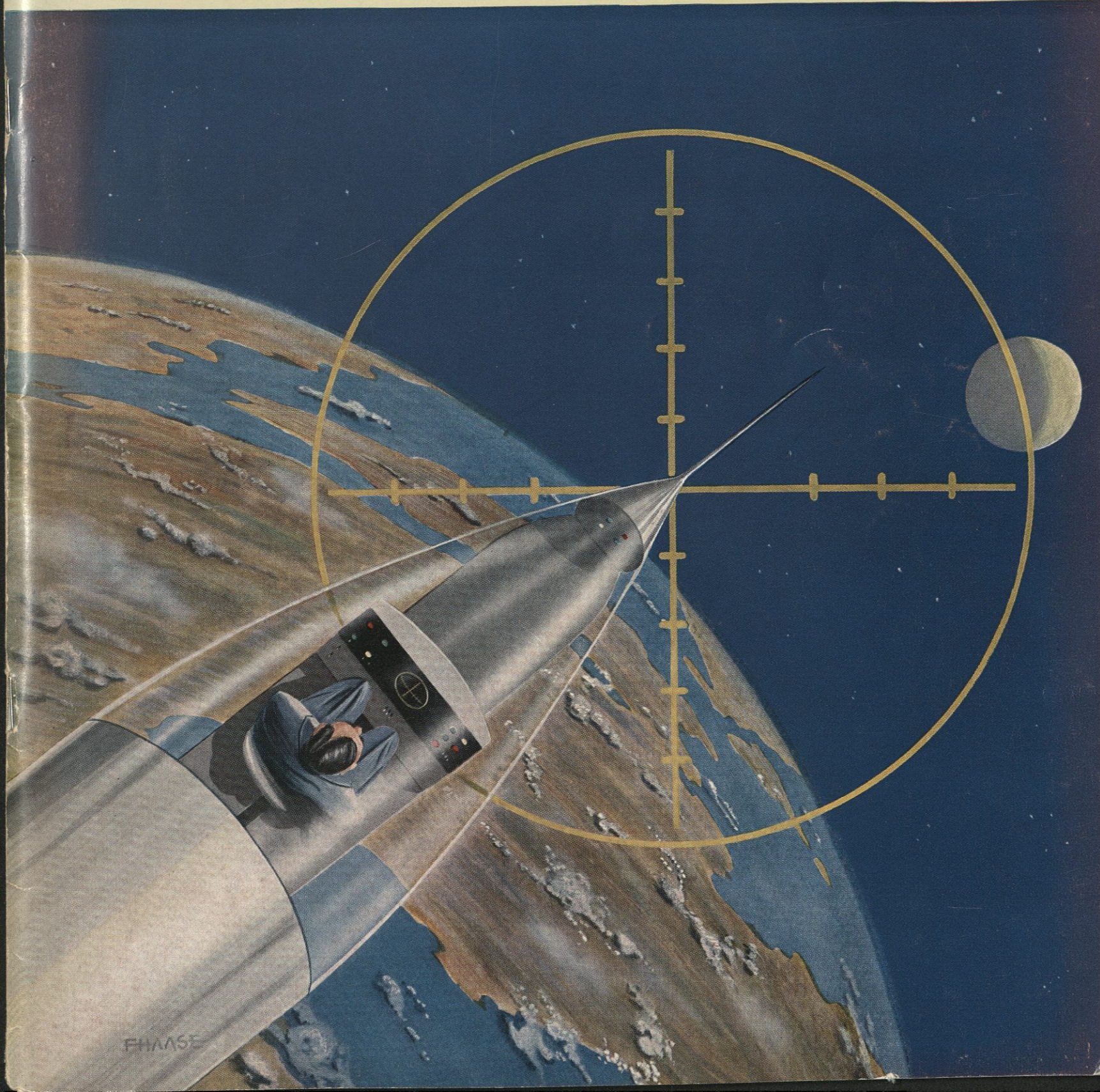


The Colorado Engineer

WORLDS OF SPACE

MARCH 15, 1950



How to make 31,000 people happy



ONE of the biggest single housing developments ever undertaken has taken its place in the panorama of New York City's lower East Side. It is the result of cooperation between private enterprise, the State, and the City.

The rise of Peter Cooper Village and adjacent Stuyvesant Town has changed the face of this 80-acre section of Manhattan . . . has transformed a slum area of tenements and factories into modern,

roomy living quarters for 31,000 people.

Many similar projects . . . some perhaps not so large, some even larger . . . must take form before America licks its housing problem. And they'll all require vast quantities of steel, for steel is the backbone of modern construction.

Today the steel industry is looking ahead toward tomorrow's big projects. At United States Steel, a vast training program is going forward continually,

preparing men to handle the many highly-technical jobs that modern steel-making involves. Many of these jobs are far removed physically from the roaring blast furnaces and glowing open hearths—at the same time, they are absolutely essential to today's precision steelmaking.

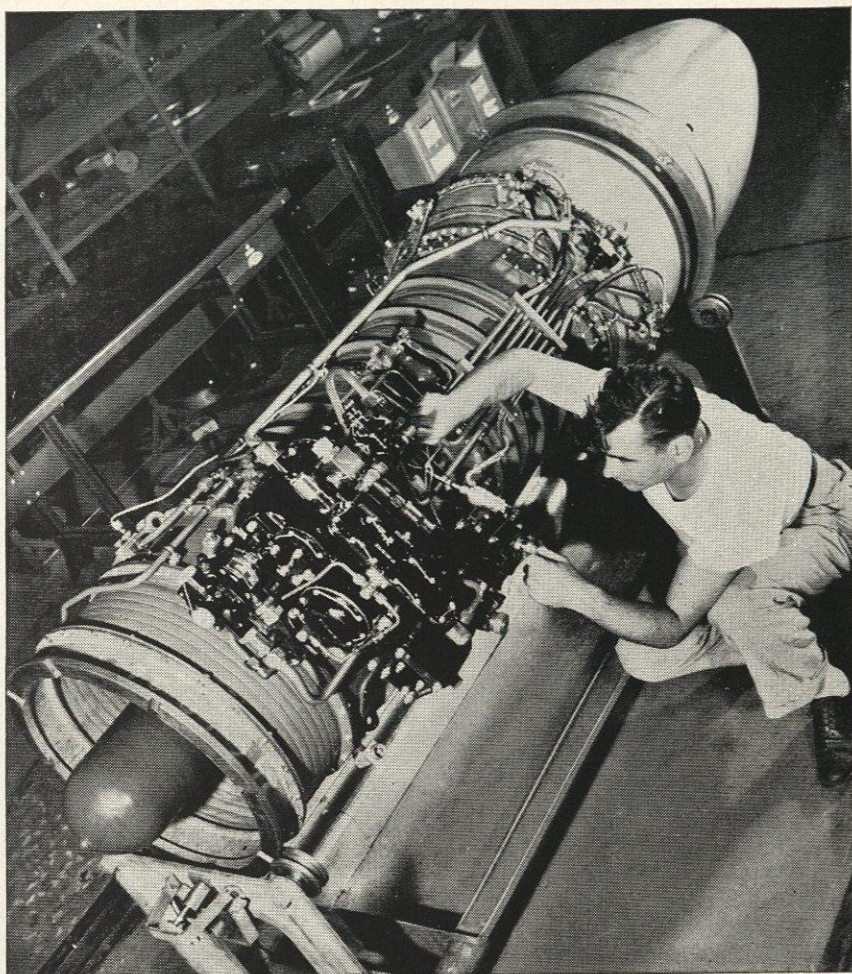
Through its training program, United States Steel is laying the foundations for promising futures for young men who meet its qualifications.



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How many Dimensions has a Name?



When you measure a name, there are many "dimensions" to consider, such as: integrity, capacity, vision, strength and skill. These qualities constitute a yardstick for professional and public recognition.

There will be many times in your career when you can increase the "dimensions" of your name by the development of a product, a method or through a decision you make.

Some idea of the dimensions of the name Westinghouse, for example, may be gained by a few facts about one of its many activities . . . building turbines.

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Such developments require a rich back-

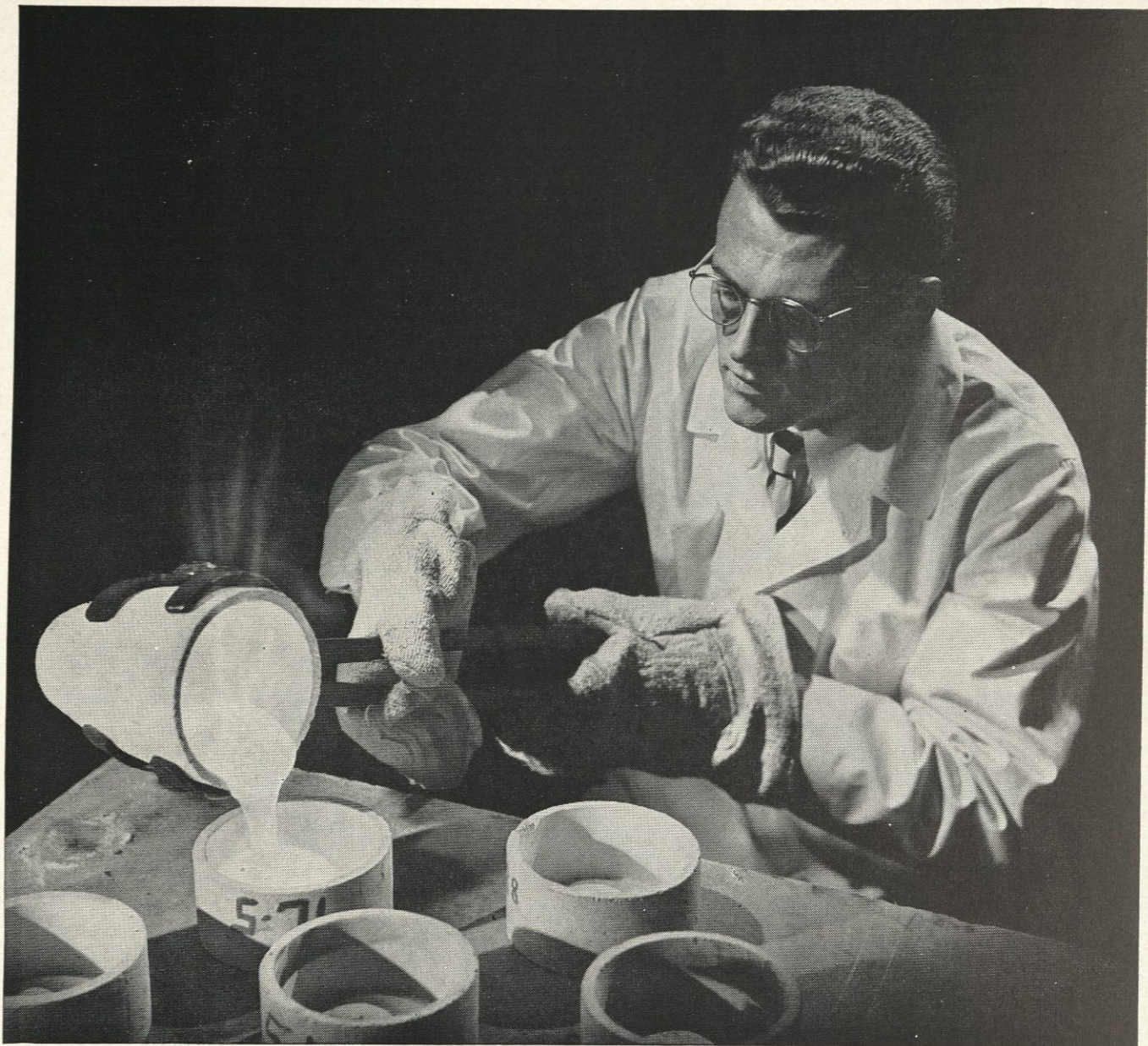
ground of experience, technical knowledge and creative skill gained through constant search for more efficient, economical sources for power . . . qualifications needed to attain the eminent position the name Westinghouse holds as a leading producer of power equipment for land, sea and air.

This is but one of many fields in which the name Westinghouse has been indelibly written over the years.

In your career you will measure many names and products in industry. As you do, you will find the name Westinghouse prominently identified with practically every one.

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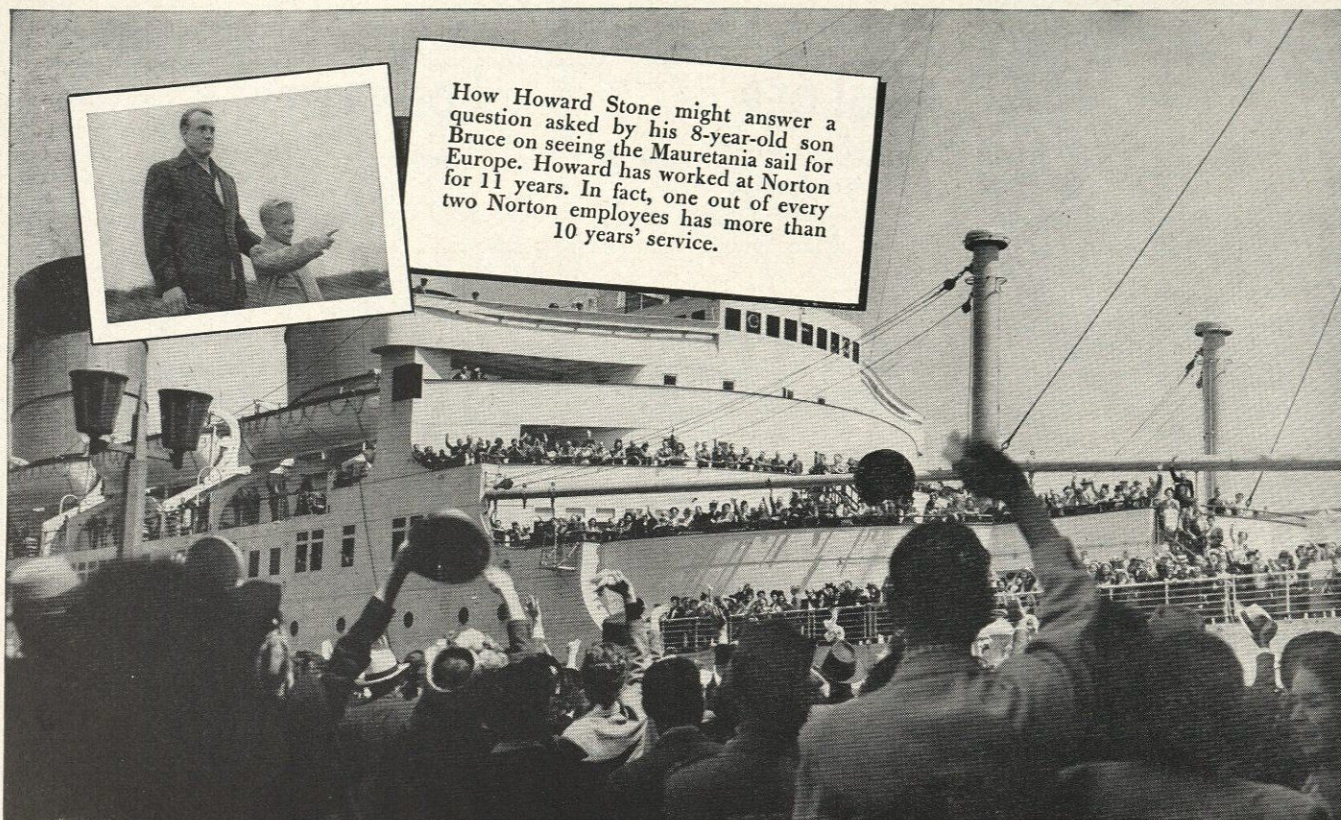
Corning makes glass so strong that it can be used as piping in a steel mill. Corning makes glass so soft that it can be melted with a match—and glass so resistant to thermal shock that it can be heated to a cherry red, then plunged into ice water without its breaking.

Today, throughout industry, Corning means research in glass—research which, along with a multitude of other developments, has made glass one of today's most

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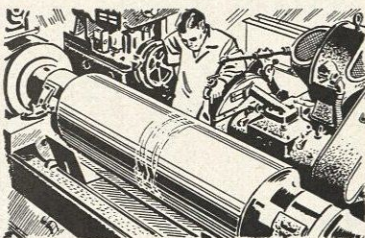
CORNING
means research in glass



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"How BIG DO THEY MAKE SHIPS, DAD?"

"Almost no limit, son, as long as the men who design and build them continue to take advantage of scientific progress in all the things that make ships strong, fast and safe.



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"To give today's floating cities extra speed and smoother sailing, propellers must have perfect surfaces... the kind that come from rough-grinding with Norton cup-shaped wheels and finishing with Behr-Manning abrasive discs.



"Yes, and attention to fine details is the sign of the wise ship designer. That's why the terrazzo floors in galleys of ships like the 'Queen Mary' get lasting, non-slip safety from a Norton product called Alundum aggregate."



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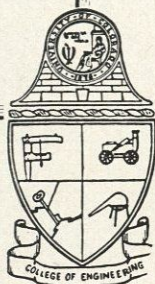
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COLORADO ENGINEER—March, 1950

MELVIN COLEMAN
Editor

ROBERT G. MILNER
Business Manager



The Colorado Engineer

VOLUME XLVI, NO. 3

CIRCULATION 3100

MAR. 15, 1950

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Cover: This painting by Frank Haase is called Spirit of Tomorrow—a fitting title, for the trip to a distant planet may not be too far in the future.

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PRICE: \$1.50 PER YEAR

Entered as second-class matter March 9, 1916, at the Postoffice at Boulder, Colorado, under the Act of March 3, 1879. College of Engineering, University of Colorado.

Published Four Times a Year, on the Fifteenth of November, January, March and May by the Students, Faculty, and Alumni of the College of Engineering.



Worlds of Space

by ROBERT MILNER, Ch.E. '50

A trip to the moon? The rocket? A history of astronomy? The glories and mysteries of the planets of the Solar System? Come along!

Perhaps the first masterpiece of creation ever to interest man was the sky at night. For thousands of years, no doubt, men have stood in awe-stricken wonder at the beauty of the heavens.

History

The earliest records of civilization which are possessed include observations of the heavenly bodies. The Chaldæan and Egyptian priests formulated records for the purpose of fixing religious festivals, but their observations were only abstract items of certain recurrent sequences. It remained for Ptolemy, in the second century A. D., to formulate the first truly workable theory concerning an orderly system of movement of the heavenly bodies.

Actually, all that can be seen from a glance at the darkened sky are small spots of light which seem to the observer to be fixed upon the inside of a great spherical surface of which the earth is the center. This surface is known as the celestial sphere. These points of light appear from time to time in different directions from the earth. Those spots which do not change relative positions are termed stars and a number of groups of stars have been fancifully noted as constellations. Certain of the lights are not relatively stationary, however, and these are called the planets or wanderers. It was soon evident that although both the sun and the moon followed regular courses of rotation, the motion of the planets was very erratic, seeming to slacken pace in their course from west to east, finally stop and retrace a portion of their course from east to west, stop again and then gradually resume both the original speed and direction. This problem concerning the irregular retrograde motion of the planets is an example of what was probably the most controversial issue of early astronomy. Two outstanding men dealt with it.

Considered as the foremost astronomer of antiquity, Claudius Ptolemy flourished in Alexandria from about 140 to 160 A.D. He collected the scattered and detached works of Hipparchus and his other predecessors, studied and revised their findings, and finally digested them into a system and advanced his hypothesis in a treatise, the *Almagest* (The Great Construction). Ac-

cepting from his predecessors the spherical character of the earth, he postulated the earth as an immovable sphere in the center of the universe, about which all the other bodies of the ether rotated. Ptolemy pictured the celestial sphere as an actual sphere to which the stars were fixed in the same relative positions in which he saw them and which also circled the earth about an imaginary axis. He postulated that in the regular orbit of a planet about the earth, there was an imaginary point, termed a deferent, which subscribed a circle around the earth moving at a uniform rate from west to east, and that the planet encircled this deferent in another, smaller orbit, called an epicycle. The path of the planet, then, was observed as a combination of two circular rotations. This epicycloidal path may be understood from Figure 1, a top view, if it be considered in the plane of the page.

Ptolemy's interest lay merely in predicting the position of any star or planet at any time, explained by an individual hypothesis for each body. This theory is extremely complicated, and although it is now considered to be quite false, it is still possible to base exact calculations and predictions on this system, according to its fundamental concepts.

The theories of Ptolemy were believed for thirteen centuries, and were not seriously disputed until Copernicus (1473-1543) issued his "de Revolutionibus Orbium Coelestium," (1531-2), commonly known as the heliocentric hypothesis. He was induced to seek a new theory because he noted that the renowned mathematicians of his day differed among themselves concerning the earth's motion. Study of ancient literature led him to believe that perhaps the ridiculous was true — perhaps the earth was in *motion*!

Copernicus began his lengthy study in 1506. He assumed a spherical shape for earth and the heavenly bodies he observed, and postulated that all astral motion was generally circular in form, because this path was



← This is artist Chesley Bonestell's conception of a lunar base for a rocket transport to earth. Notice how the distant mountains are illuminated by light from the sun reflected off the earth (upper center).



Nebula M 81 in Ursa Major—light from this beautiful space star-city takes 1,600,000 light-years to reach earth.

the only one which could be followed to return to a starting point. He next attacked Ptolemy's theories by asserting that not only was the earth not the center of creation, but that it revolved, as did the planets, around the sun. The irregular movements of the planets were due to the fact that the earth was in motion, and their retrograde motion actually did not exist, although it appeared so, because of this fact.

This phenomenon is diagrammatically shown in Figure 2, and resolves itself into the simple explanation that the earth is at that period traveling more rapidly than the planet and overtaking it. Figure 2, also a top view, illustrates exactly the same view, to an earth observer, as Figure 1, if seen in the plane of the page. Twenty-five years of arduous labor produced his calculations and relatively completed theories, which may be summarized by the following statement in his own words: "and thus I have, assuming the motions which I in the following work attribute to earth, after long and careful investigation, finally found that when the motions of other planets are referred to the circulation of the earth, and are computed for the revolution of each star, not only do the phenomena necessarily follow therefrom, but the order and magnitude of the stars and all their orbs and the heaven itself are so connected that no part can anything be transposed without confusion to the rest and to the whole universe."

Strange to say, the "Copernican revolution" included no actual physical measurements or proof, but it has been upheld and confirmed by his successors, and is congruous with all the known facts and discoveries. This is the present theory.

The Solar System

With respect to the sun, the planet sequence is as follows: Mercury, Venus, Earth, Mars, Jupiter, Saturn,

Uranus, Neptune, and Pluto. Between Mars and Jupiter are a group of planetoids called the asteroids. They number over 1500, and there are probably 20 times that number still undiscovered, but their total mass is less than that of our moon, and they will be omitted from the discussion in lieu of the more interesting planets. Although the planets are similar in the respect that they all move in elliptical orbits about the sun (which comprises 99.86% mass of the total solar system) although the sun is not at the center, and in the same direction (counter-clockwise facing north), and all shine by reflected light, they are radically different in detail, as may be seen from the table. For this reason, they will be taken up separately.

MERCURY — "the moon of the sun"

Observations of Mercury are quite limited because it is small, near the sun, and because when it is nearest to earth, it presents to us only the unlighted "back." Although Mercury reflects only about 7% of the light it receives from the sun, it can be seen with the naked eye at dawn and dusk. The nearness of the sun is responsible for a temperature (on the sun-side) of 770° F. Evidence indicates that Mercury has no atmosphere. At first this was explained by the fact that the temperature was high enough to allow the gas molecules to reach an escape velocity, and fly off. However, this theory has been abandoned by the argument that one-third of Mercury's surface never receives light. Therefore, there is an immense area of intense cold, and it is presumed that this area is large enough and cold enough to solidify gases. In time, and there has been time enough, at least the majority of Mercury's atmosphere has collected there. There is no plant life on Mercury.

VENUS — "the morning and evening star"

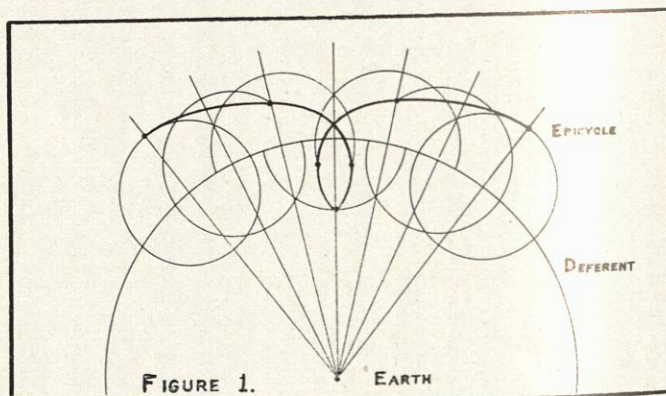


FIGURE 1.

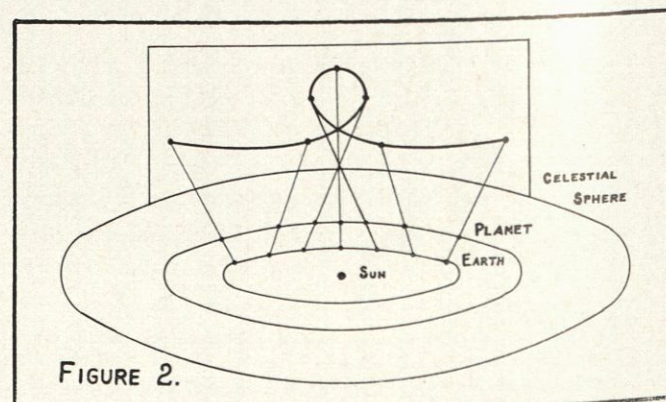
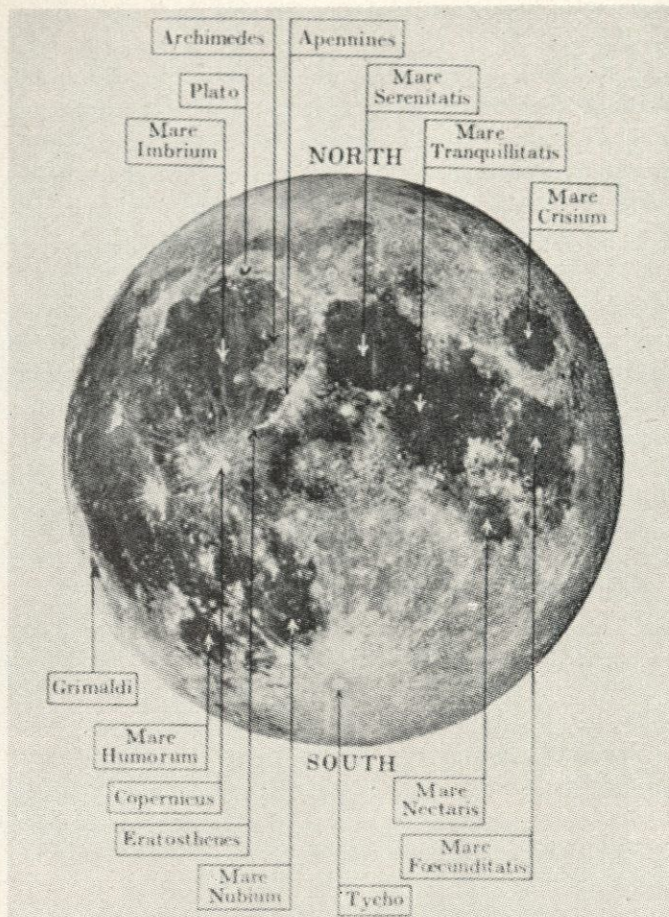


FIGURE 2.



If this plate is viewed from nine yards distance, the moon will appear full size, and it will be possible to recognize the "Man in the Moon."

Although Venus is the nearest planet to earth, it presents the greatest mystery. It is known to have the most circular orbit of all planets, and to be the most spherical. It has an extremely dense atmosphere, known to contain carbon-dioxide but very little oxygen (hence no vegetation.) This fact, coupled with the reasons why it is so difficult to see Mercury, explain why so little is known about this beautiful planet. Venus, the morning or evening star (depending on the time of year) when it is in the sky at all, may be seen with the naked eye even during the day, and all observations are made at this time. It is suspected that there is, like Mercury, a perpetually hot (212° F — ?) and cold side, on this absolutely dry planet.

MARS — "another earth"

More is known about Mars than any other heavenly body, excepting the sun and the moon, because it is comparatively easy to study. It is outside of the earth's orbit and, consequently, in full illumination most of the time. The daily temperature on Mars ranges from 50° to 72° F in the day and drops to about 10° F at night. Strikingly enough, Mars is barren—no mountains, little weather, a thin atmosphere (probably containing oxygen) consisting of blue and yellow clouds, and no open bodies of water. However, Mars does have some water—approximately one-fourth of its surface—and it does support lush vegetable growth. With water so scarce, what

is more logical than to assume that the Martians dug canals? This question has been the source of great controversy, but as of 1949, Mars has canals. Water is also in evidence by the polar ice caps—approximately one foot thick glaciers which may be seen to form in the Martian winter and melt in summer.

JUPITER — "the big" — first of the "four giants"

Jupiter is the largest planet of all, containing more mass than all the other planets combined. It may be seen as a very bright planet (not to be confused with Venus which sets early) appearing yellow, although red has been observed. The atmosphere (ammonia and methane) is extremely dense, and is included in the diameter, since the distance to the solid portion has not been determined. It surrounds an ice core which is thousands of miles thick. It is suspected that Jupiter is still in an active stage, as evidenced by massive eruptions. Its temperature is -210° F.

SATURN — "the beautiful"

This wonder of the solar system, like Jupiter, has an atmosphere so dense that it is not known how far down "solid ground" begins, and its mass, excepting Jupiter, is also larger than all the other planets combined. As one of the "four giants" it exhibits characteristics like those observed on Jupiter. Probably the most interesting aspect of Saturn is the rings. Although these rings are brighter than the planet itself, they are amazingly thin. A model, with rings cut out of paper, would have to encircle a ball about 60 inches in diameter. They appear quite substantial, but in reality are numberless particles (more or less the size of grains of sand) which revolve around the planet with varying speed. The total mass of the rings is equal to about



—Courtesy Chesley Bonestell.
From its sixth satellite, Titan, Saturn, 760,000 miles distant, in the "new" phase, appears over the horizon.



—Courtesy Chesley Bonestell.

Straight down 500 miles is Nebraska. Three of the Great Lakes and Hudson Bay are viewed to the northeast. The light in the sky is the Aurora Borealis.

1/100 the mass of our moon.

URANUS — “the freak”

Unlike the other planets, Uranus is nearly cross-wise (98°) in the sky. This presents an unusual effect because its moons have practically vertical orbits. The atmosphere of Uranus is similar to that of Jupiter, but it has less ammonia and more methane. Other conditions of this planet conform to those of the other “giants.” The surface temperature is about -300° F.

NEPTUNE — “the lonely one”

Not much is known about the last of the “four giants” except that in most respects it is similar to the other three.

PLUTO — “trans-Neptune”

Pluto, the baby of the planets, was discovered in 1930, and information concerning it is very limited. However, Pluto was a real surprise. Suspecting its existence on account of Neptune’s motion, everyone expected another giant. Pluto is actually smaller than the earth, and extremely close, relatively, to Neptune. For

this reason, many astronomers still seek the “true” trans-Neptune.

The four primary instruments in use to determine some of the foregoing data are: (1) the telescope for magnification, (2) the camera for permanent records and time exposures of very faint objects, (3) the vacuum thermocouple for temperature measurements, and (4) the spectroscope for ascertaining compositions.

To illustrate the comparative emptiness of the universe, two examples will suffice. First, consider a scale model of the solar system. Assume a ball 50 feet in diameter for the sun. In order, the planet diameter and distance from the ball (the sun) are: Mercury, $2\frac{1}{4}$ inches and 2000 feet; Venus, $5\frac{1}{2}$ inches and $\frac{3}{4}$ mile; Earth, $5\frac{1}{2}+$ inches and 1 mile; Mars, 3 inches and $1\frac{1}{2}$ miles; Jupiter, 5 feet and $5\frac{1}{4}$ miles; Saturn, 4 feet 2 inches and $9\frac{1}{2}$ miles; Uranus, 22 inches and 19 miles; Neptune, $21+$ inches and 30 miles, and Pluto 5 — inches and 41 miles. Or, on the same scale, the nearest other sun would be 270,000 miles distant — farther than our moon is in reality. One astounding fact is that if the solar system were fitted into a round box, four feet in diameter, it would only have to be 5 inches high. The second example refers to time periods. The bodies will be our moon, the nearest star, and one of the nearer nebulas. A beam of light would require $2\frac{1}{2}$ seconds, 4.3 light years, and 1,100,000 light years, respectively, to reach us.

A Trip To The Moon

Before zero hour, perhaps a few concepts should be explained in order to clarify the general functions of the rocket. “Mass Ratio” is the term applied to the division of the total takeoff weight by the total weight minus the weight of the fuel. As an example, then, a mass ratio of 2:1 means that the rocket at take-off weighs 2 times as much as the rocket minus its fuel, or that 50% of the total weight is fuel. The rocket will be fired vertically, because then it can be constructed lighter and also because this path will be the shortest route to the rarified, or non-existent, atmosphere where the efficiency will be at a maximum due to decreased air resistance. As soon as it will be practicable, the rocket will be tilted to a 45° angle. Then the “real” trajectory begins.

The tilt and velocity at “Brennschluss” (the mo-

(Continued on page 36)

PLANETS OF THE SOLAR SYSTEM

planet	mean distance from sun (million miles)	length of year	escape velocity (miles per sec.)	surface gravity (earth=1)	mass (earth=1)	diameter (miles)	moons
Mercury	36.0	88.0 days	2.2	0.27	0.04	3100	0
Venus	67.2	224.7 days	6.3	0.85	0.8	7700	0
Earth	93.0	365.25 days	7.0	1.00	1.0	7900	1
Mars	141.5	1.88 yrs.	3.1	0.38	0.11	4200	2
Jupiter	483.3	11.86 yrs.	37.0	2.64	317.0	86700	11
Saturn	886.1	29.46 yrs.	22.0	1.17	95.0	71500	9
Uranus	1782.8	84.02 yrs.	13.0	0.92	14.7	32000	5
Neptune	2793.5	164.79 yrs.	14.0	1.12	17.2	31000	2
Pluto	3675.0	248.43 yrs.	6.5?	0.9?	0.7	7700	0

The Dean's Page

by C. L. ECKEL

Students in the College of Engineering have an unusual opportunity to participate in either Army (Engineer) or Navy ROTC programs. It may, therefore, be desirable to mention briefly some of the general aspects of these programs for the benefit of next year's prospective freshmen, the younger students in the College of Engineering, and, in a few instances, veterans with service in the armed forces.

In the last war, our military strategy was closely integrated by industrial "know how," and this effort was backed up by our fundamental scientific knowledge and our ability to apply and develop known scientific principles. Recent scientific advances are creating an increased demand for men with technical and scientific training, not only in the regular branches of the Service but also in the Reserves, which must augment the regular defense establishment in the event of an emergency.

Under present conditions, the two service academies cannot furnish sufficient officer personnel to meet normal requirements, much less the needs of an emergency. Consequently, there are excellent opportunities for a Service career for the man who cannot obtain academy appointments. In any event, completion of an ROTC program will enable any college of engineering graduate to render a maximum of service in case of necessity. In a war, the man who does not serve to the utmost of his ability and capacity is a slacker just as the individual who deliberately tries to evade service.

Today's older generation has participated in two world wars and the younger generation apparently faces a catastrophic situation. Even though we are not a warlike people, we do know that war can be forced on us, and if this should happen again, more than ever before will all of our people be involved.

We all support attempts to promote international understanding and thereby create lasting peace, but this does not relieve us of responsibility for preparedness for war in times of peace. Sensible people build houses as fire-resistant as practicable, but they are not thereby relieved of the necessity of carrying fire insurance and maintaining a local fire department.

The ROTC courses are a part of the program of the College of Engineering. Twenty-seven of the thirty-six quarter hours of ROTC credit are accepted toward an engineering degree. In other words, a student who is capable of carrying a normal scholastic load and pass nine additional hours may receive his bachelor's degree in one of our branches of engineering and, at the same time, qualify for a reserve commission in the Army, Navy, or Marine Corps upon graduation.

Age, citizenship and physical requirements of the various services must be met by the candidate. In all instances, uniforms are furnished. Pay allowances during the academic year vary with the type of program. Under the programs leading to a Reserve commission, a small cash allowance (in lieu of subsistence) is paid to third and fourth year ROTC students. Army candidates are required to attend a six-week's summer camp while Navy students participate in a cruise, during which students are on a full pay status.

The Navy also has a program leading to commissions as ensigns or second lieutenants in the regular Navy and Marine Corps which involves obligation of two years active service following graduation. Appointments under this program are obtained on the basis of nation-wide competitive examinations and selection by a state board. Men thus selected are known as "regular students" and receive appointments as "Midshipman USNR." Their tuition, books and fees are paid for by the Government and they receive, in addition, fifty dollars a month retainer pay throughout a four-year course. These "regular students" make a cruise during each of their college summers. A similar program is now under consideration for the Army and may be in effect next year.

Selected engineering graduates may receive a regular commission in the Corps of Engineers. The function of the Corps of Engineers is "to keep the Army moving." In time of war this relates to war plants, camps, airfields, utilities, pipe lines, storage facilities, roads, docks, bridges, and other essential construction. In peacetime, the Army Engineers are responsible to the Congress for the nation's rivers and harbors and for flood control, as well as for the training of Army and Air Force engineer units and all new construction for both services. Chemical engineering graduates may receive their commission in the Chemical Corps and electrical engineers are eligible for commissions in the Signal Corps.

Thus it is seen that, depending somewhat on an individual's choice, the subsidy received is a substantial financial benefit to a student. In fact, this aid may be thought of as a type of scholarship and a very good one, too!

If you are interested, and any able young man should be attracted by the opportunity to participate in ROTC, I suggest that you inform yourself about these programs. The commanding officers of the Army and Navy units on the campus, or the dean's office, will be glad to be of all possible assistance to you.

Meat, Colorado's Business

by RICHARD HANSEN, M.E. '50

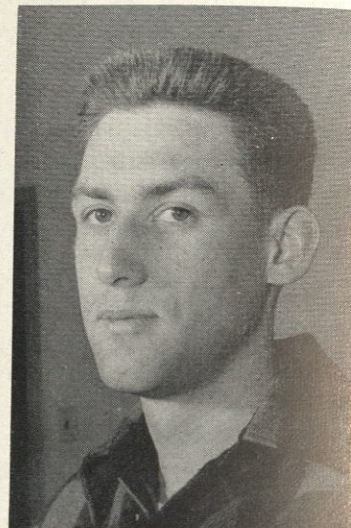
The meat industry is big business for Colorado. This is the third of a series of articles on Colorado's industries.

History

The task of raising stock and preparing meat is one of civilized man's oldest activities. As with most historical advancements, it can be traced by distinct steps or abrupt "jumps" of development. With the growth in America of communities and specialization of work, abattoirs were created where skilled craftsmen — butchers — prepared meat. For a time in the early part of our history, livestock could be provided from the immediate surrounding farm regions.

As the urban populations increased, however, it became necessary to bring animals from greater distances. The practice of "droving" stock, principally cattle, began in the East from localities such as West Virginia and Kentucky, across the Allegheny mountains to cities of the Atlantic seaboard. Later the fabulous cattle trails of the West were opened to follow the grazing seasons and to take the cattle to the railroad collection points (at the speed of 10-12 miles a day). Among the more popular of these was the Goodnight-Loving

Having worked in his uncle's packing house for several years while in high school, and being descended from a long line of butchers, Dick is well versed in the practices of the meat industry. Dick is a senior in the Department of Mechanical Engineering and has been on the staff of the **Colorado Engineer** for two years. His home is in Baltimore, Maryland, and he served a hitch in the navy. He was assistant editor of the **Dodo**, is a member of A. S. M. E. and was one of the founders of the soccer club.

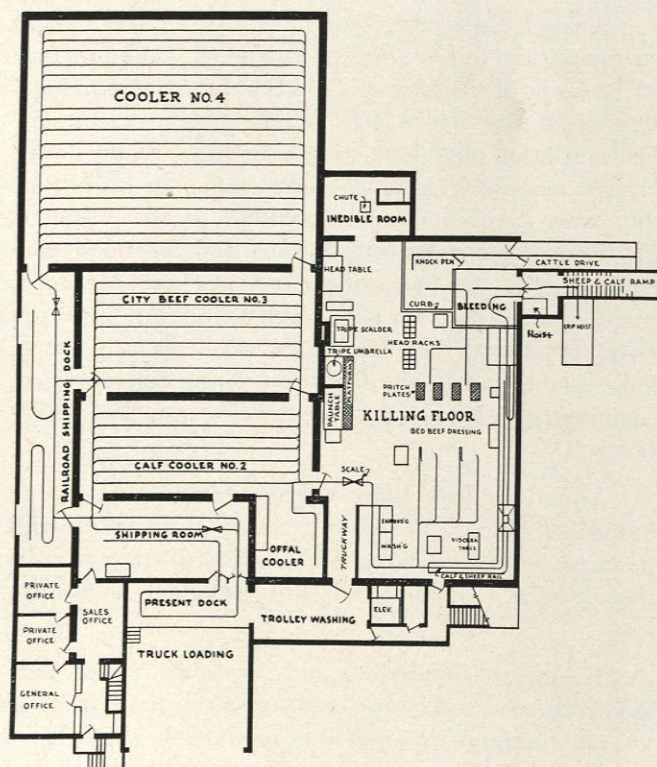


Trail through New Mexico to Trinidad and Pueblo.

Simultaneously another phase of the meat industry developed. This was meat "packing" proper, for in the original sense of the word it referred to the operation of salting and "packing" pork into barrels for shipment and storage. The meat packing industry in the early days was most extensive in the cities around the Mid-Western rivers and the Erie Canal. And it formed so prominent a part of the life of Cincinnati as to give that city the nick-name, "Porkopolis."

The next and greatest transition in the meat industry came just after the Civil War. In 1869, George Hammond experimented with shipping fresh beef packed in ice from Indiana to Boston. Within the next few years other men, Gustavus Swift and Philip Armour, began similar enterprises with considerable and long-lived success. The "dressed" weight of pork is less than 75% of live weight of hogs, and that of lamb, sheep, and cattle is never more than 60% of their respective live weights. Thus simple analysis shows us that considerable savings could be made in transportation by shipping the processed meat rather than the live animals from the locality of production. Also, the animals would lose considerable live weight in a journey from, say, Iowa to Buffalo. The development of the techniques of artificial, mechanical refrigeration allowed the American meat industry to assume its distinctive form.

At the present time about 70% of the nation's meat is consumed east of the Mississippi River, but only 37% of the meat animals are raised there. This has given a distinct west to east polarization. To overgeneralize, livestock are bred and raised in the West, fattened and slaughtered in the Mid-West, and then shipped under refrigeration to the East for eventual consumption.



—Courtesy National Provisioner
The versatile arrangement of this killing plant permits the killing of cattle, calves, or sheep.



—Courtesy Armour Company
In the dressing department, the cattle are bled, skinned, and deboweled in short order.

Where does Colorado fit in the picture? Meat is big business for the state. During the year 1948, when mining brought in nearly \$126 million and the tourist trade was only \$130 million, nearly \$300 million were derived from the sale of livestock as well as \$200 million from meat processing. This total of \$500 million in the entire meat industry represents a widely distributed source of income, extending from the Western Slope sheep herder and the Weld County cattle feeder to the Denver packinghouse worker.

Denver is probably the focal point of the entire Rocky Mountain Region. Stockmen of Montana, Utah, Wyoming, Arizona, New Mexico, and Colorado have long recognized the advantage of sending their stock to this railway center where it is "down hill" all the way east. In 1886 the Denver Union Stock Yards were formed and soon grew to be one of the largest in the nation. While being the world's largest sheep receiving center, it also handles almost half as many cattle and one-quarter as many hogs as the great Chicago yards.

Colorado itself sends a substantial number of this stock to its Denver market. The Rocky Mountains, with the fairly steep and high ranges of mixed grasses and weeds and infrequent watering places, are favorable for the grazing of sheep. The state thus ranks as the fifth largest sheep producer. The high quality of these animals is substantiated by one sheepman who insisted that the meat didn't need to be inspected but just stamped "raised in the Rocky Mountains."

Not having extensive corn crops, Colorado is not a hog producer and at most supplies only the local market.

Cattle production, however, is a different story, especially in the ranges of the eastern part of the state. There is a very interesting tie with the sister beet-sugar industry in which the beet tops and beet pulp are used for feeding cattle. These by-products provide a relatively cheap and acceptable nutrient when balanced with certain other feeds. It is estimated that \$1.30 worth of beet tops as feed can be derived from every ton of sugar beets.

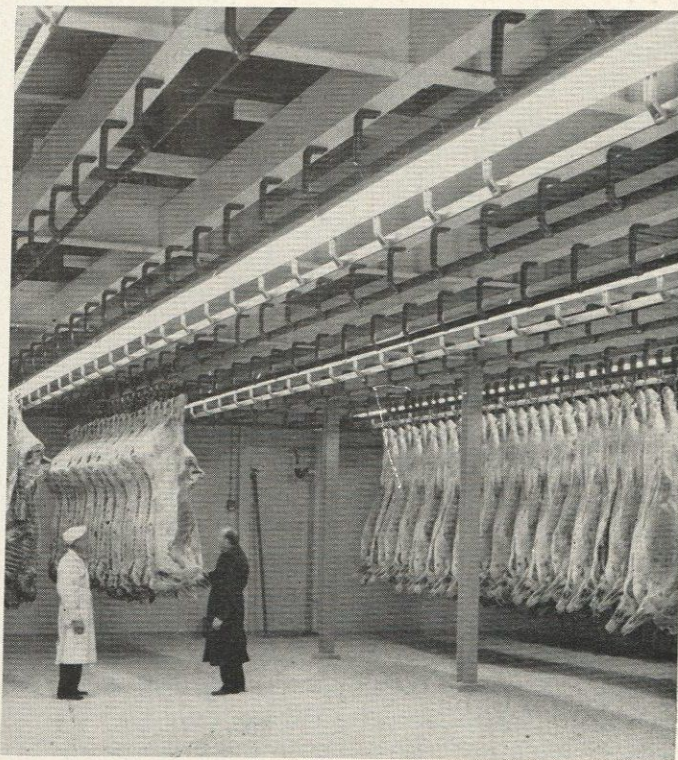
As the population of the area expanded, a local meat packing industry grew up. As early as 1898 it was reported that the packers in Denver turned out a product valued at \$2 million, which was as much as the output of the four local breweries. At that time one packer alone (The Colorado Packing and Provision Company) was handling annually 150,000 hogs, 100,000 sheep, and 20,000 to 40,000 cattle; and the problem was not in finding a market for the dressed beef but finding enough fat cattle to slaughter.

Since then the packers have kept pace with the growing population and last year processed some 350,000 cattle, 35,000 calves, 550,000 hogs, and 500,000 sheep.

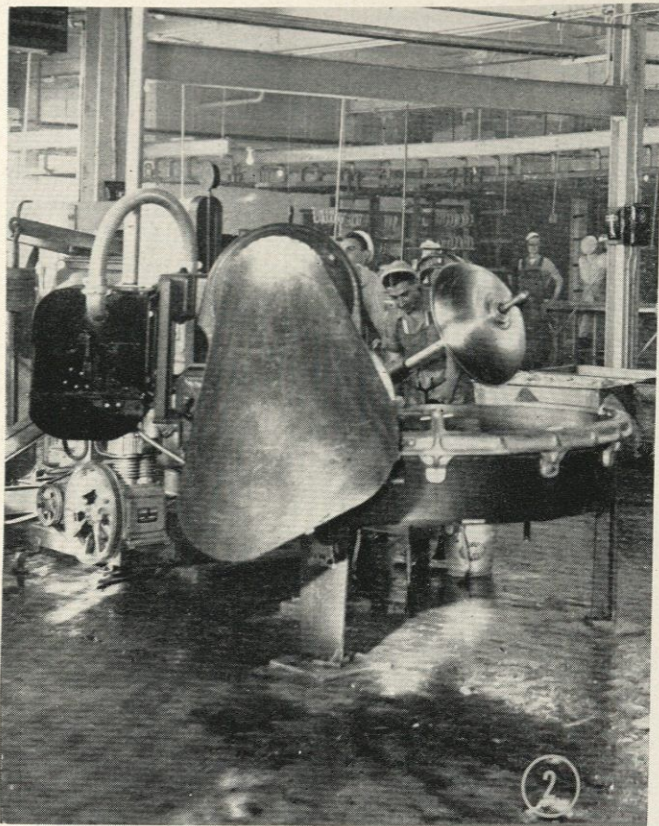
All But the Squeal

Meat packing is classified according to the three basic animals, all of which are processed in the modern plant. The essential disassembly problem is common to them all, so we shall trace through hog processing, which is slightly more complex.

The modern efficient plant is usually three to four stories high; but regardless of the building's height, the live animal is taken to the topmost floor by being driven up an inclined chute or perhaps given a ride up on an elevator. The hog is led into a narrow pen, shackled



—Courtesy National Provisioner
This is a main beef sales cooler with high level florescent illumination.



—Courtesy National Provisioner
A view from the sausage preparation section across the processing room.

by a hind leg and "dispatched" or "stuck" by cutting the jugular vein in the under neck, thus terminating its wallowing career. After full bleeding, the carcass is dropped into a scald tank of slightly basic water which is kept between 141°-148° F. This temperature must be closely regulated, as too much heat will break the skin while too low a temperature will not loosen the bristles. Then the carcass is thrown into a dehairing machine where a series of rotating cylinders lined with rubber beaters remove most of the hair.

The remaining small hairs may be removed by shaving with knives, or singeing, or by a depilating process. In this latter method, the hogs are dipped into a hot adhesive (usually a rosin compound) which cools to form a seal-like coating. As this coating is peeled off it carries with it all the remaining hair, stubble, and sebaceous material from the skin.

By this time the carcass will have been raised to a rail conveyor to be finished by assembly line techniques which, incidentally, are reported to have given the automobile people their cues on materials handling. These lines are continually moving at a speed synchronized with that of the dehairing machine, i.e., about 500 hogs per hour; and in rapid succession specialized workers will wash down the carcasses with high pressure water, remove the entrails, and split the carcasses down the backbone. Within forty-five minutes from the time the hog is "dispatched," it will be in the refrigerator.

The carcasses are inspected while they are on the conveyor rail by as many as half a dozen veterinarians,

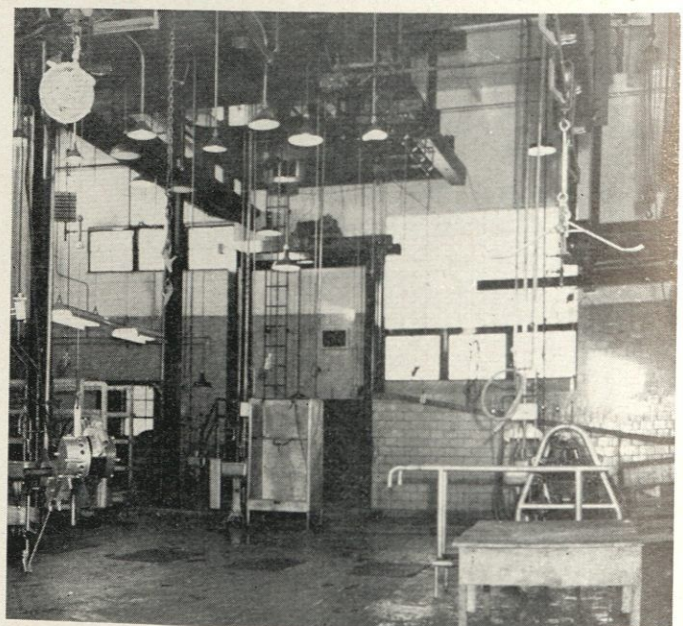
each examining a particular organ or gland. Should they find a suspect or diseased carcass, they simply switch it onto a side rail, thus eliminating any delay in the inspection process.

Proper refrigeration is an important factor in packing. Meat to be frozen will generally be quick chilled to 10° F. and then kept below 15° F. The remainder of the meat is kept at about 35° F. for a minimum of 24 hours. Adequate air circulation, as well as the proper humidity, must be maintained. Too low a humidity will "dry out" the meat and cause an unnecessary loss. Some interest has been extended to the use of ultra violet lamps in refrigeration to protect the meat from mold and bacteria growth while permitting a temperature high enough to effectively "tenderize" the meat.

After the pork carcass has been sufficiently cooled it is taken to another disassembly line where it is cut and trimmed. Extensive use is made of power saws and rotary knives by which the main cuts of hams, shoulders, bellies, and loins are separated. Specialists work on each cut; the trimmings and finished products are carried on by conveyor belts or dropped through chutes.

The basis of the "curing" process to preserve meat has remained much the same since the time pork was packed in barrels. The curing agents of plain salt, sugar, salt-peter, vinegar, and spices are still used, although each meat packer uses a different proportion in his "secret" process. The salt, in combination with the low temperature, inhibits the development of bacteria, while the sugar contributes mainly to the flavor. Salt-peter forms nitrosohemoglobin which maintains the color of the meat. Hams are cured by injection—pumping the solution into the veins and causing the curing to work from the bone outward. Dry curing of bellies (bacon before being smoked) is replacing the former method of packing the meat in brine or "pickle." The same curing constituents are used, but in the dry curing

(Continued on page 40)



—Courtesy National Provisioner
A typical killing floor.

Precision Plus

by CHARLES DEVER, Chem.E. '52

Do you want the correct answers? Claude Hathaway's precision instruments can give them. This is a story of a University of Colorado engineer's factory.

When a group of noted physicians approached a young Colorado engineer a few months ago with one of the most important and difficult problems of their profession, there was little hope of success. This particular problem—how to record dynamic blood pressures at various points on the body—had been stumping medical men for years.

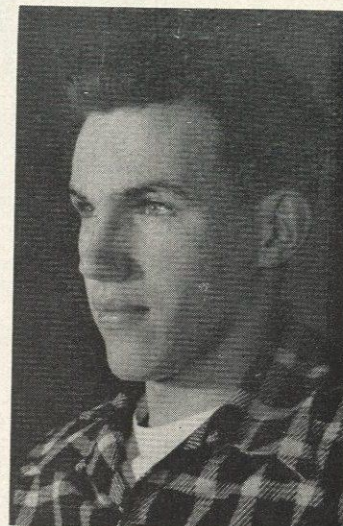
Difficult problems, however, were nothing new to this engineer, Claude M. Hathaway. His efforts, in fact, had always been devoted to solving them, and this new job was little more than routine. In six months, the Hathaway Instrument Company had completed the design and manufacture of an electronic recording device which simultaneously viewed and recorded the fluctuations of blood pressure up to frequencies of 100 cycles per second. Today the demand for the instrument far exceeds production, and it has been pronounced the best device of its kind in existence.

The man responsible for this engineering feat entered the field of technology in 1923, when he was admitted to the University of Colorado despite the fact that he had no high school diploma. Four years later, he graduated with honors from the College of Engineering in the field of electricity. The next ten years were spent in the engineering development laboratory of the General Electric Corporation in Schenectady, N. Y. He



Claude M. Hathaway is the designer of such recording instruments as this twelve element Automatic Oscillograph.

Chuck, assistant editor of the **Colorado Engineer**, is a sophomore in the Department of Chemical Engineering and has been a member of the staff for nearly two years. He is 19 years old, and his home is in Glenwood Springs, Colorado, which accounts for his interest in Colorado's industries. His various activities include: C-Book Editor, S&G Staff, Phi Epsilon Phi, and Pi Kappa Alpha social fraternity.



found time, however, to return to the University and earn his masters degree during this period. In the Fall of 1938, Claude Hathaway returned to Denver with his family, and began his private enterprise in the field of electric precision instruments.

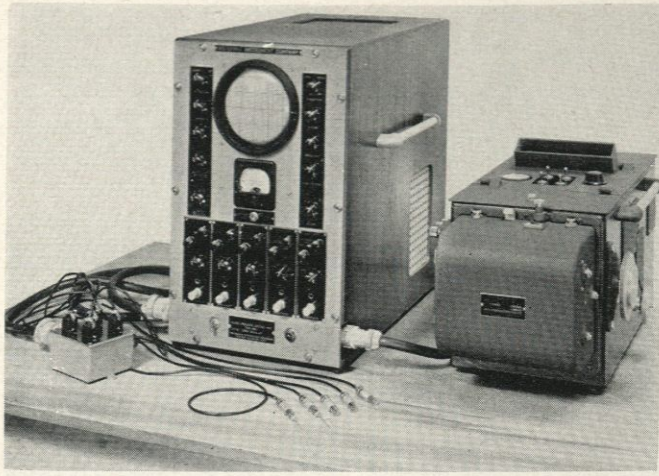
At first, the company was located in the basement of the Hathaway home. It was devoted entirely to the job of designing single instruments to solve particular problems of measurement and control in the field of science. Orders soon piled up, and the factory was moved to its present site in south Denver in 1940.

Usually only a single instrument of each design was built, but nevertheless complete plans and models were made of each. Soon it was found that certain devices were needed consistently, so standardization came about and continual production resulted.

World War II brought an increased demand for precision instruments, and the company expanded to meet it. Special problems of the military were pressed on Hathaway and his staff, and the hundreds of instruments produced to solve these problems made the company a top priority war plant.

One of the most essential problems the company faced during the war was how to compute the strain on airplane parts during flight. The known process of trial and error testing was too slow and hazardous at that time when speed of production was vital. The answer to the problem was the Hathaway Strain Gauge, so small that it could be carried in the plane and record strains at numerous points on the fuselage simultaneously. From these measurements, airplane designers pared off needless pounds and strengthened weak members, making U.S. planes the finest and fastest in the world.

Hathaway also has designed and manufactured new



This Hathaway built Blood Pressure Recorder is invaluable in the study of heart diseases. It plots the work cycle of the heart.

devices to compute such things as the muzzle velocity of artillery, physical reactions to the terrific acceleration of catapulted planes, and the impact of parachute landings. Still in operation are instruments such as those used in the testing of V-2 rockets at White Sands, N. M.

Not only did the company have to solve problems of design, but those of production as well. Its products were so unique that no sources of supply for parts and equipment could be found. Whenever this problem was confronted, the factory was enlarged to fill the need. The company began producing lenses, motors, and accurate vulcanized parts for the instruments. In the production of almost every new device, a great deal of special equipment had to be designed to overcome the special problems.

This is still true today. In the production of the blood pressure recorder, for example, a pure sinusoidal pressure was needed in order to calibrate accurately. A hydraulic pump using vertical piston action was designed to transmit the desired pressure. This was one of a number of such problems which were met and overcome in the production of this single instrument.

Perhaps the most important innovation in the production department is the foundry. From the beginning of production, each instrument called for great accuracy, durability and lightness. The cases for the equipment had to conform to these standards, yet still be inexpensive and easy to obtain. The cost factor suggested a sand casting. The weight and strength specifications could be met only by aluminum. But there was no known method of casting thin aluminum, and no sand casting was accurate enough. Hathaway and his engineers solved this problem in a very short time by perfecting a minutely accurate aluminum sand casting less than 1/16 inch thick despite the fact that industry denied it was possible.

Many factors were involved in perfecting the casting process. Metal patterns were used for greater accuracy, and although their price was about twice that of wooden patterns, they still were only one twenty-fifth as expensive as dies. The sand was packed tighter and kept under pressure as the casting was poured. The

patterns were removed by special machines built at the factory. Since no human operations were involved, the finished product was more exact. Stripping plates were also designed to aid in the removal of patterns. The resulting process saves the company and its customers thousands of dollars a month.

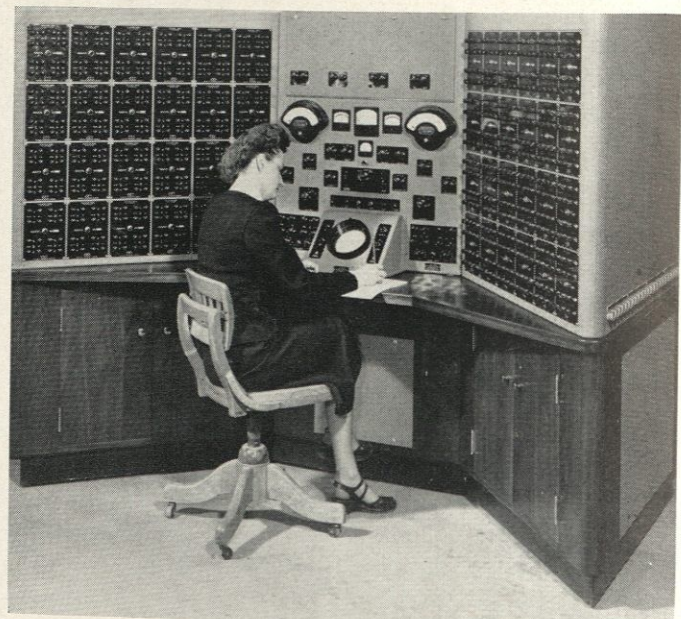
The end of the war created no problems for the company. In fact, it is producing more at present than it was at the peak of its wartime contracts, which ran into millions. The factory, which now employs over seventy persons—less than half the number on its wartime payroll—is composed of two parts, the engineering department and the production department. Mr. Hathaway is president of the company and chief engineer. Of the six other engineers, four are graduates of the University of Colorado.

In addition to the engineers, six detail draftsmen are employed. Eight model makers produce sample models used to work out factors of production not discovered on paper. There are also several laboratory technicians who assist the engineers.

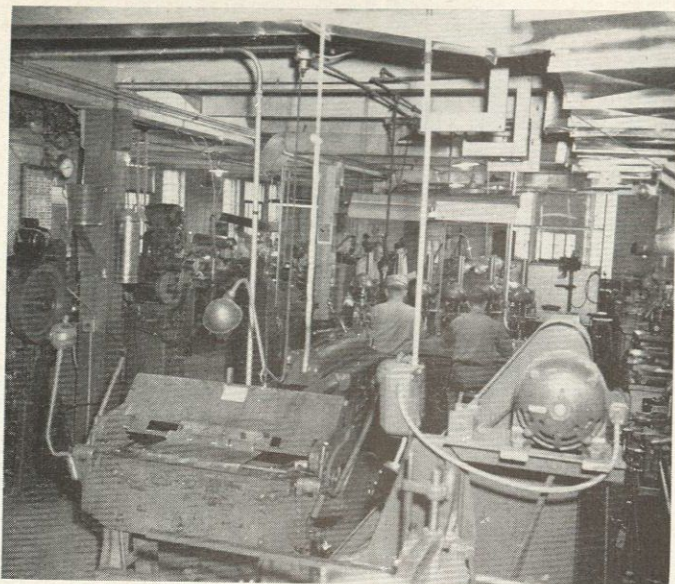
The production department is composed of divisions handling assembly, calibrating, machining, wiring, and testing, which, along with the foundry and cabinet shop, produce the finished products designed by the engineers.

The basis for nearly every instrument used for electrical measurement and recording is the oscillograph. Until a few years ago, oscillographs were large and intricate instruments which were very difficult to operate. While working in the General Electric Company development laboratory, Claude Hathaway was instrumental in perfecting a new type strain oscillograph using strong alnico magnets in place of the heavy electro magnets, and incorporating a new system of lighting. These new developments are now used universally in oscillograph design.

Fundamentally, the oscillograph is a device which



A natural speed demon, this computer produces the answers at a rate of forty a minute.



These machinists turn out precision parts for the various Hathaway instruments.

records electrical quantities that may undergo rapid variation. The record of these variations is made on photographic paper or film by tiny spots of light. Since these spots have no weight, they can be made to move at intense speeds. Galvanometers, designed for reaction to tiny amounts of current and rapid fluctuation, are used to produce the oscillating beams of light. The principle of the galvanometers is similar to that of the ordinary laboratory-type galvanometer invented by D'Arsonval.

In the oscillograph galvanometer, a tiny mirror is fastened to a loop of fine wire $1/1000$ inch in thickness and supported by ivory posts. This element is placed in a strong magnetic field. When a current is generated through the suspended wire, one strand moves forward, the other backward, thus rotating the mirror. The path of light reflected across the mirror is influenced, in this manner, by changes in current. A system of resistors is used to divert all but a tiny amount of current from the galvanometer. This is known as the bifilar type galvanometer. The natural frequency range of this type is from 400 to 10,000 cycles per second.

When slightly lower frequencies of current must be recorded, a coil type galvanometer is used. This type varies from the bifilar galvanometer in that a coil of fine wire is suspended in place of the loop. The size of wire and the number of turns which are acted upon by the electromagnetic force, produce a certain sensitivity. The natural frequency of this type galvanometer is from 35 to 800 cycles per second.

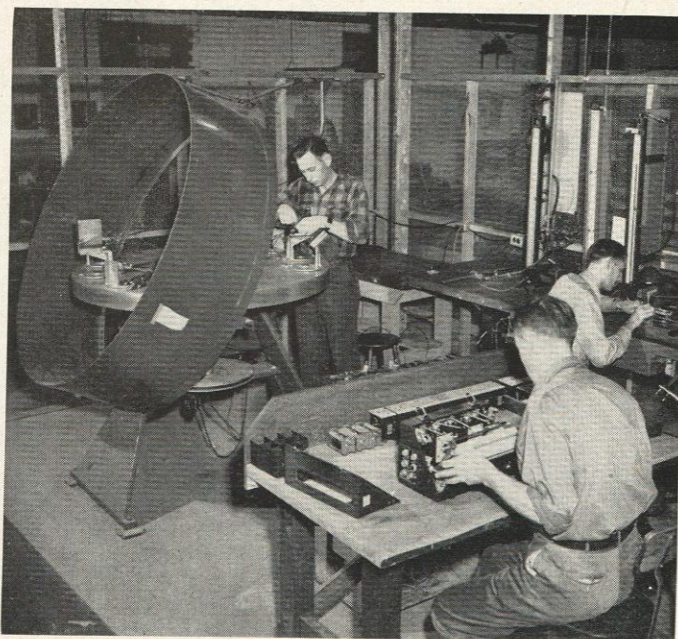
The aircraft oscillograph is an outstanding example of Hathaway leadership. Despite the fact that the Civil Aeronautics Administration ruled that commercial airline planes must carry a flight recorder to determine accident cause, no recorder was available for that purpose. Realizing the possibilities, the Hathaway Company perfected their aircraft oscillograph to conform to specifications. The multi-element recorder weighs about 30 pounds and is the size of a portable radio. Placed in the tail of a plane, it can be connected to record 24

strains, vibrations, and flight functions simultaneously. The accuracy of the instrument is not affected by excessive vibrations. Gears used in this and other instruments are designed and machined at the factory. A new spiral type gear has been perfected which gives comparatively frictionless operation.

Measuring and controlling devices of nearly every conceivable size and function are built by the company. They range in size from the micro-oscillograph, having a volume of 250 cubic inches, to the large general purpose type which accommodates up to 92 galvanometer elements. The micro-oscillograph is used in rockets and guided missiles and records up to 50 quantities simultaneously despite its small size. Because of the interchangeability of galvanometer elements, most units can be adapted to a number of different types of recording. Hathaway automatic oscillographs are used widely to record chance faults in electric power systems. These instruments record only when a fault occurs, and can reach full recording speed in 2 milliseconds.

Occasionally, frequencies greater than can be handled by electromagnetic oscillographs must be recorded, so a new type of instrument was developed. This new electronic recorder, the cathode ray oscillograph, records transient and periodic phenomena at extremely high frequencies. Using cathode ray tubes and amplifiers in place of galvanometers, the unit records quantities at frequencies up to 200,000 cycles per second with a 5% error, and up to 50,000 cycles per second with a 1% error. The Hathaway instrument is the most versatile and convenient high frequency oscillograph ever produced.

Difficulties in finding a suitable medium to record so great a frequency was perhaps the biggest problem in designing the cathode ray recorder. Finally a drum 3 feet in diameter was employed to carry a photographic (Continued on page 32)



In the calibrating department of the factory, instruments are clamped to the circular table and whirled at high speed.

CAMPUS

Score Another for the Architecturals



Robert Morrison and Barbara Rauch, constructing models for study of volumes and textures.

The Architectural Engineer's annual exhibit, opening on January 15 and extending through January 27 at the museum was better than ever this year. The exhibition won the acclaim of its hundreds of visitors for presenting a clear picture of the aims of so-called "Modern Architecture."

"Modern Architecture" is a misnomer. Those who practice it would rather call it "Contemporary Architecture" — evolved by and dedicated to our society and individual personalities. The display stresses the fact that architecture is more than pure aestheticism. It is aestheticism sculptured by logical planning and structures.

The exhibit presented the best efforts in the past year of students in all phases of development. The display room itself was designed by the seniors and constructed by the juniors, and it presented in a chronological order, the development of Architectural Engineers at the University of Colorado progressing from simple volume and texture studies by first quarter juniors to complicated factories, office buildings and residences by the seniors. Also included in the exhibition were "working drawings" drawn by the students from which their preliminary designs could be built. Among other things displayed in the exhibit were structural drawings, and history studies.

Dean Visits East Coast

Dean C. L. Eckel has recently returned from a trip to the east coast where he attended a conclave of Chi Epsilon, national civil and architectural engineering honorary. The meeting was held at North Carolina State College at Raleigh, February 24 and 25. Dean Eckel is Vice President of the fraternity. From Raleigh, he went to Columbia, South Carolina, to visit the headquarters of the National Council of State Boards of Engineering Examiners.

Department Heads Travel

W. C. DuVall, professor and head of the Electrical Engineering Department, recently attended the annual convention of the American Institute of Electrical Engineers in New York City. While enroute to the convention, he stopped in Pittsburgh where he addressed the local University of Colorado alumni and inspected a Westinghouse factory. On his return, Professor DuVall attended an alumni meeting in Schenectady and inspected the General Electric plant there. He is AIEE vice-president of the sixth geographical district comprising Wyoming, Colorado, Nebraska, and South Dakota.

Warren Raeder, professor and head of the Department of Civil Engineering, has returned to the campus following an inspection trip to three engineering schools in the West. He acted as a member of a committee sponsored by the Engineers' Council for Professional Development, an accrediting agency for schools of engineering. Professor Raeder inspected the Departments of Civil and Architectural Engineering at the University of Washington, University of Idaho, and Washington State College.

High Altitude Observatory

The joint Harvard-Colorado University High Altitude Observatory plans to complete moving this spring to a new and more favorable site on the slopes of Chalk Mountain, four miles northwest of Climax, Colorado. According to Dr. Walter Orr Roberts, director of the used along with the present five-inch instrument in the study of the sun's corona. The application of the results of coronagraph study are many, ranging from immediate, practical results of importance to long-range research program, the new location will be less exposed to wind, allow more freedom from dust, and have more room for development.

The development of the new site has been financed by government agencies and private contributions. Plans are also under way for the construction of a coronagraph having a fifteen-inch diameter, which will be results of great scientific significance.

Yngve Ohman, noted Swedish astronomer and Harvard research fellow, who has been at the Observatory for the past year, left recently for Sweden, where he holds a high position in the Stockholm observatory. Dr. Ohman has been researching in the study of polarized light from the sun's corona, and will continue his studies in Sweden.

Joseph H. Rush, recent addition to the Observatory staff, has returned from Duke University, where he completed work for his doctor's degree in physics. Study for his thesis in the field of spectroscopy was done while

NEWS

working as a research fellow on a Navy spectroscopy project at Duke for the past two years. During the war Dr. Rush was a research physicist on the Manhattan project at Oak Ridge.

Books Published

Charles A. Hutchinson, professor and head of the Department of Applied Mathematics, has signed a contract with Harper Brothers, New York, to edit a series of mathematical text and reference books. Several of the books are scheduled for publication soon, and the series will extend indefinitely. Professor Hutchinson is also an expert on giant calculating machines and works as a consultant to a number of manufacturers in the field.

W. Otto Birk, professor and head of the Department of Engineering English, is the author of a new text, "Structural Grammar for Building Sentences," published by D. C. Heath and Company. The book, which is written for the college freshman, reflects Professor Birk's more-than-thirty-years' experience in teaching college English. He returned last fall from New York City, where he spent the past year teaching English at New York University on a leave of absence from the University of Colorado.

Degree in Architecture

In September of this year the College of Engineering of the University of Colorado will formally introduce a curriculum in Architecture. This curriculum leading to the Bachelor's degree in Architecture will be offered in addition to the curriculum in Architectural Engineering, which was established in 1925.

The curriculum in Architectural Engineering has been revised to include an increased amount of architectural design and will conform with the usual four-year engineering course of study. The curriculum in Architecture will require five years of study; however, the first four years will be the same as the curriculum in Architectural Engineering. This arrangement will permit a student to graduate with the Bachelor's degree in Architectural Engineering in four years as has been the custom in the past, and if he desires, the student may continue his study a fifth year and earn a Bachelor's degree in Architecture.

If a student is interested in contracting, or sales engineering, he may extend his architectural engineering courses over five years and, at the same time, obtain enough Business School credits to graduate at the end of the fifth year with Bachelor's degrees in both Architectural Engineering and Business. The combined degree in the various fields of Engineering and Business has been offered for many years. Combined degrees in Architecture and Business are not offered; however, students in Architecture may take a number of elective

courses in the School of Business.

The four-year curriculum is recommended for students who wish to specialize in research or structural engineering; the combined Engineering and Business curriculum is offered for students who wish to enter contracting or the sales field, and the five-year program is offered for those who wish to practice as architects.

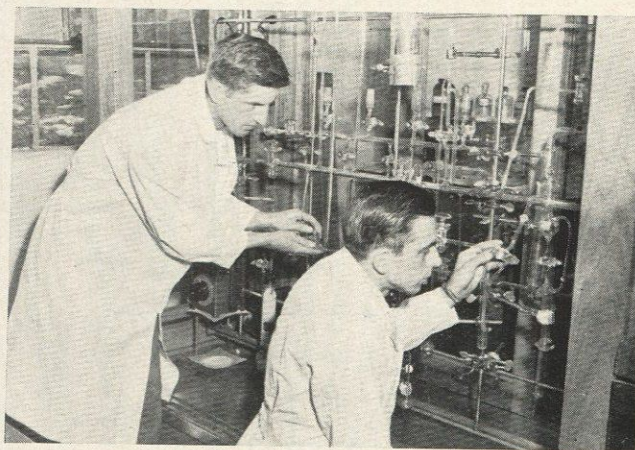
As the result of a close integration of the work in Architectural Engineering and Architecture, a student need not decide whether he will work for a degree in Architecture until he has completed the fourth year, and has discovered wherein his talents and interests lie.

The first class under the new program will be enrolled in September, 1950, as freshmen. No transfer students will be accepted for the degree in Architecture at that time; however, transfers in Architectural Engineering will be accepted in accordance with the usual policy. In the academic year 1951-52, both freshman and sophomore students will be accepted in the new program. This development will continue until 1955 when the first class in Architecture will be graduated.

The philosophy of the Colorado curriculum is that today's architect must be both artist and engineer, and that a broad training in architectural design must be integrated with a thorough training in the fundamentals of engineering. In other words, the architect must know the engineering principles involved in the building industry as related to the structural, mechanical, and electrical features of buildings. Architectural design and practice today requires that the practitioner integrate aesthetics, planning, structures, and mechanical equipment, as well as the social implications, in order to achieve good architecture.

Isotopes Laboratory

The new Isotopes Laboratory, located at the edge
(Continued on page 44)



—Courtesy Colorado Alumnus
Shown at work in the new Isotopes Laboratory are G. W. Tompkin, left, and S. E. Gebura, chemistry graduate students.

Low Temperature Refrigeration

by ROBERT H. HEAD

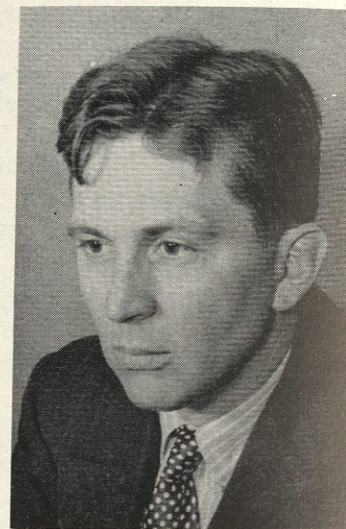
Low temperature work has been recently brought into prominence by a Nobel Prize award. In this article Mr. Head explains the processes of low temperature refrigeration.

In the general field of refrigeration, absorption type refrigeration system was the first employed. Ferdinand Carre invented the absorption machine in 1859, but history reveals that Carre was the first to adapt the principles already discovered, and not the originator of the principles.

On March 5, 1823, Dr. John A. Paris called on Sir Humphrey Davy, and upon the conclusion of the call looked up Sir Humphrey's assistant, Michael Faraday, in his laboratory at the Royal Physical Society in London.

Faraday was experimenting with hydrate of chlorine, which was being heated in closed glass tubes. Dr. Paris noted some drops of a dark oily looking substance in one of the tubes and called Faraday's attention to it, and criticised him for not using cleaner tubes. Admitting the fault, Faraday took a file and broke the fuse point of the tube. A slight explosion resulted and the oily substance vanished from the tube. Neither Faraday nor Paris could explain the explosion or the disappearance of the oily drops. However, the next day Dr. Paris received the following letter which startled the world with the newly discovered fact that gases

Mr. Head, an instructor in the Mechanical Engineering Department, was graduated from Alabama Polytechnic Institute at Auburn, Alabama, in 1947. After graduation he spent one year with Westinghouse Electric Corporation and then came to the University of Colorado to teach and work on his masters degree in Mechanical Engineering. He spent five years in the army during the war. He is married, has two boys, and is a member of Pi Tau Sigma and A. S. M. E.



could be liquefied.

"Dear Sir:

"The oil you noticed yesterday turns out to be liquid chlorine.

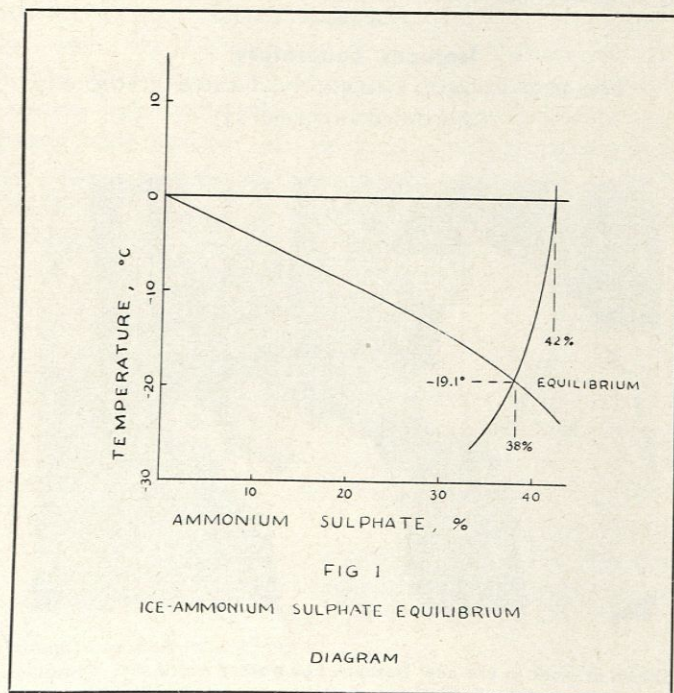
Your faithfully,
Michael Faraday."

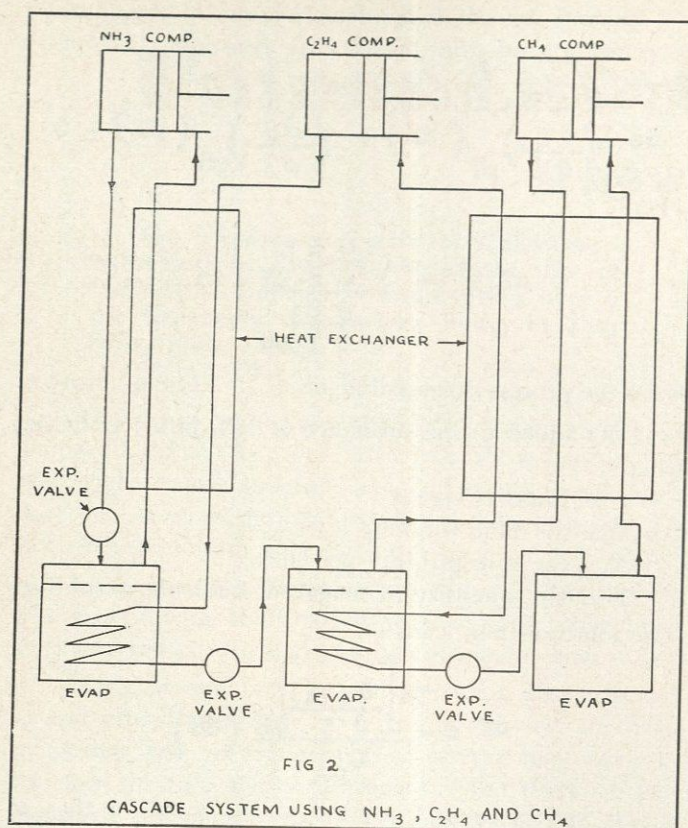
Thus was laid the cornerstone for application of one of the most useful principles of modern science—controlled removal of heat from a desired body. This field can generally be classified as refrigeration.

Low temperature refrigeration is one of the least written about and least discussed phases of refrigeration. Some of its varied applications are:

- (1) Solidification of carbon dioxide;
- (2) liquefaction of air for the purpose of fractional distillation to obtain oxygen, nitrogen, hydrogen, and helium;
- (3) liquefaction of gases; and
- (4) various research fields.

Since the first concepts of heat were expounded there has been a struggle to attain increasingly lower controlled temperatures. Several experiments have been made which have theoretically agreed that the lowest obtainable temperature is -459.69°F . This is the absolute zero temperature and can be predicted by determining the change in volume of a perfect gas with a change in temperature at constant pressure. Since a perfect gas would contract $\frac{1}{459.69}$ of its volume when lowered 1°F at 0°F , the number of degrees drop in temperature required to reduce the volume to zero can be calculated to 459.69°F below 0° . The existence of this temperature has been a challenge to produce successively lower temperatures in the laboratories. Progress toward the absolute zero is not merely directed to the creation of





new records but to actual study of effects associated with energy changes of such magnitude that only in this region can they be observed.

Processes used to produce cooling are:

- (1) solution of salts, acids or gases in water or ice;
- (2) evaporation of liquid;
- (3) adiabatic expansion of a gas with performance of external work;
- (4) controlled expansion of a gas utilizing the Joule-Thomson effect;
- (5) adsorption;
- (6) absorption; and
- (7) adiabatic demagnetization.

Solution of Salts

One of the earliest recorded methods of artificially obtaining temperatures below those of ice, and one of the simplest, is to place an excess of ice in contact with a salt, whereby a salt solution is formed. The transformation into the solution requires heat; and if the mixture is thermally insulated, the heat required for the transformation comes from the internal energy of the mixture itself, thus lowering its temperature. This quantity of heat is equivalent to the latent heat of the ice minus the heat of solution.

The formation of the saline solution dissolves more ice until a minimum temperature is reached. Figure 1 shows the equilibrium diagram for ice and ammonium sulfate. In this case contact between the salt and ice forms a solution of 42% ammonium sulphate by weight. More ice is then dissolved and the temperature is lowered until the mass reaches a minimum temperature of -19.1°C and a concentration of 38%.

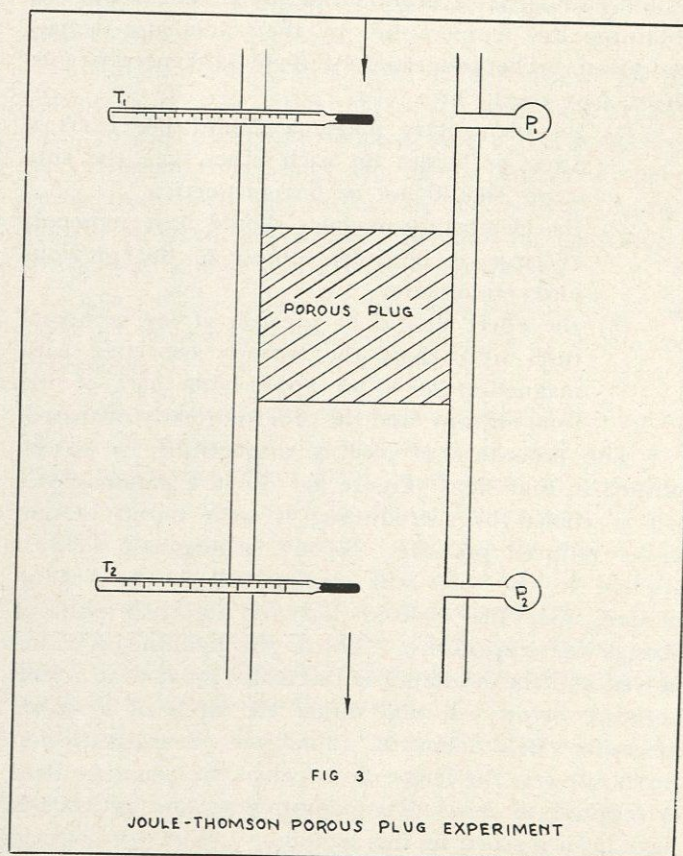
Evaporation of a Liquid

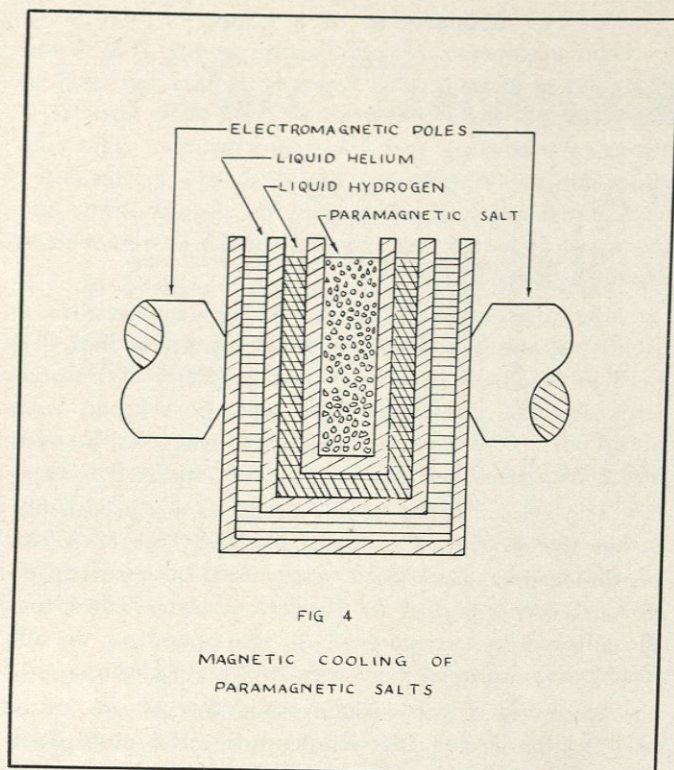
The absorption of heat accompanying the transformation of a liquid to a vapor is utilized not only in the standard vapor-compression cycle but also as a means of producing very low temperatures. The container for the evaporating liquid should be insulated from sources of heat other than the liquid itself, and the vapor formed in the process should be removed as rapidly as it is formed.

The attainment of extremely low temperatures is usually accomplished by the evaporation of liquefied gases in insulated containers and generally at reduced pressures. By this means 90°K may be reached with liquid air, 54.3°K with liquid oxygen, 35.6°K with liquid hydrogen, and below 1°K with liquid helium.

The use of vapor-compression for the production of low temperatures is limited inherently by the solidification temperature of the refrigerant, the evaporation pressure corresponding to the desired temperature, and the difficulties encountered in the operation of any mechanical equipment at very low temperatures.

However, if vapor-compression systems are to be used for producing low temperatures, the most desirable method is the cascade system, in which a series of refrigerants with progressively lower boiling points is used in a series of single-stage units (Figure 2). The evaporator of the first system operating at the highest temperature is used to cool the condenser of the second system, the evaporator of this unit is used to cool the condenser of the third system, and so on. Thus, each refrigerant circuit is comparatively simple and is a system in itself; and each refrigerant can be chosen





that operates best within the required narrow temperature and pressure range.

Adiabatic Demagnetization

The lowest recorded temperatures have been obtained through the demagnetization of certain paramagnetic salts, which have been previously cooled by liquid helium and then subjected to a strong magnetic field. Some of the paramagnetic salts, such as gadolinium sulfate, have been found to be best suited for obtaining low temperatures by their adiabatic demagnetization. The properties of these salts necessary to secure best results are:

- (1) the elementary magnets should not exert a direct influence on each other, i.e., the substance should not be ferromagnetic;
- (2) the elementary magnets should have moments as large as possible, subject to the previous instructions; and
- (3) the effect should be greatest at low temperatures since there the entropy associated with magnetization is an appreciable part of the total entropy, and the order is greatly increased.

The procedure of cooling magnetically is accomplished in four steps (Figure 3). First, a paramagnetic salt is cooled by surrounding it with liquid helium under reduced pressure. Second, a magnetic field is applied to the salt, still surrounded by the boiling helium, and the evolved heat is absorbed without change in temperature. Third, the helium gas is removed and the substance is thermally isolated at a temperature below 1°K and under the stress of a strong magnetic field. Fourth, adiabatic demagnetization further lowers the temperature when the magnetic field is reduced to zero. Temperatures as low as 0.004°K have been reached by this method.

During the adiabatic demagnetization the entropy is constant and the pressure is constant (vacuum). Hence:

$$ds = \left(\frac{\partial S}{\partial H} \right)_{pT} (dH) + \left(\frac{\partial S}{\partial T} \right)_{pH} (dT) = 0$$

Then:

$$dT = - \frac{\left(\frac{\partial S}{\partial H} \right)_{pT} (dH)}{\left(\frac{\partial S}{\partial T} \right)_{pH}}$$

Since the process is reversible, $dS = \frac{dQ}{T}$. The quantity of heat dQ added to the substance is $dU + pdV + HVXdH$, where

U = internal energy

V = the mol volume

X = the susceptibility per cm^3 .

H = the intensity of magnetic field magnetization.

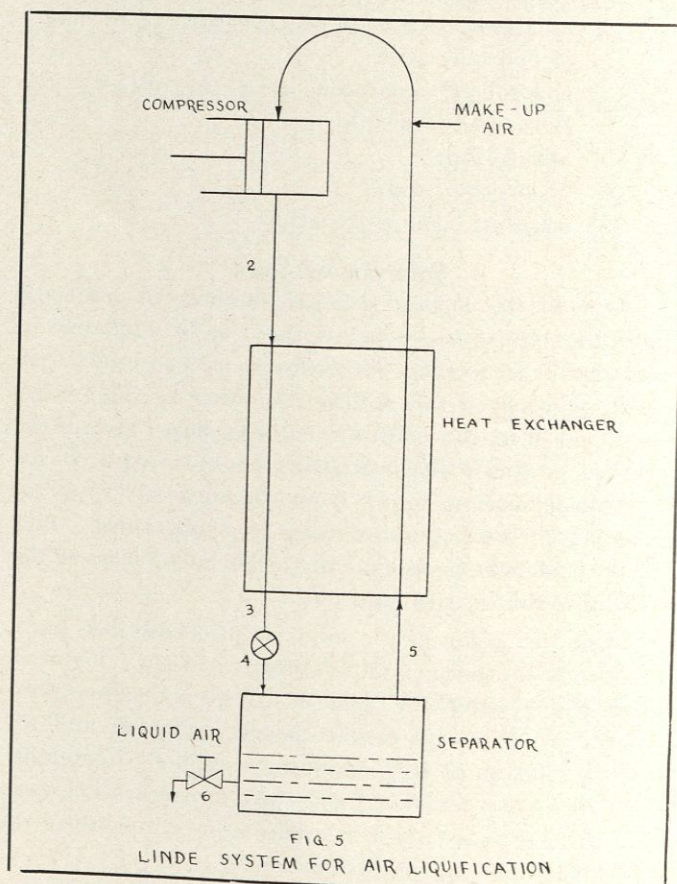
The solution then leads to:

$$dT = - \frac{TH \left[\frac{\partial (VX)}{\partial T} \right]_{pH} (dH)}{C_{pH}}$$

It can be seen from the above equation that to make dT large the magnetic flux density and the susceptibility of the salt must be large, and the specific heat of the salt must be small.

Substances which obey the Curie-Langevin law, at low temperatures, are best suited for the magneto-calori-

(Continued on page 48)



Patent Law Opportunities

by EDWIN M. THOMAS

Mr. Thomas, a native of Colorado, is interested in Colorado students. He attended the College of Engineering here at the University and is now living in Short Hills, New Jersey.

All of you young engineers who want to earn ten thousand dollars in your first year in industry, raise your right hands and say "aye." You who said "aye" may now turn to the next article, because this one was not written for you.

I am writing to those of you who will sacrifice big paychecks during the first few years of your professional lives for opportunity—opportunity in patent law.

Many people may be called patent attorneys. A second rate shyster who advertises his services in cheap magazines and an eminent trial lawyer may have in common the title of patent attorney. But there are perhaps only 2500 men in the United States who are *capable* patent attorneys. The man who is *capable* in this field probably has the following attributes:

1. A competent technical education—preferably he should have at least a bachelor's technical degree from a good university.
2. A general ability to handle the English language, both written and oral, with dexterity—without it he will be handicapped.
3. An appreciation for accuracy of terminology, the exact and proper use of words.
4. A fundamental understanding of basic industrial techniques.
5. A healthy curiosity for delving into new ideas.
6. A wholesome dissatisfaction with present standards in the physical arts and sciences.
7. An outlook broad enough to undertake the mastery of the law.

Many engineers will turn cold at the last item. However, the study of law supplements surprisingly well the education of a first-class engineer. Think twice before saying no. A patent attorney's work is presumably interesting and economically fruitful.

If you are still interested in the possibilities in this field take note of the following method used by many successful patent attorneys to secure their specialized training.

In an average year the United States Patent Office recruits from a dozen to several dozen Junior Patent Examiners, usually from the ranks of engineering college graduates. The starting salaries, about \$2900 per year, must support the high cost of living in Washington. Promotion is slow and working conditions are just fair. In addition, the Civil Service examination is difficult.

A lucky graduate with his diploma in his hand may make more money at the start and in more attractive surroundings.

Some of the recruits, perhaps most, will learn to like Washington, and some may elect to stay in the Patent Office. There they will likely be earning about \$6000 per year after ten years — \$10,000 is the absolute tops and \$7,000 will be as high as most will earn. Some may transfer to other branches of the government.

However, perhaps two-thirds will remain with the Patent Office for only three or four years. During that time they will attend one of the excellent law schools in Washington, possibly two hours a night, five nights a week. The tuition is about \$220 a year. Upon graduation from law school, these forward-looking young men will enter either the employment of an industrial organization or the law office of a patent attorney.

The enterprising recruits will learn every phase, every detail, of procedure in the Patent Office during their stay. Engaging in research, they will become thoroughly familiar with the ingredients necessary for patents on inventions.

First, there is needed a clear comprehensive description of each invention, in terms so clear that none need misunderstand. Since patents preserve the useful arts for posterity, clarity of the description is of great importance.

Second, a concise definition of the "claims" for the invention must be given that clearly and unmistakably distinguish the invention from all others. Just as the deed to a Colorado ranch must describe the property so that it corresponds with the survey, so the patent "claims" must show specifically what the inventor has contributed to the total sum of useful human knowledge.

Last, all the formal legal requirements must be met. To supply this ingredient a knowledge of the law is necessary.

The ambitious men, having so equipped themselves with the knowledge of the techniques of patenting, will resign from the Patent Office and begin to represent industry, large and small, in the field of patents. Their job will be to secure for their employers the proper and desirable protection of patentable ideas. Industry, thus given temporary monopoly of the developments of their employees, will have a better chance to thrive and grow. These new patent attorneys will share in the satisfaction and profits that result.

In short, an interesting and useful career in the field of patent law is open to all those who can meet the rigorous requirements of education, training, and natural capability.

EDITORIALY

A FIVE YEAR PLAN

The adequacy of an engineer's education has been a subject of controversy for more than thirty years. Since the first recognition of the shortcomings of a too-highly specialized curriculum, educators have been trying to broaden the field of training without sacrificing technical subjects. Particularly in the last five years the "humanities" have been injected more prominently into many curricula. While the suggested methods of presentation have been controversial, the desirability of such courses seems rather universally agreed upon.

Engineering training is now, perhaps, as well balanced as that offered in most other professions, but it seems that considerably more than the minimum number of humanities courses should be available to those who want a broader education.

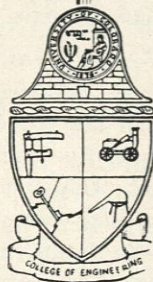
Facilities are available, of course, for a man to study on his own, and in some discussions of the question the point has been made that the student seriously wanting a more general background should and will dig it out for himself. He is limited, however, in his ability to dig things out by himself, without the benefit of instruction or class discussion. Time seems to be the greatest obstacle, whether it is class time or individual spare time.

The big question then is "When?" Although four years of humanities are required in some engineering colleges and technical institutes, sufficient room is hard to find in a four year schedule. But what about an optional five year plan? For those who want a more general education than the average engineer gets, a five year curriculum seems like a possible solution.

The Massachusetts Institute of Technology recognizes this desire for broader learning by offering a program under which a prospective engineer can take his first three years of training at one of various liberal arts schools. Then after two years at M.I.T. he has two degrees and a college education. It seems unreasonable that a broad education for the potential engineer should be unavailable at a university. If technical standards can be maintained under such an arrangement between separate institutions, it does not seem unreasonable to suppose that similar arrangements might be made between colleges of engineering and other schools on the same campus.

At a university, a combined course distributed over the five years might be preferable—and thoroughly feasible. Such a curriculum might follow, in other fields, the general pattern of the present combined courses in business and engineering offered here at the University of Colorado. It could provide not only a good basic engineering education but also a good general background for the engineer who wants more than engineering.

Educational adequacy is determined by one's profession. It is determined by society. It is determined by oneself. A college education is adequate only when the educated person feels satisfied that he has been at least exposed to some of the studies he wants outside his field, as well as those he needs for his profession itself. — Donal Borland.



SPEAKING . . .

ENGINEER DAYS - 1950

We've heard rumors that sirens will blow, bands will play, and whistles will shriek to set off the celebration of the 1950 Engineer Days.

Starting at 11:00 on Friday, May 12 there will be an engineering convocation featuring the vice president of General Electric Company as the principal speaker. At this convocation, which will be similar to the University's honors convocation, awards will be given, including the Colorado Engineering Council award to the outstanding senior in the College of Engineering.

In the afternoon of the 12th, there will be a field day at which time the playoffs for the departmental softball championship will be determined. (It's our personal hope that someone can give those Civils a run for their money.)

Then in the evening of the 12th and on the morning of the 13th, the doors of the engineering building will be swung open, and a general open house for students, faculty, alumni, high school students, and every interested person, will be held. Now this open house won't be just a gab session over coffee and doughnuts. It'll be a show of displays and demonstrations of engineering topics which are interesting to the layman as well as the engineer.

Each society and department in the College of Engineering will construct the exhibits, and an award will be given to the winning demonstration as well as individual prizes to the persons assisting in its construction.

How do you engineering students fit into the scheme of things? It's simple. Just fill out one of the application blanks which are available in the *Colorado Engineer* office. Or if you prefer not to work on the general committee, contact your society's president and find out how you can help on the demonstrations.

Incidentally—all classes for engineers are excused from 11:00 on May 12 through Saturday morning.

THERE ARE LIMITS

The action taken on recent polls conducted by the *Silver and Gold* has induced considerable discussion on the worth of student government. From the outcome of these polls and the subsequent action taken by the Senate and the Board of Regents, the general opinion has arisen among students that their votes are entirely neglected by these officials.

But whether student votes are recognized or not is not the question, but rather—are their ballots justified? Certainly there is some value in any kind of student opinion poll, but also there is such a thing as placing too much confidence in a poll taken at an institution such as a university.

It was seen from the results of the recent poll taken on the preference of a quarter system or a semester system, that students favored the present quarter system. Soon after the ballots were counted, the officials of the University decided to change to a semester set-up. This action unjustifiably aroused many students, even to the point of disgust on the part of a few. Unjustified, for it is the University official's prerogative to make such changes as they feel are needed for long term operation. The average student is in college for a period so short that any dent he may make in the overall operation of the college is negligible.

It is granted that ideas and suggestions from all possible sources are indeed desirable, but how can a student justifiably feel that he should run the University? He is here primarily to take what the school has to offer in the way of education. If the system of teaching does not measure up to his expectations, he is privileged to leave. After all, when he buys a pair of overalls he doesn't tell Levi Strauss and Company how their product should be made. —gmc.



BOOK REVIEWS

Plain Concrete

Third edition, by Edward E. Bauer, McGraw-Hill, 1949, pp. 430, \$5.00.

This text will be useful to a beginning student in materials testing or design of concrete mixes. There is a fairly detailed study of the manufacture and testing of standard Portland cements, and very brief mention is given to various types of concrete. Various aggregates are mentioned — sand and gravel, crushed stone, slag, cinders, and Haydite. Methods of sampling, grading and testing are studied, both for the components of concrete and the concrete itself. The theories and practice of proportioning are analyzed and the importance of good mixing procedure and proper curing are stressed. A number of good curing procedures are advocated to meet different conditions.

Much of the most important material in this book can be secured in pamphlet form at little or no cost from various cement companies. However, *Plain Concrete* will be valuable to those who wish a more permanent book on the matter.

Electronics in Engineering

By W. Ryland Hill, McGraw-Hill, 1949, New York, pp. 269, \$3.50.

A student of electronics would find this book quite relaxing to read in comparison to most texts on this subject. It is written in a clear, analytical method allowing the reader to picture in his mind how complicated electronic gadgets work. There are many illustrations consisting of curves, circuit diagrams, and wave forms that help a student obtain this mental picture so necessary to complete understanding of this type of material.

In content the book is about one half radio engineering, the remainder consisting of radar, television, and electronic control circuits. Although volumes could and have been written about each of the above topics, this book presents a clear understanding of the basic ideas of each.

Applied Mechanics

Fifth Edition, by Alfred P. Poorman, McGraw-Hill, 1949, New York City, pp. 377, \$4.00.

This fifth edition of a book that has had some thirty years of successful use as an engineering text will continue to be popular because of its clear and concise treatment throughout. The content of the book is very much the same as that of any other textbook on mechanics, but it is much more stimulating in presentation than most others. Examples are clearly presented, and the additional problems are all accompanied by answers. In this edition there is a treatment of acceleration of bodies in plane curvilinear motion as given in the law of Coriolis.

Architectural Practice

By Clinton H. Cowgill and Ben John Small, Reinhold Publishing Corp., 1947, New York City, pp. 390, \$12.00.

This is a comprehensive book covering the professional, business, and legal aspects of architectural practice. It will be invaluable to both the student, who should read it thoroughly, and the experienced practitioner, who will need references. It explains in detail the daily activities of architectural offices from the moment the potential client enters the office until the construction contract is fulfilled. There are sections on preliminary design and securing of jobs, working drawings and specifications, administration and management, accounting and financing, contracts, bonding, liens, legal procedures, and certification of architects. Throughout the book there are numerous A.I.A. recommendations and reports. Both the traditional and the abbreviated methods of specification writing are explained in detail. Many important forms and documents are illustrated.

Students will find a comprehensive bibliography and many actual examination questions to aid in their preparation for state licensing examinations. There are a number of review questions at the end of each chapter, making the book adaptable for textbook use. It would make an ideal text for comprehensive courses in office practice. It will be well worth any other three books the young architect could buy.

Seismicity of the Earth

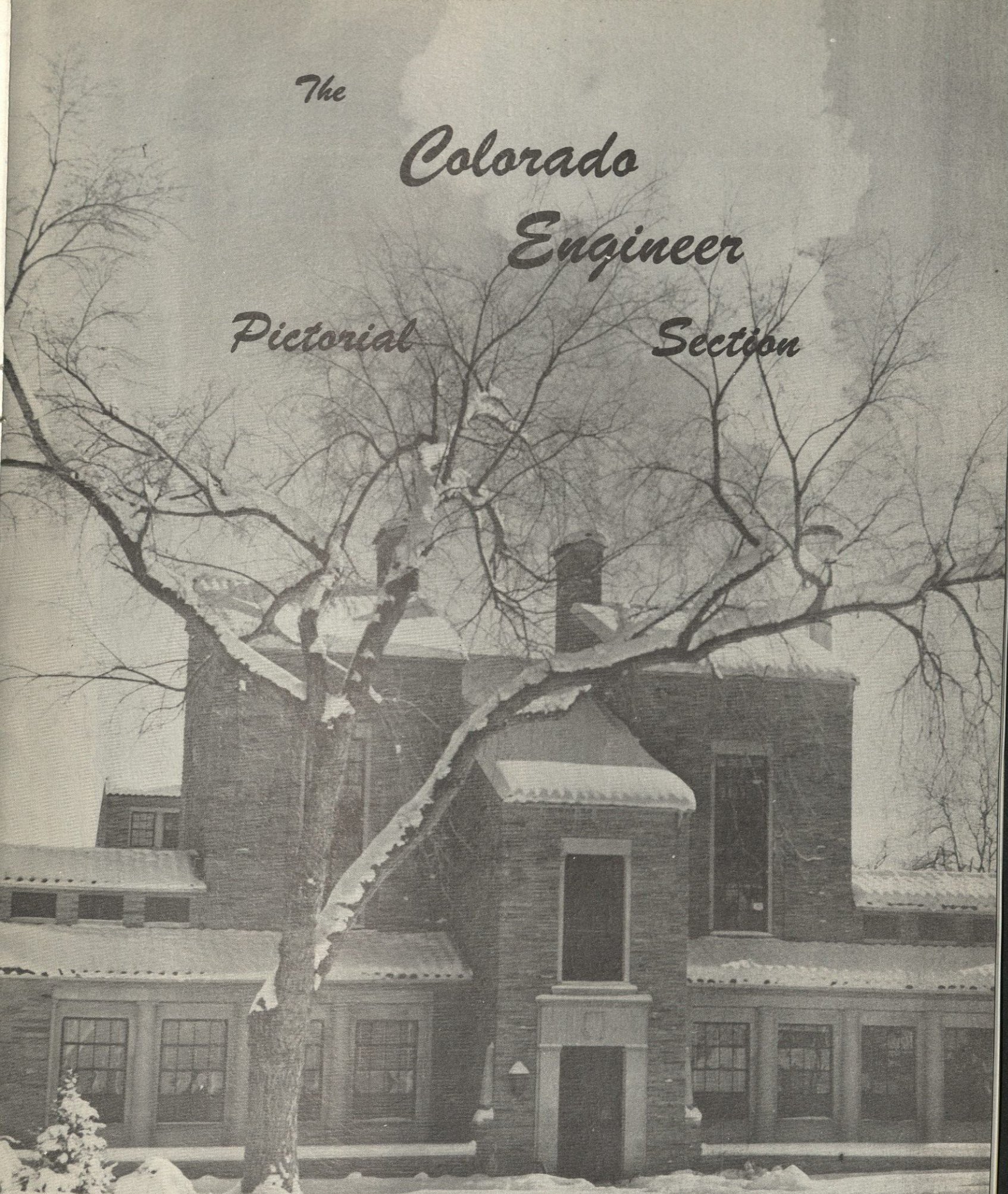
By G. Gutenberg and C. F. Richter, Princeton University Press, 1949, pp. 273, \$10.00. Reviewed by E. E. Wahlstrom.

In this book, the geographical and geological relations of the principal earthquake zones and areas are summarized and discussed by two well-known seismologists from the Seismological Laboratory of the California Institute of Technology. An effort is made by these men to correlate earthquake activity with mountain structures, ocean deeps, gravity anomalies, and active volcanoes.

The origin of earthquake is discussed, particularly with reference to the development of island areas in the Pacific. Use of a newly developed magnitude scale has yielded more reliable statistical data regarding the distribution of energy released in earthquakes than have been heretofore attainable. Plastic flow of rocks at great depths is accepted as a working theory, but the flow is regarded as too slow to prevent the rapid accumulation of stresses sufficient to cause earthquakes as deep as 450 miles below the earth's surface.

Extensive tables record the seismological data gathered in the past four decades from recording stations in various parts of the world.

The
Colorado
Engineer
Pictorial *Section*



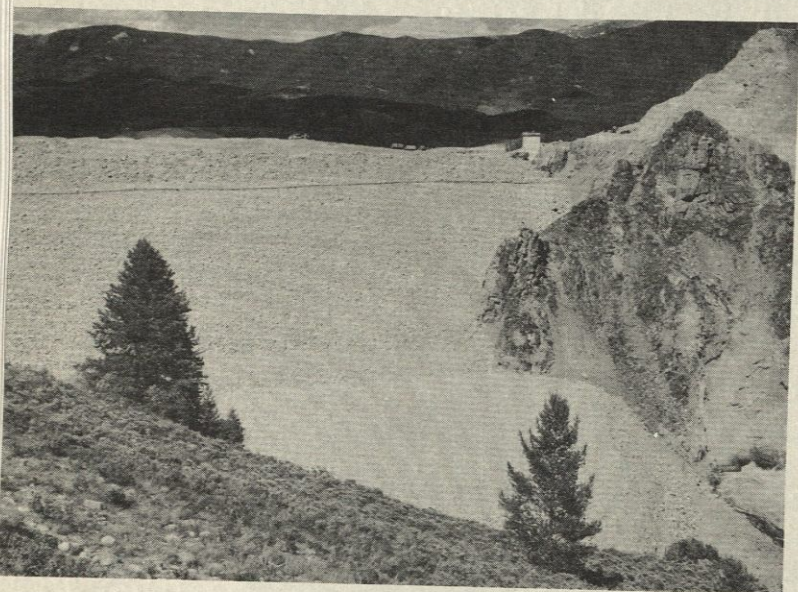
A PICTURE MAY INSTANTLY PRESENT WHAT A BOOK COULD
SET FORTH ONLY IN A HUNDRED PAGES. — TURGENEV



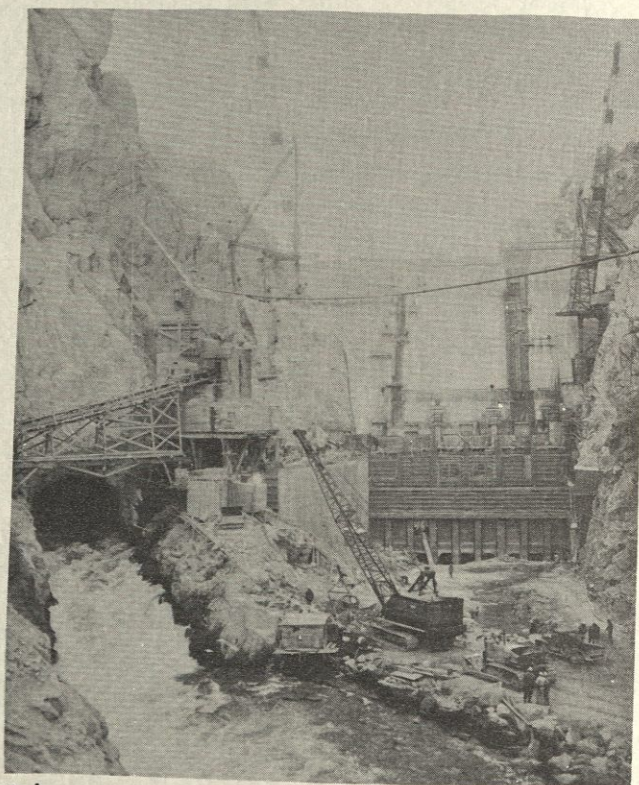
PATHFINDER DAM. Located on the North Platte river, this masonry arch-gravity type dam stands 214 feet high.

Rocky Water

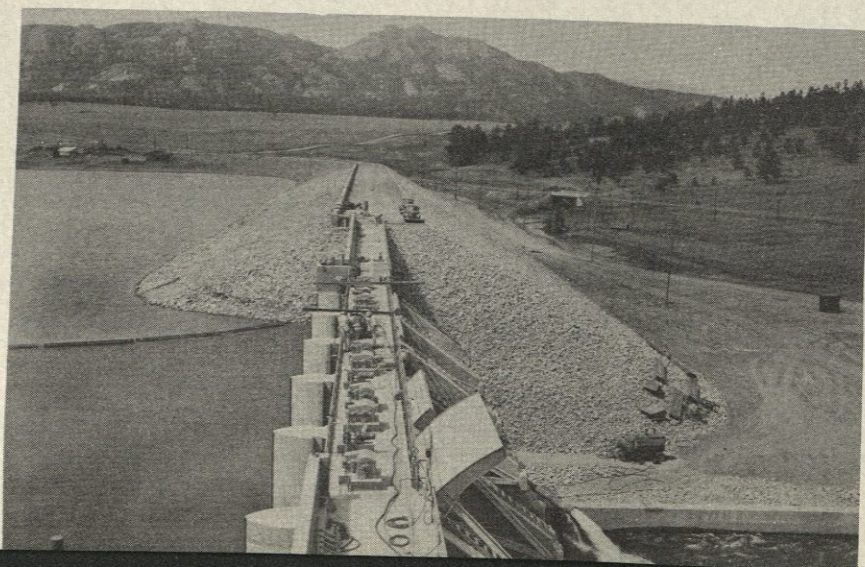
UNDER CONSTRUCTION (below). Wyoming's Kortes Dam in the Missouri basin will be used for generation of electric power when completed.



GRANBY DAM. Part of Colorado's Big Thompson Project, the earth dam has a maximum capacity of 546,000 acre-feet of storage.

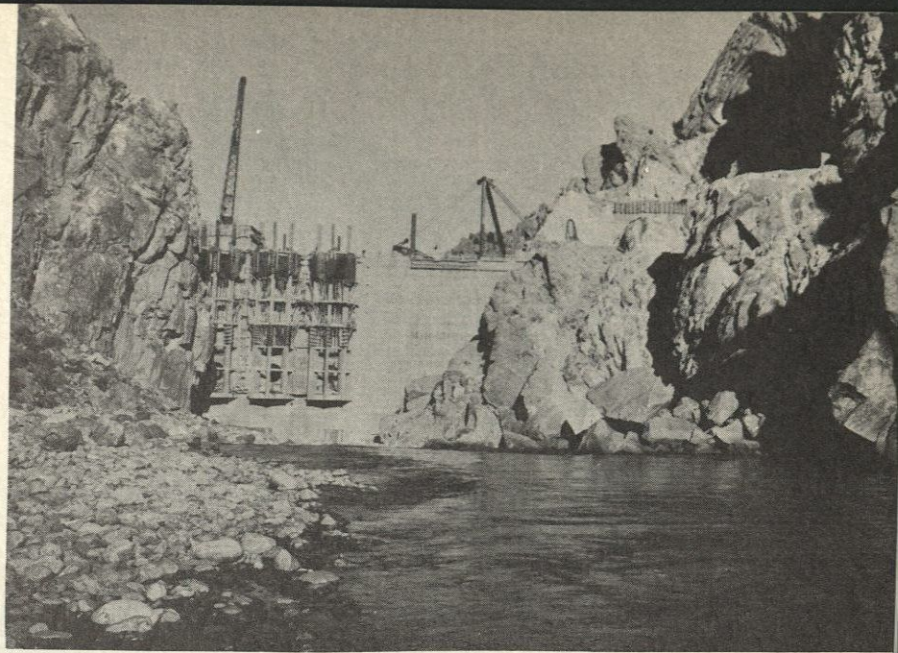


OLYMPUS DAM (below). This storage and diversion dam is located on the Big Thompson river. It is one of nine dams in the Big Thompson system.



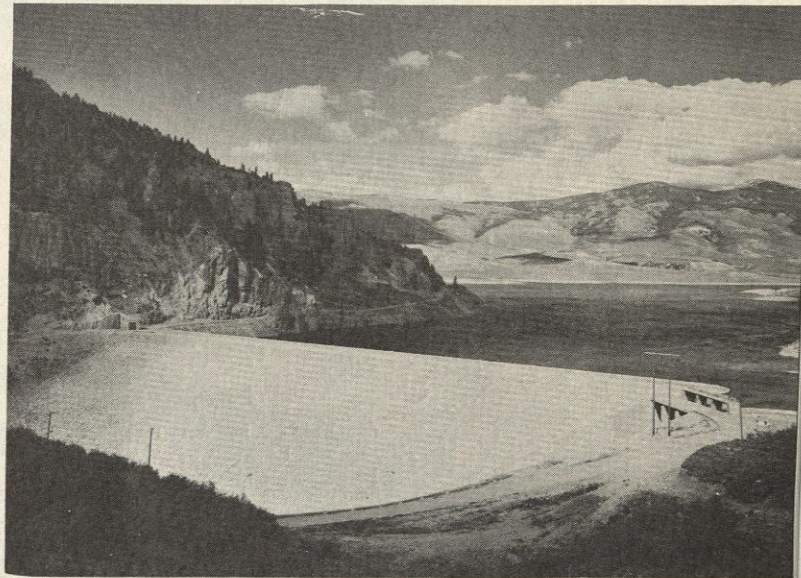
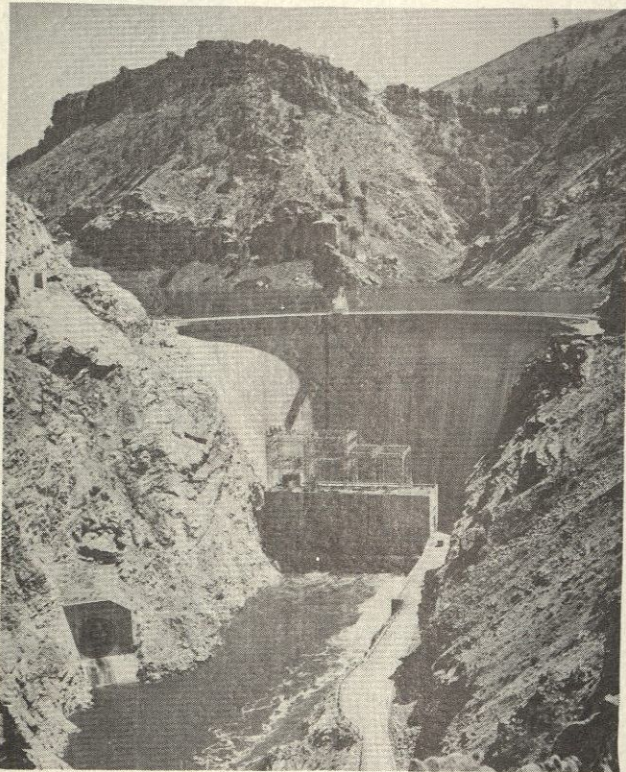
—Photos
U.S. Bureau

Mountain Power



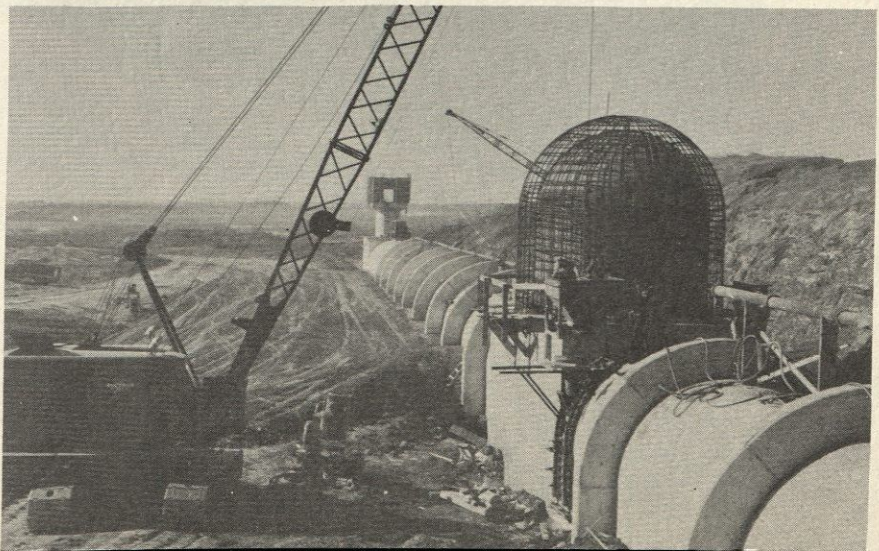
KORTES DAM. This concrete gravity power dam will be 240 feet high when completed.

SEMINOE DAM (below). Part of Wyoming's Kendrick Project, this large power dam utilizes water from the North Platte river.



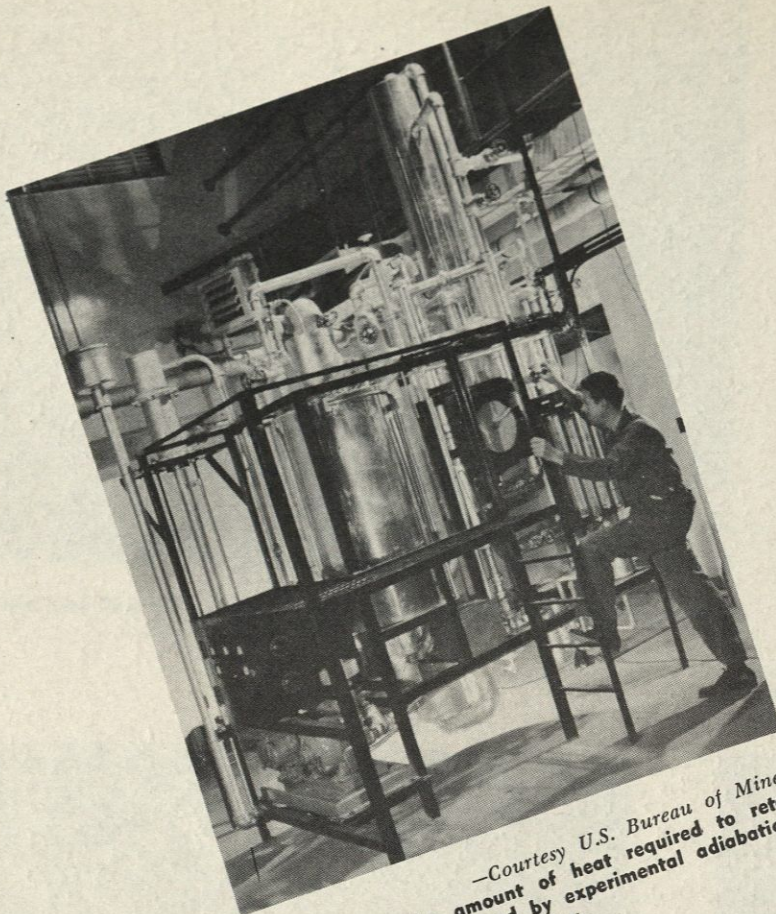
GREEN MOUNTAIN DAM. Located on the Blue river, it was the first Big Thompson dam completed (in 1943).

OUTLET WORKS (below). A gate chamber in the outlet of the incomplete Cedar Bluff dam is assembled.

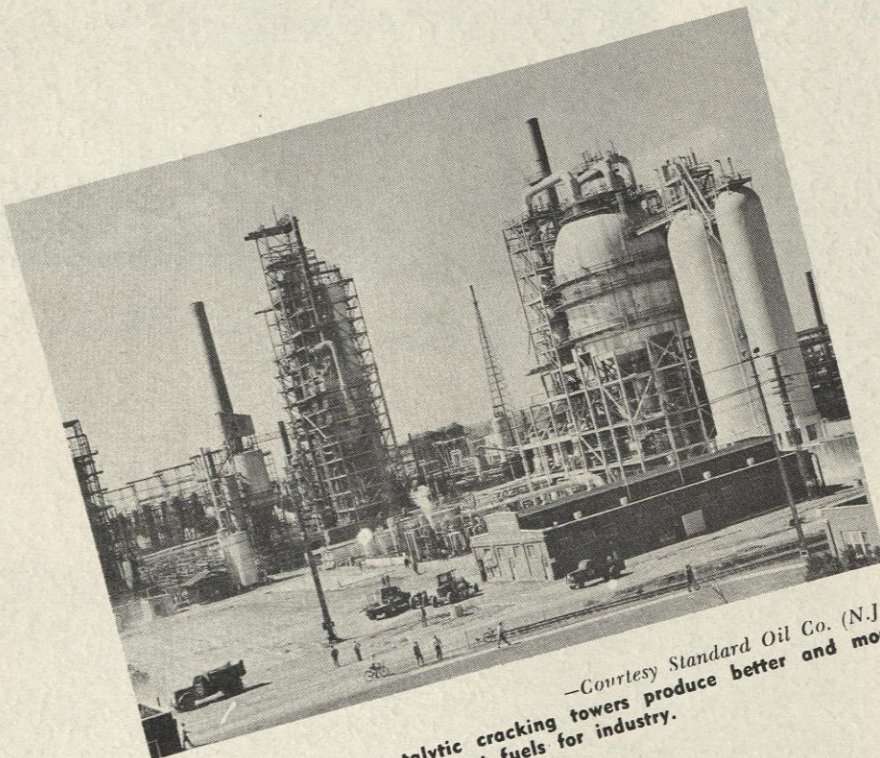


What's

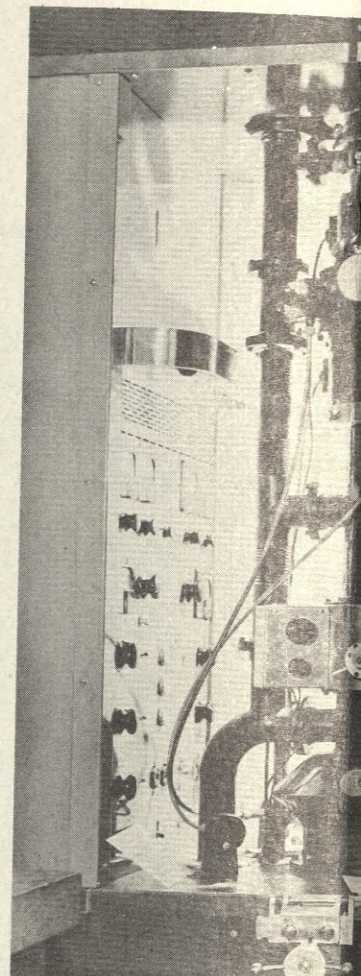
Science and



—Courtesy U.S. Bureau of Mines.
SHALE OIL. The amount of heat required to retort shale oil is determined by experimental adiabatic retorting.



—Courtesy Standard Oil Co. (N.J.)
PETROLEUM. New catalytic cracking towers produce better and more abundant fuels for industry.

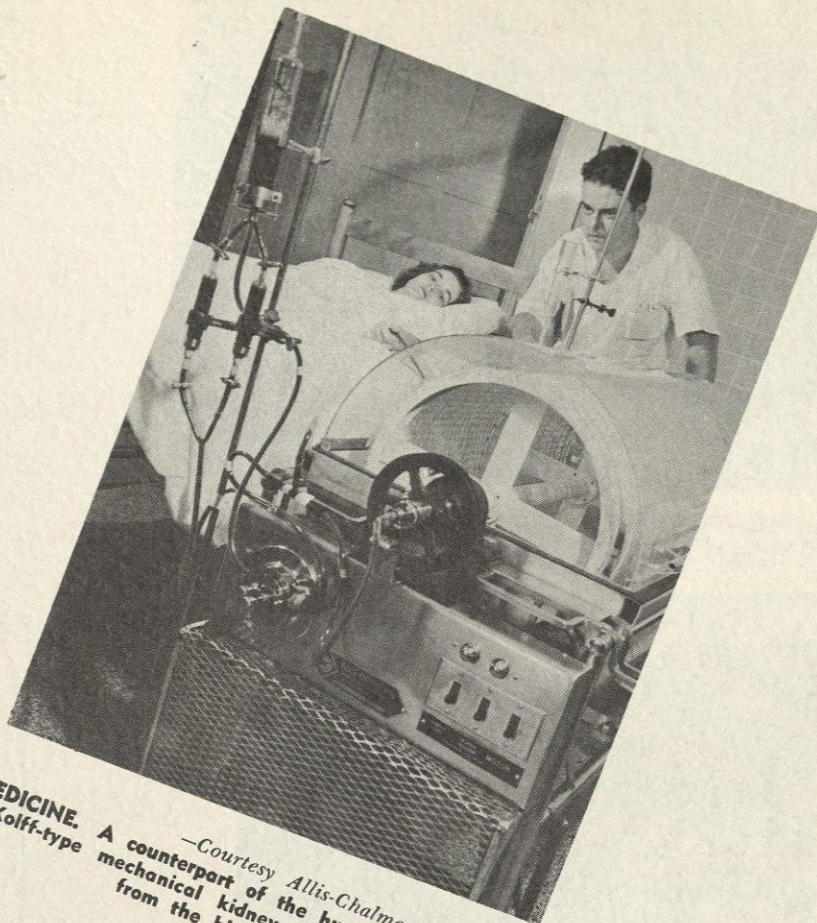


RESEARCH. The electron microscope, has opened new frontiers in science.

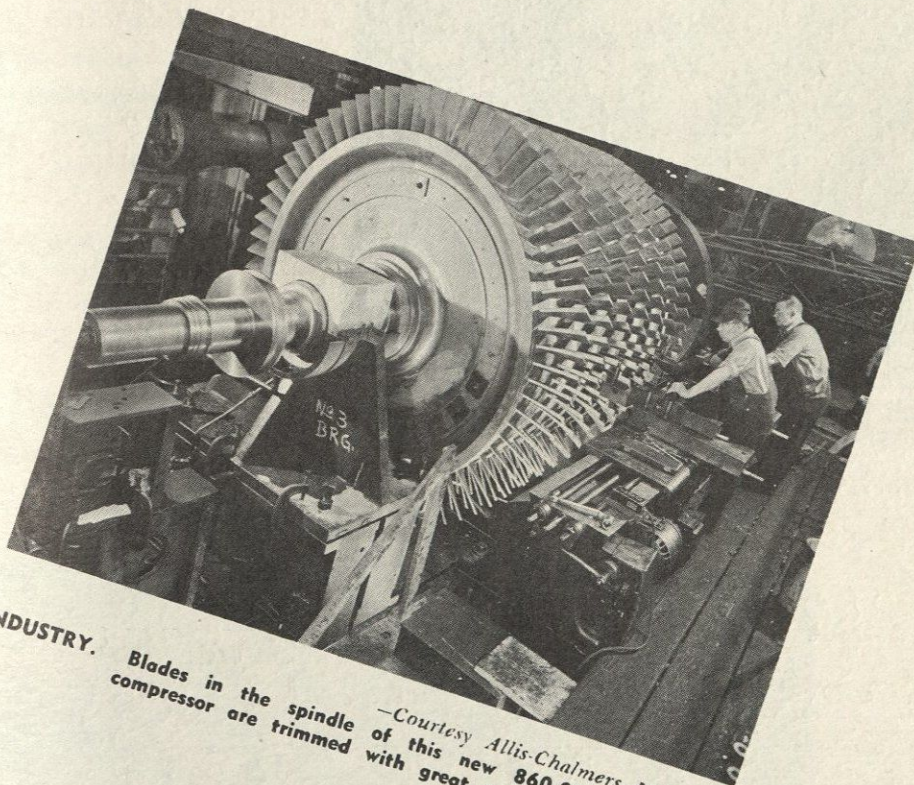
s New Engineering



—Courtesy Standard Oil Co. (N.J.)
Microscope, which magnifies 100,000
times fields in scientific research.



—Courtesy Allis-Chalmers Mfg. Co.
MEDICINE. A counterpart of the human kidney, this
Kolff-type mechanical kidney removes impurities
from the bloodstream.



—Courtesy Allis-Chalmers Mfg. Co.
INDUSTRY. Blades in the spindle of this new 860,000 cfm axial
compressor are trimmed with great accuracy.



Queen finalists, Mary Alice Cook, Esther Paper, Mary Marvin, Joan Smoot, and Charlene Klausner, demonstrated lively interest in engineering as the engineers voted.



Crowning the Queen, Mary Alice Cook, is Tom Hutchinson, president of the Combined Engineers.

The Eng

THE
COLLEGE OF ENGINEERING
PRESENTS

Parade of the Decades

THE
FIFTIETH ANNUAL
ENGINEERS' BALL

SATURDAY, FEBRUARY ELEVENTH
NINETEEN HUNDRED FIFTY

AT
THE MEN'S GYM

Dancing to Verne Byers orchestra gave the engineers a chance to forget the problems of slide rule and test tube.



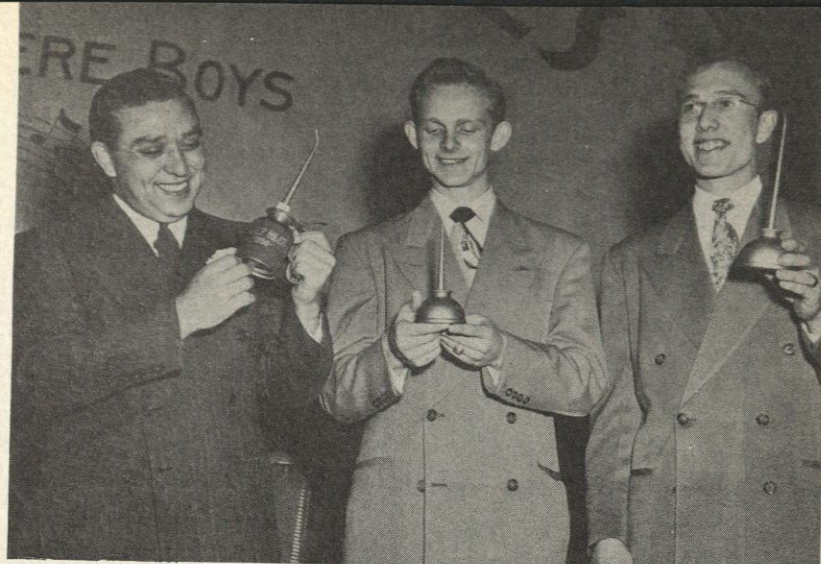
ine Ball

Oil Can Award of the Half Century

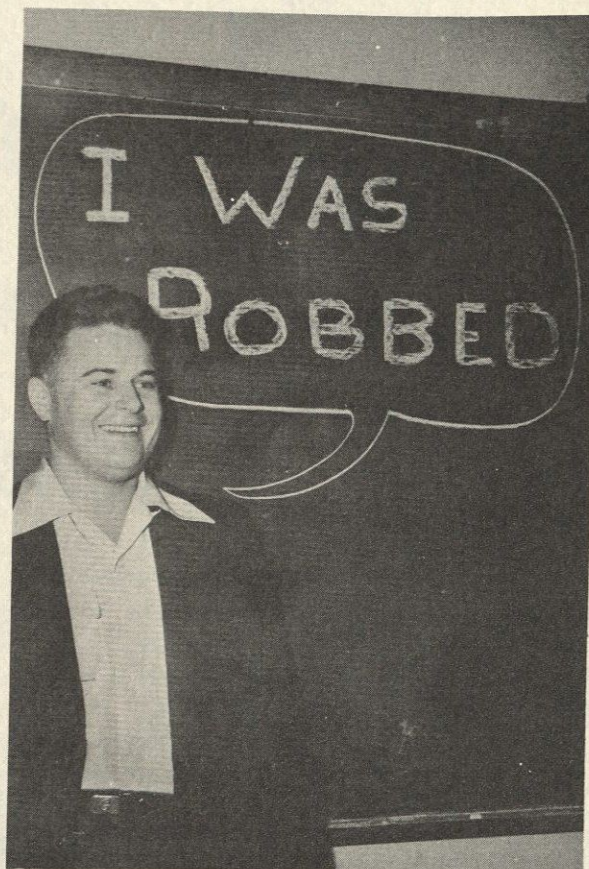
Awarded to the COLORADO ENGINEER'S Oil Can Editor who performed the 20th century's prize error in presenting the annual Oil Can Award.

Gus Hysom, Oil Can section editor, named F. A. Gates Chief Oiler, to the consternation of P. E. Gates, the real Chief Oiler. Hysom's reward is shown at bottom.

—Photos by Carl Goss and Floyd Walters



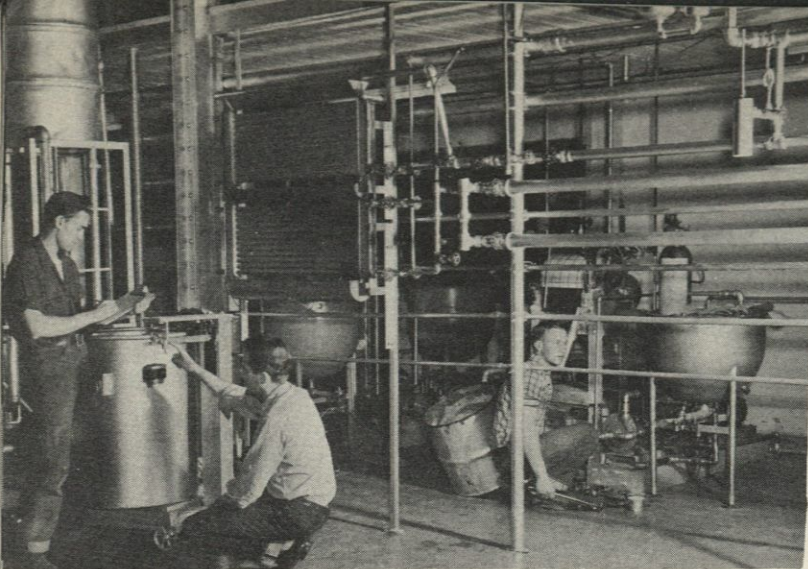
At intermission, three engineers were presented Oil Can Awards. Receiving the oil cans were F. A. Gates, Chief Oiler; Harold Lee, Keeper of the Oil; and Henery Pohl, Chief Spout Wiper.



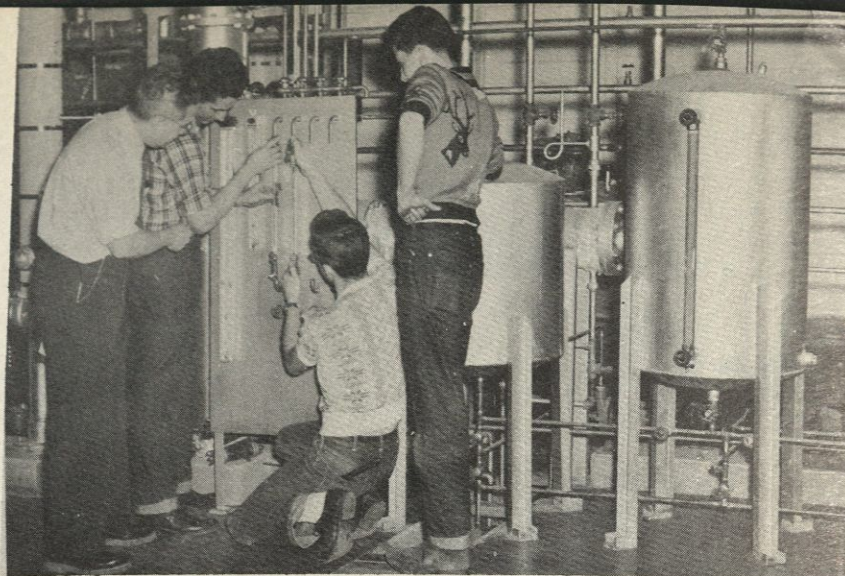
Angered at his omission, P. E. Gates, the real Chief Oiler, threatens revenge against the COLORADO ENGINEER.

Gus Hysom, Oil Can editor, receives a thorough lubricating job from the outraged Chief Oiler. Along with the grease, Hysom received the half-century Oil Can Award.

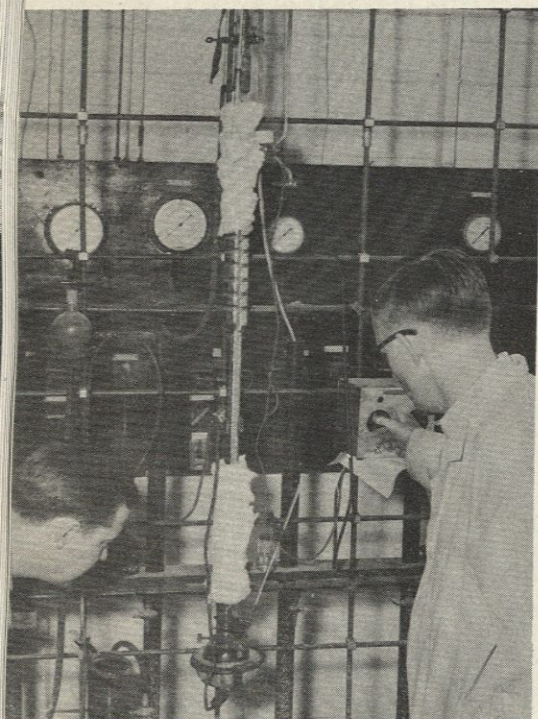




R. G. Milner takes data as C. C. Christenson takes a weight in a fluid flow experiment. In the background, O. W. Marks is working on apparatus for the levulose project.



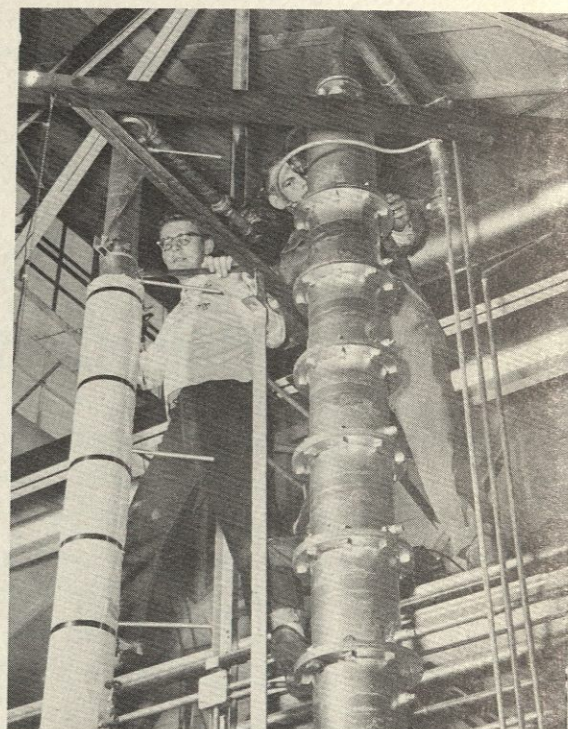
Mr. W. W. Wolf is showing the students, J. M. Cain, H. R. Macpherson, and J. S. Hallam how to connect the control board for the plate rectification tower, which is used to separate binary liquid mixtures.



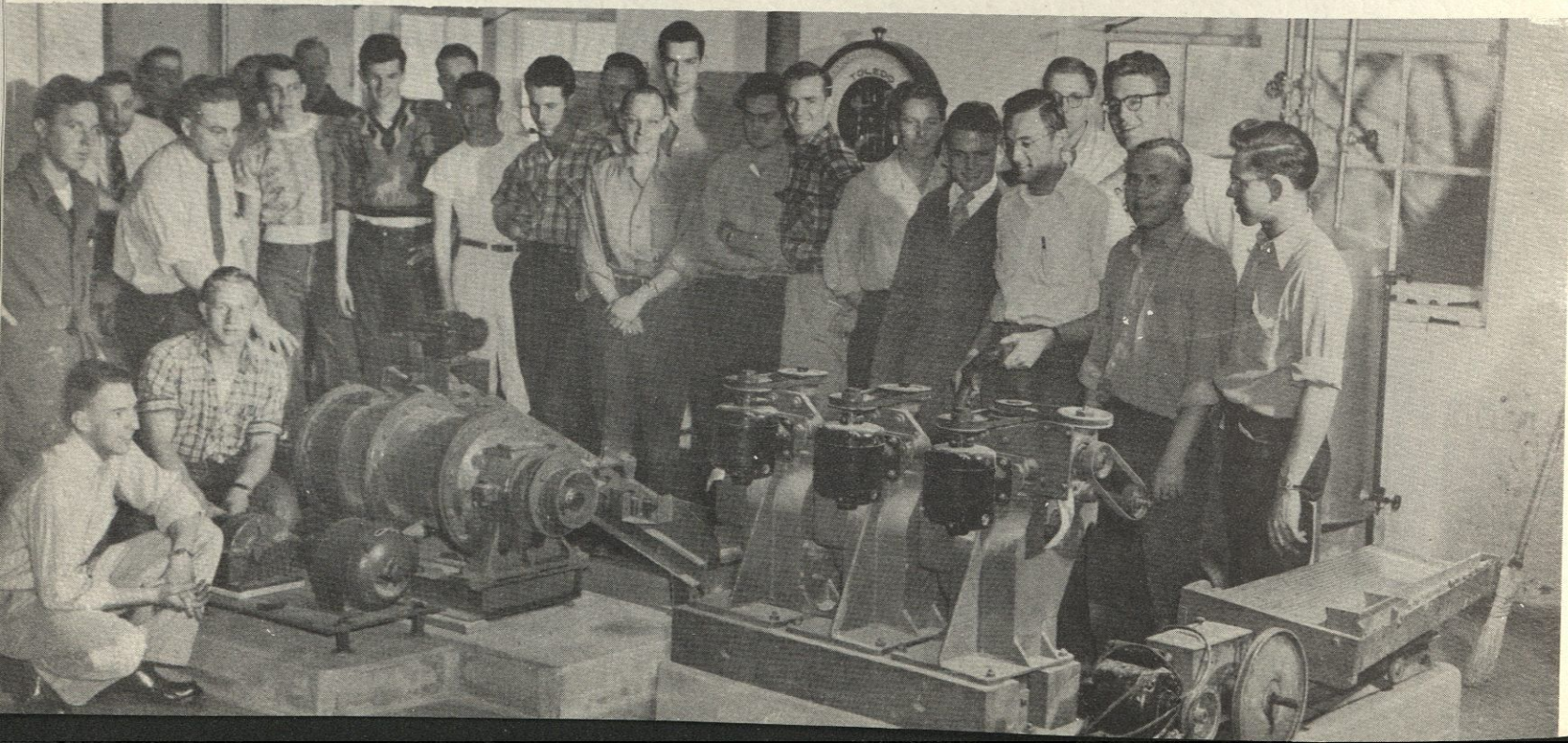
Graduate students, G. Panula (left) and R. Purcell, work in the oil shale research laboratory with the reflux column, which extracts constituents of oil shale.

Chemical Engineering Laboratory

Photos by Carl Goss



C. A. Herbst (left) is insulating the packed fractionating column, while J. E. Gwyn connects the plate rectification tower.



The Tuesday afternoon lab section students stand posed around the newly installed reduction and classification equipment.

The Engine Ear

The Bride Wore White

With no feeling of guilt whatsoever we steal the following from *The Emory Wheel*, which, in turn, stole it from *The Bulloch Herald*. William Worth McDougald, the guy being written up, is an Emory student and ex-editor of *The Wheel*.

"Among the lovely social events of last week was the marriage early Saturday evening of William Worth McDougald and Miss Charlotte Lorraine Ballanger in the Pleasant Grove Baptist Church near Summerville.

"The Groom, the oldest son of Mrs. Walter Edwin McDougald and the late Mr. McDougald, of Satesboro, was accompanied to the altar by John Horace McDougald, his half-brother. For his wedding outfit the groom was radiantly attired in a white tropical suit, cut on the double-breasted style, with matching rows of buttons down the front. The buttons were a lovely coral to match the suit. He wore a sky-blue four-in-hand tie, caught up tightly at the collar of his white shirt. His socks, a leftover pair from his days in the Navy, were clear white, and were worn with white buckskin shoes tied at the center, relics, likewise, of service to his country.

"For his flowers the groom chose a white carnation, fastened with a borrowed pin to complete the 'something old, something new, something borrowed and something blue' motif. He carried as a sentimental piece, an empty billfold in his left rear pocket. His jewelry was simple, consisting entirely of a battered antique wrist watch some 15 years old.

"His hair was cut short, styled by Waters Tonsorial Emporium (below the Bulloch County Bank). It was slicked down with hair grease combined with water in equal parts, and parted slightly to the left of center.

"The bride wore some sort of a white outfit."

Ode to My Slide Rule

This is my slide rule.

There are many like it, but this one is mine.

My slide rule is my friend,

And I shall learn to love it as a friend.

I will obey my slide rule.

When my stick tells me 5×5 is 24.8,

Then by God 5×5 is 24.8.

I will learn the anatomy of my slide rule.

Though it kills me, I will use faithfully every scale —

The black scale and the red, the inverted C, the

Inside out log, the reversed A and the

Mutilated D.

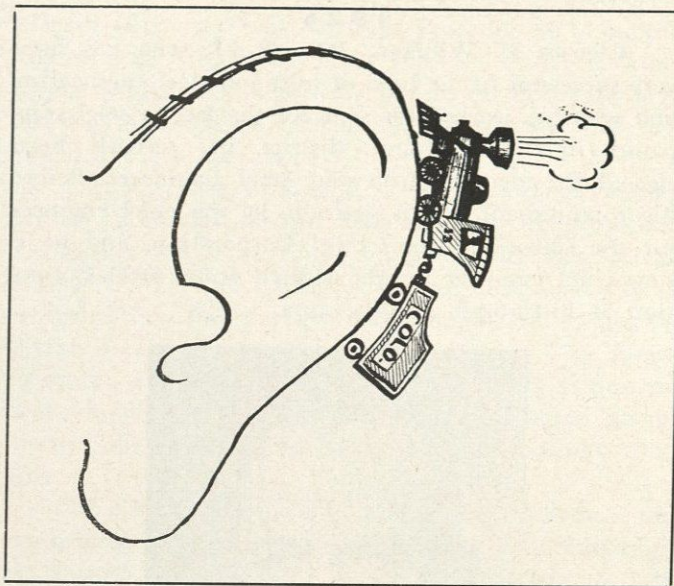
I will master them all, and they will serve me well.

They will!

I will cherish my slipstick and treat it kindly.

I will call it my baby and never shall

Profanity sear its long, graceful mohogany limbs.



My slide rule shall be my brother in suffering.

Through long hours of midnight toil

We will work together, my slide rule and I.

And on the great day when my slide rule

And I have finished our appointed tasks,

And the problems are done and the answers right,

I will take that darn stick and have one

Helluva fire.

I will!

Chemical Analysis of Kiss

Properties: Ethereal in nature. Taste, sweet; color, colorless to deep red. Is not affected by water, but reacts strongly to alcohol.

Occurrence: Cars, porches, parlors, and parks. In most cases the compound has only a transitory existence, but it may exist for a considerable period time.

Chemical Behavior: It quickly breaks up when exposed to a bright light, but it seems more stable by moonlight. It frequently plays the part of a catalyst producing bonds of a more permanent nature. The appearance of the *parent* compound produces a quick and violent displacement of the individual members of the compound.

Future Developments: Although it is not new, it is constantly being rediscovered. Very little is known about the nature of the compound, in spite of the fact that many heads are busily engaged on the problem until late every night.

A family was objecting to their high school son's selection of a girl friend. They said he ought to be more particular about the company he kept.

"I'm sorry, dad," the boy replied, "but she's the best gal I can get with the car we've got."

ALUMNI

1926

Charles H. Williams, B.S. (E.E.), who has been very successful in the field of iron and steel engineering and who has worked for some of the largest steel companies in the Pittsburgh district, has recently been elected President of Iron and Steel Engineers. Before his appointment to this position, he was chief engineer for the Carnegie-Illinois Steel Corporation, and he is now chief engineer for the United States Steel Corporation at Pittsburgh, Pennsylvania.



Charles H. Williams

1910

Roy P. Roberts, B.S. (C.E.), who has had varied engineering experience, became city manager of Montrose, Colorado, on January 1, 1950. During the past ten or twelve years, Mr. Roberts has been engaged in the furniture business in Montrose. Previous to that time, he was an engineer in China. Mrs. Roberts is the former Marie Seeley. In high school and at the University, Mr. Roberts was an outstanding football player.

1911

Fred B. Hartford, B.S. (C.E.), visited the campus on December 16. Hartford is an engineer with the American Mission for Aid to Turkey. His address is 243 Ataturk, Bulvari, at Ankara, Turkey. Mr. Hartford expects to return to Turkey in about a month. He visited the alumni office and elaborated in some detail on his experiences.

Colonel Harland C. Woods, B.S. (C.E.), has been paid tribute to by the members of the Buffalo, New York, section of the American Society of Civil Engineering. He has been civil engineer and authority on Niagara power and Great Lakes waterways and harbors. He recently retired as special assistant to the district engineer, U.S. Corps of Engineers, in Buffalo.

1912

Cecil Van Gundy, B.S. (C.E.), who was Engineer for the Defense Plant Corporation at Nashville, Tennessee, is now a structural and consulting engineer in Denver. His address is 1980 Hoyt Street, Lakewood, Colorado.

1920

Philip G. Apel, B.S. (C.E.), is Engineer for the K-C Construction Supply Company, Inc., at 1800 West Colfax Ave., Denver. Apel visits the campus regularly and otherwise maintains a keen interest in the University. His son, Philip, Jr., expects to enter the College of Engineering in September, 1950.

1921

John S. Harry, B.S. (C.E.), who is a colonel in the Coast Artillery branch of the Regular Army, spent the Christmas holidays in Boulder. Harry has been stationed in New York, and is now on his way to Istanbul, Turkey, where he will head the American anti-aircraft mission.

Alfred C. Stiefel, B.S. (C.E.), was chairman of the publicity committee which arranged for the Fall meeting of the American Society of Civil Engineers, which was held in Washington early in November. Mr. Kenneth B. Keener, B.S. (C.E.), Chief Engineer, Dam Engineering Division, Bureau of Reclamation, Denver, gave a highly technical paper on the controversial subject of uplift in dam design at this same meeting.

1923

Charles LeRoy Coleman, B.S. (M.E.), visited the campus on January 16. "Roy" is a rancher at Saguache, Colorado. His son, Glenn Melvin Coleman, is present editor of the *Colorado Engineer* and a senior in the College of Engineering.

D. E. Jack, B.S. (M.E.), has resigned as the Vice-President in charge of Engineering and Sales for the Duriron Co., Inc., in New York City. He is going to California to establish his own company as manufacturers agent; however, he will retain his position on the Board of Directors of the Duriron Co., and will be their West Coast Technical Director.

Robert H. Owen, B.S. (E.E.), who is Chief Engineer at the KOA Broadcasting Station of the National Broadcasting Company, participated in the celebration of the anniversary of the 25th year of broadcasting at this station.

Jack N. Withers, B.S. (C.E.), is now residing at 9730 Florence Heights Boulevard, Omaha, Nebraska.

1927

Joseph L. Ottenheimer, B.S. (E.E.), who is a consulting engineer in private practice at 373 State Street, Albany, New York, visited in Colorado and on the campus December 20. His nephew Leon Feinberg, plans to enter the College of Engineering as a freshman in

NEWS

September, 1950. Mr. Ottenheimer has made a very distinguished record as a consulting engineer in New York, and should be considered to be among our more successful graduates.

1928

Chris H. Bartlett, B.S. (E.E.), was in Boulder over a week-end in December. Bartlett is now Sales Manager of the Sharon Division of the Westinghouse Electric Company at Sharon, Pennsylvania.

Vernon J. Duke, B.S. (E.E.), who lives at 32 Fountain Ave., Rockville Center, New York, recently visited his daughter, Eleanor Jeanne Duke, a junior in Arts and Sciences. He is presently employed as Staff Engineer with the National Broadcasting Company and is in charge of television development.

Frank C. Tyrrell, B.S. (C.E.), has a permanent rank of Commander in the U.S. Navy. Until last summer his assignment was with the Bureau of Yards and Docks in Washington, D. C. Tyrrell was slated to accompany an expedition to the Antarctic with Admiral Byrd, but the expedition was cancelled. Tyrrell then organized a Mobile Battalion of CBS at Norfolk and stopped in Boulder enroute to his new station at Hueneme, California, where he is to be in command of the U.S. Naval Research and Evaluation Laboratory. Mrs. Tyrrell is the former Helen Davis, B.A., 1930.

1930

Hary J. Deines, B.S. (M.E.), has been named manager of advertising and sales promotion for the Westinghouse Electric Corporation. In his present position, he will be living in Pittsburgh.

Carson Riddle, B.S. (C.E.), who visited the campus in December, was recently awarded the meritorious Civilian Service Award because of demonstration of his "ability to handle very involved negotiations aggregating several million dollars in value." The award was made in connection with his work as Contract Superintendent with the Puget Sound Naval Base, Bremerton, Washington.

1933

Frederick C. Knoth, B.S. (C.E.), who is head of the Department of Special Effects at Universal Pictures Company, Inc., Universal City, California, spent the Christmas holidays in Boulder and in Colorado. Mr. Knoth visited the College of Engineering on Wednesday, December 21. He was accompanied by Mrs. Knoth and their daughter, Lecia. Mr. Knoth furnished the information for an article on trick movie effects which appeared in the alumni magazine some time ago.

1935

Frank C. Ciochetto, B.S. (C.E.), is now residing at 2722 Wyoming, Omaha, Nebraska.

1939

Dr. Joseph E. Stepanek, B.S. (Ch.E.), Ph.D. at

Yale in 1942, who was Assistant Professor of Chemical Engineering (1945-1947), has recently returned from China to his home at 4540 W. Moncrieff Pl. in Denver. He was an UNRRA official in China before he was forced to leave the country.

J. E. Warnock, M.S. (C.E.), passed away on December 26. Although he had been seriously ill, his death was unexpected at the time. Only 46 at the time of his death, Mr. Warnock had international fame in the field of hydraulics and devised many important hydraulic devices used in Hoover Dam and other major U.S. dams. In recent years, he was connected with the U.S. Bureau of Reclamation in Denver and has contributed much towards the development of the Rocky Mountain Empire.

Carroll W. Griffin, B.S. (C.E.), who has been an engineer in the office of the U.S. Bureau of Reclamation at Antioch, California, has been transferred to the Bureau's office at Fresno, California. Mrs. Griffin is the former Patricia Eckel, B.S. (Home Economics), 1944. The Griffin address is 1126 Shields, Fresno, California.

1940

Ivan E. Houk, Jr., B.S. (C.E.), is Chief Concrete Inspector at the Anderson Dam, in Idaho, for the U.S. Bureau of Reclamation.

1943

William C. White, B.S. (C.E.), spent the Christmas holidays in Boulder. White is an engineer with the U.S. Bureau of Reclamation at Santa Barbara, California.

1944

Charles A. Hutchinson, Jr., B.S. (Ch.E.); B.S. (E.E.) 1948; M.S. (Ch.E.) 1948, his wife and son, visited the campus and his parents during the Christmas holidays. Hutchinson is an engineer with the Atlantic Refining Company at Dallas, Texas.

1945

James I. Morris, B.S. (M.E.), is now Acting Division Production Engineer for the Pure Oil Company at Worland, Wyoming. His postoffice address is P.O. Box 700, Worland, Wyoming.

1946

John L. Wletcher, B.S. (Aero. E.), is an aerodynamitist with the Douglas Aircraft Corporation at Santa Monica. He and Lyle Beattie are both working in the same group at Douglas.

1947

Lyle W. Beattie, B.S. (M.E.); M.S. (M.E.), who is currently employed as an engineer with the Douglas Aircraft Company, Santa Monica, California, his wife, the former Patsy McCauley, and their two daughters, visited Boulder during the Christmas holidays.

PLAN TO
ATTEND

"ENGINEERS' DAYS"

* * * *

MAY 12 and 13

Engineering Convocation

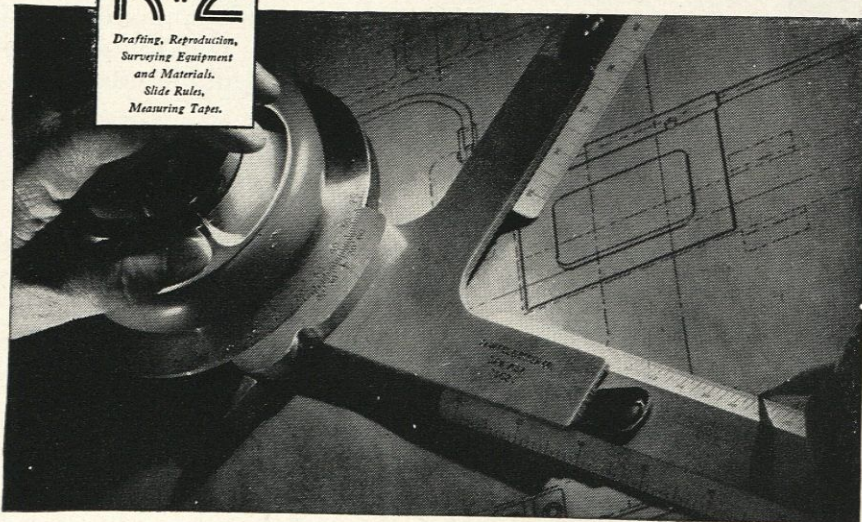
Engineering Field Day Events

Engineers' Open House



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K & E drafting instruments, equipment and materials have been partners of leading engineers for 81 years in shaping the modern world. So extensively are these products used by successful men, it is self-evident that K & E has played a part in the completion of nearly every American engineering project of any magnitude.



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Denver, Colorado



New and shorter big screen 16-inch kinescope developed by RCA scientists.

*Problem: shrink the television tube, but keep the picture **big!***

Some rooms accommodate grand pianos; a small spinet is right for others. Until *recently*, much the same rule held true for television receivers. Your choice of screen sizes was largely governed by room space.

Now the space problem has been whipped by RCA scientists, who have *shortened the length of 16-inch television "picture tubes" more than 20%! All the complex inner works—such as the sensitive electron gun that "paints" pictures on the screen—have been redesigned to operate at shorter focus, wider angle. Even a new type of faceplate glass, Filterglass,*

has been developed for RCA's 16-inch picture tubes—on principles first investigated for television by RCA.

Filterglass, incorporating a light-absorbing material, improves picture quality by cutting down reflected room light . . . and by reducing reflections inside the glass faceplate of the kinescope tube itself. Result: richer, deeper black areas and greater contrast in the television picture!

* * *

See the newest advances in radio, television, and electronics in action at RCA Exhibition Hall, 36 West 49th St., New York. Admission is free. Radio Corporation of America, Radio City, N. Y.

Continue your education with pay—at RCA

Graduate Electrical Engineers: RCA Victor—one of the world's foremost manufacturers of radio and electronic products—offers you opportunity to gain valuable, well-rounded training and experience at a good salary with opportunities for advancement. Here are only five of the many projects which offer unusual promise:

- Development and design of radio receivers (including broadcast, short wave and FM circuits, television, and phonograph combinations).
- Advanced development and design of AM and FM broadcast transmitters, R-F induction heating, mobile communications equipment, relay systems.
- Design of component parts such as coils, loudspeakers, capacitors.
- Development and design of new recording and producing methods.
- Design of receiving, power, cathode ray, gas and photo tubes.

Write today to National Recruiting Division, RCA Victor, Camden, New Jersey. Also many opportunities for Mechanical and Chemical Engineers and Physicists.



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For hauling loads of 10 to 100 tons and more, intermountain contractors, Federal, State and County agencies and heavy hauling contractors almost invariably choose W-W lowbeds.

"Rocker beam," single axle or tandem axle types in semi- or full trailers with load capacities up to 50 tons are standard. Other trailers for special purpose use are built to specific requirements.

Inquiries concerning any hauling problem are invited.

The WINTER WEISS Co.

2201 Blake St.
Denver 2, Colorado

6130 No. 2nd St.
Albuquerque, N. M.

INSTRUMENTS

(Continued from page 17)

chart about 10 feet long. The drum moves the chart past the elements at a maximum speed of 6000 inches per second. To do this, the drum must rotate at a speed of 3000 revolutions per minute. At such a speed, wind resistance on the drum is so great that 5 horsepower must be used to overcome it. A number of other types of record magazines can be adapted to the recorder for the lower frequency ranges.

The cathode ray recording elements used on the oscillograph are each complete elements and are instantly removable from the recorder. This is an example of the unit construction developed for all Hathaway instruments. In this system of construction the various fundamental components are assembled as individual units which are electrically connected to the main wiring system by multi-terminal plugs. This construction makes it possible to assemble the instruments to meet any particular requirement.

The most widely used measuring instrument built by the company was designed for use in colleges and schools. It marked an important development in the field of measuring devices, for it combined the accuracy and durability of every expensive instruments with low cost and simplicity of design. It has perhaps the widest field of usefulness because it is priced in the range ideal to schools and smaller industries, and because it is adaptable to almost every possible requirement by change of galvanometer characteristics. It is used by

nearly every large corporation in industry as well as most universities.

One of Claude Hathaway's most recent inventions is the principle computer. This instrument solves a complicated equation involving electrical quantities nearly instantaneously. Involving electromagnetic torque hookups, the machine solves as many as 40 separate problems per minute.

At the present time, there are Hathaway oscillographs and controlling instruments for nearly every demand. Because of the fact that the company can build such devices to fulfill so many needs in industry and research at low cost, it has filled a large gap in industry and has become the leader in the new instrument field.

Two Marines were sitting in the Public Library, one deeply interested in a book he was holding, "What's that you're reading?" asked the other.

"It's called 'What Millions of Women Want,' " was the reply.

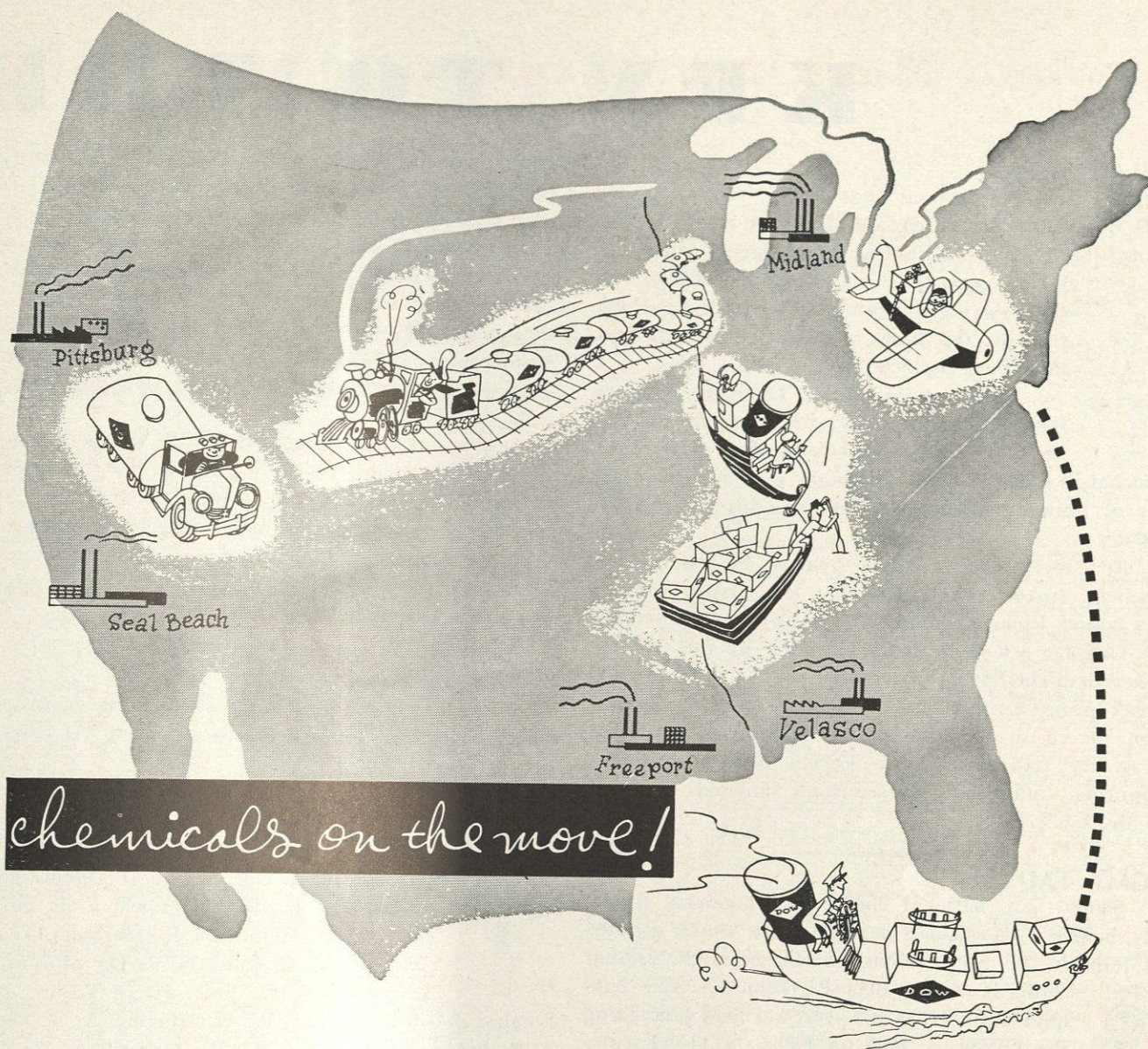
"Lemme see that," said the questioner reaching for the book. "Wanna see if they got my name spelled right."

"Darling, the maid has burned the eggs. Would you be satisfied with a couple of kisses for breakfast?"

"Sure, send her in."

Engineer's son: "Daddy, give me a nickel to buy an ice cream cone."

Engineer: "Shut up and drink your beer."

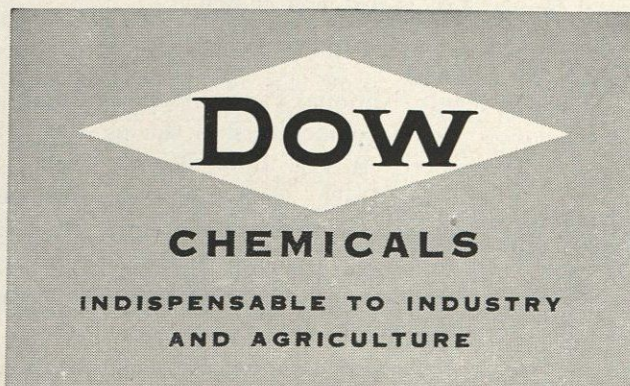


By plane, train, truck . . . by boat and barge . . . by nearly every type of transportation, Dow chemicals move across the nation. There are weed killers for the prairies, insecticides for the almond and fruit growers in California, epsom salt for the tanneries in Massachusetts, caustic soda for the paper mills of Washington and soil fumigants for the truck gardens of Florida. These are but a few of more than five hundred Dow chemicals serving American industry and agriculture.

A well-organized sales and distribution system is required to move so varied an output of chemicals into a multitude of major industries from coast to coast. At Dow, this complex distribution problem is solved by strategically locating plants, branch offices, and warehouses near the nation's production centers. In many instances, the much-needed material can be shipped overnight from Dow to processing plants in the vicinity.

This close relationship to industry results from Dow's progress throughout the years in production, sales and distribution of chemicals "indispensable to industry and agriculture".

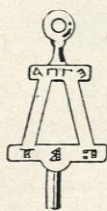
THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN
 New York • Boston • Philadelphia • Washington • Atlanta • Cleveland • Detroit
 Chicago • St. Louis • Houston • San Francisco • Los Angeles • Seattle
 Dow Chemical of Canada, Limited, Toronto, Canada



KEY TO THE

TAU BETA PI

Tau Beta Pi, national engineering fraternity, will hold initiation ceremonies and banquet early in the spring quarter for those members pledged during the Winter quarter. Selection of members is made during the candidate's junior or senior year on the basis of high scholarship and exemplary character.



The Annual Sigma Tau-Tau Beta Pi Banquet, traditionally held preceding the Engine Ball, was given on February 11 at Blanchard's Lodge. Undergraduate and faculty members of both organizations attended with their wives or dates.

At a meeting early in the quarter, Professor Allen Deschere, treasurer, reported that the chapter was in very sound financial condition. Also at this meeting the Chapter voted to hold elections in the Winter rather than the Spring quarter.

A bronze bent, official emblem of Tau Beta Pi, has been placed in the engineering honoraries' showcase across the hall from Dean Eckel's office; polishing, mounting, and elbow grease were donated by Paul Combs, Ch.E. '51.

SIGMA TAU

Sigma Tau, national engineering honorary fraternity, held its first business meeting of the winter quarter on January 18. Main discussion concerned the annual Sigma Tau-Tau Beta Pi banquet. The banquet this year, as last year, was held preceeding the Engineers' Ball on February 11. Faculty members of both groups were invited to attend.



Filling an obvious need in the College of Engineering, Sigma Tau authorized the purchase of an electric clock for the Engineering Administration building. It will be mounted on the wall of the central hall; the word "Coors" will not appear on the face as rumored.

At the February business meeting, plans for Engineers' Day were discussed and the candidate for the annual Sigma Tau award was chosen.

SIGMA PI SIGMA

Sigma Pi Sigma, National Physics Honorary, received twelve new men into membership during the Fall quarter. They were: Roscoe Bloss, Robert Doherty, George Duke, Harold Epstein, William Ericson, Norman Humphrey, Eugene Kartchner, Raymond McGavin, William Mimmack, Thomas Preece, Liburn Shaw, and Alan Talbert.



A steak banquet following the reception ceremony featured Dr. William A.

Rense, Associate Research Physicist at the University, who spoke on "Theory and Experiment in Physics." Dr. Rense cited many examples of the confusion of the two in elementary physics books, and contended that abstruse and often ephemeral theory should be left for the more advanced students. Shortly after the reception, new member Harold M. Epstein, University Chug-a-lug Champion, announced that he would carry the colors of Sigma Pi Sigma into future beer swigging engagements.

In a recent open meeting, Sigma Pi Sigma presented Mr. Richard Daum, research physicist in the Denver Bureau of Reclamation. Mr. Daum, an alumnus of the University, described the many intriguing problems which have engaged the attention of his department, and stressed the application of class room studies, which time and again made their solution possible.

PI TAU SIGMA

The fall initiation banquet was held at the Wagon Wheel Lodge in Boulder Canyon. Mr. F. H. Prouty was the guest speaker.



The following men were initiated: S. H. Achtenhagen, V. Arapkiles, T. E. Bailey, P. O. Barth, R. W. Bender, S. E. Burke, E. R. Carroll, W. A. Chronic, D. D. Davidson, C. E. Deering, Jr., R. J. Doubek, K. L. Gillespne, W. B. Hamilton, D. Harrison, E. W. Johnson, H. C. Johnson, R. D. Johnson, K. L. Jones, W. M. Jude, H. D. Lasley, J. J. Lorzing, Jr., J. I. Murphy, W. M. Murphy, A. G. Negro, L. N. Peterson, F. S. Pratt, H. R. Richards, A. R. Taylor, D. R. Vondy, J. C. Ward, and I. F. Zagar.

Mr. D. C. Jardine was initiated as an honorary member. Mr. Jardine is president and a contractor of the Jardine Engineering Company, which specializes in design and installation of heating and ventilating equipment, plumbing systems, and steam power plants. The Jardine Engineering Company is located in Colorado Springs, Colorado.

ALPHA CHI SIGMA

At the first meeting of Eta Chapter of Alpha Chi Sigma for winter quarter officers for 1950 were elected and installed. The men who have been selected to represent Alpha Chi Sigma are as follows: Master Alchemist, Robert Doremus; Vice-Master Alchemist, J. Bauer; Reporter, Bob Parker; Recorder, Wayne Snyder; Treasurer, Wayne Turner; Master of Ceremonies, John Miner; Alumni Secretary, Orin Marks; and Chapter Advisor, Professor H. B. Van Valkenburg.



The annual smoker was held in conjunction with

SOCIETIES

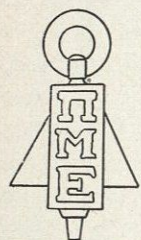
the Phi Lambda Society this year on Friday, January 27. Door prizes which included handbooks and laboratory kits were awarded and, of course, free cigars and cigarettes were available. The entertainment included songs by Syl Devereaux, and movies of the atomic bomb project and 1948-49 football highlights.

The initiation of Fall quarter pledges and the initiation banquet was held Friday, February 10.

Alpha Chi Sigma is a professional, not an honorary fraternity. All chemists and chemical engineers are eligible and are cordially invited to all open meetings of Eta Chapter.

PI MU EPSILON

Pi Mu Epsilon, national mathematics honorary fraternity, held an open meeting on January 17 to hear Mr. Robert E. Glover, Research Engineer and Mathematical Consultant, discuss the operation and uses of the Electric Integrating Machine. His lecture was illustrated with a number of very interesting slides.



At the meeting Lloyd Timblin, chapter president, announced the pledging of twenty-two students, some of whom presented talks on the subject of mathematical puzzles on February 8 and 23.

ETA KAPPA NU

Eta Kappa Nu is the national electrical engineering honorary fraternity. Its members are elected twice a year from those students who are in the upper fifth of the junior class or the upper third of the senior class. They are chosen for their outstanding character, scholarship, and ability.



At the last meeting, two projects were decided upon for chapter activities this quarter. The first was the decision to set up help sections for sophomores who are having difficulty with their electrical engineering courses. Members will officiate at the help sections. The other project decided upon is an examination of the present electrical engineering curriculum in the university in the light of comparison with those in other schools of comparable size and rank. This inspection will be accomplished with the help of Eta Kappa Nu chapters on other campuses.

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

The joint student branch of A.I.E.E.-I.R.E. has been approved and is now functioning as one organization for the benefit of all Electrical Engineering students. The two separate organizations, A.I.E.E. and I.R.E., were combined recently to form a joint student branch in compliance



with recommendations from the national offices of both groups.

Professor W. C. DuVall, regional vice-president of A.I.E.E., delivered his annual message to the branch on January 11. Speaking on "Instrumentation," Professor DuVall described the various types of electrical controls used in industrial devices and in home appliances.

On January 25, Mr. Tom Morrissey, chief engineer for station KFEL in Denver, spoke about "Smashing Electronic Barriers." Mr. Morrissey traced the development of the various frequencies used for radio broadcasting and explained the methods used in extending the frequency ranges available for our use.

The meeting held on February 8 featured Mr. Francis F. Stevens speaking on "Switchgear Equipment and Components." Steven's talk was illustrated with slides and traced the development of switchgear equipment and explained its present-day use and design.

The combined branches had a very interesting discussion March 9 when a group of engineers from radio station KOA, Denver, demonstrated the experimental broadcasting and receiving equipment which they have designed. They continued with a ten-minute broadcast of student talent and an explanation of the operation of their equipment.

SOCIETY OF AUTOMOTIVE ENGINEERS

The student club of the Society of Automotive Engineers now has a membership approaching one hundred. Application was made in January for a student branch charter, and according to word recently received by Professor Brown, favorable passage of the petition by the council meeting in April is almost a certainty. Providing the application goes through, the student branch at the University of Colorado will be the twenty-ninth such organization in the nation. Currently, the S.A.E. student club ranks ninth in national membership.



Club activities during the Winter quarter have been numerous, and interesting. Of special interest was a meeting of the Denver group held January 31 when they heard Mr. G. Burrell, Motor Engineer of Oldsmobile Division, General Motors Corporation, speak on "The Rocket Engine." A field trip through the network of the Pacific Intermountain Express was conducted February 21 under the auspices of the Denver group.

Tentative plans have been made to have Mr. R. M. Schaefer, Allison Division of G.M.C., give a talk before the student branch in May. Mr. Schaefer, who is now engaged in a new project for General Motors, plans to

(Continued on page 50)



External Gaging shown. Equipment also available for internal gaging.

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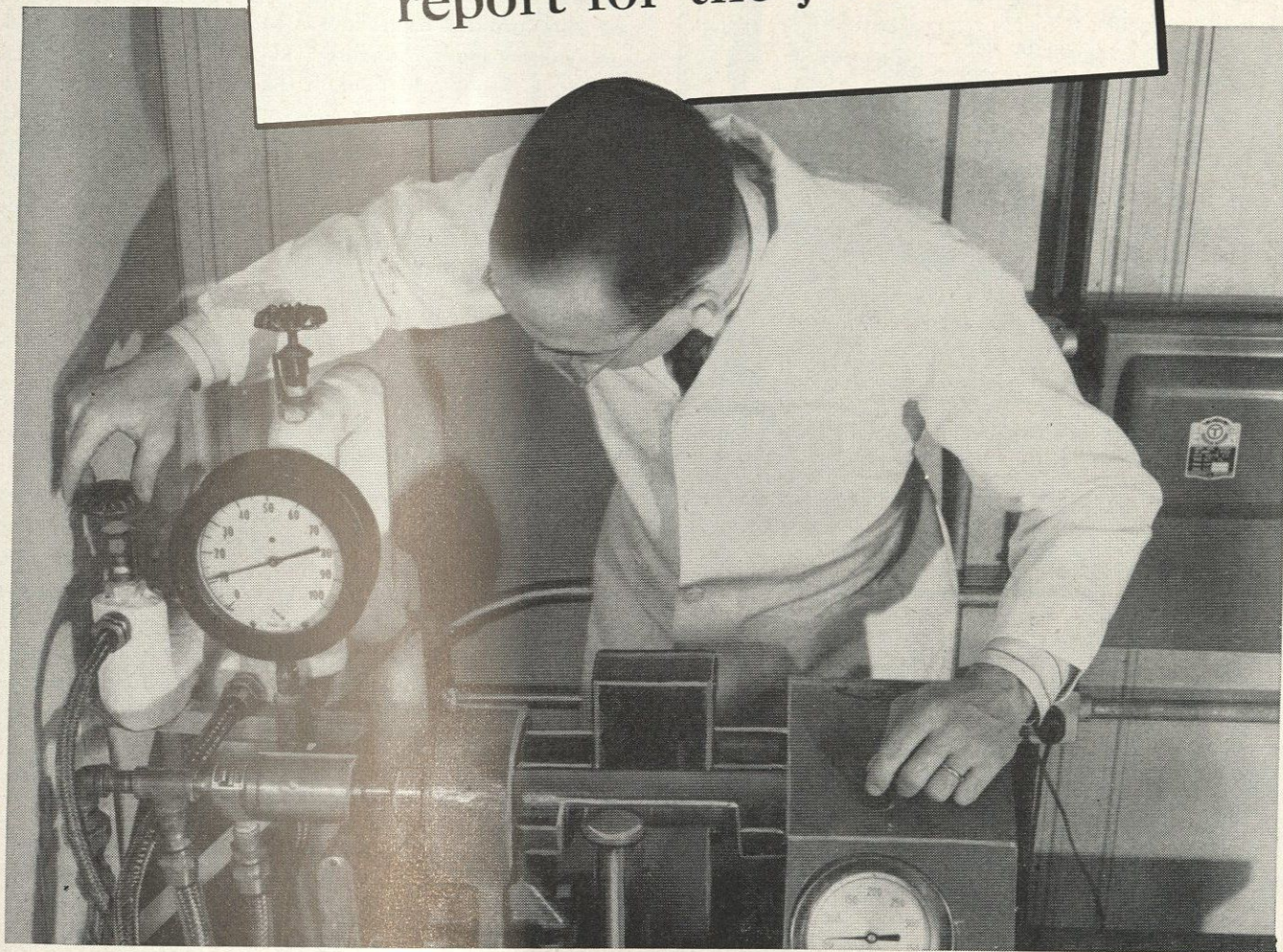
ASTRONOMY

(Continued from page 10)

ment the fuel is entirely consumed) are the deciding factors, and ideally, the tilt should equal 45° and the maximum velocity attained at Brennschluss for maximum range. These results can be obtained in two ways: one would be to have a fuel of tremendous exhaust velocity, but this is somewhat curtailed by natural chemical properties; the other would be to have a high fuel load, which raises the mass ratio to a very large figure. The velocity required at Brennschluss in order to resist the earth's gravitational pull must be 7 m.p.s. (miles per second). At an acceleration of 4 gravities (which is high to be humanly bearable), it will require 500 seconds to attain the 7 m.p.s. This will be sufficient to give a thrust reaching 9/10 of the distance to the moon after 300,000 seconds, and just carries the rocket over the neutral point of the gravities of earth and moon. When the rocket crosses over, regardless of its speed, it will fall toward the moon. Here again, there will be a fuel requirement, because due to the moon's gravity, rocket speed at landing would be 2 m.p.s. and a braking effect will be imperative. Now this will be a shock. For the 7 m.p.s. velocity which is required, the mass ratios for 2, 3, and 4 m.p.s. exhaust velocities would be respectively 33:1, 10.2:1, and 5.75:1. This last begins to sound plausible. There is one way to increase the mass ratio, and that is rockets within rockets. The nth root (n =number of rockets) of the desired mass ratio will give the mass ratio which must be developed for each rocket. With the parting thought that the initial possibility of this trip depends upon two factors — that the solar system is flat, and that planets move in the same direction—the rocket is ready to go.

It's almost time—"five"—"four"—"three"—"two"—"one"—"rocket away"! The noise is terrific and resembles the roar of a large waterfall. The rocket is quivering, is steadying herself, and laboriously beginning to climb, accelerating at an amazing rate. During these seconds of the take-off, the thrust developed is approximately equal to $\frac{1}{2}$ the rocket weight. Now the pumps are working, and force developed is twice the rocket weight, and remember, the rocket is losing weight at the rate of 265 pounds of fuel expended every second, with an escape rate of 70,000 feet per second. This rate, and the fact that the rocket is decreasing in weight, is sufficient to increase steadily both velocity and acceleration. Fifteen miles up! — and now the atmosphere is virtually non-existent, so the rocket is possessed of 15% more power. The fuel supply for this leg of the trip has been used! This is Brennschluss and the rocket is screaming onward at 7 m.p.s., losing 32 feet per second velocity during every second. Until the velocity has been eaten away at this rate, the rocket will continue forward. Its nose has been pointed to the spot where the moon will be in four days. To be really on the way, it takes eight minutes. This number comes from the fact that, calculated at a gravity of 4, it takes 8 minutes to attain an escape velocity. During the latter part of the

We have good news to
report for the journals



SOME JOURNALS are technical publications. Some journals are the parts of rotating shafts that turn in bearings.

For both kinds of journals, there's good news in Standard Oil's performance testing program. One result is a new testing device for mill and locomotive driving-journal grease that enables us to tell more accurately than ever before what our greases will do under actual conditions of use. That, in turn, enables us to proceed more directly with the job of making our greases still better.

Standard Oil took the lead in performance testing, and is a leader today. During the war

our tests furnished information that enabled the Army to procure certain products with greatly increased reliability of performance. Some of our tests have become a part of government specifications. Many users of our products are benefiting, both from better products and from more accurate information.

As time goes on, we are doing more and more performance testing. In some cases, we have to develop not only the tests but also the testing equipment. But to Standard Oil researchers and engineers, any effort is worth while if it will help make better, more useful petroleum products.

Standard Oil Company

(INDIANA)



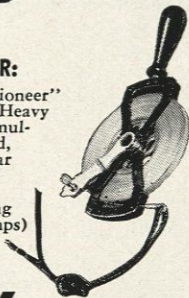


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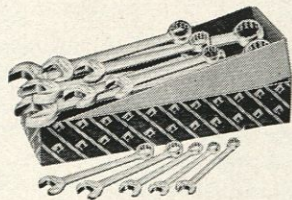
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8 minutes the pilot may have "blacked out," but the rocket is automatic. We are not capable of doing much due to the shock, because for 8 minutes the gravity has been four, but now is reduced, not to one, but to zero! We are weightless, and this condition will continue for the four days of the journey. This is amusing at first but it will become a nuisance, for everything is weightless which is not bolted down. The slightest tap, and the article will fly away not to mention that we also will sail off. For this reason, the rocket interior is padded and also contains loops for us to pull ourselves around since the ordinary "pushing" of walking is impossible. Too, it is rather odd to note that the food we brought weighs nothing, but still contains the same nutritional value. Aside from being struck by some flying object, we must be careful not to spill any liquids because the large drops would splatter into a floating vapor when they hit the floor. Many unusual situations will confront us during these four days.

We are landing now! It is very like the takeoff and the moment we hit the pilot will cut the rockets. There is gravity here on the moon, reduced of course, but enough to sustain somewhat normal movement, although we must take care to reserve our action in order not to vault around.

We're on the moon!! What about those craters? Why the great valley in the "Alps"? Is there life, and what kind? We'll find the answers quickly now, because *this is the moon*, and we are the first humans ever to have landed on its surface! ! !

The railway coach was crowded and a none-too-well dressed little boy had taken a seat alongside a very haughty and fashionable dressed woman. The boy was sniffing in a very annoying manner. Finally the woman turned to the boy and asked:

"Have you got a handkerchief?"

"Yes," replied the boy, "but I don't lend it to strangers."

The automobile motor began to pound, and finally stopped. The worried boy friend said to his companion: "I wonder what that knock could be?"

"Maybe," replied the blonde, "It's opportunity."



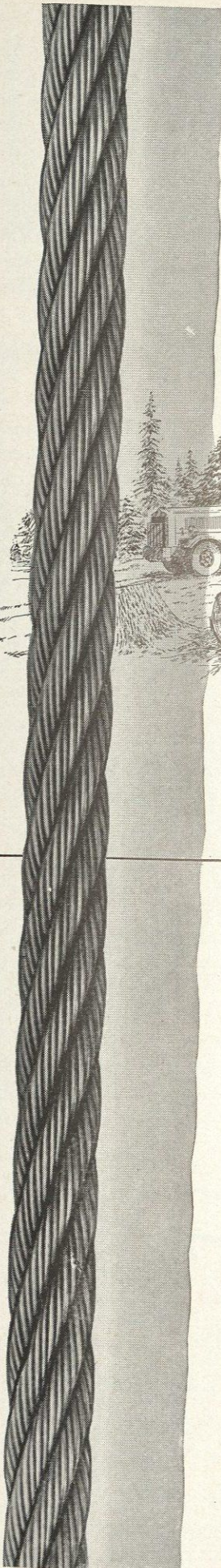
IF YOU DON'T WANT

Some other fellow taking your widow on moonlight rides

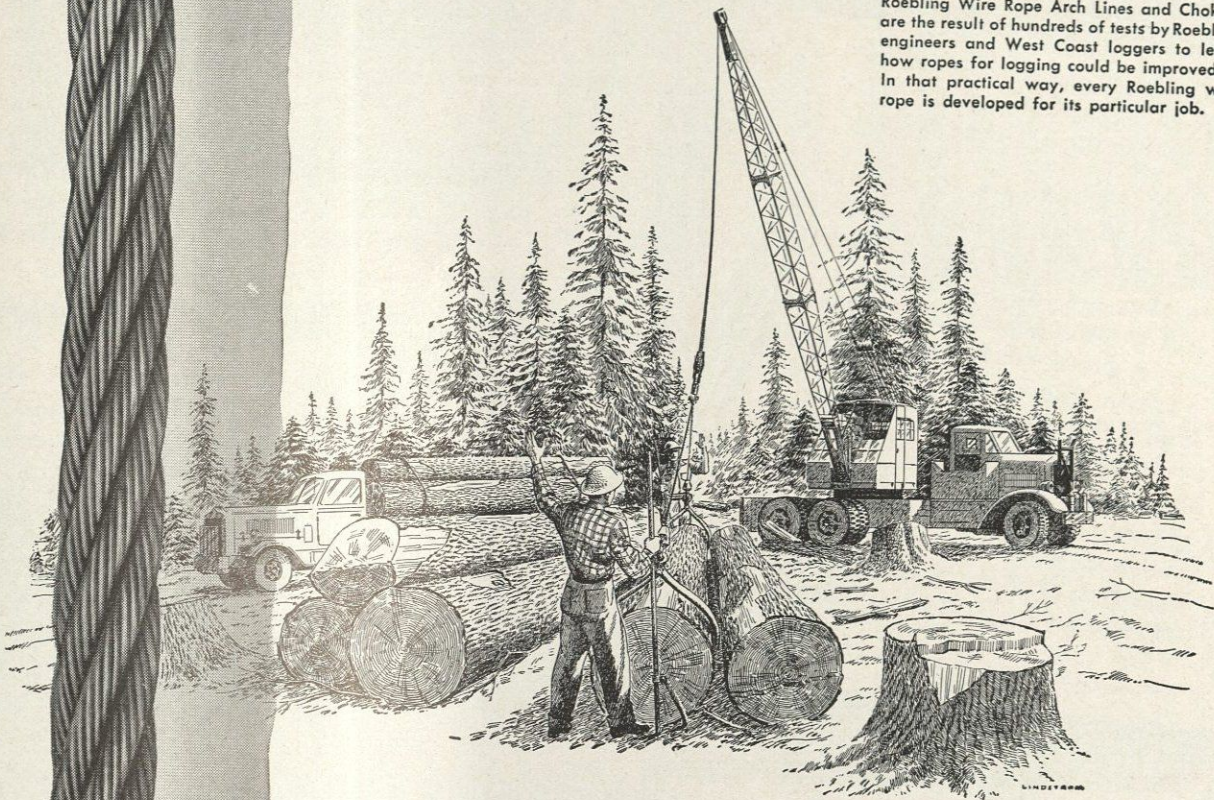
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MEAT

(Continued from page 14)

process the meat must form its own solution from its natural meat juices without the addition of any liquid. The "fast cure" pumping for hams requires about a week, whereas curing bellies takes from three to four weeks.

"Smoking" of meat is a misnomer, since the existence of a great deal of smoke is undesirable. The modern "smoking" process is usually done with gas heat. Most preferred is a "slow smoke" using only moderate heat, extending as long as a day.

It has been estimated that 28-30 pounds of lard are derived from each hog. Considering this to be 10% of the weight of the animal, one can appreciate the importance of lard in the meat processing operations. Fats and fatty oils are composed of glycerides which on hydrolysis will yield molecules of glycerol and fatty acids (such as stearic, palmitic and oleic). While existing in the live animal tissue, fats are neutral; that is, they contain no fatty acids. But the fat splitting enzyme, lipase, is contained in the fatty tissue, and with moisture present, hydrolysis begins immediately after the death of the animal and the fatty acids appear. These fatty acids are kept as low as possible through the lard rendering process.

Depending upon the type of fat used — leaf fat being the best — the rendering process is accordingly different. After the fat has been cooled and minced, it is steam heated to a temperature between 120° F. and 260° F. Also, it may be either dry or wet rendered. In the latter case the steam is introduced directly into the fat and the rendered lard must be drawn off the top of the water. "Dry rendering" is simply indirect heating of the fat in steam jacketed units. The molten lard is allowed to stand for a period in order that the cell tissue material may settle; and then the lard is drawn off, strained and cooled. Usually the cooling lard is subjected to some sort of agitation or rolling to insure its being homogeneous. The lard rendering process is under the continual surveillance of the chemist, who must not only ascertain its purity and composition but also prevent rancidity.

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THE DU PONT DIGEST

Science Makes a Better Mop

Cleaning tasks lightened by new
Du Pont cellulose sponge yarn



An ordinary mop has a bad habit of unraveling. It often leaves a trail of lint. And it wears out fast. A man who sold yarn to mop manufacturers decided to do something about these nuisances. Perhaps some reinforcing material might be combined with the yarn. He did some experimental work of his own but more and more he wondered if it might be possible to use a cellulose sponge coating.

THREE YEARS OF RESEARCH

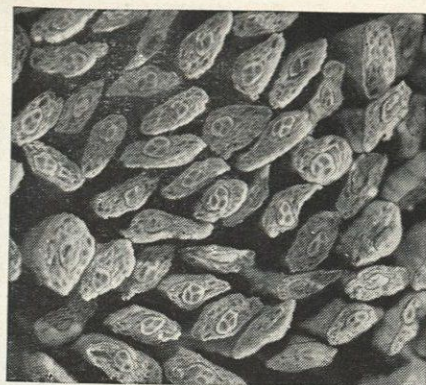
So the man called on Du Pont, the company that had introduced the cellulose sponge to America in 1936. The suggestion of a sponge yarn presented a challenging problem.

Some way would have to be found to extrude a tightly fitting cellulose sponge jacket around each strand of

the yarn. The whole sponge process would have to be adjusted for use in an especially designed machine. Du Pont chemists and engineers tackled these problems.

Even the very first cellulose sponge yarn produced experimentally made mops that were strong, absorbent and durable. But the process had to be changed and improved time and time again. Then the mops were tested in places where they would get the hardest usage—railroad stations, for example.

The mops performed so well that Du Pont built a pilot plant near Buffalo and, under a license from the man who had the original idea, manufactured the yarn on a small scale. Only after three years of study and testing was Du Pont able to



CROSS-SECTION of the new mop yarn. Each cotton fiber strand is jacketed with cellulose sponge material.

offer mop manufacturers the yarn in commercial quantities.

FASTER AND CLEANER

Mops made with cellulose sponge yarn pick up and retain so much water they need wringing less often. You can mop a floor with them in far less time than it formerly took. They dry quickly, leave no lint. They outwear other mops three to five times. Best of all, perhaps, they stay dirt-free longer than ordinary mops. Here is something women will appreciate—a clean mop!

The introduction of these new cleaning tools is another example of how business firms of all sizes depend on each other. The Du Pont Company had facilities for specialized research on cellulose sponge. Because Du Pont could supply sponge yarn economically, some twenty mop manufacturers today have a better product that saves maintenance people and the American housewife time, labor and money.

★ ★ ★

SEND FOR "The Story of Cellulose," a 43-page booklet that tells how wood and cotton are transformed into sponges, textile fibers, lacquers, plastics, coated fabrics, Cellophane and many other useful products. Illustrated with photographs, charts and chemical equations. For free copy, write to the Du Pont Company, 2503 Nemours Bldg., Wilmington 98, Delaware.



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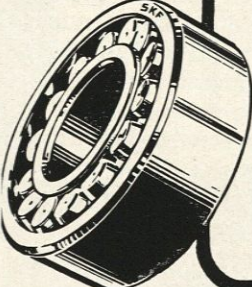
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8 REASONS WHY SKF IS PREFERRED BY ALL INDUSTRY

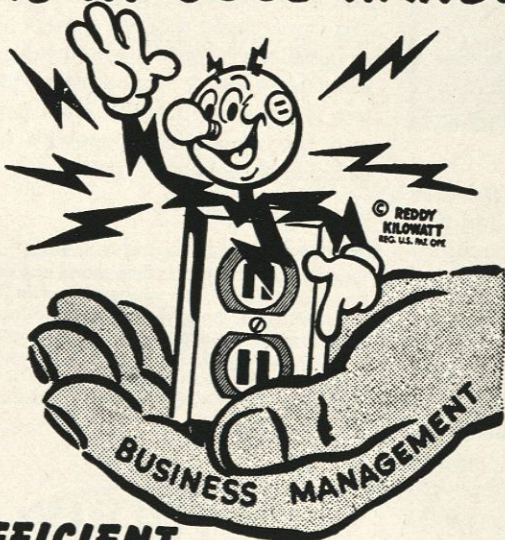
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Up to this stage the packing house processes are relatively simple, for in the disposition of the carcass proper, the butcher's task has probably not altered in hundreds of years. However, the engineer and chemist are gradually assimilating control over the use of by-products, and they are creating a maze of sub-industries and even parallel industries.

Simplest of the by-products are the internal organs such as the liver, heart, tongue, and kidneys, which are sold directly as food. The hides also have always found a ready market.

One can hardly avoid the trite but characteristic expression of the packing house that everything but the squeal of the hog is saved. The greater sophistication of large scale packing houses, scientifically managed, has not just recently created this truism. Instead, the great mass of animal derivatives which formerly went into the "catch all" by-products of animal feeds and fertilizer, are finding more valuable uses. Blood is being used for water-proof glues and plastics. From bones and hog skins, gelatin is being made for use in pharmaceutical capsules, photographic film, and paper. And then there is the mass of other by-products such as insulin, soaps, special fats, "cat gut" bristles, etc.

The success of meat packing depends, however, to a large extent on the raw material used. Good meat animals produce quality meat. The interest in raising better stock has been considerably promoted by the Annual National Western Livestock Show at the Denver Stock Yards. Begun in 1906 by a group of public spirited local livestockmen, it has become one of the outstanding shows in the country. In the recent 1950 show, more than 1400 head of breeding and fat cattle were exhibited, and a total of nearly \$100,000 was awarded as prizes and premiums. During recent years it has become apparent that the present stadium is simply not adequate to accommodate all the spectators desiring to see the stock exhibit. Therefore, in September, 1949, ground was broken for the construction of a more adequate \$2,760,000 stadium. It is expected that these facilities will be available for the 1951 National Western.

You can lead an engineer to water, but why disappoint him?

DIAMOND SETTING
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JEWELRY GIFTS

SPRINGBOARD TO A CAREER IN ENGINEERING

by J. F. ROBERTS
 Manager, Hydraulic Department
 General Machinery Division
 ALLIS-CHALMERS MANUFACTURING COMPANY
 (Graduate Training Course 1919)

YOU HAVE to start somewhere—and as far as I know, flagpole painting is the only job where you start at the top. Next best thing is to get in where there are many opportunities, and many interesting, worthwhile paths to follow—particularly if you are not entirely sure just what type of work you want to do. You then have a chance to try more than one field, and eventually find the work that will give you the most in satisfaction and success.

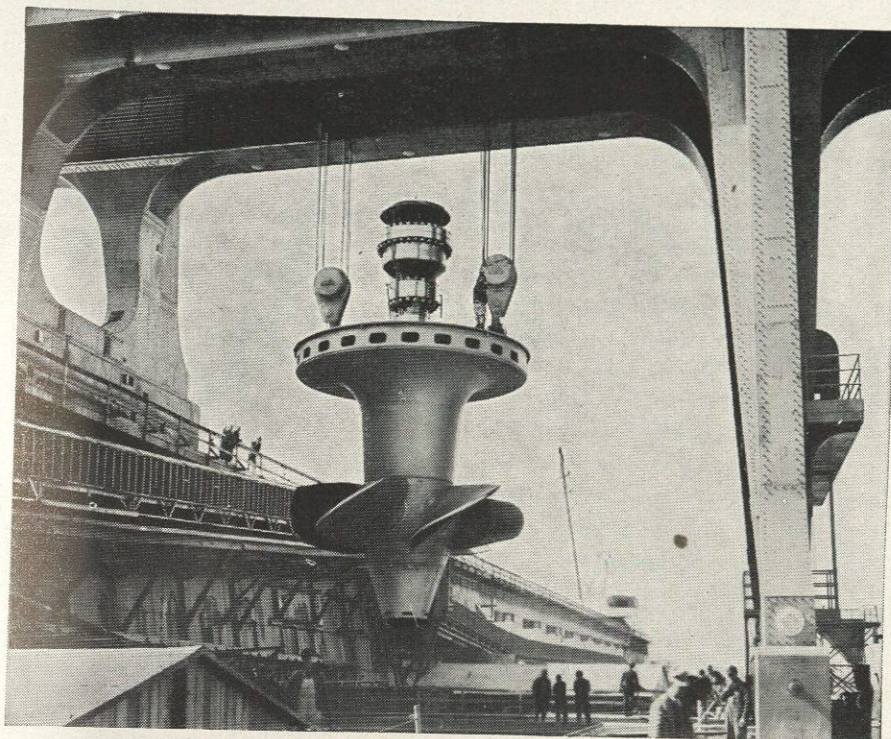


J. F. ROBERTS

Growth of Hydraulics

The field I'm best qualified to discuss is hydraulic engineering. Crude waterwheels were man's first mechanical source of power. Today, in highly perfected modern form, they're still a major source of abundant, low-cost electric power. The field is constantly expanding and holds a world of opportunity. Hydraulic power becomes increasingly important to the nation as the need for low-cost power steadily increases. Moreover, a hydraulic plant once installed produces energy with a minimum of manpower. There's no fuel to mine, prepare, ship, unload and burn—small operating personnel is required.

Right now at Allis-Chalmers we're designing and building turbines for vast new hydro-power projects, not only for the U.S.A. and Canada, but also for Mexico, South America, Norway, New Zealand



Kentucky Dam TVA Field erection view of 250-ton gantry crane lowering hydraulic turbine assembly. One of five 44,000 hp, 48-ft. head, Kaplan type turbines.

and the Philippine Islands. We're also restoring many veteran turbines to better-than-original efficiency and capacity after long years of faithful performance.

Hydraulics was a field that I hadn't seriously considered as an undergraduate at the University of Wisconsin. I graduated as a Mechanical Engineer in 1918, and entered the Allis-Chalmers Graduate Training Course in January 1919. It was there that I got interested in the big waterwheels.

My first assignment was in steam turbine erection. Then I moved over on the hydraulic turbine test floor. In May 1919 I was sent to North Carolina on the acceptance tests of a big hydro-electric power installation. I continued with hydraulic field work such as tests and trouble shooting until 1925, when I went into the sales end of the work. Two years later I left the manufacturing side and became Hydraulic Engineer for the Power Corporation of Canada, supervising the design and installation of some 15 plants.

In 1936 I became Hydraulic Engineer for the U. S. Government TVA, involving 12 projects and 30 large units. I returned to Allis-Chalmers in 1942 as Manager of

the Hydraulic Department—and had the unique experience of building some of the same turbines that I had purchased for TVA.

Vantage Point for All Industries

These personal notes serve to illustrate two interesting facts about the Allis-Chalmers Graduate Training Course. First, it's tailor-made for each student. Since 1904, graduate students here have been helping plan their own courses—making changes as they went along and new interests developed. They've had an opportunity to divide their time between shop and office—follow important projects through from drafting board to installation.

Second, the organization is in close contact with virtually all phases of industry: hydraulic or steam electric power plants and utilities; mining, smelting and rock products; public works; steel and metal working; textiles; food processing; flour milling. Allis-Chalmers builds basic machinery for ALL these industries and many more. Its engineers, executives, salesmen and production experts have a ringside seat for industry in action.



Graduate students conduct performance tests of centrifugal pump units.

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HARDESTY DIVISION

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Denver 1, Colorado

ARMCO DRAINAGE PRODUCTS



CAMPUS NEWS

(Continued from page 19)

of the campus just north of the stadium, will be dedicated this quarter. This laboratory is to be utilized by the Departments of Chemistry, Biology, and Chemical Engineering in the study of radioactive isotopes, which are now available from the Atomic Energy Commission operations at Oak Ridge, Tennessee. It is hoped that in addition to the function of training graduate students in the specialized techniques of working with radioactive substances, the laboratory will be instrumental in the solution of many mysteries concerning the effects of radioactivity upon living organisms.

Grants totaling \$33,630 in 1949-50 have been awarded by the Atomic Energy Commission to the University for the purpose of studying the derivatives of nucleic acid, which is a component of all living cells.

Experiments in which radioactive carbon is fed to rats may answer many questions regarding the nature of biological growth processes and may provide an insight into the cancer problem. Other work to be done in the lab includes crystallographic identification of compounds using the microscope and the assaying of radioactive substances.

The Isotopes Laboratory, having been specifically designed for this type of work, is equipped with many features, including the most modern type of ventilation to remove hazardous vapors in case of accident, and stainless steel tables for utmost cleanliness.

Supervising the work in the laboratory are Professors John R. Lacher and Orville J. Sweeting of the Department of Chemistry.

Pringle Awarded Kopper's Fellowship

John Pringle, graduate student in chemical engineering at the University of Colorado, has been awarded the annual fellowship given by the Koppers Company for research.

Pringle, a native of LaJuanta, is now working on a Ph.D. degree. He already holds bachelor and master of science degrees from Colorado and a B. S. in physics from the University of California.

Koppers Company is one of the world's largest producers of coal tar distillation products, and has plants in over fifty different cities in the United States. The

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SHOCK STRENGTH



Strength factors of Long Life!

No pipe that is provably deficient in any of these strength factors should ever be laid in city streets

Without shock strength—or, for that matter—without all of the strength factors listed opposite—no pipe laid 100 years ago in city streets would be in service today. But, in spite of the evolution of traffic from horse-drawn vehicles to heavy trucks and buses—and today's vast complexity of subway and underground utility services—cast iron gas and water mains, laid over a century ago, are serving in the streets of more than 30 cities in the United States and Canada. Such service records prove that cast iron pipe combines all the strength factors of long life with ample margins of safety. No pipe that is provably deficient in any of these strength factors should ever be laid in city streets. Cast Iron Pipe Research Association, Thos. F. Wolfe, Engineer, 122 So. Michigan Ave., Chicago 3.



SHOCK STRENGTH

The toughness of cast iron pipe which enables it to withstand impact and traffic shocks, as well as the hazards in handling, is demonstrated by the Impact Test. While under hydrostatic pressure and the heavy blows from a 50 pound hammer, standard 6-inch cast iron pipe does not crack until the hammer is dropped 6 times on the same spot from progressively increased heights of 6 inches.

CRUSHING STRENGTH

The ability of cast iron pipe to withstand external loads imposed by heavy fill and unusual traffic loads is proved by the Ring Compression Test. Standard 6-inch cast iron pipe withstands a crushing weight of more than 14,000 lbs. per foot.

BEAM STRENGTH

When cast iron pipe is subjected to beam stress caused by soil settlement, or disturbance of soil by other utilities, or resting on an obstruction, tests prove that standard 6-inch cast iron pipe in 10-foot span sustains a load of 15,000 lbs.

BURSTING STRENGTH

In full length bursting tests standard 6-inch cast iron pipe withstands more than 2500 lbs. per square inch internal hydrostatic pressure, which proves ample ability to resist water-hammer or unusual working pressures.

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regional plant is located at Rifle.

The annual fellowship is awarded to a Colorado student for research in the uses of oil shale. Officials of Koppers Company authorized the fellowship award for the purpose of stimulating additional interest and activating the successful commercial use of Colorado's rich oil shale resources.

The Sync-Chek

The Sync-chek is a new device just placed on the market which is of interest to camera repair men, news photographers, amateur photographers, or anyone employed in flash photography. The unit was designed by Carlton Goss, a C.U. Engineering Physics senior, and is produced by *C. J. Applegate and Co.*, an electronics research and manufacturing firm of Boulder, Colorado.

The device electronically checks a camera shutter for synchronization with the flash bulb. A selector switch permits synchronization with any type of flash bulb desired.

The principle of operation is based on the "strobe-light" method of synchronization. A gas tube is placed behind the camera lens or at the ground glass in a press-type camera. The camera is adjusted for taking a flash picture with the lens diaphragm wide open, and a cord from the unit is plugged into the flash gun. The observer then looks into the lens as the camera is fired. If the shutter is "in sync" he sees a full field of light from the gas tube. The duration of the flash of light from the gas tube is 100 microseconds; therefore, if the shutter is slightly "out of sync" the observer sees the shutter leaves or a star pattern of light. Since the peak light output of a flash-bulb does not occur for a few milliseconds after it is fired, the flash of the gas tube is delayed to correspond to the time of this peak.

The Sync-Chek facilitates rapid and accurate synchronization for the photographer who is going out on that "big assignment."

"Lady," the small boy said, "if you give us a quarter, my little brother will imitate a hen."

"What will he do," asked the lady, "cackle?"

"Naw," replied the boy in disgust. "He wouldn't do a cheap imitation like that; he'll eat a woin."

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REFRIGERATION. . . .

(Continued from page 22)

fic effect. In these substances the magnetic atoms are widely separated so that mutual interactions are small. This law states that the magnetic susceptibility is proportional to the ratio of intensity of magnetization and the magnetic intensity.

Definitions:

Intensity of Magnetization: The net moment per unit volume.

Moment: Product of pole strength and distance between two magnetic poles.

Magnetic Intensity: Measured in gauss where one gauss is equal to one maxwell per cm².

Maxwell: Unit of magnetic flux.

Oersted: The intensity of a magnetic field in which a unit magnet pole experiences a force of one dyne.

Irreversible Expansion of Gas

The free expansion of a perfect gas results in no change in temperature. The actual change in temperature experienced by most gases upon free expansion may be used as a measure of the degree of imperfection of that gas. This change by some gases may be a means of refrigeration. The change in temperature with drop in pressure at constant enthalpy is termed the Joule-Thomson coefficient,

$$\mu = \left(\frac{\partial T}{\partial p} \right)_H$$

This coefficient varies with both the temperature and pressure of the gas.

For each gas there is an inversion point at which this coefficient is zero. Above this point there is an increase in temperature with drop in pressure, and below this point there is a decrease in temperature with a drop in pressure. Since the coefficient varies with pressure, the inversion point is not unique.

The factors affecting the magnitude of the Joule-Thomson coefficient may be seen by the theoretical equations for the porous plug experiment (Figure 4). The Joule-Thomson porous plug experiment followed Joule's free expansion experiment and revealed the fact that a temperature change was experienced in the adiabatic free expansion of a gas.

The solution of the nonflow energy equation with a few identities, (*Refrigeration* by Jordon and Priestley), reveals that

$$C_p \left(\frac{\partial T}{\partial p} \right)_h = - \left(\frac{\partial U}{\partial p} \right)_T - \left[\frac{\partial (pV)}{\partial p} \right]_T$$

In the Joule-Thomson experiment the quantity observed was the change in temperature per unit pressure change $\left(\frac{\partial T}{\partial p} \right)_h$. From this equation it is seen that the Joule-Thomson coefficient is dependent upon two competing quantities. The quantity $\left(\frac{\partial U}{\partial p} \right)_T$ is usually

negative, but the second $\left[\frac{\partial(pV)}{\partial p}\right]_T$ represents the deviation of the gas from the perfect-gas laws and may be either positive or negative. When the Joule-Thomson coefficient equals zero, this defines the conditions for the inversion temperature, or the temperature and pressure conditions under which expansion results in neither heating nor cooling of the gas. Under these

$$\text{conditions } \left[\frac{\partial u}{\partial p}\right]_T = \left[\frac{\partial(pV)}{\partial p}\right]_T$$

Above these conditions expansion will result in heating, and below these conditions expansion will result in cooling.

For all gases under high temperatures and pressures the Joule-Thomson coefficients are negative; therefore, throttling results in warming of the gas. The inversion temperature for most common gases are above temperatures normally encountered; hence if throttling occurs at ordinary pressures and temperatures, a cooling results.

A typical example of the use of Joule-Thomson expansion is the Lindle system for the liquefaction of air. (Fig. 5). This system uses the Joule-Thomson expansion in conjunction with the expansion of air against a restraining force. Here air is compressed between points 1 and 2 to a pressure of 100 to 200 atmospheres and is then cooled in its passage through the heat exchanger between points 2 and 3 to a temperature of approximately -160°F . An irreversible adiabatic expansion occurs between points 3 and 4 with the air dropping to atmospheric pressure and a temperature of -312°F . corresponding to the boiling point. A portion of the air, depending primarily upon the initial pressure, is liquefied; with an initial pressure of 200 atmospheres this amounts to approximately 10 per cent. The remainder of the cold gas leaves the separator at point 5 and returns through the heat exchanger to the compressor.

When Jane returned from a ride, her mother noticed that one of her shoes was muddy.

"Why is just your right shoe muddy and not your left?" she asked.

"I changed my mind," she answered simply.

Freshman: "I don't know."

Sophomore: "I'm not prepared."

Junior: "I can't remember."

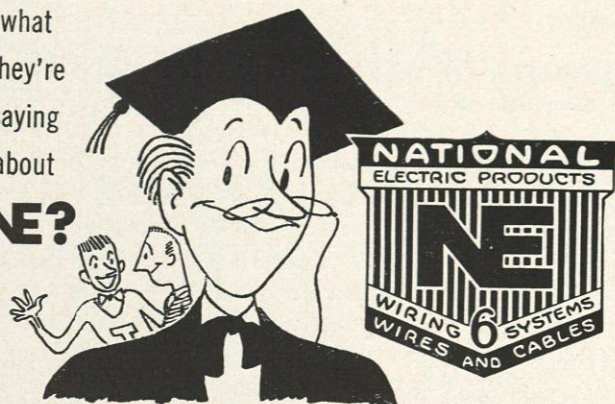
Senior: "I don't believe I can add anything to what has already been said."

"Now gentlemen," said the president of the Homely Baby Bottle Co., "We have 50,000 of these feeding bottles in stock, and we expect you salesman to go out and create a demand."

Hear about the dog who saw a sign on a fire plug that read "Wet Paint" and decided to be accommodating?

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they're
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SOCIETIES

(Continued from page 35)

be in Colorado at this time on a vehicle testing trip and will stop in Boulder to lecture on the latest research he has done.

INSTITUTE OF AERONAUTICAL SCIENCES

The first meeting of the Institute of Aeronautical Sciences for the Winter quarter was devoted to planning the program for the quarter. A representative from the Civil Aeronautics Administration was contacted as a speaker to be engaged at some future date. Two films, "Atomic Energy," and a documentary of the atomic bomb development, "Atomic Power," followed the business meeting.

At an open meeting, February 1, Mr. Shirley A. Johnson, former design engineer in the turbo-jet division of General Electric and at present assistant director of the Industrial Research Institute at the University of Denver, was the guest speaker of the evening. His discussion enveloped a variety of topics dealing with turbo-jet engines and their application in modern aviation.

It was announced that Mr. Ross Radey, Instructor in the Aeronautical Department, will replace Mr. Claude Waddell as faculty sponsor of I.A.S. Mr. Waddell is leaving the University to accept a position with Consolidated Vultee Aircraft Corporation.

ARCHITECTURAL FORUM

The Architectural Forum is one of the youngest professional societies in the College of Engineering. It was organized in the fall of 1946 to give those students interested in architecture a broader background in the practical aspects of this fascinating field of engineering, and an opportunity for the members to discuss different ideas of the Architectural field.

At the initial meeting of the Winter quarter Mr. Joseph Bailey, guest speaker of the evening, from the Portland Cement Association, gave several reasons for the importance of the Portland Cement Association in the manufacturing of cement. With the aid of color motion pictures on cement manufacturing, Mr. Bailey continued with an interesting discussion of how cement is manufactured.

PHI LAMBDA SOCIETY

The Phi Lambda Society, local honorary chemistry society, this quarter has completed and entered a formal petition for membership in the national honorary chemistry society, Phi Lambda Upsilon. This petition was prepared by the charter members of the society under the direction of President Tom Hutchinson and the sponsor, Dr. Frank Germann.

Together with Alpha Chi Sigma, the society sponsored a smoker for all chemists and chemical engineers on January 28 with the inimitable Jay Bower as master of ceremonies. Don C. Tabler, junior chemical engineer, was presented the Society's Outstanding Sophomore

Award for 1948-1949 by virtue of his outstanding record in chemistry and his overall scholastic record.

New members, selected on the basis of scholarship and character, will be initiated early in the Spring quarter.

A. S. C. E.

The A.S.C.E. meeting in January was highlighted by the presence of Mr. Thomas, the president of the national organization. During his talk, Mr. Thomas stressed the importance of developing proper appearance, personality, and character along with technical knowledge during an engineer's schooling. He also mentioned that the engineer's past indifference to life in his community has not helped to bring the engineering profession to the same prominence as that held by other professions.

The activities of the organization for the rest of the quarter will consist of the annual election of new officers and the evaluation of competitive technical papers. The winning paper will be read at the Denver Regional Conference to be held on April 23rd and 24th. The winner of this conference will then represent the region in the Los Angeles Spring Convention to be held later in April.

CHI EPSILON

The student chapter of Chi Epsilon recently voted \$10 to the Warnock Fund which is to be used for a student fund.



Two chapter delegates, Robert Meighs and John Houston, are going to Raleigh, North Carolina, the last of February for the national conclave.

Present plans are for a speaker on "moment distribution" as well as an exhibit for the coming Engineers' Day.

A. S. M. E.

The Winter quarter began for the American Society of Mechanical Engineers with a meeting on January 31 when Dr. J. H. Rush of the Climax High Altitude Observatory gave an enlightening speech on engineering aspects of atomic energy.

The student branch wishes to express its appreciation to all of the members of the Engine Ball committees for a job well done. In addition, we send our congratulations to the queen and her court and to the new officers of the Oil Can Society.

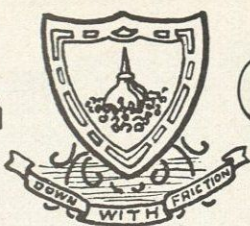
On February 15 the chapter heard Mr. Otto De Lorenzi, author of *Combustion Engineering*, speak on Stoder fuel beds and methods of firing pulverized coal. Both of the subjects were illustrated by films and proved most interesting.

The student branch now has an announcement box in the hall of the Engineering II building, and all members are asked to refer to the box at least once a week.

The total membership of the branch is one hundred eighty members. For June graduates, the deadline for changing junior membership is March 15. Also, the society placement bureau is still at your service.

OIL CAN

THE HONORARY SOCIETY OF
LUBRICATION ENGINEERING



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

At the close of another year of the bitter struggle to subordinate man's worst enemy, friction, the tired old Chief Oiler called a meeting of his deputies: the Chief Spout Wiper, the Keeper of the Oils, and the Matron of the Friction Engineering Squad. With the aid of generous supplies of the most modern fortified lubricant developed by today's genii of engineering, these deputies slid to the appointed meeting-place, an old abandoned pipe line that had not been too carefully drained when it went out of service. After tapping his gavel, the Chief Oiler announced in his thick oily voice that the meeting had been called for the sole purpose of picking a list of candidates of new, younger, and more capable experts of lubricity to take over the responsibilities of the highest offices of the Society. A unanimous "glug!", obviously meant as a cheer, issued from the throats of the three officials. They proceeded to compile a list of all eligible candidates who had shown by their own merits during the past year that they were unique in the de-frictionizing profession. Imagine the chagrin when it was discovered that not even one woman engineer had contributed to the dispersion of friction during the past year, and therefore no candidate was eligible to run for the position of Matron of the Friction Engineering Squad! The 'Old Matron' was so sad that she swam down the pipe in the few inches of standing oil and has not been heard from since, so the society will have to slip through the coming year without a woman's touch to keep the wheels running smoothly. The meeting was adjourned and the list of candidates was given to the other members of the Oil Can Society who voted for their favorites in the field of experts. The votes were tallied, and the results were as follows: Chief Oiler—P. E. Gates; Chief Spout Wiper—Henry Pohl; and Keeper of the Oils—Harold Lee. The names were given to the editor of the Oil Can who quite unintentionally dropped the biggest glob of grease ever dropped on the wheels of officialdom when he disregarded the initials belonging to the newly elected Chief Oiler and informed Mr. F. A. Gates instead of the rightful Mr. P. E. Gates, that he had been elected to the highest office. And so it came to pass that a man who has never oiled the wheels of friction received an engraved oil can at the annual Engineer's Ball, along with the other two men who rightfully earned their rewards.

We proudly hail into the Oil Can Society a new member from the Civil and Architectural Department. It was in a book report entitled, "*Standard Construction Methods*," for Arch. E. 41 class that Donald E. Hame-

link made the astounding statement of fact: "Brick is a popular material for the construction of brick walls."

Nomination is also in order for K. C. Schneider as a new addition to the ever-growing Society. In a recent drawing quiz the class was asked to name three principal uses of threads. Mr. Schneider gave as one of the principal uses: "Wood screws to hang one piece of material to another. For example: a coat hanger in the wall."

The Society is now confronted with a problem as to whether Mr. Moore or his whole Algebra class should receive membership in the organization. It seems that Mr. Moore included in one of his quizzes the following problem: Divide 2^{x^2} by 2^x . Out of his class of twenty-seven students he received the answer, 1^x on exactly twenty-seven papers.

In the process of designing a plate girder in Mr. Smith's Steel Design class he explained the necessity of building the girder in sections and then splicing them together. He then asked the class, "Now, where should the splice be made?" One anonymous student thought hard for a moment and then said, "It wouldn't be too good to splice it at the end, would it?"

Our old standby, the Mechanical Department, has once again come to our rescue in the removal of friction concerning the strength of different kinds of metal. In an M.E. 79 quiz the question was asked, "What type of iron would be specified for an application where high strength is needed?" Joe Berghheim readily gave the following answer: "The type of iron would be brass."

In Contracts, (E.E. 98), a Senior Electrical, Frank Hellwig, anxious to learn the "scoop" on the intricacies of law asked, "Is an express contract one shipped by express?" The discussion at hand was concerned with the express contract as distinguished from the implied contract.

The age old difficulty of not being able to read the fifth carbon copy of the data sheet in Electrical Power Laboratory has been solved once and for all by Hank Wagner, another Senior Electrical. As he was taking notes one day it was noticed that he was making six carbon copies although there were only five men in the group. When questioned about this he replied that he always had to take the last sheet and it was never legible, so this time he would take the next to last one and then he could discard the last one!

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It's a picture that gives automotive engineers clear-cut facts on performance—a picture that suggests how photography with its ability to record, its accuracy and its speed, can play important roles in all modern business and industry.

No, this is not the "doodling" of a man on the telephone. Far from it. It's the photographic record of an oscilloscope trace that shows, and times, detonation in a "knocking" engine. It all happens in a few hundred-thousandths of a second—yet photography gets it clearly and accurately as nothing else can.

Oscillograph recording is but one of countless functional uses of photography in bettering prod-

ucts and improving manufacturing methods. High speed "stills" can freeze fast action at just the crucial moment—and the design or operation of a part can be adjusted to best advantage.

And high speed movies can expand a second of action into several minutes so that fast motion can be slowed down for observation—and products be made more dependable, more durable.

Such uses of photography—and many more—can help you improve your product, your tools, your production methods. For every day, functional photography is proving a valuable and important adjunct in more and more modern enterprises.

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*"Nothing is stronger than
public opinion. Given the
facts, nothing is wiser."*

On Competition

Hatch a good idea and you hatch competitors.

It works this way—to take General Electric as an example:

In 1934, the automatic blanket was initially developed by General Electric. Today there are twelve other companies making electric blankets in competition with G. E.

In 1935, General Electric first demonstrated fluorescent lamps to a group of Navy officers. In 1938, the first fluorescent lamps were offered for sale. Today they are being manufactured by a number of companies.

The first turbine-electric drive for ships was proposed and designed by G-E engineers. Today four companies in this country build this type of ship-propulsion equipment.

After several years of laboratory development, General Electric began production and sale of the Disposall kitchen-waste unit in 1935. Today fourteen other companies are in this field.

The first practical x-ray tube, developed at General Electric years ago, is now a highly competitive business for seven manufacturers.

In 1926, a practical household refrigerator with a hermetically sealed unit was put on the market by General Electric. Today 34 companies are manufacturing household refrigerators with hermetically sealed mechanisms.

* * *

Research and engineering snowplow the way, not only for new public conveniences, but also for new companies, new jobs.

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Any American company that plows back money into research and engineering development makes new business not only for itself, but for others.

The economy that does most to foster competition is the one that makes easiest the establishment and growth of business.

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