COLORADO Engineer

March 15, 1954

Reductio ad optimum

U·S·S CARILLOY electric-furnace aircraft quality steel meets every requirement for these vital parts. The precision machining and expert heat treatment it gets at Cleveland Pneumatic Tool Company complete the job.

● "Reduced to the most favorable degree" describes exactly what happens to the huge U·S·S CARILLOY steel ingots from which are formed the rugged main columns in the landing gears of *every* B-36.

To provide the tremendous strength and shock resistance required to safely cushion the landing impact of 179 tons of bomber weight—and, at the same time, to keep the weight of the landing gear as *low* as possible—calls not only for steel of the highest quality but also for unusual procedures in fabrication as well.

Consider these facts. The original ingot weighs approximately 37,500 lbs. From it are produced two cylindrical columns weighing only about 1200 lbs. apiece. Approximately 93% of the steel is removed by machining to proper contour and in hollow-boring the column. When finished, a mere 7% of the original ingot is left to do the job.

That U·S·S CARILLOY steel has been exclusively selected for this application—one of the most exacting in the aircraft industry—is, we believe, highly significant. The same care and skill, the same ability to meet requirements that are beyond the ordinary, go into every order of CARILLOY steel we make—whether it's an ingot of giant size or a few tons of special steel.

U·S·S CARILLOY is just one more example of the better steel products developed and produced by United States Steel. If you are interested in additional engineering training, why not investigate *your* opportunities with U. S. Steel? For more information, contact the Placement Director of your school, or write to United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pa.

USS

UNITED STATES STEEL

A MESSAGE TO
COLLEGE ENGINEERING
STUDENTS

from A. C. Montieth, Vice-President
in Charge of Engineering and Research,
Westinghouse Electric Corporation,
Queen's University, Kingston, Ontario, 1923

The second most important decision in your life

Now, as you near graduation, you are about to make a decision—second in importance only to choosing your life's partner.

I'm talking, of course, about that all-important first job. Which company will it be? I wouldn't presume to answer that question for you. But I would like to emphasize the importance of this decision.

You have a lot at stake. The direction your career takes will most certainly be influenced by the company with which you cast your lot. May I offer a few personal suggestions.

Choose a company not for its bigness or smallness, but for how it will treat you as an individual. Choose it not only for its engineering activities alone, but also for how it is set up to help its engineers develop themselves professionally. Choose your company with an eye on the opportunities ahead—and an eye on the future of the company itself. Above all, select a company that has a definite program to help you determine the work for which you are best fitted.

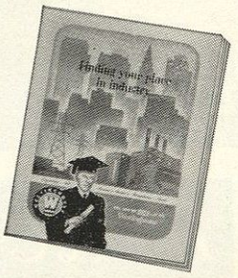
Only you can make this vital decision. Whatever it may be—good luck!

G-10275

YOU CAN BE SURE...IF IT'S
Westinghouse

For information on career opportunities with Westinghouse, consult the Placement Officer of your university, or send for our 44-page book, *Finding Your Place in Industry.*

Write: Mr. R. H. Thach, Regional Educational Co-ordinator, Westinghouse Electric Corporation, 411 N. Seventh Street, St. Louis 1, Missouri.



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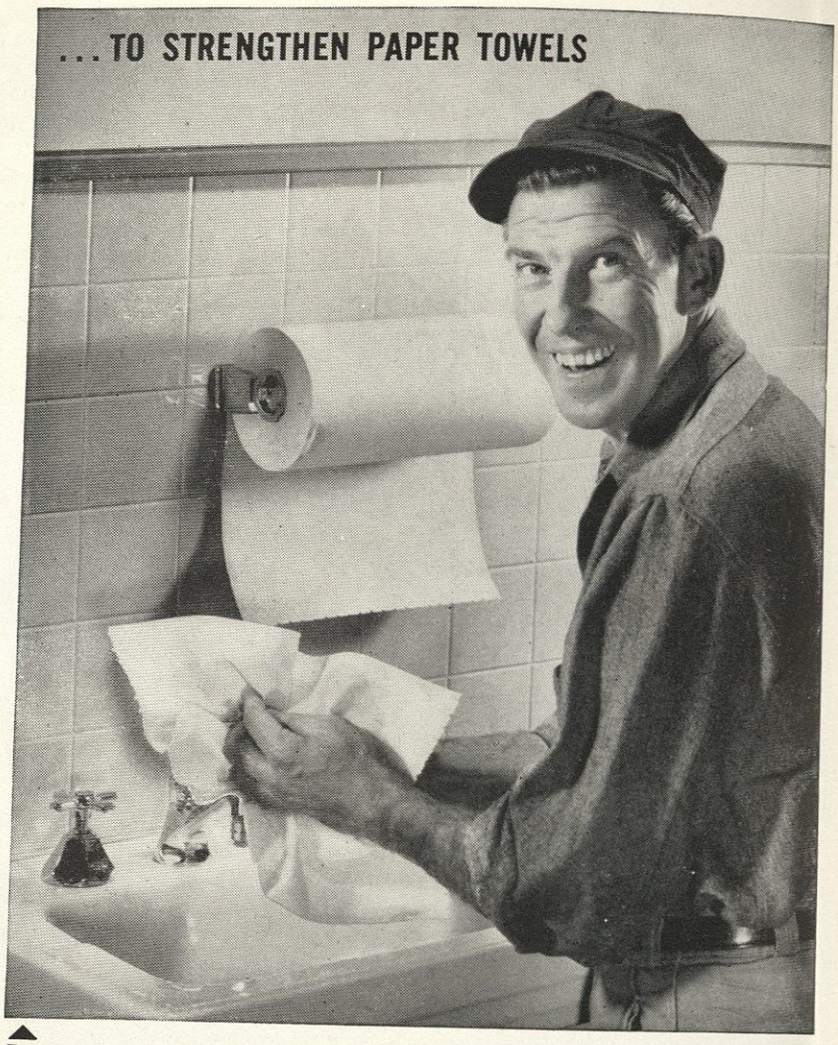
Hercules' business today helps almost everyone's business. It embraces the production of synthetic resins, cellulose products, chemical cotton, terpene chemicals, rosin and rosin derivatives, chlorinated products, and many other chemical processing materials—as well as explosives. Through close cooperative research with its customers, Hercules has helped improve the processing or performance of many products.

...TO STRENGTHEN PAPER TOWELS



Paper towels absorb more moisture without falling apart when Hercules Kymene® resins are added in manufacture. These resins, a few of many of Hercules' varied papermaking chemicals, help improve many other types of wet-strength papers and paperboard, including map paper, V-board, and bag papers.

...TO GREASEPROOF FLOOR TILE

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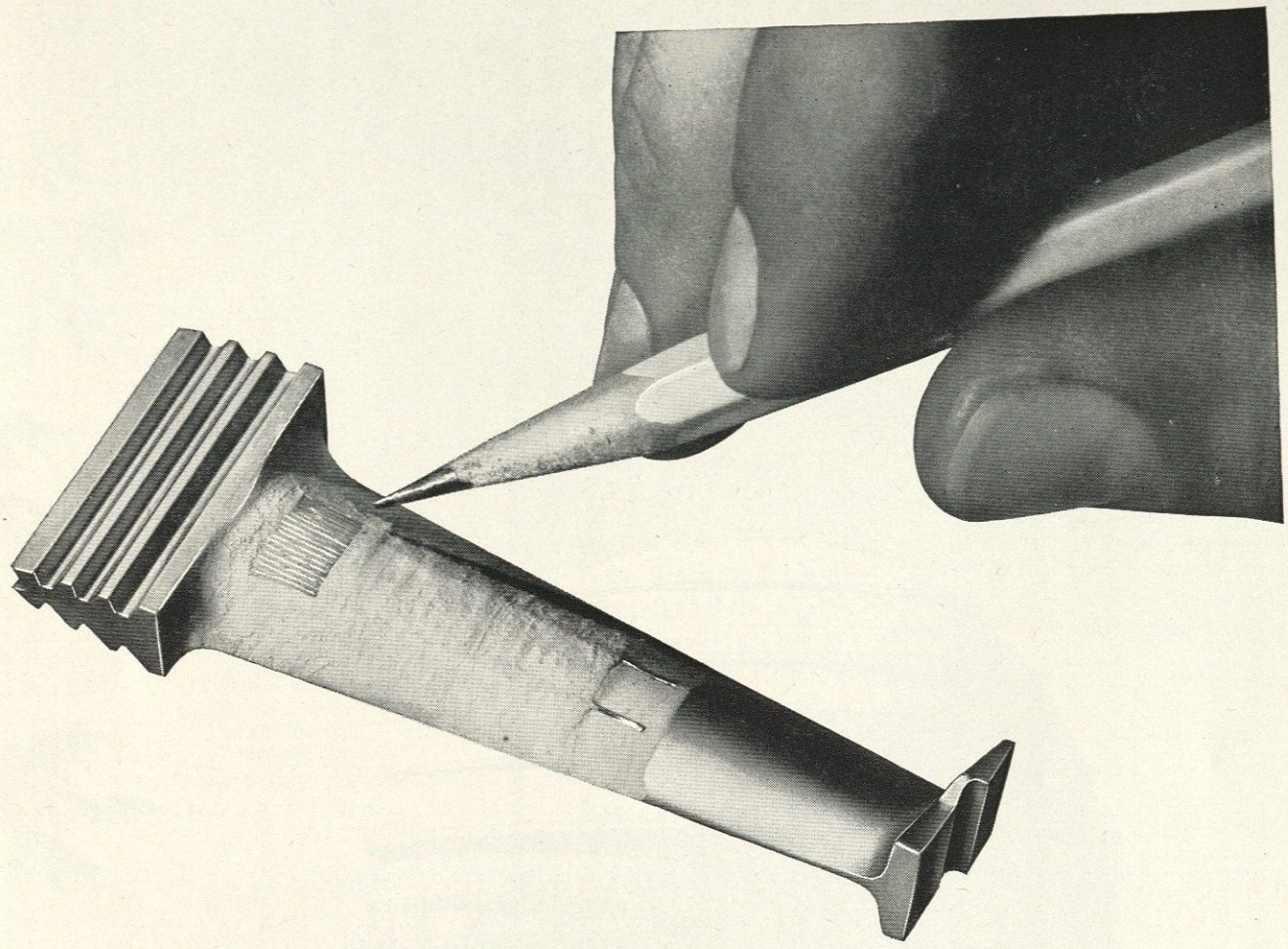

important wire on a hot subject . . .

Even at temperatures of 1500° — speeds of 12,000 rpm — this tiny wire grid reports to our engineers on the strains in jet turbine blades. It gives them accurate measurements for calculating stresses caused by resonance and flutter.

This basic information, in turn, permits the design of blades that combine the optimum aerodynamic characteristics with structural integrity.

Strain gages are not new. But our engineers had to advance the art considerably to get readings at these high speeds and temperatures. It required the development of improved cements, instrumentation, slip rings . . . new application techniques and calibration curves.

Nothing can be left to chance in the design of aircraft engines for supersonic flight. Thus we use — and frequently improve on — every advanced technique and engineering tool. This straight-forward approach to engineering problems is one of the reasons many outstanding engineering graduates decide on a career at Pratt & Whitney Aircraft.

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Division of United Aircraft Corporation

East Hartford 8, Connecticut

SPHERE FOR ATOMIC SUB (See opposite page)

—Courtesy General Electric

COLLEGE OF ENGINEERING

UNIVERSITY OF COLORADO

The COLORADO Engineer

VOLUME L, NO. 3 — MARCH 15, 1954

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.

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In This Issue

ARTICLES

SECTIONS

COVER

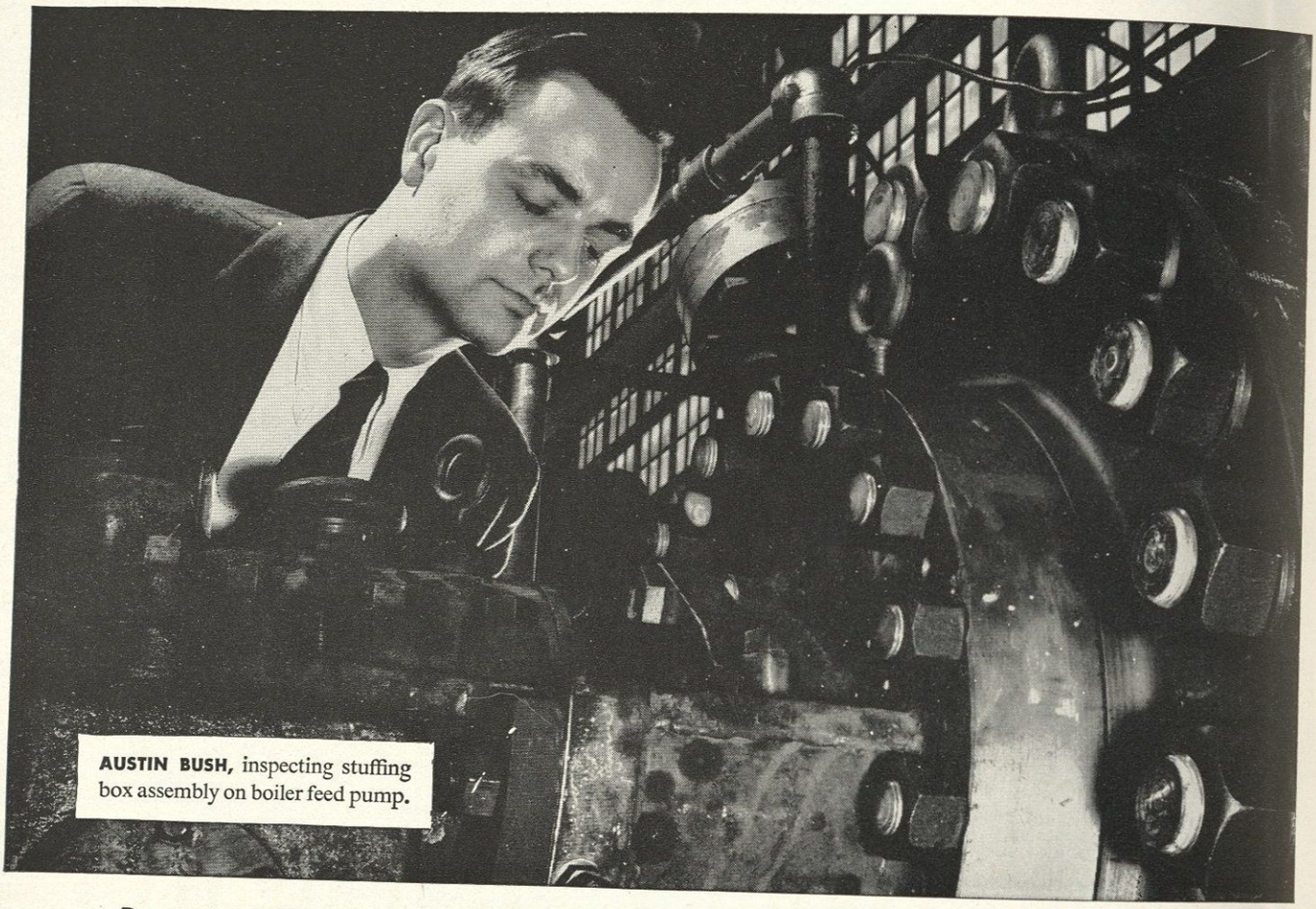
The striking view on the cover is the world famous Matterhorn in Switzerland. The photograph was taken on Ektachrome film (f/8 at 1/25 second). (Photo courtesy **Eastman Kodak Co.**)

FRONTISPIECE (opposite page)

View of the completed steel sphere at the Knolls Atomic Power Laboratory's West Milton, New York site, where the General Electric Company is test-operating a prototype atomic power plant for submarines.

MEMBER OF
ENGINEERING COLLEGE MAGAZINES ASSOCIATED
Thomas Farrell, Chairman
State University of Iowa
Iowa City, Iowa

Austin Bush, Rensselaer, '50, Helps Develop New Pump



AUSTIN BUSH, inspecting stuffing box assembly on boiler feed pump.

Reports interesting project engineering assignments at Worthington

"Despite its size as the leading manufacturer in its field," says Austin Bush, "I have found Worthington pays considerable attention to the interests of the individual. The company's excellent training program consists of several months of working with the various types of equipment manufactured, augmented by technical lectures, and talks on the organization of the corporation.

"Following this training, I was given an opportunity to choose the department in which I wanted to work—engineering, sales, or manufacturing. My choice was the engineering department where I have already been assigned to several interesting projects.

"In addition to the training program, the members of our engineering department hold monthly seminars at which engineering topics of general interest are discussed.

"Opportunities for advancement are good, and pleasant associates make Worthington a fine place to work."

When you're thinking of a good job, think *high*—think *Worthington.*

FOR ADDITIONAL INFORMATION, see your College Placement Bureau or write to the Personnel and Training Department, Worthington Corporation, Harrison, New Jersey.

WORTHINGTON

The Sign of Value Around the World

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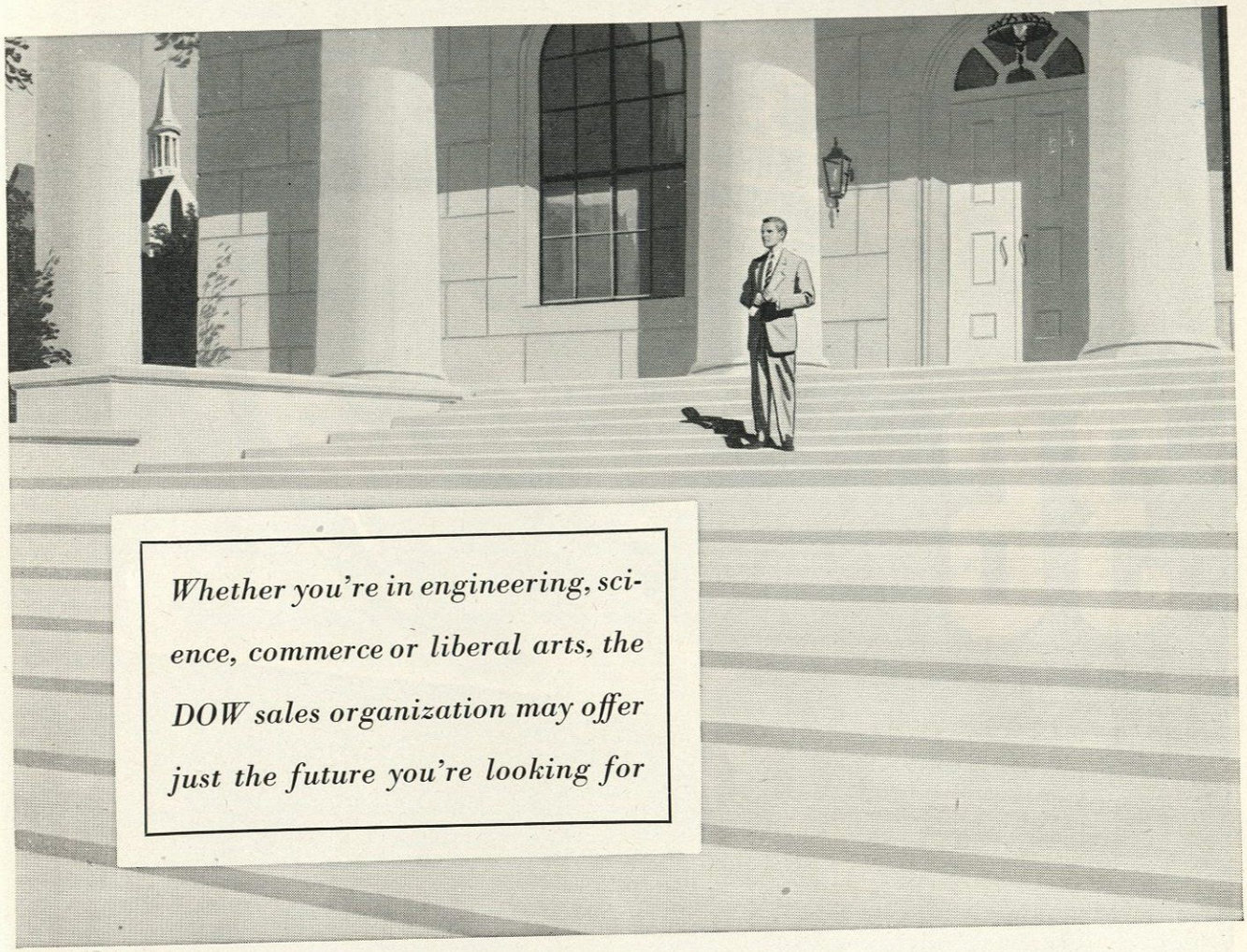

What About Your Future?

Your opportunities for advancement are excellent because Dow is growing—continually building new plants, developing new production operations—adding new products, opening new markets.

Dow fits you for the job with a comprehensive training course which explains company organization, policy, finance, research, production, technical service and sales methods.

You'll find that Dow is a friendly company. You'll discover that promotions are usually from within, from Dow's own staff. Seldom is an outsider considered for a top job at Dow. Moreover, you'll find a highly developed spirit of cooperation between men and departments.

At Dow, your future can be more secure because of Dow's diversification of products serving many different markets —a real advantage if business slows—and certain to multiply opportunities as business expands. Also at Dow —group insurance, pension plans and employee stock purchase plans have been a tradition.

If you or any of your friends majoring in other fields of study who have had pre-engineering or one year or more of college chemistry are interested in finding out more about a future at DOW, write to Dow's Technical Employment Department today.

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you can depend on DOW CHEMICALS DOW

From The Editors' Desk

ENGINEERS WANTED!

As our country moves into a spectacular era of technological development, we find that we lack what we need most—trained engineers. But how can we get the engineers that we need? One answer is to encourage more young men and women to study engineering. But how can we get more people to study engineering? One possible solution to the problem is to establish pre-engineering clubs in high schools. These clubs would have as their purposes:

(1) To increase the interest of high-school students in engineering in order to encourage more of them to study engineering in college.

(2) To inform high-school students of the requirements of engineering colleges in order to prepare them more adequately for the study of engineering.

(3) To provide a social outlet for students with similar interests.

The clubs would function as follows:

(1) Sponsor meetings among the members for the general discussion of the engineering profession.

(2) Sponsor speakers and moving pictures. The speakers could be professional engineers and college students who would be able to help the students in planning their careers.

(3) Sponsor inspection trips to industrial plants and construction projects where the work of engineers could be observed first hand.

(4) Sponsor trips to regional colleges to inspect facilities of these colleges.

A club could be formed of members of one high school or of several adjacent high schools. The membership of the clubs would be composed of students interest in engineering and related fields. Advisors for the clubs could be science or math teachers who are familiar with engineering and engineering training. It might be advisable for one or more professional engineers to serve as sponsors.

After clubs were started, regional organizations of clubs could be formed to sponsor and participate in district events of interest to members.

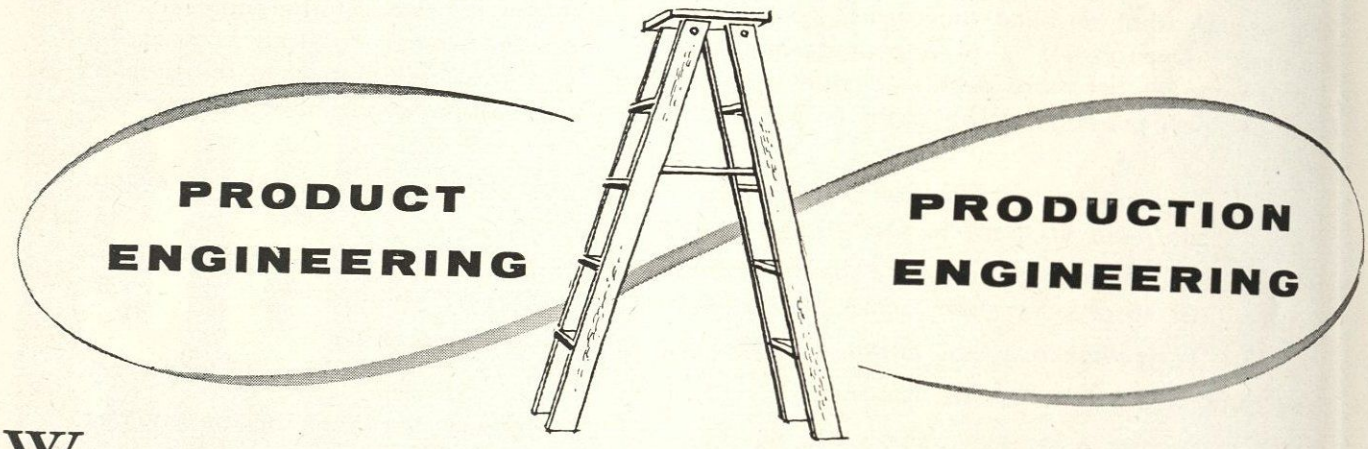
A program similar to this has been used in other fields. Clubs such as Future Teachers, Future Farmers, and Pre-law have been organized in many high schools, offering evidence that Future Engineers clubs could be organized if given the proper sponsorship. Organizations such as the Colorado Society of Engineers, the Colorado Engineering Council, or the Professional Engineers of Colorado would be logical groups to sponsor these clubs. The Kentucky Society of Professional Engineers began sponsorship of a statewide organization of these clubs a little over a year ago and to date has helped in the establishment of over 15 Future Engineers clubs.

Although sponsorship by organizations of engineers would aid in the formation of these clubs, there is no reason why these clubs could not be started on the initiative of the high-school students, teachers, or principals, or of former students of the high school.

To offer impetus to this movement, the **Colorado Engineer** is prepared to furnish further details about existing Future Engineers clubs and about plans for establishing these clubs. We believe that this plan offers a truly positive solution to the problem of relieving the critical shortage of engineers.

jim

TWO MORE WAYS TO CLIMB THE GM JOB LADDER



When considering your first engineering job—ask yourself this:

What kind of person am I? The kind of person who likes to *invent* things—or *design* them?

The kind who likes to be in on the *birth* of an idea? Or the kind who likes to meet the challenge of new designs, new inventions, new ideas — by figuring out how to *build* them in quantity at a price to make them available to the greatest number of people?

For — the first type is bound to be happiest as a *Product* Engineer; the second as a *Production* Engineer.

In Product Engineering, GM offers you a successful career whether your interest lies in automotive or Diesel engineering, design, fuel and plastic research, or creating new beauties of motorcar styling.

In Production Engineering, GM also—as has been proved by its success in mass production of fine products—is a leader in manufacturing processes and production techniques, with all the fine career opportunities that this implies.

And the same goes if you have your sights fixed on Research, the exciting hunt for knowledge in the field of applied science — or if you're contemplating a career in Plant Engineering, the planning, developing, installing and maintaining of GM plant equipment and services.

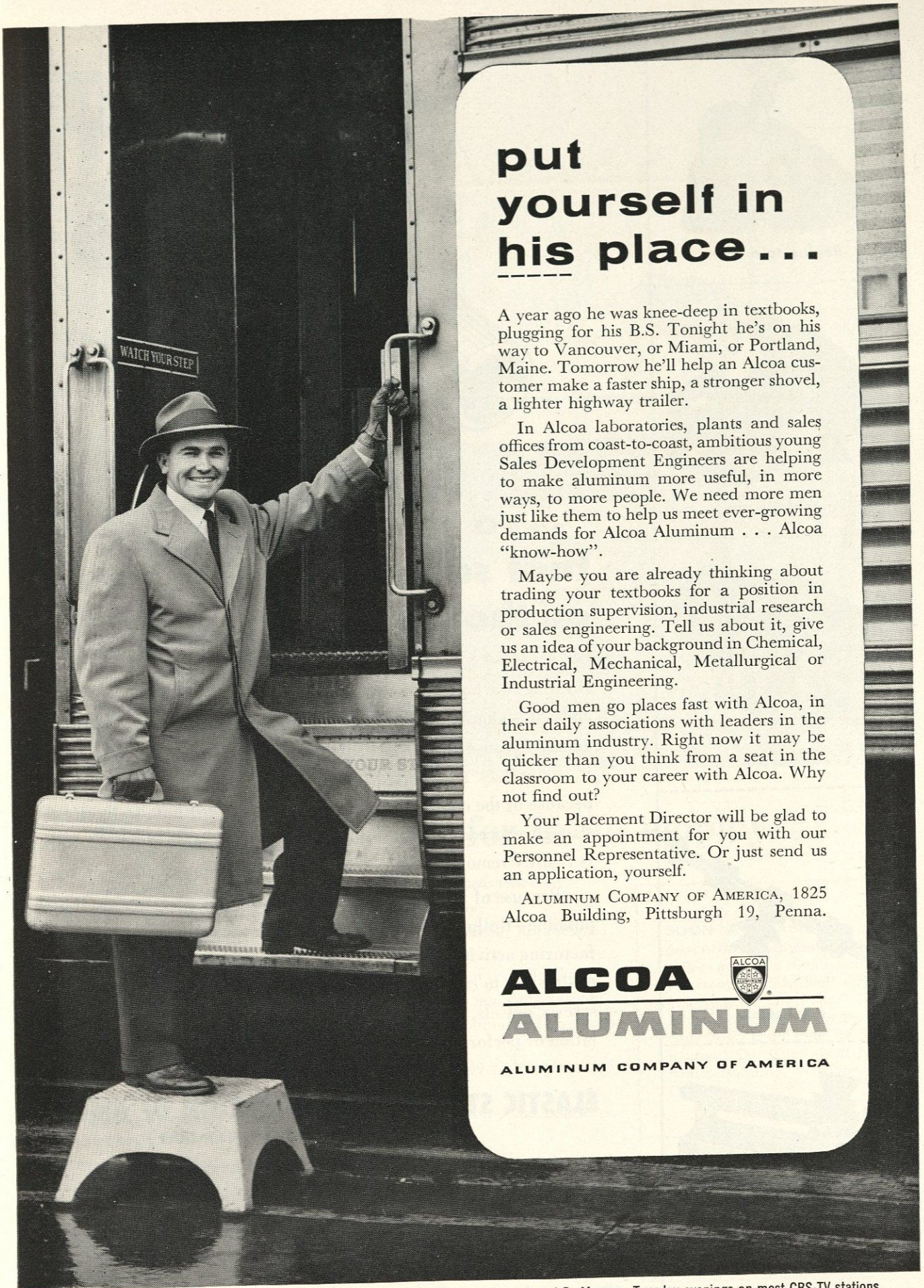
Yes, there are *all* kinds of opportunities for the graduate engineer who has what it takes to climb the GM job ladder.

GM positions now available in these fields:

MECHANICAL ENGINEERING
METALLURGICAL ENGINEERING
CHEMICAL ENGINEERING
ELECTRICAL ENGINEERING
INDUSTRIAL ENGINEERING
BUSINESS ADMINISTRATION

GENERAL MOTORS CORPORATION

Personnel Staff, Detroit 2, Michigan



put yourself in his place...

A year ago he was knee-deep in textbooks, plugging for his B.S. Tonight he's on his way to Vancouver, or Miami, or Portland, Maine. Tomorrow he'll help an Alcoa customer make a faster ship, a stronger shovel, a lighter highway trailer.

In Alcoa laboratories, plants and sales offices from coast-to-coast, ambitious young Sales Development Engineers are helping to make aluminum more useful, in more ways, to more people. We need more men just like them to help us meet ever-growing demands for Alcoa Aluminum . . . Alcoa "know-how".

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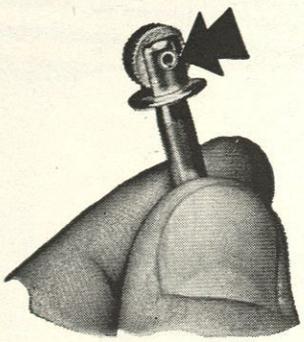
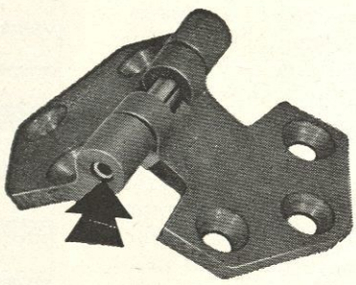
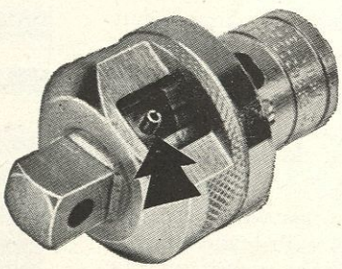


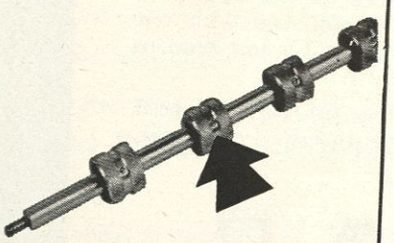
Replacing a rivet



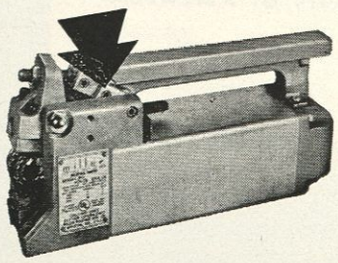
. . . a hinge pin



. . . a stop pin



. . . a set screw



. . . a bolt and nut

dia. from 1/16" to 1/2"

. . . a modern fastener that saves time and money on thousands of applications

Rollpin is a hollow, split, cylindrically formed pin with chamfered ends. It is simply driven into holes drilled to normal production tolerances. Because Rollpin is slightly larger than standard sized holes, it compresses as inserted. It is self-locking—and vibration-proof—because of the constant pressure it exerts against hole walls. Its shear strength exceeds that of a cold rolled pin of the same diameter. Rollpin is readily removed with a drift or pin punch—and can be reused.

Because of its versatility—and the production economies it makes possible—Rollpin is finding wide usage in almost every phase of manufacturing activity. Write for design information on the Rollpin. It will enable you to cut costs for many applications where use of rivets, set screws, dowels, and straight, serrated or cotter type pins create installation or performance problems.

ELASTIC STOP NUT CORPORATION OF AMERICA

2330 Vauxhall Road, Union, New Jersey

Elastic Stop Nuts with the famous red collar are another ESNA product

What do YOU look for in an employer?

Undoubtedly, you'll want most of the following characteristics:

1. Job satisfaction—the chance to do work you really enjoy.
2. Recognition—the assurance that good work will be noticed, appreciated, and properly rewarded.
3. Opportunities for advancement—a growing company can provide them.
4. Security—the knowledge that a company is both stable and progressive.
5. Pride—a feeling that your company is respected by the public and produces goods which contribute to a better way of life.
6. Good companionship—a factor which contributes greatly to happiness on the job.
7. Good pay—not in salary alone, but also in terms of vacation plans, pensions, and other benefits.
8. Safe working conditions.

How can you obtain this kind of information in advance?

One of the best ways is to discuss the matter with an acquaintance already working for the company you are considering. You will also find it helpful to consult your college placement officer, your professors and company representatives visiting your campus.

The selection of an employer is one of the most important decisions you'll make. It justifies considerable thought and effort.

SOON AVAILABLE for student ASME chapters and other college groups, a 16-mm. sound color movie—"Mechanical Engineering at Du Pont." For further information, send post card to E. I. du Pont de Nemours & Co. (Inc.), 2521 Nemours Building, Wilmington, Delaware.

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...THROUGH CHEMISTRY

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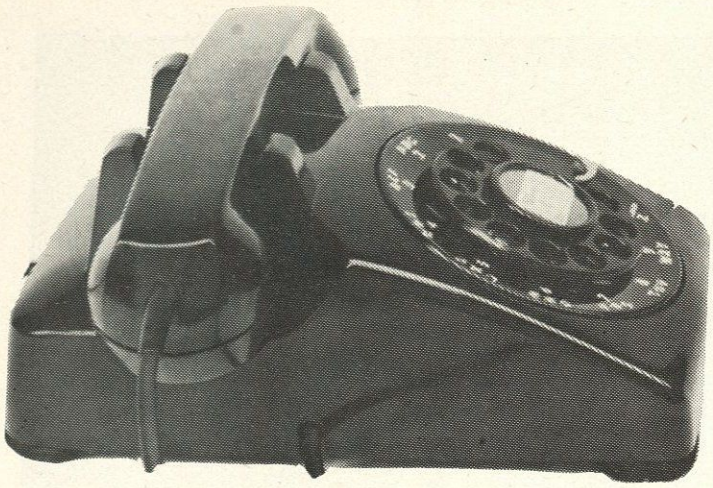


MAGIC DIALS

THE STORY BEHIND YOUR TELEPHONE

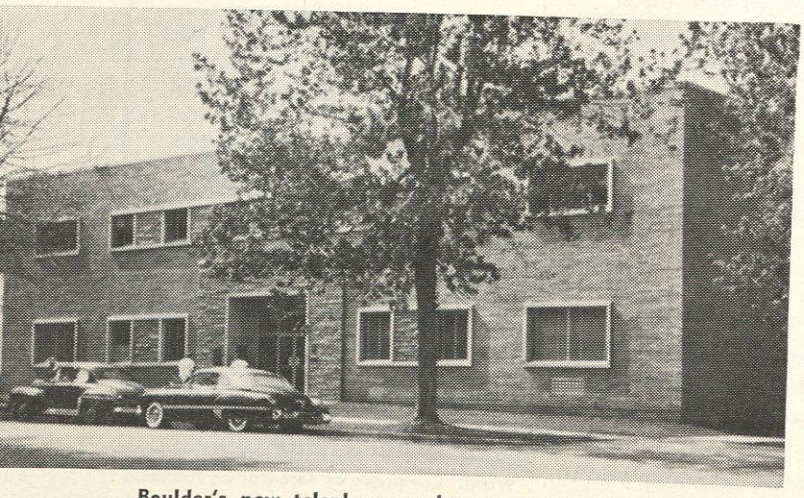
Commemorating Boulder's New Dialing Exchange and The 75th Anniversary of The Mountain States Telephone and Telegraph Company

by RICHARD D. KELLER, E.E. and Bus. '54

ON midnight of March 6, 1954, Boulder's ultra modern $2,000,000 dial telephone system was officially inaugurated.

No longer need you wait for an operator to inquire "Number please?" Instead, with a few flicks of your finger, thousands of unseen and unheard relays click your call through to its destination automatically and in a fraction of the time heretofore required.

Boulder thus becomes the first community in the Rocky Mountain Empire equipped with the remarkable new "Number 5 Crossbar" dialing system, an efficient all-relay switching system developed by the Bell Telephone Laboratories and manufactured by the Western Electric Company, Bell's wholly-owned equipment supplier. The "Number 5 Crossbar" is compatible with all present dialing systems and is easily adaptable to future nation-wide toll dialing.



Boulder's new telephone exchange at 16th and Walnut.

Dick is well known to readers of the ENGINEER, *for this is his third article in the past year. A Navy veteran, he is a Lieutenant (jg) in the Organized Naval Air Reserve in Denver. His experience and interest in electronics and sound led him quite naturally to the research which resulted in this article.*

The Birth Of An Idea

The world's most modern personal communication system comes to Boulder almost 78 years to the day after the first intelligible sentence was carried over a pair of wires. It was on the evening of March 10, 1876, in a small Boston boarding house room, that Thomas Watson heard the feeble metallic sounds "Mr. Watson—come here; I want you!" emerge from a small box.

Running into the next room, he shouted "Mr. Bell, I heard every word you said—distinctly!", and young Alexander Graham Bell, a 27-year-old speech specialist and teacher of the deaf, was elated with his success, for this was the culmination of over three years of gadgeteering and experimenting with new ways to transmit intelligence over wires.

Within the year, a company had been formed to lease pairs of phones for voice communications between

points "not more than 20 miles apart." Only one wire was necessary for such a connection between two subscribers (ground being used for the return path). Soon, however, groups of subscribers desired interconnecting lines, and problems arose; *direct* connections among 5 subscribers required 10 lines (see figure 1), among 10 subscribers, 45 lines, and between 100 subscribers, 4950 lines were necessary!

Consequently, in 1878 the central switchboard was introduced, with all local phones connected to terminals on it so that any two lines could be connected together, thus requiring only one line per subscriber. Boys, used as operators in the beginning, were so noisy and inefficient that women operators were employed after 1879 (the year in which local telephone service was introduced in Denver). With the switchboard developed, the telephone industry moved forward with tremendous strides.

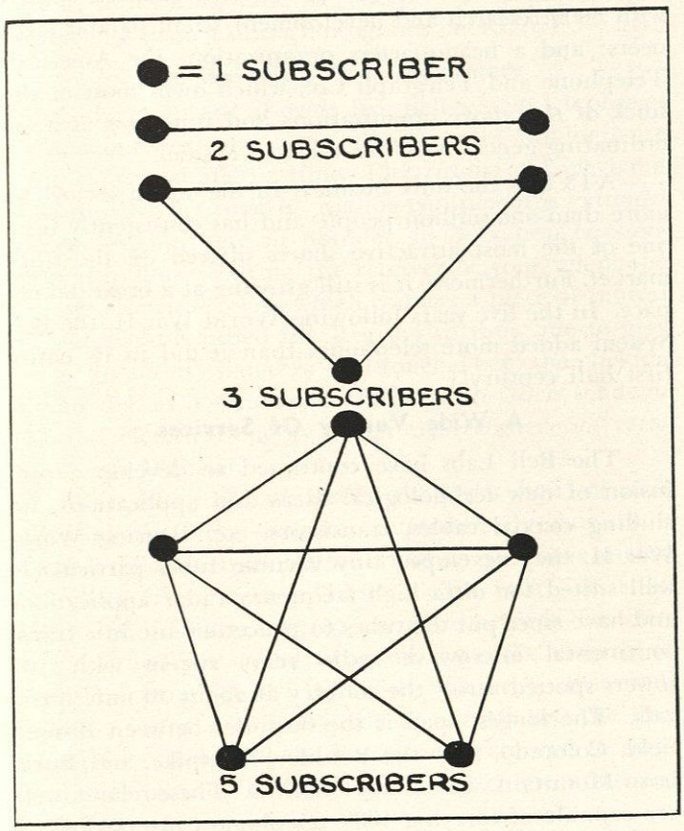
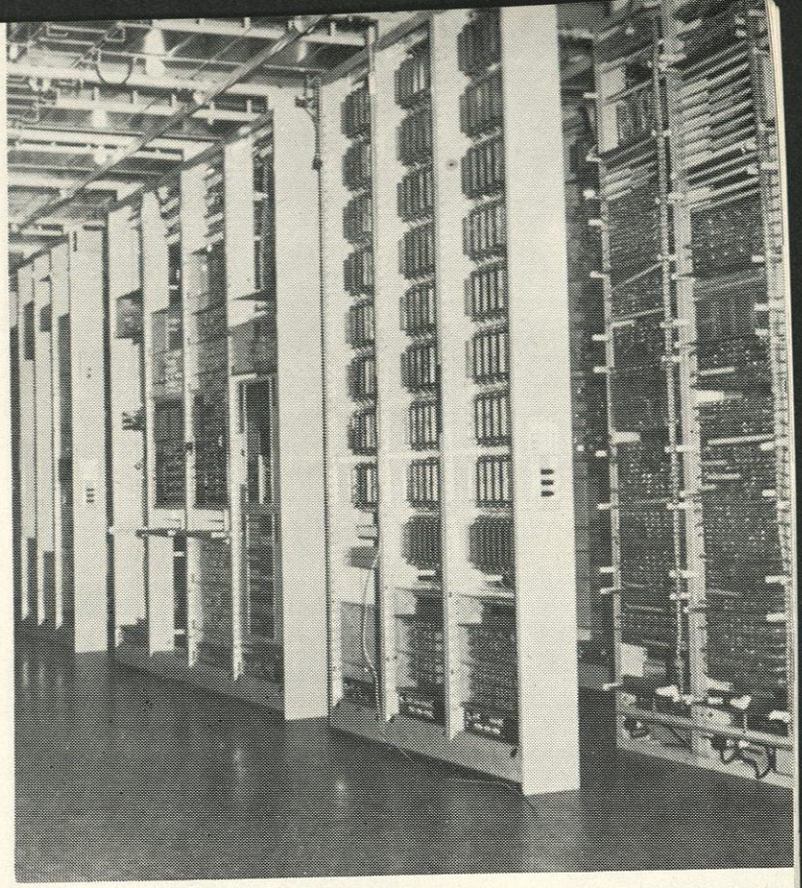


Figure 1.
When more than three telephone subscribers were directly connected, the number of interconnecting lines increased rapidly. The central switchboard alleviated this problem.

Engineering Developments

Having helped his invention rise to wide public aceptance and use, Mr. Bell retired from an active part in the telephone business in 1881. He was forced, however, to spend many years after this defending his patent rights against others who conceived the telephone idea almost simultaneously.

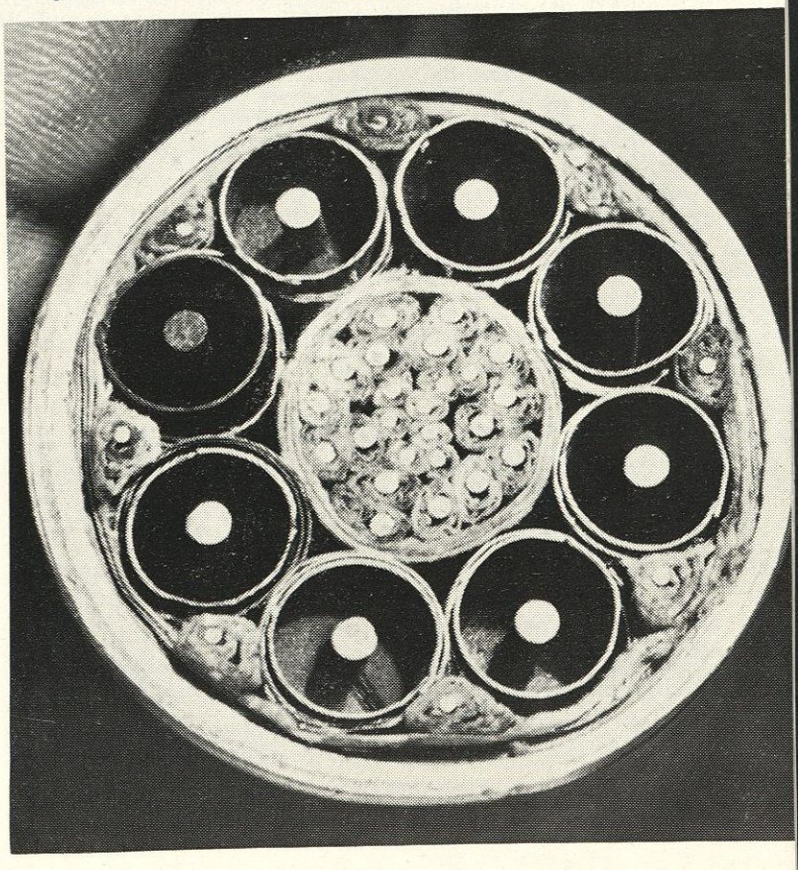
The following year, the Bell Company purchased the Western Electric Company, the best of the manufacturers who had entered the telephone field, in order to be assured of a dependable source of standarized high quality equipment.

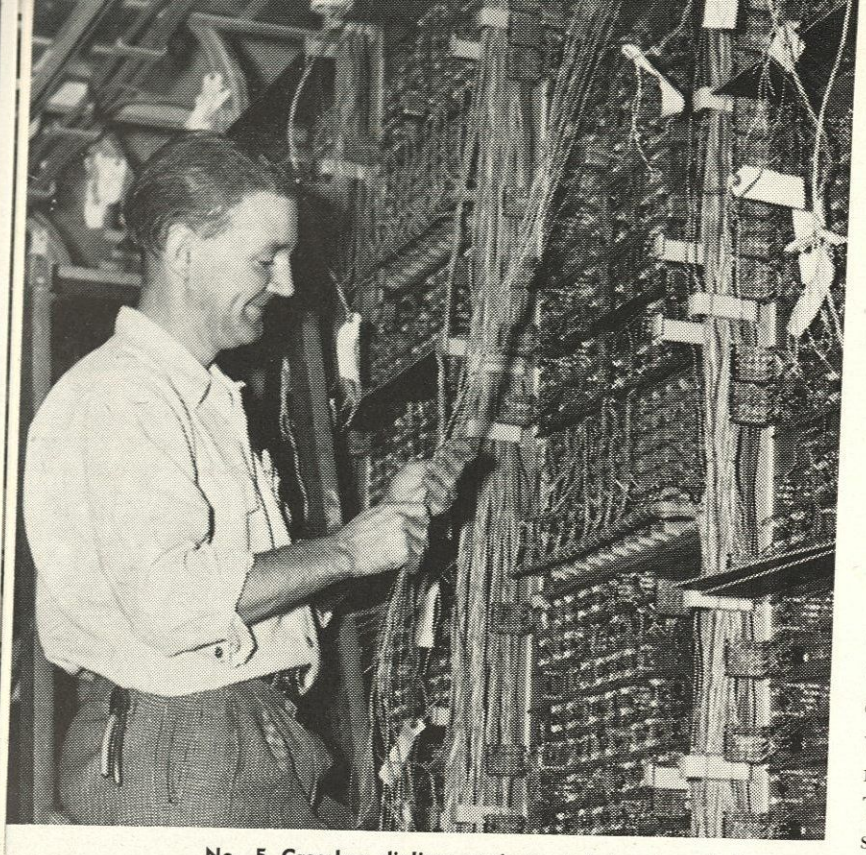


Banks of No. 5 Crossbar dialing equipment.

—Photos courtesy Mountain States Telephone and Telegraph Co.

This cross section of a coaxial cable shows the eight coaxial voice highways which are capable of transmitting up to 1800 simultaneous conversations without cross interference.





No. 5 Crossbar dialing equipment being installed.

Research continued, especially on the longer lines which tended to be quite noisy. The substitution of a second wire for the ground return helped somewhat, but as business increased and numerous circuits had to be mounted upon a single row of poles, a new trouble arose—the various circuits cross-talked to one another. This was finally cleared by transposing the various circuits on the pole lines in a systematic fashion, so that electric and magnetic inductive effects causing energy interchanges among the circuits largely cancelled each other.

Cables were inaugurated in 1888 to relieve city poles of some of their ever-increasing loads. Up to 50 pairs of wires could now be carried in a single cable buried beneath city streets, and crosstalk was prevented by properly twisting and positioning the various wire pairs.

Long distance circuits developed slowly. Service between Boston and New York opened in 1884. By 1892, telephone lines linked Chicago with New York. In 1911 they reached to Denver and by 1915 the entire continent was spanned. To make transcontinental voice communication possible, research engineers of the Bell Labs had applied vacuum tube amplifiers and loading coils to give renewed energy to currents weakened by inherent line characteristics. Today the small "repeater" or "booster" huts are located anywhere from 8 to 75 miles apart along country telephone lines, depending upon the type of line or cables in use.

By World War I switchboards in the larger cities had grown termendously large and complex; therefore, Bell engineers developed automatic dial switching equipment which they introduced in the larger cities in 1921. One of these early "step by step" systems involving mechanical moving arms and fingers was installed in Denver where it is still serving very satisfactorily.

50 Million Telephones

Today the Bell System with over 40 million telephones is interconnected with some 5500 other companies serving 10 million more telephones. The 5500 independent American companies buy their telephones and equipment from such manufacturers as Automatic Electric Company, Stromberg Carlson, etc., and together with the Bell System, provide the United States with more telephones (over 30 for each hundred people) than all the rest of the world combined.

The huge Bell System itself consists of four essential components: the seventeen operating companies (of which the Mountain States Telephone and Telegraph Company is geographically the largest, covering Montana, Wyoming, Idaho, Utah, Arizona, New Mexico, Colorado, and El Paso, Texas); the Western Electric Co., the manufacturing and supply organization for the entire system; the Bell Telephone Laboratories, staffed with 8000 research and development scientists and engineers; and a headquarters organization, the American Telephone and Telegraph Co., which owns most of the stock of the above organizations and functions as a coordinating general staff for the Bell System.

AT&T is the only business in the world owned by more than one million people and has consistently been one of the most attractive shares offered on the stock market. Furthermore, it is still growing at a breathtaking pace. In the five years following World War II, the Bell System added more telephones than it did in its entire first half century!

A Wide Variety Of Services

The Bell Labs have continued to develop a profusion of new technological ideas and applications, including coaxial cables, transistors, etc. During World War II, they developed tiny vacuum tubes particularly well suited for ultra high frequency radar applications and have since put the tubes to peacetime use in a transcontinental microwave radio relay system with 107 towers spotted across the country at about 30 mile intervals. The longest span is the 60 miles between Broomfield, Colorado, near the Boulder Turnpike, and Buckhorn Mountain, west of Fort Collins. These relay towers are capable of carrying 1800 telephone conversations at a time, or two TV shows along with 600 telephone conversations. These relay towers and four-inch coaxial cables, also capable of carrying 1800 conversations simultaneously by utilizing intricate filtering circuits, form the backbone of the nation's television networks.

Interestingly enough, the telephone company also makes national radio networks possible. Since 1923, the year of the first network broadcast, all such programs have been carried from their point of origin over long-distance telephone lines to individual stations for broadcast to local areas.

Radio telephony has been developed by the Bell labs to bring traveling telephone service to ocean liners, trains, aircraft, and automobiles. Overseas radio telephony has been extended so that today a United States

phone can be connected to 96% of the world's 86 million telephones. Overseas calls are being made at the unprecedented rate of over a million a year, and the completion of a $35 million Atlantic cable in 1956 will triple the number of available circuits to Great Britain. (The present Atlantic cable can carry only telegraph messages —no voice signals. All European calls are now relayed by radio.)

Private line service—including telephone, teletypewriter, wirephoto, Morse telegraph, and a new nationwide simultaneous punched card accounting system—is provided for the government, press, and many companies in a wide field of business activity.

Perhaps the most recent development has been an automatic telephone answering set which delivers a short recorded mesage to each caller and then tape records as many as twenty incoming messages of thirty seconds each. (For unannounced recordings of telephone conversations, a warning tone or "beeper" is required—ever hear the "Denver Calling" programs on KOA?)

The Amazing Dial Machinery

Today, four out of every five Bell System telephones are dial operated and more, like those in Boulder, are being converted all the time. Electrically and mechanically, the "No. 5 Crossbar" dialing equipment is extremely complex, but here in Boulder, its operation is essentially as follows: Lifting the receiver of your telephone actuates electrical relays which connect a piece of central office apparatus called the Register to your line to give you a "go ahead" signal or dial tone. Then, the clicking of your dial as it returns to rest between twirls sends in pulses of electrical energy which are recorded or "racked" in this Register.

As soon as you have dialed the seven digits of your called number, the Register automatically cuts in a marker which analyzes the information you have dialed and either (a) connects a "busy tone" to your line if the called line is in use, or (b) connects a trunk between your line and the called line and starts the ringing of the called party's bell. When the phone is answered, ringing is automatically tripped or cut off and the line is clear for talking. In the few seconds required to complete such a call, hundreds of relay connections are involved.

The No. 5 crossbar system has been designed to connect easily with the new AMA (Automatic Message Accounting) system, the heart of long distance toll dialing. In order to eliminate the long distance operator, AMA equipment records the telephone numbers involved in each call, the billing rate, the timing, and other essential information, all automatically. Of course, this system allows only station-to-station calls since there is no way for the machinery to distinguish individual persons.

Direct cross-country dialing to certain cities and areas is now available to residents of Englewood, New Jersey; Birmingham, Michigan; and Pittsburgh's Valley exchange, and will eventually be available nationally. It is very easy to use. A simple three number code is dialed for the city being called and then the desired telephone number. Automatic toll switching equipment finds the best path to the destination and completes the call without any assistance.

Actually, operators have been dialing cross-country for several years. Two-fifths of all long-distance calls are now completed by local operators in this manner without further assistance anywhere else along the line. Furthermore, nine-tenths of all long distance calls are put through on a "no hang up" basis, having taken an average time of only 1.8 minutes to complete.

In the birth and growth of the telephone lies one of America's outstanding success stories. Alert thinking and sound engineering together have provided our nation with one of its most useful and vital services.

Buckhorn Mtn., Colorado—One of the microwave radio relay towers linking the nation with TV and telephone service from coast to coast.

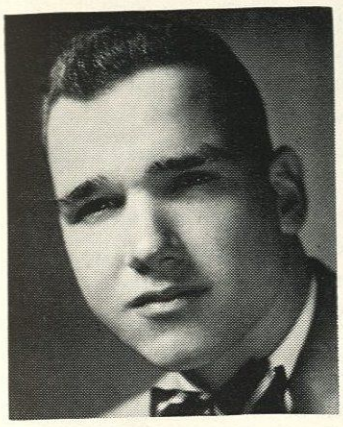
A portion of the world largest ski lift located at Squaw Valley, California. The lift has a vertical rise of 1843 ft.; horizontal length of 7740 ft.; and a capacity of 600 passengers per hour.

—Photos courtesy
Heron Engineering Company

Engineering A Ski Area

by DAVID L. EVANS,

C.E. and Bus. '56



A 21 year old junior from Joliet, Illinois, Dave is taking a combined civil engineering and business course. He has served on the Welcome Week general committee and is a member of Phi Epsilon Phi, ASCE, and the Delta Upsilon social fraternity. Dave is in the Naval R.O.T.C. program and edits the campus news section of the COLORADO ENGINEER.

SKIING is fast becoming America's most popular winter sport. The past century has seen American skiing grow from transportation for mountaineers to a recreation enjoyed by almost two million people. Their ability ranges from expert to novice, but their desires are coincident: to become better skiers and to achieve maximum enjoyment.

The increased popularity of skiing has created a demand for ski areas which reached its zenith following World War II. The demand for areas in the West reached its peak at this time, and over one hundred areas have been developed in the last nine years. The first ski area with lift facilities was opened in 1934 in Woodstock, Vermont, and since then ski lifts have been constructed in many sections of the United States. This country possesses about sixty major ski areas with the greater concentrations being in the East and West, although the northern Midwest has some areas. The total number of areas is probably in excess of five hundred with the demand still unsatisfied.

Engineering skills have been an integral part in the expanding of the ski industry into the thriving business which it is today. Much technical knowledge must be utilized in order to locate a slope and to develop it into a profitable ski area. After finding a suitable location ski trails must be cleared of vegetation, lift routes surveyed and cleared, lifts installed, shelters constructed, and parking areas and often accessible roads provided.

Selection of Ski Area

The selection of the ski area is not as simple as it might appear. Accessibility, gradient, vegetation, direction of exposure, variation in trails, and climatic conditions must all be considered. Ski areas are usually developed in regions which retain snow the longest. High altitude, bowl-shaped areas with a northern exposure and sufficient growth of trees will provide the maximum amount of snow over a given length of time.

Arapahoe Basin, west of Denver, is an example of a very ideal location because most of the necessary features are provided. The ski area at Berthoud Pass, west of Denver, is not too well provided with wind breakers and is exposed to the east and west. The latter, however, does lend itself to more sunny skiing for which there is a growing demand these days.

The feature of northern exposure is not too important except at lower elevations or where the temperature is extremely warm. Areas with northern exposure, however, will tend to have a longer skiing season.

Denver's Winter Park is a good example of the affect of elevation. Because more snow falls on the upper slopes of the mountain and because the temperature there is lower, snow is retained much longer than that which falls near the base. However, in the case of Winter Park, since the lower slope is surrounded by fewer trees than the upper, some of the variation in the amount of snow retained is caused by the difference in exposure to the sun.

When considering the altitude of an area one must remember that a location at a lower altitude can support more grassy vegetation which allows the slope to resist erosion when it is cleared of all logs and stumps. A high altitude will not support grasses; therefore, when the area is cleared, logs and stumps are often left to help control erosion. Also, on steep slopes stumps are sometimes left to aid in retaining the snow acting in a manner similar to that of a snow fence.

The accessibility of an area is another important feature considered in selecting a ski area. Good all-weather roads must pass close to the area in order to provide transportation for skiers. The Sugar Bowl ski area, in California, has eliminated the obstacle of no roads to the area by construction of an aerial tramway which provides transportation from the highway to the ski area some distance away.

Naturally the ski trails within the ski area must be of a nature which will provide for the ability of the various types of skiers. The lower areas must provide space for buildings and parking areas. Thus, one can see that there are many things to consider when selecting a location. The initial investment in the facilities provided will usually be dependent on the proximity of the populus and the ability of the area to draw from it.

Ski Lifts

After selecting the most feasible location the next consideration must be given to the ski lift facilities. Both the type and the number of the facilities is usually dependent upon the length of the season, the vertical and horizontal lengths of the tow, and the estimated demand. Unless the season is reasonably long and the demand large, expensive lift equipment can not be economically installed and operated. Therefore, it is necessary to accurately estimate the anticipated capacity.

When considering the cost of the ski lifts both the cost of the construction and the cost of maintenance must be considered. Lift facilities include rope tows, "T-Bar" tows, chair lifts (single and double seat), and aerial tramways. Rope tows are usually considered to be cheapest while tramways are the most expensive. Since the advent of the new double chairlift, it has been found that construction and maintenance of the latter is more

Terminal of the "Magic Carpet" aerial tramway installed in the Sugar Bowl ski area in California by the Heron Engineering Company of Denver, Colorado, the largest firm in the United States engaged in the design and construction of ski lifts.

economical in the long run than is that of the popular single chair lift. The twin chair design doubles the capacity and the revenue, while the installation cost is only about one-third more than that of a single chair lift. The first double chair lift was installed on Berthoud Pass soon after the end of World War II. This chair lift has the capacity of six hundred passengers per hour and moves at a speed of four hundred feet per minute.

The type of tow to be constructed is determined by the length of the tow, the vertical lift, and the cost. The rope tow is usually satisfactory for short distances with a gentle slope, while the "T-Bars" and chair lifts are better for long, steep slopes. The latter has been designed mainly for the comfort of the skier, and because of the increased cost of operation of a "T-Bar" on a steeper slope. The steeper the slope the closer the "T-Bar" comes to approximating the chair lift because of increased cable tension which necessitates stronger support towers. "T-Bars" allow for a larger capacity than the chair lifts though the lifts are much more relaxing to the hard skier. "T-Bars" are usually cheaper to operate since the power needed is only that required to pull the skier while the chair lift must support and pull the skier. One advantage of the chair lift is that it can also be used to accommodate summer sightseers, thus providing a greater return on the initial investment.

The new French Poma lifts which have been installed in some American areas have many advantages, but appear to be rather fragile in design. These tows operate in a manner similar to a "T-Bar" in that the skier is pulled. He is towed by a single bar which is engaged by clutch action when he and the bar are in the starting position. The maintenance cost of these tows may prove to be rather excessive. One of their main advantages, however, is that of safety, since the skier does not grasp a moving tow.

The design problems encountered when erecting a chair lift may serve as an example of a typical installation. After the lift route has been selected and a profile of the ground contour plotted, the location of the towers and upper and lower terminals is determined. These locations will be dictated by the vertical rise, horizontal length, estimated capacity, and any obstructions which might be in the path of the lift. These factors will also influence the size and strength of the structural materials chosen for the towers. The clearance allowed the chair must be sufficient to safely clear all obstructions including snow, yet not so high that passenger safety is affected.

Rollers on the towers support the load on the moving cable. The number of rollers and the design of the towers is determined by the reaction of the tower under the maximum possible load. The size of the cable is found by computing the tension under a capacity load which occurs when both the chairs going up and down are in service. The design of the upper and lower terminals calls for ease of boarding and leaving the lift as well as space for waiting skiers. The type of power unit to be used will depend on the location. Rope tows usually are operated by an internal combustion engine while electricity is usually employed for larger lifts.

The drive wheel of a chair lift is known as the "bull wheel" and has a diameter of about eight or ten feet. The horse power of the motor is determined by the vertical lift, speed desired, and the capacity of the lift. The capacity which is determined by the demand of the skiers is regulated by the number of chairs. Thus the tow is completed and the safety features added.

And so a natural slope is developed into a recreation area for skiing. The job is a precise one and errors in estimating the demand of skiers can be costly. Many areas will never advance beyond the rope tow stage while others shall continue to prosper and grow.

Aspen, Colorado, is an example of an area which has thrived, although confronted with several problems. The season is comparatively short, elevation low, and exposure to the south and east. However, a variety of slopes, national publicity, and a gay night life have pushed it to the top of the list of many skiers.

One can see from this illustration that there are many ways to substitute for the conditions which an area lacks. This will always be true as long as Americans retain their ability to capitalize on new business demands. One can easily see that publicity and facilities will determine whether an area is for local, state, or national use. Rabid skiers will travel world wide to gain skiing pleasure. Chili has become a popular country for summer skiing. Whether you ski at Aspen or on a slope with a portable rope tow you are enjoying the sport which shall continue to grow and fulfill America's modern need for winter recreation.

WE SHOULD ALL BE CONCERNED

by C. F. KETTERING

Research Consultant, General Motors Corporation

Charles Franklin Kettering, nationally famous inventor and scientist, is noted for his invention of the automobile self-starter and his development work in connection with anti-knock fuels, automotive finishes, the high speed, 2-cycle Diesel engine and high compression automobile engines. Since his retirement as Director of the General Motors Research Laboratories in 1947, he has been devoting a great deal of time to several fundamental problems of a scientific nature including an extensive research project on photosynthesis.

EVERY year a certain number of you young fellows are handed diplomas and wished Godspeed. Usually, along with the sheepskin, some dignitary will give you some advice—some constructive, some more or less oratorical. There is one thing, though, no one can give you on that momentous occasion—experience . So, in lieu of that, perhaps I can offer a few observations based on the results of experience—over 50 years of experience in the fields of research and engineering.

When you advance from year to year in your engineering course, whether it is mechanical, electrical, chemical, civil or what not, you may have the feeling that engineering is a never ending parade of formulas that must be memorized and applied. In other words, you may get the impression that almost any engineering problem can be solved if you can just find the right formula to fit it.

I certainly wish that were so. It would certainly simplify our research and engineering work. However—and this applies particularly to research work—we find formulas can be very misleading. Let me give you an illustration.

One of our research problems involved a simple beam about 23 inches long. In fact it was simply one of the leaves of an automobile spring which some of our people wanted to put to work in a production machine. They had figured it out several times and were sure this piece of steel was strong enough and flexible enough to do the job. But when they got the machine running, the springs began to break after about 2000 cycles. So they turned the problem over to research to get the answer.

We had five suppliers of leaf spring material send us some samples and tell us what they thought we should use after we gave them the working specifications. They all used the same formulas and the springs followed the formulas very well—they all agreed that about 2000 cycles was about right for the life of the spring.

We then asked them to send us some pieces of the

spring material and mark them for identification. It didn't have to be a secret mark because we wanted each of them to get back its own piece. We gave each of those springs a physical treatment and returned them to the manufacturers for test. And none of them broke in *two million* cycles!

That was a one hundred thousand per cent improvement, and yet you would have been perfectly justified in saying that this material obeys the formula and therefore you can't expect anything else.

Please don't misunderstand me. I don't mean you should disregard every formula. But I think you should make sure your formula is applicable to the case you have at hand.

It is just possible when you have gotten your degree that some of you may seek a job with a tire manufacturer. You know it is a big business today—in fact, it does a billion and a half dollar business annually, employing 100,000 people to produce 95 million tires. So it *is* a big business and employs lots of engineers.

But I wonder if you have ever seen in your school engineering library a text book containing formulas for designing an automobile or truck tire? I haven't! Yet how did engineers achieve the remarkable progress in tires—what procedure did they use to improve tire life from 3,000 miles up to 75 or 80 thousand miles?

You read a lot these days about the great calculating machines used to solve difficult problems but we have been using a giant calculating machine for years—our Proving Grounds covering thousands of acres. We don't put in something and push buttons and wait to see what comes out. We put an entire automobile into our machine and drive it 25 thousand miles, tear it apart and inspect every piece. These tests on our Proving Grounds are just as much computing machines as the modern integrating machines with their vacuum tubes—and the results are far more conclusive.

And this machine has helped us greatly to improve tires. Here is an automobile, we put on two new tires, one on the front wheel and one on the back, diagonally opposite and run them around under the same conditions as the average driver encounters. After thousands of miles of this kind of usage we examine the tires and say "This tire is better than that one." So we use these roads as integrating machines and the results have been beneficial to everyone.

The most successful engineer tomorrow will be the one who can intelligently apply formulas and calculate things that can be calculated, yet is able to recognize that intelligent experimentation is the only way to solve certain problems. He doesn't have to belong exclusively to a mathematical or an experimental group—he should be adept at using either tool.

So often we think we can *design* a thing without letting the thing speak for itself. Actually, in our research work we have discovered one of the best methods of getting results is simply to run errands for an idea.

For example, we designed what we thought was an ideal piston for a new Diesel engine but the engine in which the piston was tested had different ideas and said "I'll only give you 50 thousand miles on that one." So we made up half a dozen different kinds of pistons and offered them to the test engine, one by one, for its verdict. And to show you how much smarter the engine was than our engineers, the piston it finally selected ran over a million and a half miles.

I remember a well-known engineering educator who visited me after that said "I don't think that piston is any good. It is the most peculiar looking thing I ever saw, and I know it isn't right."

I asked, "How do you know that?"

He said, "I am an engineer."

"But," I asked, "Were you ever a piston in a Diesel engine?"

And when you get out into the world of business you will run into some representatives of the "can't be done" school like the Englishman who visited me some years ago. He said to me "When I was over here last year you told me you were driving these Diesel-electric trains over a hundred miles an hour and now I find you take power off the front wheels of your locomotive. You can't do that and stay on the track at that speed."

"Well," I said, " I hope the locomotive doesn't discover that."

And he said, "I have the figures and the formula right here in my briefcase to prove it."

"No," I said, "I won't look at those but I will arrange a ride on that train for you."

To make a long story short, he took a ride on the train from Chicago to Denver and on his return dropped into my office. I told him I was surprised to see him alive since he must have gone over a hundred miles an hour. He said "Do you know what they did for me when I was up in the cab? They put the locomotive up to 120 miles an hour and it had no tendency to jump the track. The thing that worries me is how we could be so absolutely wrong in every detail."

"The reason you were wrong," I explained, "was simply because your figures had nothing to do with this locomotive. They applied to another type of locomotive which we do not build."

He was talking about a rigid frame locomotive, while our locomotives have individual trucks like every railroad car but we put motors on them. But here was a man who was perfectly willing to say, without a trial, that it was impossible to do what were already doing.

These are a few of the things you are apt to run into which are probably not covered in the text books you have gone through. But there are other things you will encounter which neither I nor any other person can predict. They are the thousands of opportunities that lie ahead—the thousands of things that need to be done to fulfill the needs and desires of our rapidly growing nation. And when you travel along that road to Tomorrow, keep your eye on the road up there ahead, not on the rear view mirror, because we should all be concerned with the Future since there's where we are going to spend the rest of our lives.

Making the Weather Pay

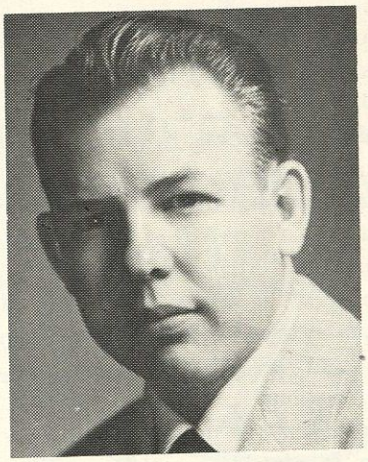
by DARRELL MACKAY, Ch.E. and Bus. '55

Remember the old saying, "Everybody talks about the weather but nobody does anything about it." A firm in Denver is now doing something about the weather and making the weather pay for the firm and for the people it serves.

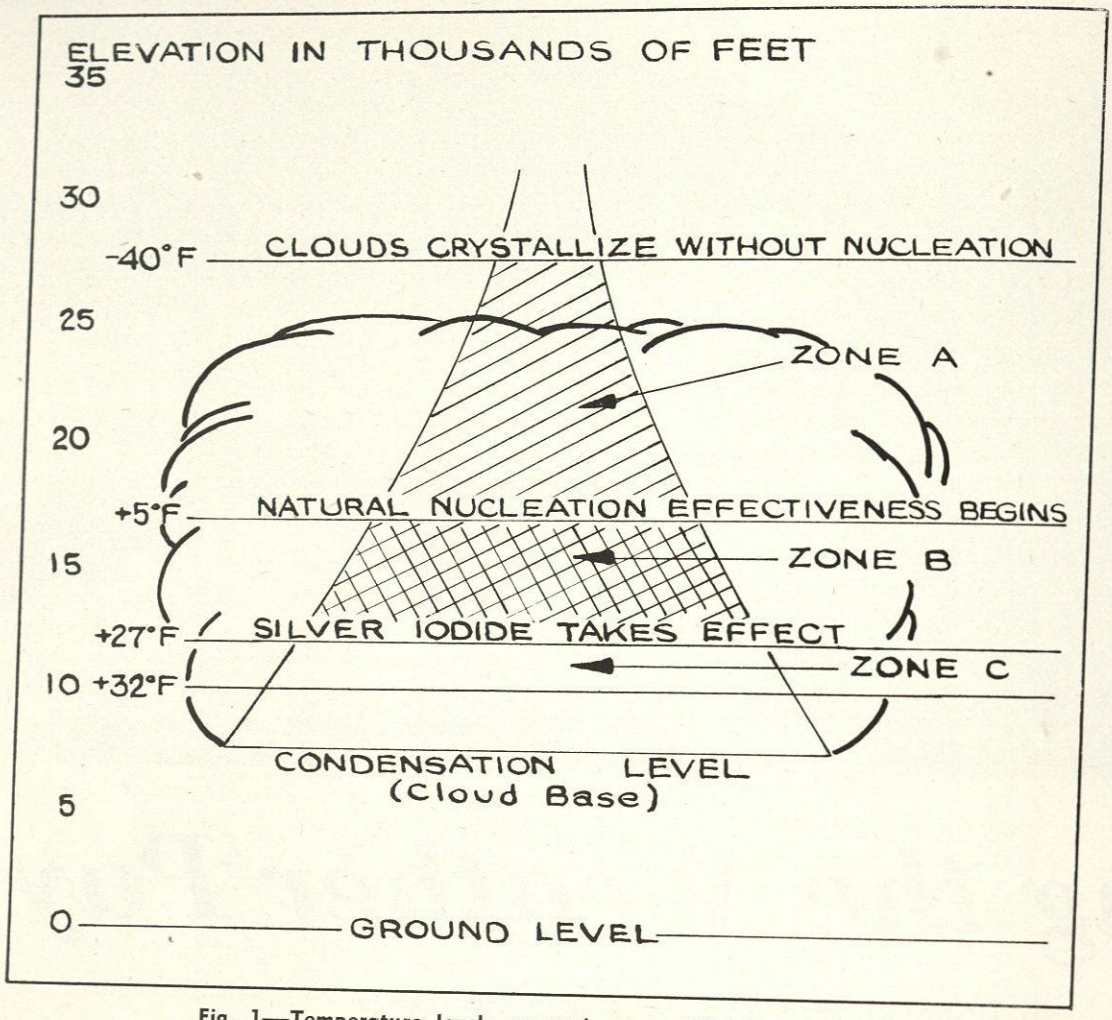
DENVER, Colorado, is the home of the biggest weather modification and meterological consultant firm in the United States. Many of us are not aware of the important part a staff of eighty people is playing in alleviating the water shortages throughout the country and in accurately predicting weather for many industries. This group offers its services to all of us in this country and even to foreign nations. The group is actually organized as two separate corporations—Irving P. Krick, Ph.D., Meteorological Consultant, and the Water Resources Development Corporation. Dr. Krick, who was formerly head of the meteorology department at the California Institute of Technology, is president of both concerns. Because of the many scientific and economic implications involved, the weather modification portion of the business will be discussed in more detail.

Water Resources Development Corporation

The Water Resources Development Corporation concerns itself with modifying the weather for the purpose of increasing rainfall and suppressing hail. Before we can appreciate the problems and methods involved in changing the weather, we must understand the importance of water as a natural resource and the need for increasing the supply of water. Water has been, and still is, what may be called a "thread of life." Many millions of gallons of water are consumed each year for drinking, cleansing and cultivating purposes; however, the most important consumer of water is industry. Water vaporized to steam drives the turbines which supply



Darrell, a 21 year old Denverite, has engaged in many activities during his four years at C.U. He has been president of the Men's Glee Club and secretary of the A.I. Ch.E., and is a member of Sigma Tau, Tau Beta Pi, Alpha Tau Omega, and Phi Lambda Upsilon. In addition, he works part time for the Bureau of Standards and is "Campus Profiles" editor on the ENGINEER *staff.*



Zone A. This portion of water content can be affected by natural nucleation.

Zone B. This portion of water content can be affected by silver iodide nucleation.

Zone C. This portion of water content is unaffected by nucleation.

Fig. 1—Temperature levels responsive to artificial nucleation by silver iodide or natural nucleation.

electrical power for all phases of industry. Water is used as a cooling agent, as a solvent, and in many other ways.

The easiest way to realize the importance of water is to ask ourselves—what would happen if suddenly the supply of water to our country was cut off? Think about it. Even the most skeptical must agree that water is a "thread of life." You may say, "That's fine, but why worry about our water supply? Is it not true that three-quarters of the earth's surface is covered with water, that even if the total available land were thickly populated, there would still be plenty of water?"

The argument is sound, but we must realize that most of the available water is salt water and cannot be used as such, either domestically or industrially. Therefore rain is the major source for these uses.

This fact brings us to the second point, the need for increasing the water supply. The population of this country is increasing steadily and likewise industry is growing rapidly. Since the rainfall patterns do not change appreciably from year to year, there will inevitably come a time of an acute shortage of usable water. We are aware, even now, of water shortages in all parts of the nation and although all are not dangerously critical, they are signposts indicating that something must be done to increase water resources.

Since we now see the problem, let us investigate the methods of Dr. Krick and his associates employ to combat this shortage. There are two possible methods for increasing the water supply: (1) distilling sea water, and (2) increasing the rainfall. The former method is costly and requires a vast distribution system to transport the water from the seacoasts to the interior. Increasing rainfall utilizes mother nature to perform the distillation and to distribute the moisture by atmospheric circulation. Nature's process, however, has a very low efficiency. Even under the most favorable storm conditions, only about 1% of the available water is precipitated. It is easy to see that if we could increase this efficiency to 2%, the amount of water that reaches the earth's surface would be doubled. This situation prompted Dr. Krick to say, "Obtaining sufficient water for all human activities no longer remains a problem. The development of storage and distribution systems to handle additional water in semi-arid areas of the world remains the principal problem to be solved."

The history of weather modification dates way back to the 1890's when dry ice was first projected into clouds as a nucleating agent. Interest in these early attempts lagged and the subject wasn't revived until 1946. The General Electric Research Laboratories under the direction of Irving Langmuir, Vincent Schaefer, and Bernard Vonnegut began vast experiments in the field.

Dr. Krick, who was then engaged in supplying in-

dustry and agriculture with interpretive weather advice, became interested in the General Electric experiments from the standpoint of applying these principles to the water problems of agriculture, industry, and commerce. Research into the practicability of cloud seeding led to the establishment of the Water Resources Development Corporation in the spring of 1950.

To understand the technique utilized by the corporation we must first visualize nature's precipitation process. In the middle latitudes much of the water is precipiated from the skies in two stages: the first stage is the formation of very small droplets by nucleation, the process by which water vapor, depending on the temperature, condenses on a particle of foreign matter such as minute particals of dust; the second stage is the agglomeration of these droplets until they are of sufficient weight to fall. When ice crystals and super-cooled liquid water droplets are found together, the ice crystals grow rapidly at the expense of the water. Often, in nature, clouds contain large amounts of super-cooled liquid water along with a shortage of crystals upon which to attach themselves. To increase this normal rainfall, some type of artificial nucleating agent must be introduced into the clouds. By experimentation, silver iodide has been found to be the most effective nucleating agent.

Explanation of the principle of artificial nucleation can be aided by the use of Fig. 1. The ordinate shows the height of a typical cloud or cloud mass on a summer day. The indicated temperatures are not the same for every storm or season; that is, in the winter they are lower, but they are reasonable for the sake of an example. The triangular area represents the proportionate water content at different levels. As observed, the higher elevation resulting in a lower temperature is the region where natural nucleation occurs. This region contains a relatively smaller amount of available moisture. The next lower region is affected by silver iodide nucleation.

In a few words, the process of weather modification consists of precipitating additional water by introducing a nucleating agent which acts in a portion of the cloud mass that is normally not affected by natural nucleating agents.

Vaporized silver iodide is entrained into the cloud masses by means of ground generators. It takes advantage of the rising air current accompanying storm passages to carry the particles into the clouds. The procedure usually followed on any project is to make exhaustive pre-operational studies, to direct the field operations, and to evaluate the results. The pre-operational studies consist of (1) studying the historical weather records in order to evaluate cloud seeding potentials for the different seasons of the year and (2) developing relationships between the cloud seeding potentialities of an area and its economy. The silver iodide generators are

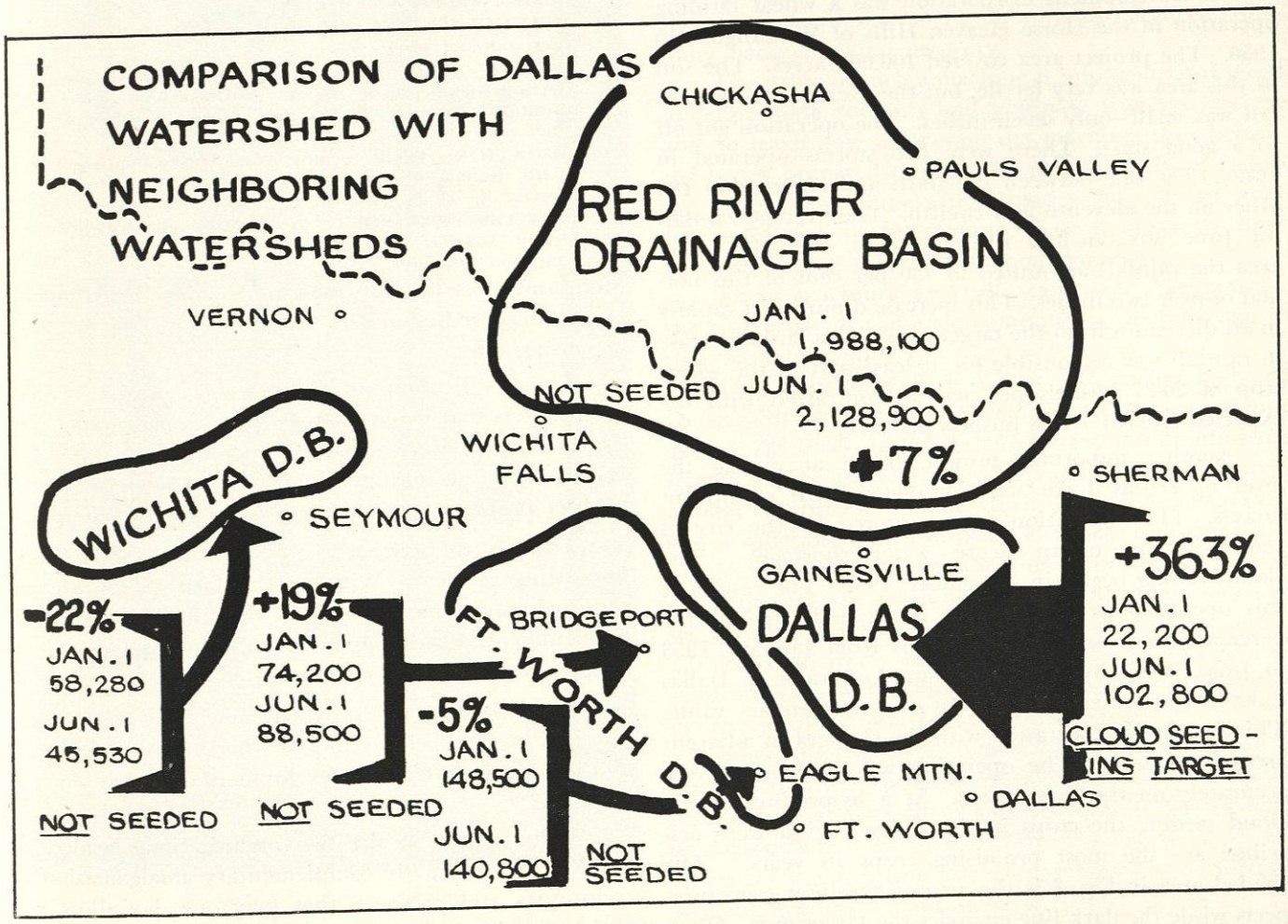


Fig. 2.

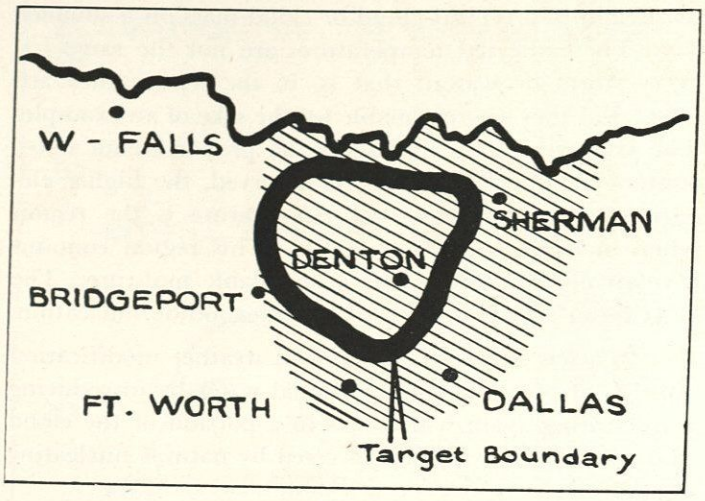


Fig. 3.

dispatched to their appropriate positions around the target area and put into action when the weather circumstances are favorable to increase natural rainfall.

This discussion unduly simplifies the operation as there are many variables that must be studied and controlled to make a project successful; but instead of delving into the detailed aspects of weather modification, the projects attempted by the corporation and the results obtained will be discussed first.

The first project undertaken by the Water Resources Development Corporation was a wheat farming operation in the Horse Heaven Hills of Washington in 1950. The project area covered 100,000 acres. The soil in this area was very fertile, but the average yearly rainfall was small—only seven inches. The operation got off to a good start. There were two storms operated in June, 1950, one between the sixth and eighth and the other on the eleventh and twelfth. The average rainfall for June was one-half inch; however, over the target area the rainfall amounted to 430 per cent of this normal or over two inches. This increase diminished rapidly in all directions from the target area. This large increase in rainfall was responsible for at least part of the wheat crop of 20-27 bushels per acre as contrasted with the expected crop of 7 to 8 bushels per acre.

Another important project aimed at raising the level of Dallas Lake was completed with significant success. (The operation was sponsored by the city of Dallas because of an acute water shortage). The cloud seeding began in November, 1952. The results of this operation as seen in Fig. 2 are indicated as the percentage increase in water supply from January, 1953 to June, 1953. By June the volume of water in Dallas Lake had increased 363 per cent over the January value. This increase as contrasted with the changes in adjacent areas is amazing. The operation was pin-ponted very accurately on the target area. As a by-product of the cloud seeding the crops in the Dallas region were described as "the most promising crops in years." The shaded area in Fig. 3 is the area of excellent crop prospects while the dark line encircles the target area. Quoting from the Field Crop Reporting Service Regular Bulletin No. 30, 1953 (McKinney, Texas, May 28, 1953):

> "A very fine crop of wheat checking over 100% or 20 bushels per acre. It is still green to yellow, most of the fields are turning color. . . .
> "This area has also one of the finest spring and winter oats crop we have seen for many years. . . ."

These two cases are indicative of the good Dr. Krick and his associates are doing. Present cloud seeding operations are being conducted in the United States, Canada, Spain, and other Mediterranean countries for the benefit of agriculture, industry, municipalities, and hydroelectric companies.

Irving P. Krick, Ph.D., Meteorological Consultant

The forecasting and interpretation of weather is handled by this group. In the middle thirties Dr. Krick and his staff at Cal. Tech., using new techniques of weather forecasting, interpreted the weather in terms of the business man's needs.

Some of the industrial applications are:

RAILWAYS: Terminal fog planning, route weather, track laying, standby planning for storms, communication and signal line protection, passenger weather service.

FILM PRODUCTION: Exterior shooting schedules, crowd calls, location selections, production planning, technical advisory service, daily operating photo transparency values.

CONSTRUCTION: Storm warnings, temperature protection for concrete molds, employment schedules for casual labor.

INSURANCE: Premium risks, statistical weather studies, weather probabilities.

MANUFACTURING: Seasonal planning, material testing (outdoor products).

POWER, HEAT, AND LIGHT: Overhead line protection, temperature trends, peak loadings, precipitation amounts, "degree day" system of planning fuel consumption.

AVIATION: Flight weather for testing, optimum path techniques for extended flight, interpretative service for charter and survey flight planning.

MOTOR TRANSPORT: Road conditions, visibility, storm activity, tempertatures for perishables, snow and ice probability.

More and more business men are turning their thoughts to weather prediction as a factor in lowering costs and increasing sales.

The justification for the existence of any business enterprise is that it must satisfy some human want. The firm outlined here is serving one of the most important and basic needs of our time—more knowledge about weather processes from forecasting to weather control.

The affinity between weather "control" and weather forecasting is clear. Without the latter . . . without thoroughgoing knowledge of what has happened, is happening and will happen in the atmosphere, cloud seeding cannot function properly.

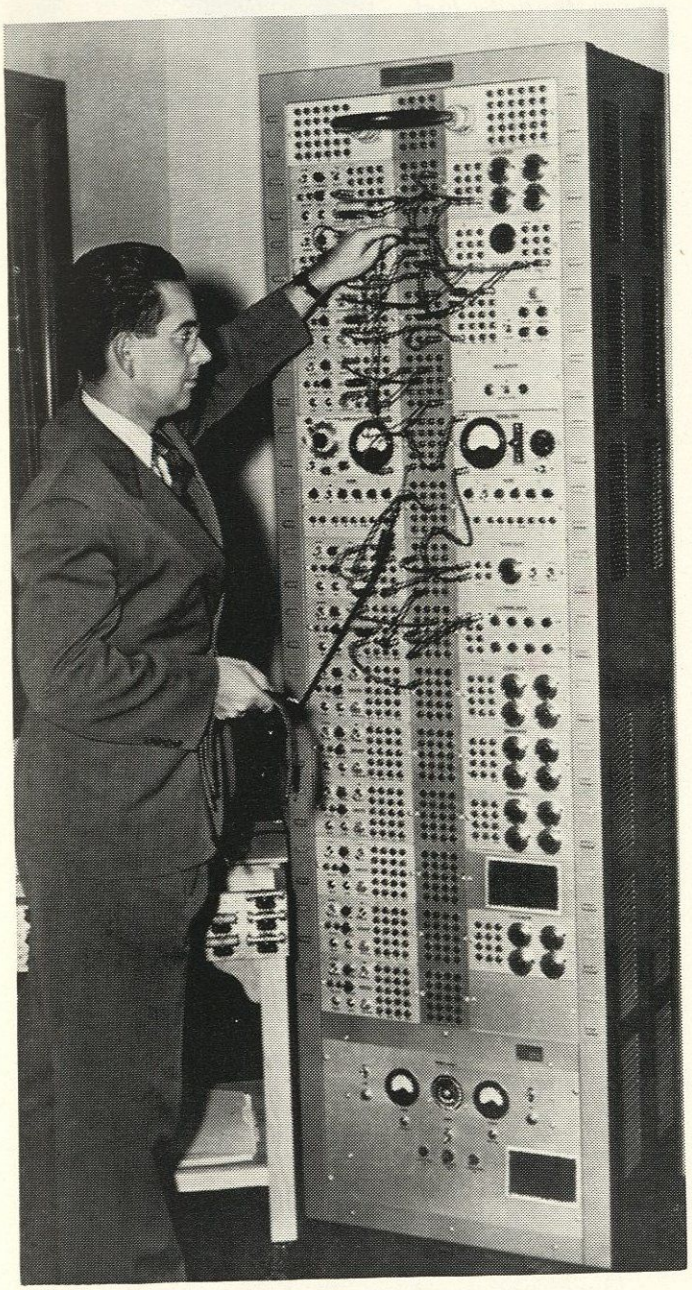
Cloud seeding has provided new knowledge of the physical process behind the weather. It has also acted as a spur to a more rapid development of meteorology as a science.

Thus we see in the two organizations headed by Dr. Krick, a mutually complementary amalgamation of techniques and processes that may one day allow you and me to *demand* and *get* the kind of weather we want!

DANGER!
110,000 MILLIVOLTS

by HERBERT C. HENDRICKSON

THIS terse warning keeps those who are unfamiliar with wiring away from the University of Colorado's new $8,000 analog computer. This electronic slide rule instead of adding distances to multiply as an ordinary slide rule does, adds voltages. This fascinating device is making possible the solution of differential and algebraic equation systems impossible to perform before its development.



Mr. Varner and the computer.
—Photo by Floyd Walters

It was built by the Boeing Airplane Company to simulate the actual physical set-up in a design problem. As an example Walter W. Varner, applied mathematics instructor and supervisor of the machine's operation, states that the variables encountered in calculations of airplane surface stress could be set up on the machine. Then, each variable (such as the movement of the rudder) could be changed over its entire range, while the effect upon the other variables was continuously recorded. Before this machine was introduced, theories of airplane design were tested on the actual airplane. Many of the theories failed, resulting in plane crashes; therefore, the development of a rigidly accurate computer became a vital necessity.

The value of such a machine is apparent. Advanced undergraduate students and graduate students will be able to learn how to operate the machine, thus becoming better prepared to meet the new demands of industry. Also, the machine will be used to do contract work for companies in the region. Several contracts have been made, and there is still room for more.

These machines are still scarce. At the present, the University of Colorado computer is the only one in this entire region.

The machine itself is 7 feet, 9½ inches high, 24 inches wide, and 18 inches deep. Upon its face are four gauges, 728 holes, 42 switches, 75 knobs, and 27 adjusting screws. Inside are 120 tubes, 20 potentiometers, 12 operational amplifiers (each of which can add or integrate), and a wide assortment of other electrical components.

Varner breaks down the time required to solve a problem with the machine this way: (1) four hours to set up the problem, wire, and pre-set the computer; (2) less than thirty seconds for the machine to give its solution; (3) thirty minutes to evaluate the graphs and meter readings produced by the computer.

The opportunity to master this amazing device is open to all. Mr. Varner teaches the accurate use of the machine in A.Math 561, a course which is offered both on campus and by extension. Here is an opportunity for students to get abreast with the present and to prepare more adequately for the future.

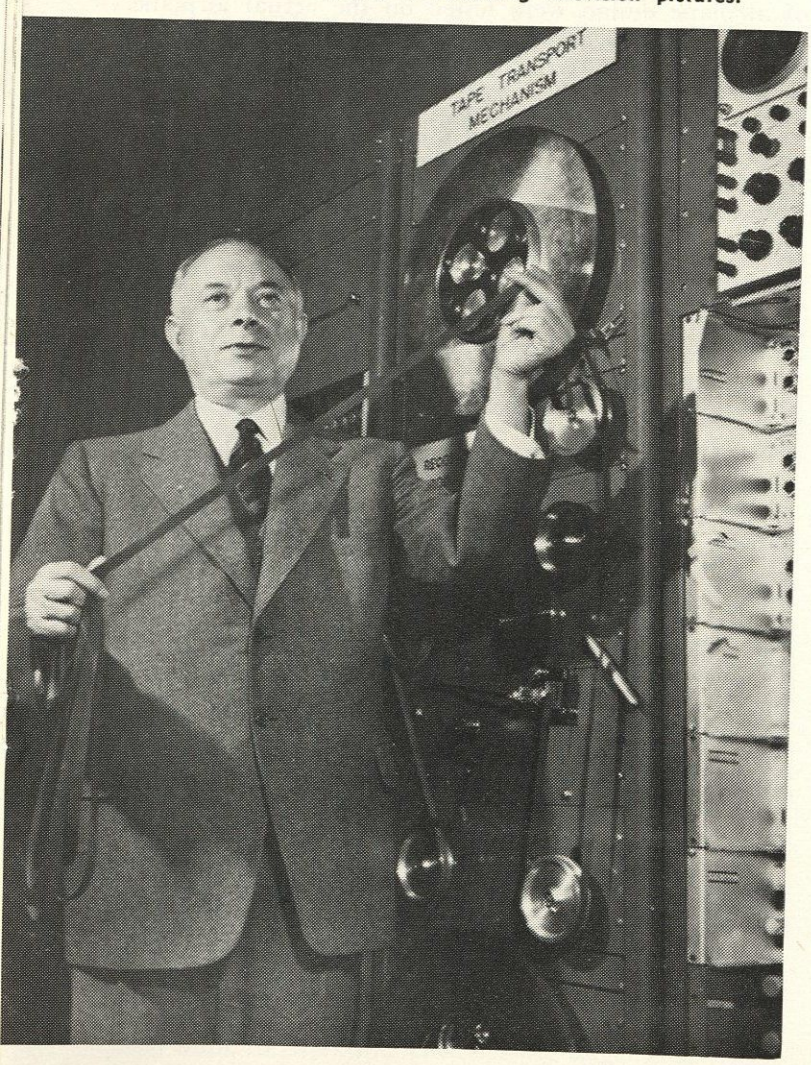
A New Era—

Electronic Photography

by SANDRA LAULAINEN, Ch.E. '57

WITH the demonstration recently of magnetic tape recordings of television, the new era of electronic photography marked its first major step. The demonstration was the first showing of both color and black and white tape recordings and was an important milestone of many years of work by Radio Corporation of America scientists. Although the demonstration was successful, several refinements will have to be made before the tape can be put into actual use—probably in two or three years.

Brig. General David Sarnoff, Chairman of the Board of the Radio Corporation of America, shows the magnetic tape which RCA demonstrated in recording television pictures.



Sandra, who is 18 years old, is originally from Minnesota, but she finished high school in Cheyenne, Wyoming. Just getting a foothold in the College of Engineering, she is a member of the Society of Women Engineers and works on the staff of the COLORADO ENGINEER.

The new tape has several advantages over the present film. The most important is that the tape requires no chemical processing. Pictures may be viewed as soon as they are taken. This advantage will be an added help to the motion picture industry, allowing them to find their mistakes in shooting a scene immediately instead of waiting for the film to be processed. Furthermore, the same apparatus that handles the recording can play the tape back as soon as it has been rewound.

In the present kinescope recording process, the television program passes from the television camera to a small picture tube where the program is photographed by a special motion picture camera. Then the film must be chemically processed and reproduced. In order to rebroadcast the kinescope recording, a television camera tube must pick up the picture from a movie projector. The kinescope method requires four separate pictures to be formed besides running into all the hazards of the television system and the photographic process. The magnetic tape recording, however, stores the electrical signals as they come from the camera, and no processing of any type is required before the playback. Only one piece of equipment is needed for the whole procedure.

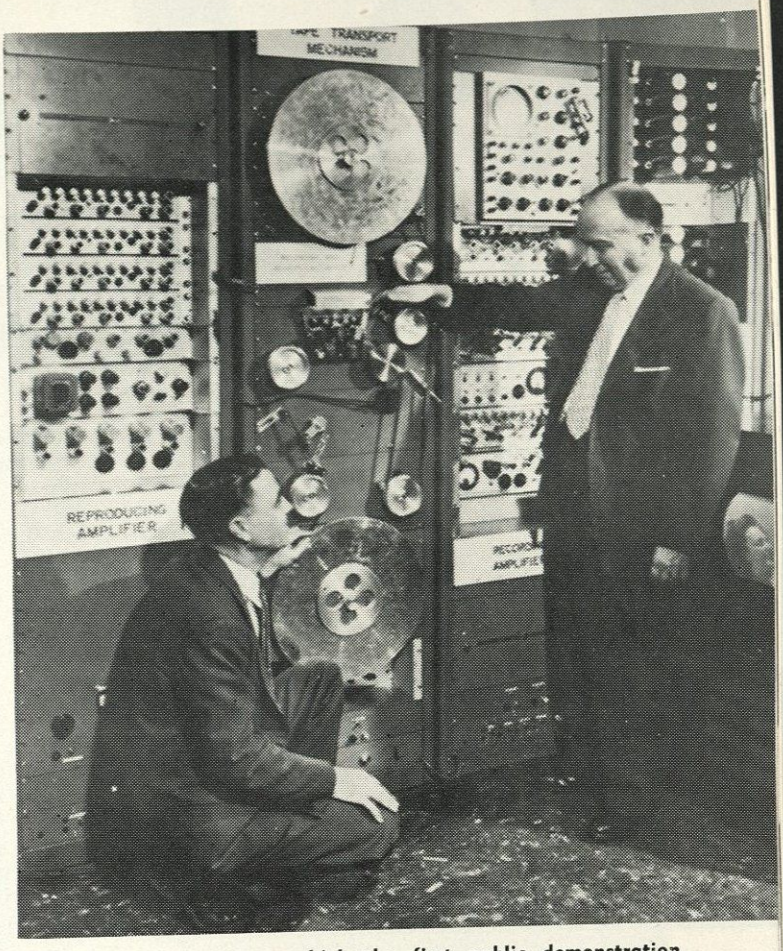
The cost of recording a TV program in color on the tape will be approximately 5% of the cost of a film in

color. Though the tape is very expensive, the fact that it can be used many times and needs no processing before playback compensates for the high cost. Recording black and white programs on film is approximately five times as costly as it would be on one-fourth inch magnetic tape, provided the tape can be reused.

The method of video recording is similar to the technique used to record music and speech on magnetic tape sound equipment. Electrical signals impressed through a recording head continuously change the magnetic polarity of the ferrous oxide particles on the tape. This forms a compact code of the original signal, and when the tape is drawn across the head for the playback, the magnetic signals on the tape cause an alternating current to flow in the windings around the reproducing head. This reproduced current closely duplicates the original signals to form the picture. In the recording of black and white pictures, two tracks are required on the tape—one is used for sound and the other for the picture. For color recordings one track for each of the primary colors is added.

At the present time, the speed of the tape is such that thirty feet per second is required. A four minute program requires a reel seventeen inches in diameter. The present aim is to develop a nineteen inch reel that can carry a fifteen minute show.

The magnetic tape has many possibilities for the future, not only in television but also in other fields. Eventually, it will be available to the public; but probably its most important uses will be in national defense, education, industry, and motion pictures. Some day it may be possible to record an entire day's programs on a single reel.



Laboratory equipment on which the first public demonstration of tape recording of both black-and-white and color television was made. Checking the apparatus are W. D. Houghton (left) and Dr. Harry F. Olson, Director of RCA's Acoustical Research Laboratory, who head RCA's seven-man research team, working towards simple and economical methods of reproducing motion pictures for television broadcasting and home entertainment.

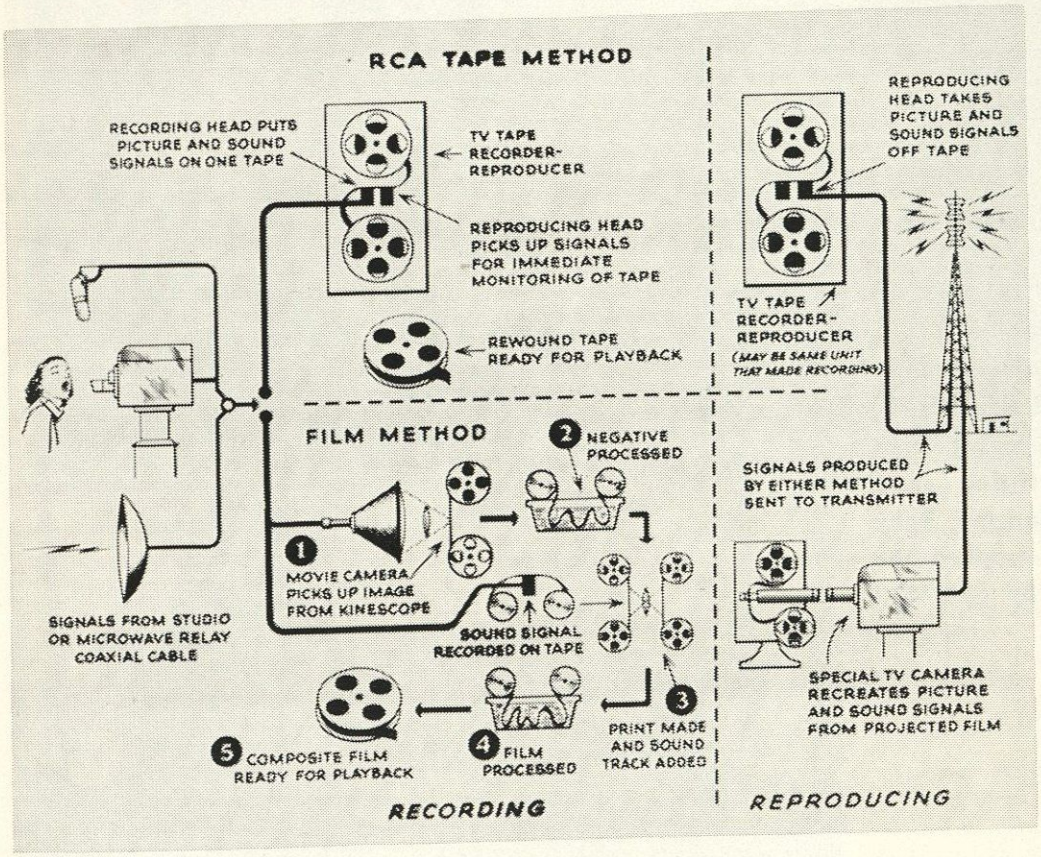


Diagram shows steps in recording and reproducing a television program by RCA video tape method as compared to typical film method used in a broadcasting station today. The recording of television pictures on magnetic tape in color and in black-and-white was demonstrated for the first time recently, at the David Sarnoff Research Center of RCA, Princeton, N.J.

—Photos courtesy RCA

—*Photos by Floyd Walters*

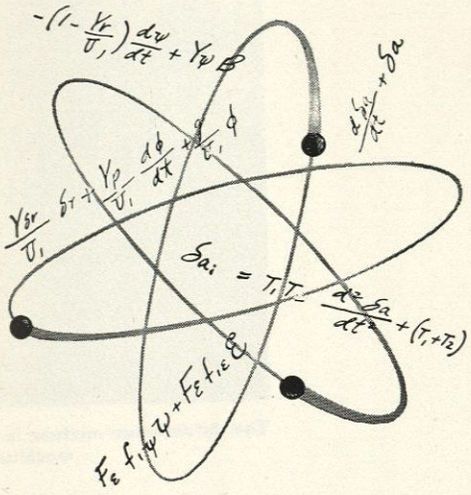
Left: The five finalists for queen of the Engineers' Ball. Left to right they are Marcia Hunt, Ginger Bonney, Barbara Janson (Queen), Prudy McCracken, and Peggy Apgar.

Below: Barbara Janson, queen of the Ball.

ENGINEERS' BALL

On the eve of Saint Valentine's Day, the engineers held their annual Engineers' Ball. The science fiction theme, A Valentine From Venus, was carried out with decorations consisting of a rocketship and several planets. Rolly Roberts and his orchestra supplied the music which was enjoyed by over 400 engineers and their dates.

Future of Automatic Controls brings new opportunities for engineers and scientists at Honeywell



As science advances, and as our country continues to develop its industrial might, the business of automatic control gets bigger and increasingly important.

For the prime force behind the 20th century revolution has been and will continue to be *automatic control.*

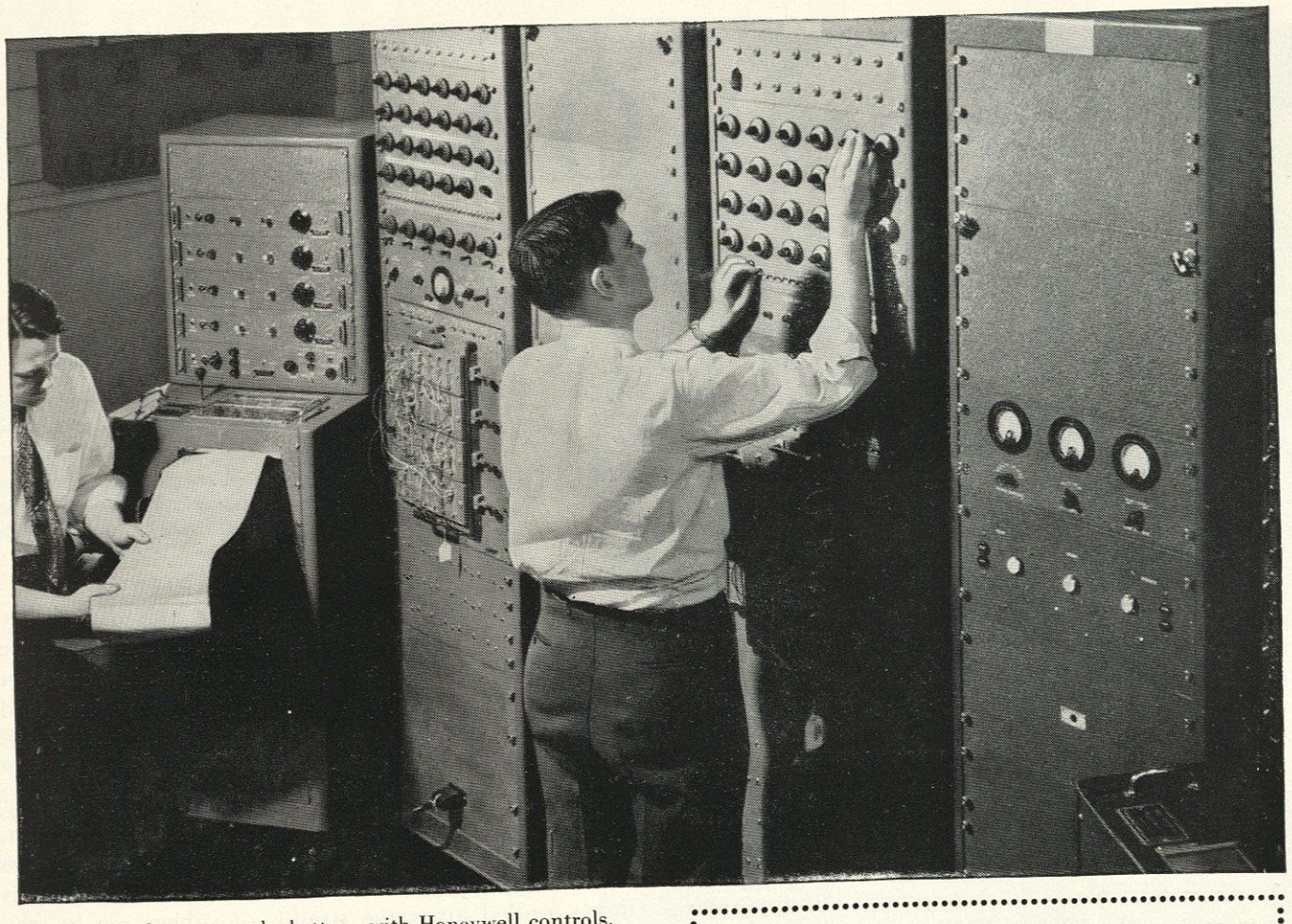
So at Honeywell, leader in this field for over 60 years, it of course means a bigger, more exciting, more challenging job ahead—all of which adds up to greater opportunities for engineers and scientists.

And that's why we're always looking for men with ideas and ambition to grow with us.

Here at Honeywell one out of ten employees is engaged in research and engineering activities.

Shown below is part of our Aeronautical Division's analog computing equipment, which helps our research engineers to develop and simulate flight tests on automatic controls for aircraft. It's typical of work being done by all of the company's eight divisions in plants across the country.

So if you're an engineer or scientist and like to use your imagination freely in such fields as electronics, hydraulics, mechanics, chemistry, physics, and a wide variety of others, be sure to send in the coupon below.



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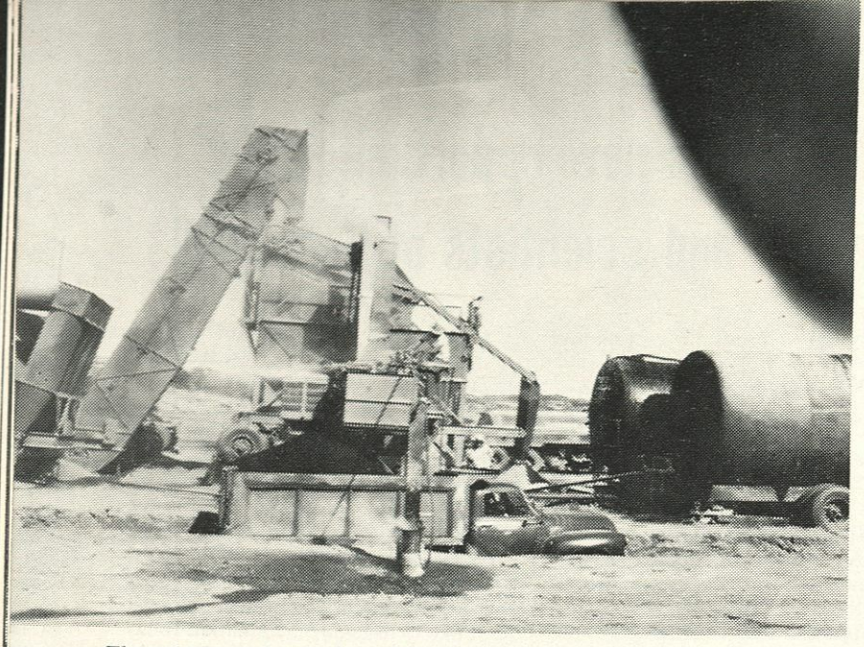
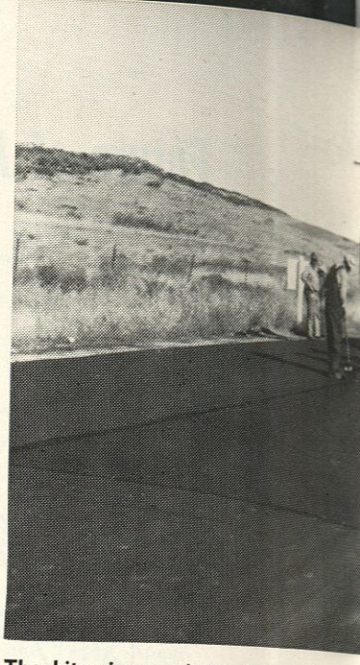


The rubber asphalt is brought to the hot mix plant, where it is mixed with aggregate and heated.



The bituminous mixture is then loaded machine which lays

A ROAD TO BOUNCE ON

by ROBERT ADELSTEIN

Roads of rubber may some day be commonplace. The rubber industry, fearing that it will have a surplus of rubber in the future, is now trying to find new uses for its product. One of the ideas has been to apply the unique properties of rubber to road construction.

Through experimentation, a rubber asphalt has been developed. This rubber asphalt consists of four per cent liquid latex and two per cent powdered rubber, mixed by a special process.

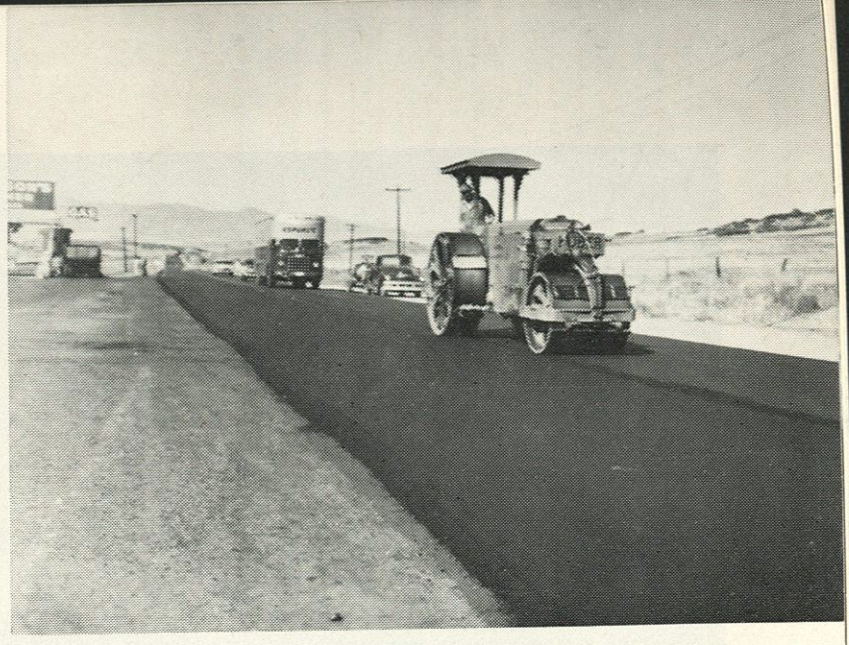
This new rubber asphalt has been found to reduce temperature susceptibility. This means that the road is more elastic in the winter and harder in the summer. The advantages of this would be that instead of getting brittle when cold and cracking under stress as the asphalt now used does, it would be more pliable. In the summer, as the temperature increases, the viscosity would decrease; therefore, instead of getting soft as present day asphalt does, the rubber asphalt would get hard making the road better and preventing water from seeping in.

Knowing that these facts are not enough to prove whether it is worth the twenty per cent cost increase over regular asphalt, many states have laid down test strips. In Colorado two such test strips have been laid down, each one mile in length. One strip is six miles south of Pueblo, and the other is on "Johnson's Corner," outside of Sedalia. The asphalt for the job was brought in by truck from the Texaco plant located at Casper, Wyoming. This rubber asphalt, by special process, is mixed so that when a heated sample of the asphalt is slowly pulled apart the strands of rubber can be seen mixed evenly throughout the asphalt.

The handling of the rubber asphalt is not any different than that of regular asphalt. It has to be heated and laid down in the same manner.

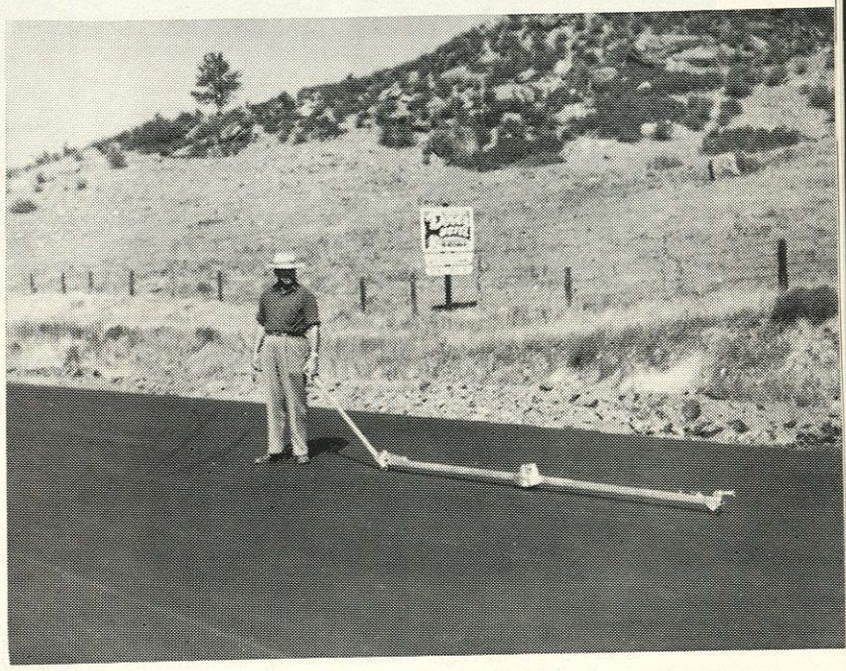
It will be about three years before the final results of the test strips will be known. If these test strips prove successful then we can expect to be driving on rubber roads in the future.

into trucks, which carries the load to this down the bituminous.



Above right—

The particles in the mixture are loose and do not adhere to each other. For this reason they must be compressed, which is done by the roller.



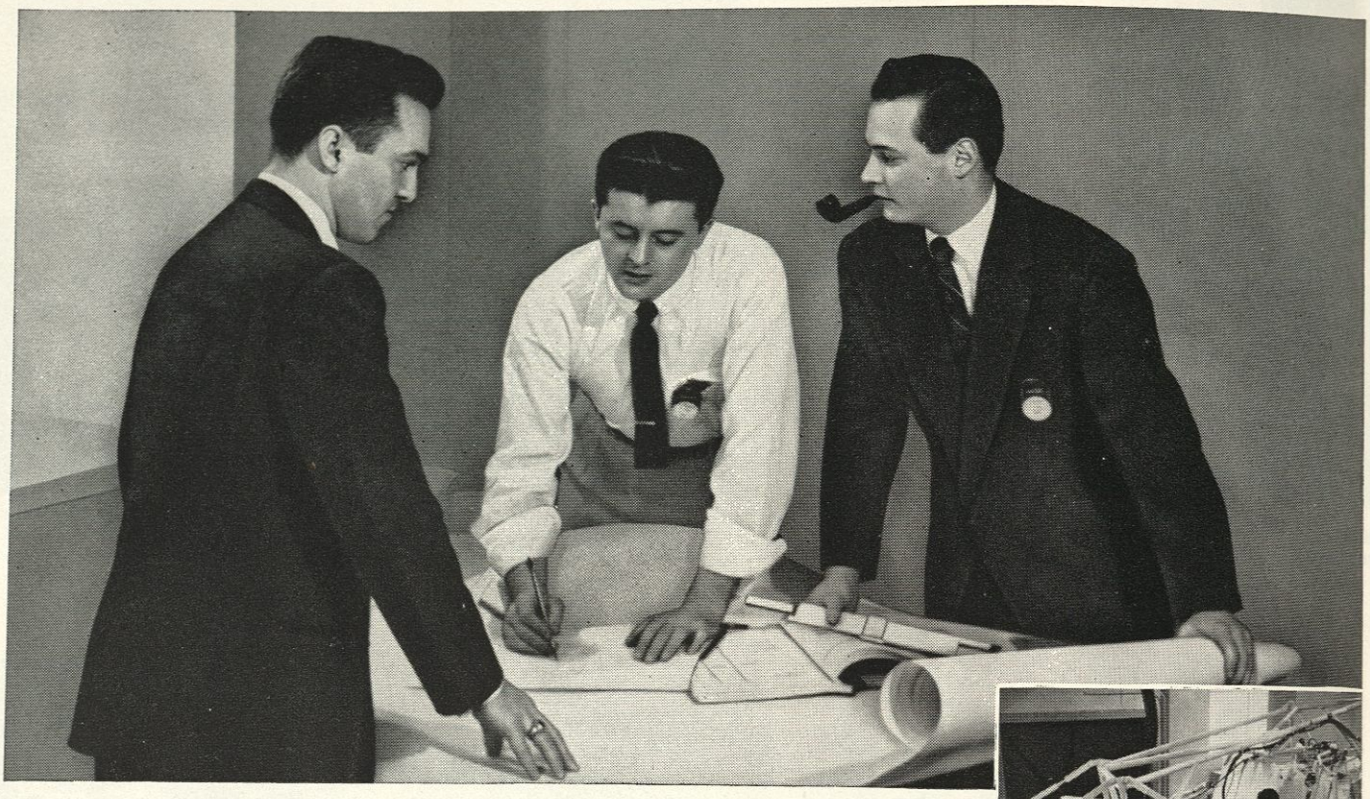
Right center—

Whether the asphalt has been rolled smooth enough or not can be measured by this instrument, the roughness indicator. As its name implies it measures the roughness of the surface of the road.

Below right—

Before the bituminous is laid down, a ring is placed in the road bed. After the bituminous has been laid down, the ring is pulled out with the sample. The sample is then tested for its specific gravity.

—Photos Courtesy of the Colorado State Highway Department



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This is the approach to engineering that Republic has successfully followed for over 22 years, and it has paid off for everyone concerned. It has made us a leader and top producer in the aircraft industry. It has provided stability, genuine opportunity, and top salaries for our engineers.

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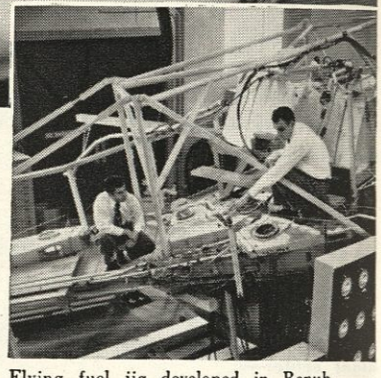
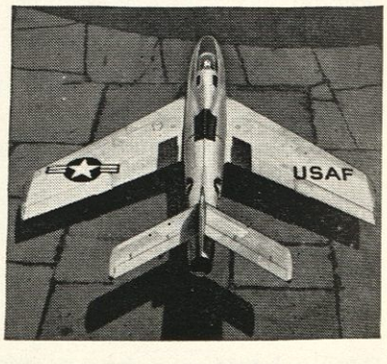


Flying fuel jig developed in Republic's laboratories to simulate actual conditions of in-flight refueling.

Analogue computer at Republic simulates flight conditions mathematically, materially shortens flight test period.

Republic's F-84F Thunderstreak, swept-wing fighter-bomber, whose performance far exceeds that of all previous types.



Brig. General David Sarnoff, Chairman of the Board, Radio Corporation of America

Sees No. 1 wish come true!

Television Tape Recording by RCA Opens New Era of Electronic Photography

In 1956, RCA's General Sarnoff will celebrate his 50th year in the field of radio. Looking ahead to that occasion, three years ago, he asked his family of scientists and researchers for three gifts to mark that anniversary: (1) A television tape recorder, (2) An electronic air conditioner, (3) A true amplifier of light.

Gift No. 1—the video tape recorder—has already been successfully demonstrated, two years ahead of time! Both color and black-and-white TV pictures were instantly recorded without any photographic development or processing.

You can imagine the future importance of this development to television broadcasting, to motion pictures, education, industry and national defense. And you can see its entertainment value to you, in your own home. There the tape equipment could be used for home movies, and—by connecting it to your television set—you could make personal recordings of your favorite TV programs.

Expressing his gratitude for this "gift," Gen. Sarnoff said it was only a matter of time, perhaps two years, before the finishing touches would bring this recording system to commercial reality. He described it as the first major step into an era of "electronic photography."

Such achievements as this, stemming from continuous pioneering in research and engineering, make "RCA" an emblem of quality, dependability and progress.

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You're sure to find the exact type of challenge *you* want in Engineering Development, Design, or Manufacturing at RCA. Men with Bachelor's, Master's or Doctor's degrees in EE, ME, IE or Physics are needed. *You'll find your optimum career work* among the hundreds of products RCA produces for the home, science, industry and Government.

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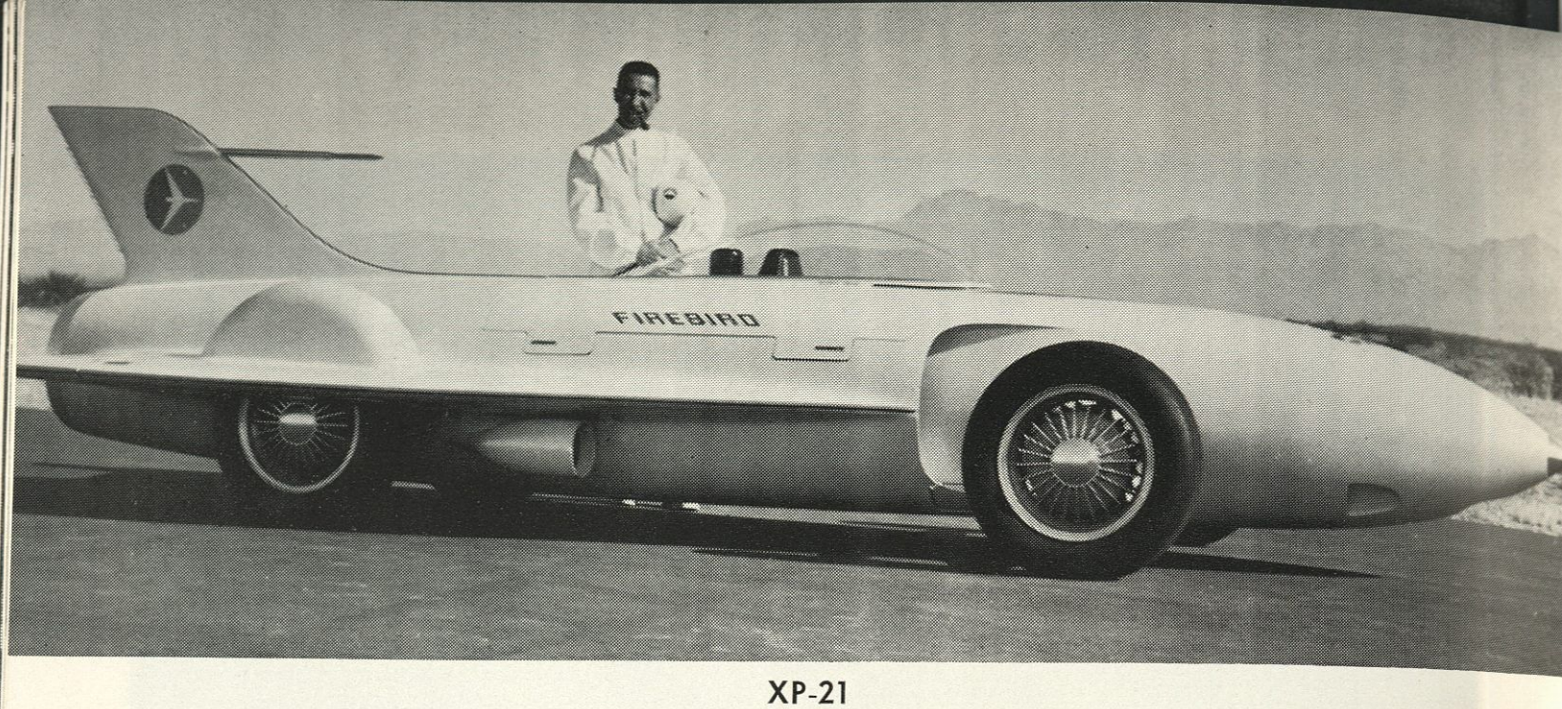
RADIO CORPORATION OF AMERICA

World leader in radio — first in television



XP-21

THIS TODAY

What Tomorrow?

Edited by DON GONGLEWSKI and BILL BOYLE

The first gas turbine automobile ever to be built and tested in the United States has been announced by General Motors. The XP-21 Firebird, a slick, white single seater with aerodynamic styling was constructed as an experiment to study the future possibilities of the gas turbine for commercial uses and to add to G. M.'s knowledge of thermodynamics.

The Firebird has a "needle" nose, delta wings swept back along the rear half of the body, a vertical tail fin and a plastic bubble over the driver's cockpit. The tail fin was a necessity in the design in order to give the body directional stability and to hold it on course when in motion. Electronically-controlled flaps on the trailing edges of the wings give the car braking stability.

The 370 H.P. Whirlfire engine weighs only 775 pounds while the Firebird's overall weight is 2500 pounds.

The power used in the Firebird comes from the turbine rather than from the thrust of exhaust gases through a tailcone as in turbo-jet aircraft. This is the major difference between an auto-motive and an aircraft turbine. A large tailcone is needed in the Firebird because of the comparatively large volume of air the gas turbines swallow, digest and expel.

In order to facilitate rapid cooling the braking system differs from conventional design with brake drums outside rather than inside the wheels.

The Firebird has an overall length of 222.7 inches, a 100 inch wheelbase, and 80 inch width at the wingtips. It is 41 inches high at the top of the plastic bubble and 55 inches high at the top of the rear vertical fin.

★ ★ ★ ★

WORLD'S LARGEST LIGHT BULB

General Electric has developed a 75,000-watt incandescent lamp bulb, half again as large as the previous largest bulb.

Its glass bulb, largest ever made, was hand blown by the Corning Glass Company.

The lamp produces 2,400,000 lumens, or units of light. To produce this amount of light would require 28,742 60-watt household bulbs, all burning simultaneously. This single light bulb uses enough electric energy to light 83 American homes as they are normally lighted today. Twenty-three of them could illuminate a major league baseball stadium according to modern standards.

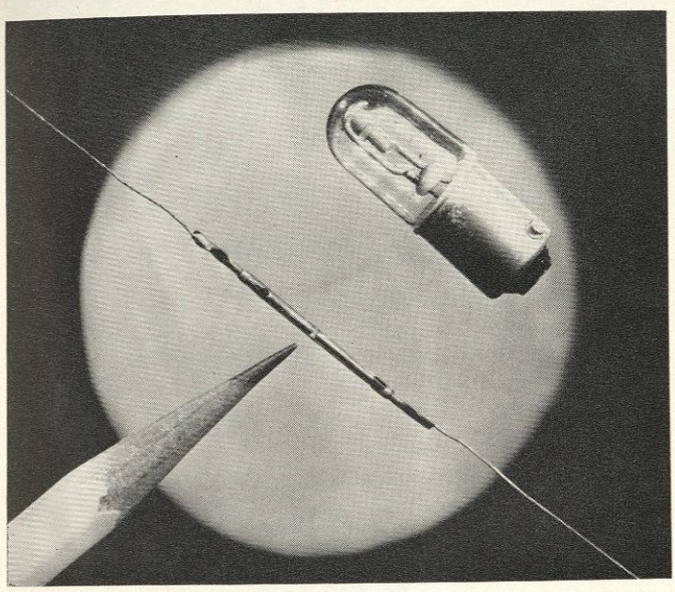
The lamp's filament alone weighs 2.7 pounds, which is enough tungsten to make the coiled-coil filaments for 67,500 60-watt lamps. The filament is made of a tungsten ingot, hammered to a diameter of three-sixteenths of an inch. It is 12½ feet long.

The huge lamp is so bright and hot that observers are advised not to look directly at it or stand close to it when it is burning at full brilliance.

LAMPS THE SIZE OF A PENCIL LEAD

A new Westinghouse light source is smaller than the head of a pin. It is a subminiature, neon-argon glow lamp and has a special job to do. Fifty of them are laid out side by side in front of a moving strip of 35-mm film for recording events in laboratory experiments where space is scant. This "lamp" is a slender glass tube 0.05 inch in outside diameter and 1¼ inches long. When a 110-volt, d-c potential is impressed across the lamp, a glow is formed in a gap 1-mm (1/25 inch) long between 0.03-inch diameter Kovar electrodes in the glass cylinder. This lamp is a contender for the title of the "world's tinest lamp."

The lamp and a tiny series resistor to limit the current—½ milliampere—draw only 1/20 of a watt. The current in the glow is but 1/30 of a watt. One of the problems in making such a tiny glow is that the volume of gas is so small that any slight contaminant has a large



effect. Even the seemingly inconsequential volume of gas contained in the bit of glass pinched off the end when the tube is sealed must be taken into account.

★ ★ ★ ★

MORE POWERFUL SEALED IGNITRONS

This new sealed ignitron mercury-arc rectifier developed by Westinghouse Electric Corporation is capable of rectifying 1000 kw at 250 volts direct current or 1500 kw at 600 volts using only six tubes, each of which is only 12 inches in diameter.

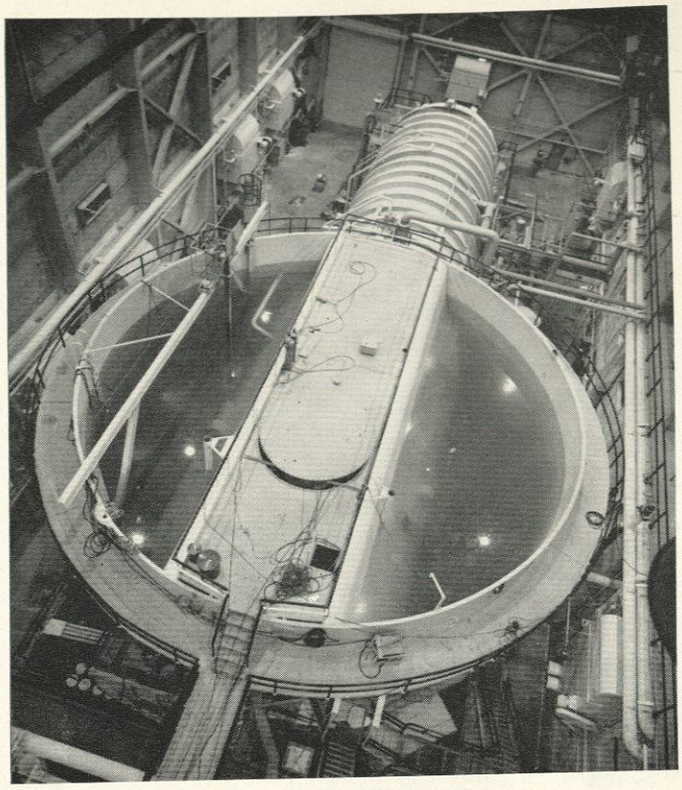
The new tubes are designed so the welds can be cut, the tube repaired, and then rewelded—a factory operation that makes the tube as good as new.

Light enough to be handled by two men and mounted in neat, compact enclosed cubicles, these new tubes simplify rectifier installations in industrial plants, mines, railways, and locomotives.

★ ★ ★ ★

LAND-LOCKED ATOMIC SUBMARINE ENGINE

The first atomic submarine engine, contained in the land-based submarine hull shown here, was generating power when this picture was taken inside the main building at the submarine thermal test site. The large sea tank is about 50 feet in diameter and almost 40 feet high. The hull passes through the tank so that the reactor compartment is located within the tank and completely submerged in water. The tank's water capacity is about 385,000 gallons. The Mark I power plant, with



its associated propulsion equipment, has been assembled in this hull much the same way the Mark II engine is installed in the Nautilus. Installation of both atomic engines in the submarine hulls was done by Electric Boat Division of General Dynamics Corporation, builder of the Nautilus.

★ ★ ★ ★

HURRICANE GENERATOR

These six-foot-long cast steel blades, each weighing two-thirds ton, are mounted in a stator section for one of five giant wind-tunnel compressors now under con-

struction at the Sunnyvale, Calif. plant of Westinghouse Electric Corporation. The compressors are for a U. S. Air Force transonic and supersonic wind tunnel at Tullahoma, Tenn. The "portholes" will receive forged-steel housings for bearing inserts in which the controllable stator blades will be mounted. Rotor blades will rotate at 600 rpm between each two rows of stator blades, creating air speeds up to 2500 miles per hour.

* * * *

FACTORY LIGHTING

Lighting experts may be observed these days carrying around large envelopes punched full of holes. These are not for airing correspondence, but for demonstrating some facts about factory lighting. By sliding a black-dotted insert back and forth, the experts can represent various numbers of lamp burnouts to be expected in a group lighting installation.

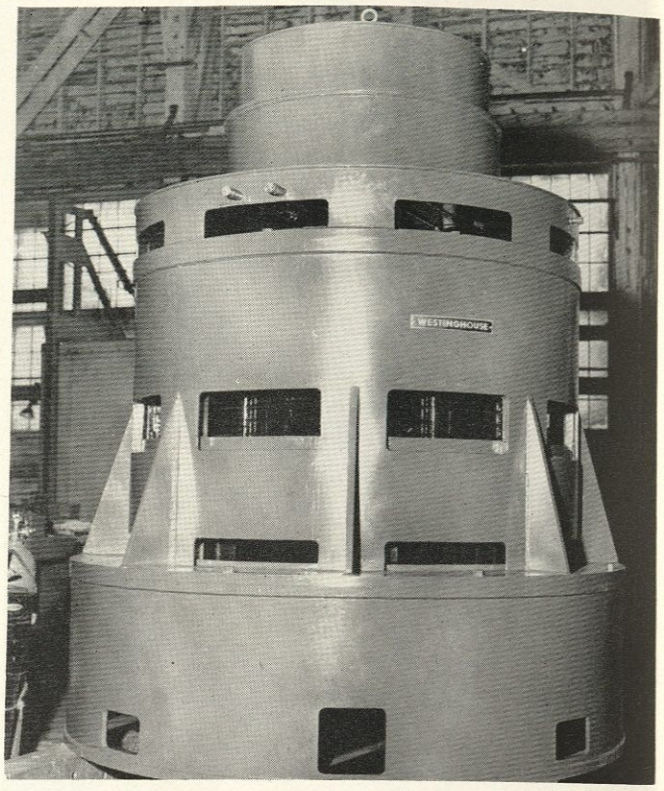
They have found that while new lamps are not expensive, replacing them can be. For example, it takes about 33 hours of a maintenance man's time to replace 100 burnouts one at a time, and an equal amount of production time is generally lost in the process. Depending on labor costs, the lamp change may be more expensive than the lamp itself.

The experts recommend that lamps be replaced in groups, saving the brighest, cleanest 20% of lamps for spares. Then replace burnouts with these spares. When the spares are gone it's time for group relamping again.

* * * *

MOTORS DESIGNED TO OPERATE THROUGH POWER INTERRUPTION

To power pumps which must continue to run even through momentary interruption of power, Westinghouse Electric Corporation produced 12 specially-designed, vertical squirrel-cage induction motors such as the one shown here. Each motor is rated 900 hp, at 585 rpm, and has a built-in seven-foot diameter flywheel. The flywheel has an energy storage of 4,260,000 pound feet, which will maintain the pump above half speed for a 15-second power interruption.



This germanium refining method keeps impurities down to less than 5 parts in a billion

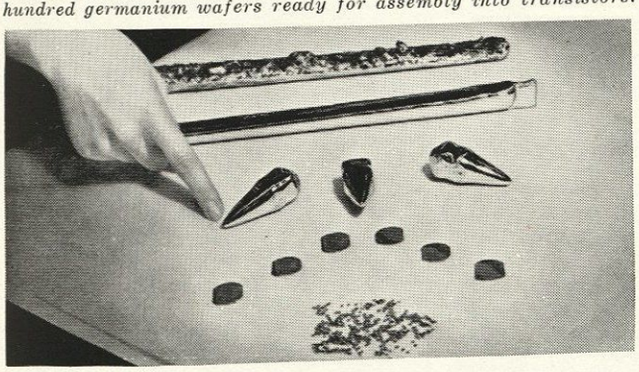
In this refining apparatus, at Western Electric's Allentown, Pa. plant, germanium is passing through multiple heating zones in tandem, producing a bar containing impurities of less than 5 parts in a billion for use in transistors. Note heating coils on the horizontal quartz tube.

A new method of metal refining, currently in use at the Western Electric plant at Allentown, results in the production of germanium that is better than 99.9999995% pure – the highest degree of purity ever attained in a manufactured product.

The need for germanium of such exceptional purity came about when research by Bell Telephone Laboratories in the field of semi-conductors led to the development of transistors, which are manufactured by Western Electric.

The transistor is a tiny crystal device which can amplify and oscillate. It reduces space requirements and power consumption to a minimum.

Various forms which germanium takes before being used in transistors are shown in this photo. Bar at top is an ingot of germanium after reduction from germanium dioxide. Next is shown the germanium ingot after the zone refining process used by Western Electric. Below the ingots are shown 3 germanium crystals grown by machine, 6 slices cut from these crystals, and several hundred germanium wafers ready for assembly into transistors.



Germanium crystals of the size required in transistors do not occur in nature; they are artificially grown at Western Electric. At this stage in transistor manufacture, other elements are introduced in microscopic quantities to aid in controlling the flow of electrons through the germanium. But before these elements can be introduced, it is necessary to start with germanium of exceptional purity, so that the impurities will not interfere with the elements that are deliberately added.

So Bell Telephone Laboratories devised an entirely new method of purification, known as zone refining, which was developed to a high-production stage by Western Electric engineers.

In zone refining a bar of germanium is passed through a heat zone so that a molten section traverses the length of the bar carrying the impurities with it and leaving behind a solidified section of higher purity. By the use of multiple heating zones in tandem, a number of molten sections traverse the bar. Each reduces the impurity content thus producing a bar which contains impurities in the amount of less than five parts per billion.

Because of the importance of the transistor in electronics, the zone refining process – like so many other Western Electric developments – has been made available to companies licensed by Western Electric to manufacture transistors.

This is one more example of creative engineering by Western Electric men. Engineers of all skills – mechanical, electrical, chemical, industrial, metallurgical, and civil – are needed to help us show the way in fundamental manufacturing techniques.

Western Electric

A UNIT OF THE BELL SYSTEM SINCE 1882

Manufacturing plants in Chicago, Ill. • Kearny, N. J. • Baltimore, Md. • Indianapolis, Ind. • Allentown & Laureldale, Pa. • Burlington, Greensboro & Winston-Salem, N. C. • Buffalo, N. Y. • Haverhill & Lawrence, Mass. • Lincoln, Neb. • St. Paul & Duluth, Minn. Distributing Centers in 29 cities and Installation headquarters in 15 cities. Company headquarters, 195 Broadway, New York City.

O-MAN PERFORMS

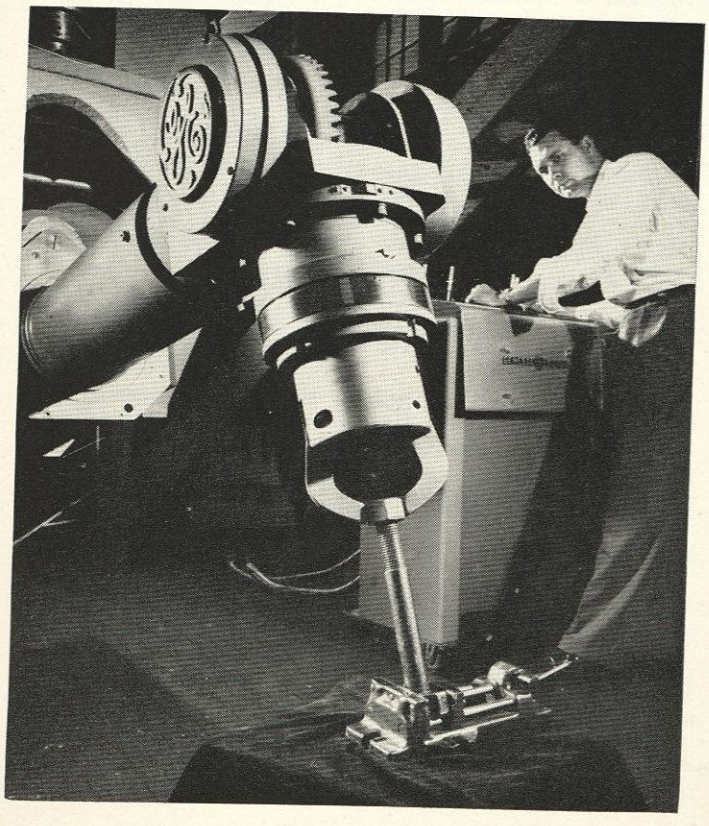
It pours liquid

O'Man (a contraction of "overhead manipulation") is the world's biggest and strongest arm. Developed by General Electric Company for the Atomic Energy Commission, O'Man weighs 15 tons and can lift 7,000 pounds; however, its touch is delicate enough to handle an egg.

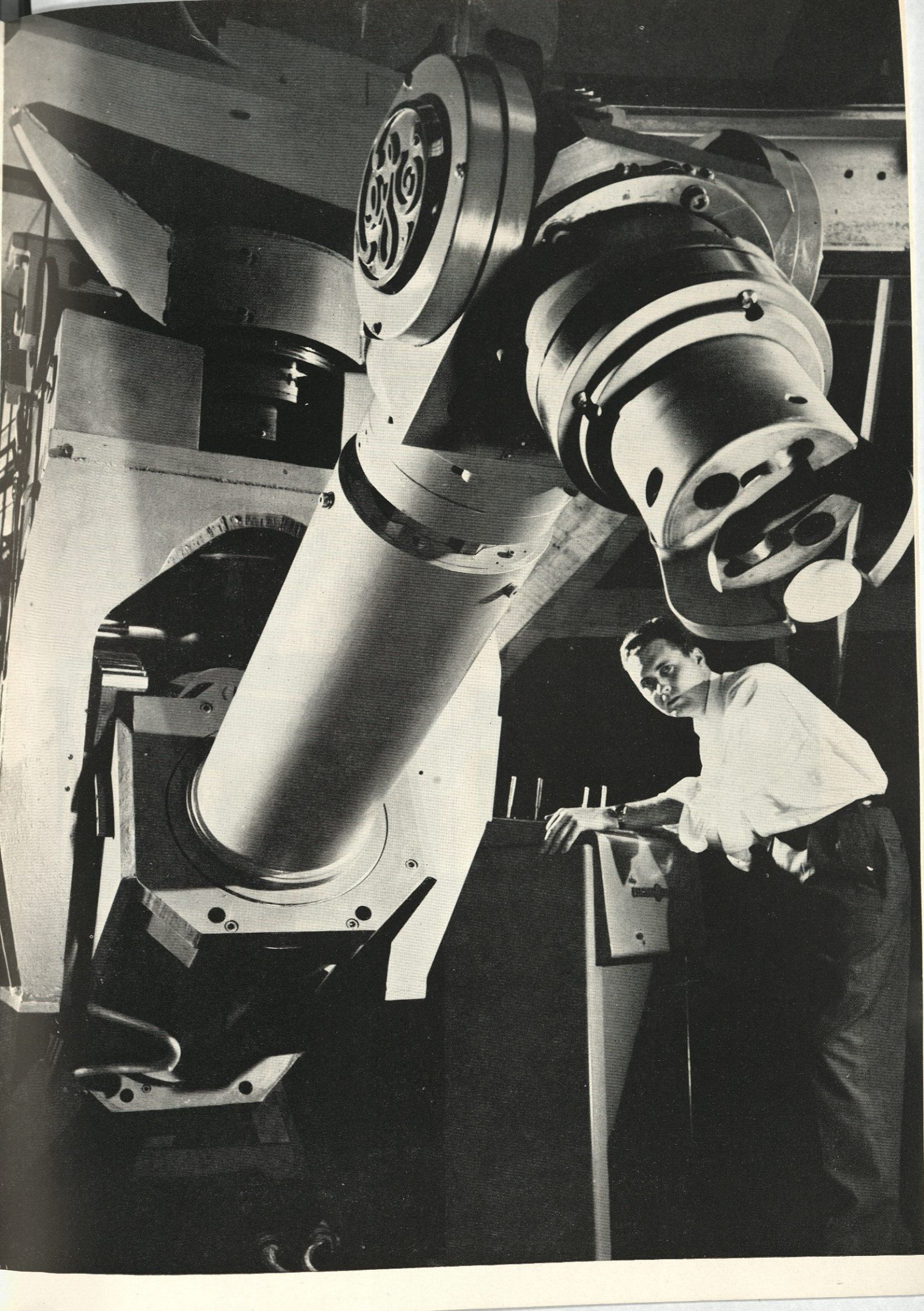
While building atomic engines scientists have needed a mechanical helping hand that could reach into dangerously radiated chambers to assemble "hot" engine parts. O'Man's job will be to supply the enormous strength needed to hoist massive atomic engine parts into place and to fit them together gently. In addition O'Man can screw small bolts in place, use power wrenches, hammers, and even saw sheet metal.

—Photos courtesy General Electric

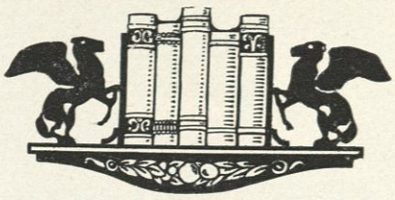
. . . turns bolts



. . . or bends steel



FOR YOUR LIBRARY . . . .



Engineering Drawing (College Outline Series)

By Josef V. Lombardo. Albert J. Lombardo, Lewis O. Johnson, and W. Irwin Short. Pub. by Barnes & Noble, Inc., $2.00

The purpose of the College Outline Series of texts in the fundamental subjects is to supply the students with self-teaching texts, in a paper binding at a reasonable price.

The authors in this case have done an excellent job in presenting the fundamental principles of drawing in simple and easily understood text material, and in most cases the illustrations are unusually large for a text of limited size. This writer could discover nothing to find fault with regarding the body of the text. Hence, I can recommend the book as an excellent self-teaching text in the fundamentals of engineering drawing—theory and practice. Inclusion of the American Standards in Drawing and Drafting Room Practice is, in my opinion, a very valuable part of this text.

It is obvious from the make-up of the text that it was prepared to be used as the one and only text in a standard course in engineering drawing. If the text is to be used in this way it must be admitted that the binding is both inadequate and unsatisfactory. Students who plan to use the book as their main text in a drawing course would do well to remove the pages from the binding, punch them properly along the left margin, and fasten them in a loose leaf binder. Another serious deficiency relates to the dimensioned drawings, and especially to those found in the problem section. It is evident that the original drawings were not prepared to be reproduced with so much reduction in size as here employed. As a result, many dimensions and notes are reproduced in a size too small to be legible.

Many students carelessly omit the axis from drawings of threaded parts. A standard text should not set for the students an example to do so, as is done in some illustrations in this text.

As usually happens in a first printing of a new text, errors may occur. It is hoped that the few errors which have been found will be corrected before a re-printing of the text.

Wm. F. Brubaker

Principles of Numerical Analysis

By Alston S. Householder. Pub. by McGraw-Hill Book Co., $6.00.

This book is another in the highly respected International Series in Pure and Applied Mathematics of the McGraw-Hill Book Company. This book should find its greatest value as a reference text for any numerical mathematician. The book is designed to lay a rigorous foundation for those who will use or are using high speed digital computing equipment. A large portion of the book is devoted to an excellent treatment of matrices and rightly so because of the wide use in machine solutions. Even the very new *Monte Carlo Method* is discussed and described. This book is one to be studied in order to be able to do the strange mathematics necessitated by high speed computing machinery. It is not an operations manual, does not deal with programming any particular machine, and is not a collection of formulas and methods. Rather it is a unified presentation that develops the mathematical principles upon which many computing methods are based and in the light of which they can be assessed. The book is written for students having no further mathematical background than calculus and all topics not ordinarily contained in courses up through calculus are developed. It is especially rich in bibliographic notes which will be of great value to any reader. The subject of error analysis is treated well in the first chapter and reference is made to it through the text where it is useful and appropriate. Non-standard notation in many places in the book makes reading difficult but in no way affects the utility of the book.

Walter W. Varner

PROGRESS OF A PROBLEM

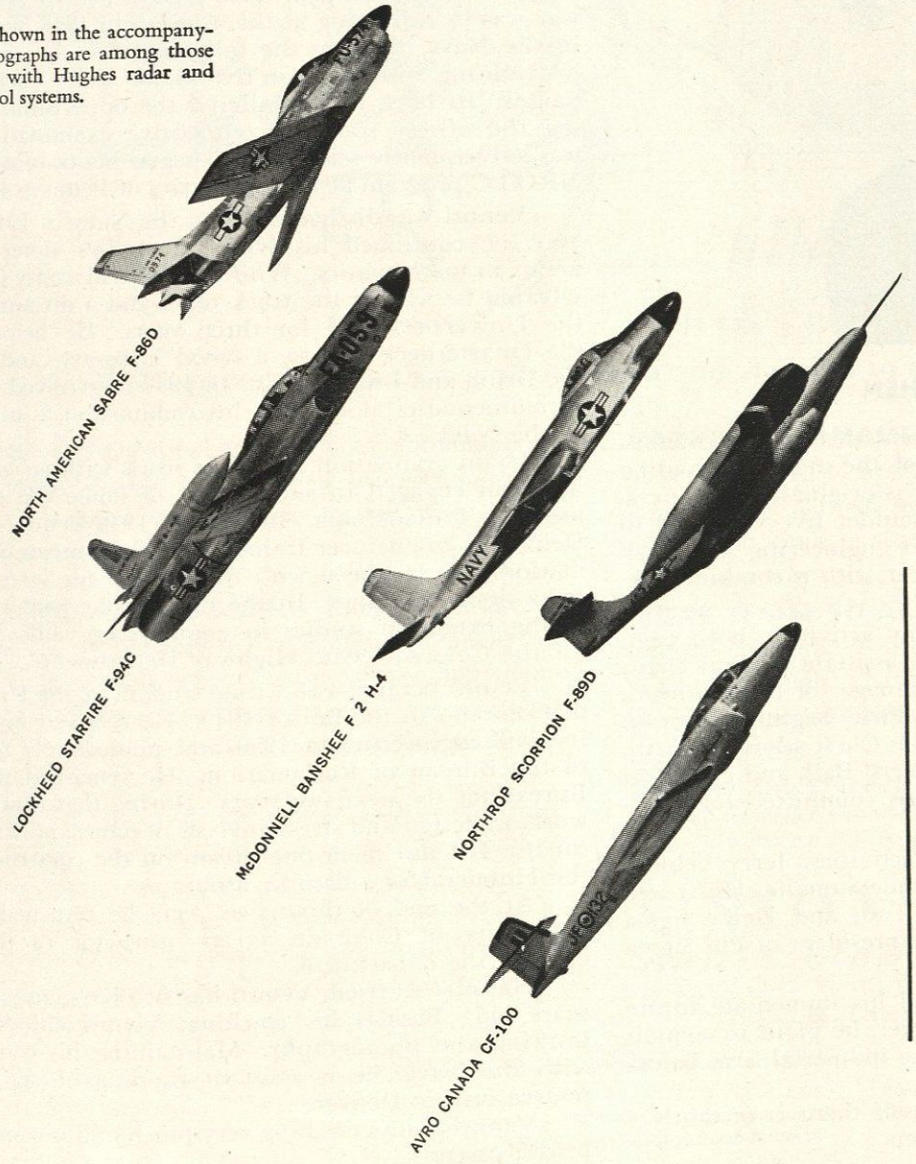
THE PROBLEM:

To design and manufacture advanced radar and fire control systems for military all-weather fighters and interceptors—equipment that must be light in weight, versatile, and capable of accurate operation day or night under extreme conditions.

At Hughes the answers to these requirements for complexly interacting systems involving advanced radar and fire control have been under continuing development from *1948* and in production since *1949*. Even more advanced systems are currently in process of development for supersonic aircraft.

Beginning with systems engineering and analysis, the military studies are initially concerned with evaluation of the strategic and tactical needs of the services in order to establish design objectives. This is followed by the analysis of problems involving noise, smoothing and prediction, multi-loop nonlinear servos, aircraft dynamics and controls, and the properties peculiar to conversion of analog information to digital quantities. From the analytic stage evolve the requirements for systems design and circuitry, designs of computing sub-systems, microwave transmitting and receiving equipment, the presentation of information to an airplane pilot, and advanced testing needed to optimize over-all system performance.

Aircraft shown in the accompanying photographs are among those equipped with Hughes radar and fire control systems.



SYSTEMS ENGINEERS

CIRCUIT ENGINEERS

Further advancements in the fields of radar and fire control are creating new positions on our Staff for engineers experienced in the fields of systems engineering and circuit design, or for those interested in entering these areas.

SCIENTIFIC
AND
ENGINEERING
STAFF

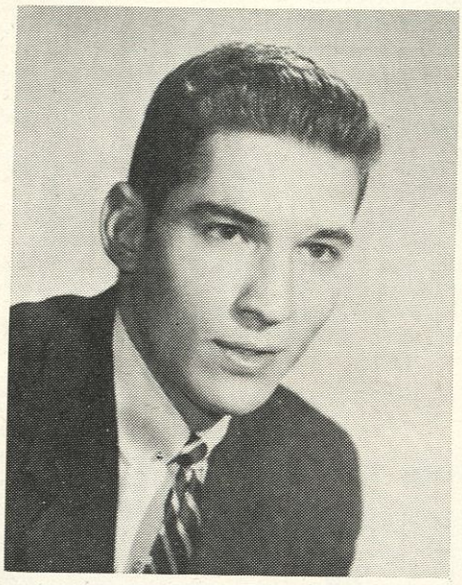
HUGHES

RESEARCH AND DEVELOPMENT
LABORATORIES

Culver City, Los Angeles County
California

Campus Profiles

by COLIN COUPER and DARRELL MACKAY



JERRY COHEN

Jerry Cohen, who is at present the finance commissioner on the A.S.U.C., is one of the most outstanding engineers on the campus. Jerry is originally from Syracuse, New York. He came to Boulder five years ago to begin his studies in aeronautical engineering and business. Jerry will graduate this year with a combined degree in those fields.

He has participated in many activities, both engineering and all-school, including assistant general chairman of C.U. Days, advertising manager of the *Flatirons,* Homecoming dance chairman, First Nighter program chairman, student advisor, Campus Chest advisory board, publicity chairman for an Engineers' Ball, and chairman of the program and convocations committee for Engineers' Days.

Along with his numerous activities, Jerry belongs to several honoraries. These include Sumalia, Heart and Dagger, Pi Tau Sigma, Sigma Tau, and Delta Sigma Phi. He was also at one time vice-president of Phi Sigma Delta social fraternity.

Jerry is in the AROTC and his immediate future involves some service time; however, he plans to commit himself to employment with some industrial firm before he begins active duty.

Wherever he may find himself there is certainly a great future ahead for Jerry Cohen.

WILLIAM J. VENUTI

William J. Venuti became an instructor in the civil engineering department in the fall of 1952. Prior to that time he served in the Navy, attended college, and worked for a time in the field.

Venuti was raised in Philadelphia, Pennsylvania, where he was graduated from high school in 1942. The war was in full swing at this time so in 1943 he enlisted in the Navy. During the following year he completed his training and served in five major South Pacific campaigns. In 1944, he was offered the opportunity of taking the officer training competitive examination. He was subsequently selected and began his training in the NROTC program at the University of Pennsylvania.

Venuti was discharged from the Navy in 1946; however, he continued his NROTC studies along with a major in mathematics. While at the University of Pennsylvania he was on the track team and a drummer with the University band for three years. He belonged to the Quarterdeck society, a naval honorary, and was in the Drum and Bugle Corps. In 1947 he received his A.B. in mathematics along with his commission as an ensign in the Navy.

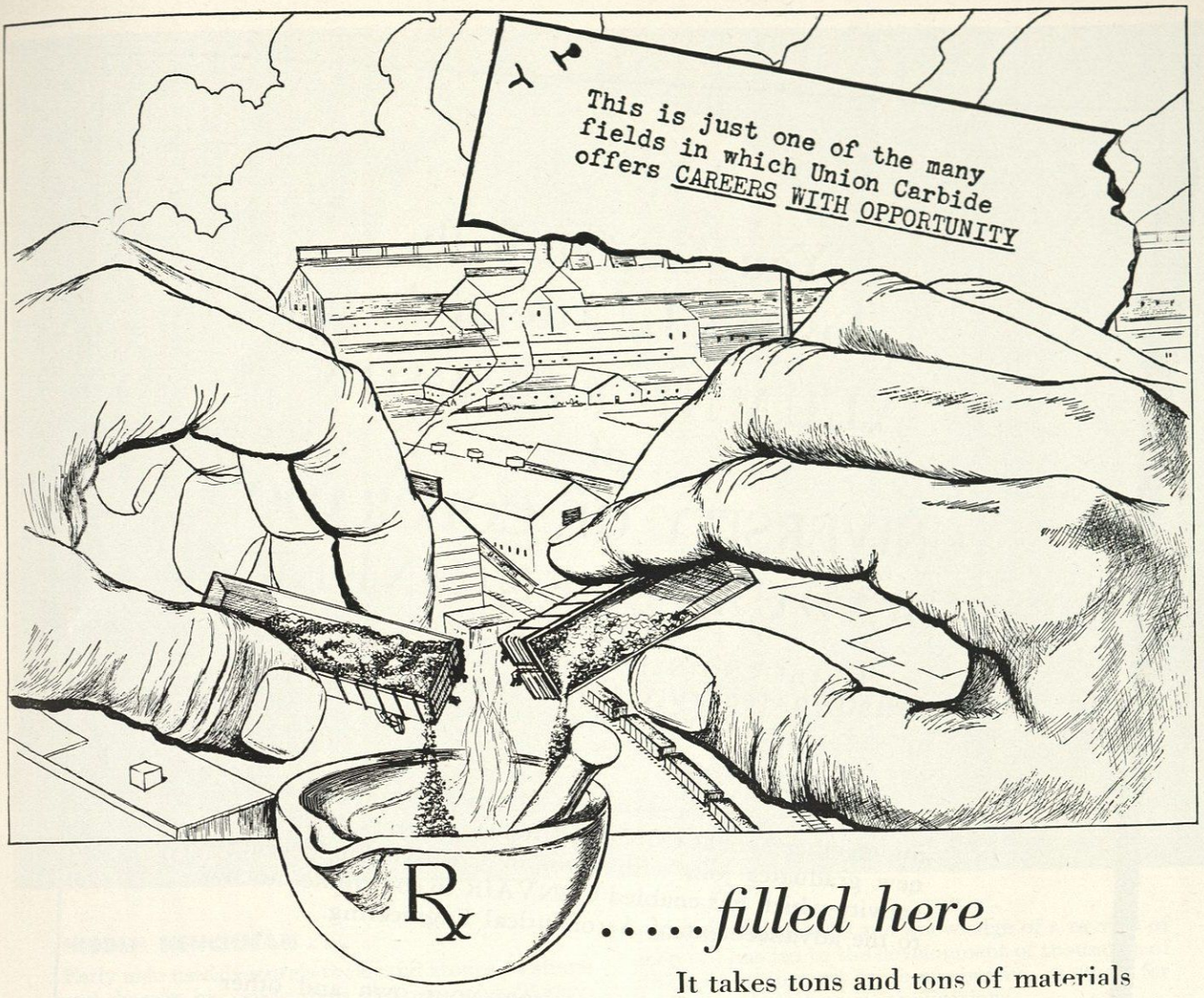
Upon graduation he began work with an engineering firm engaged in subdivision of home site developments in Philadelphia. In June of 1948 Venuti came to Denver as an engineer trainee with the Bureau of Reclamation. He has been with the Bureau for several summers since that time. In the fall of that year he began taking extension studies in engineering while working for the Colorado State Highway Department.

Venuti became a full time student at the University of Colorado in the fall of 1949. He received his degree in civil engineering in 1950 and immediately returned to the Bureau of Reclamation. He remained with the Bureau for the next two years. During that time he did work on design and stress analysis of dams and irrigation canals. He also spent one season on the construction of the Hungry Horse dam in Montana.

At the end of those two years he returned to the University of Colorado as an instructor in the civil engineering department.

Happily married, Venuti has two boys, one and two years old. Besides his teaching, Venuti enjoys woodworking and photography. Maintaining his connection with the Navy, he is assistant training officer with a reserve unit in Denver.

Venuti enjoys teaching very much and is considering it as a career.



Rx .....*filled here*

It takes tons and tons of materials to fill the prescriptions that give strength and stamina to the steel you use

THE STEEL that's everywhere—in your automobile, in trains, machines, and buildings—is stronger and more enduring because it has been treated with special "vitamins and tonics."

STEEL GETS ITS VITAMINS from the industry's "drugstores"—the plants where alloying metals are made. Here, prescriptions usually call for ingredients by the ton. Their huge "mixing bowls" are white-hot electric arc furnaces, in which temperatures reach over 3,500 degrees Fahrenheit.

These alloying metals are refined and concentrated forms of both rare and common metals. Among them are chromium, boron, silicon, tungsten, columbium, and vanadium. Individually, or together, they give steel durability, toughness, hardness, rust and corrosion resistance, and other special qualities. Chromium, for example, is the secret of making steel stainless.

VARYING COMBINATIONS of these and other alloys are added to every ton of molten steel produced today. Without them we wouldn't have the hundreds of different kinds of steel that do so much for all of us in so many ways.

MORE THAN 50 ALLOYS—The people of Union Carbide pioneered in the development and production of alloying metals. They produce more than 50 different alloys for steel and other metals that go into products that serve you.

STUDENTS AND STUDENT ADVISERS: *Learn more about career opportunities with Union Carbide in* ALLOYS, CARBONS, CHEMICALS, GASES, *and* PLASTICS. *Write for booklet K-2.*

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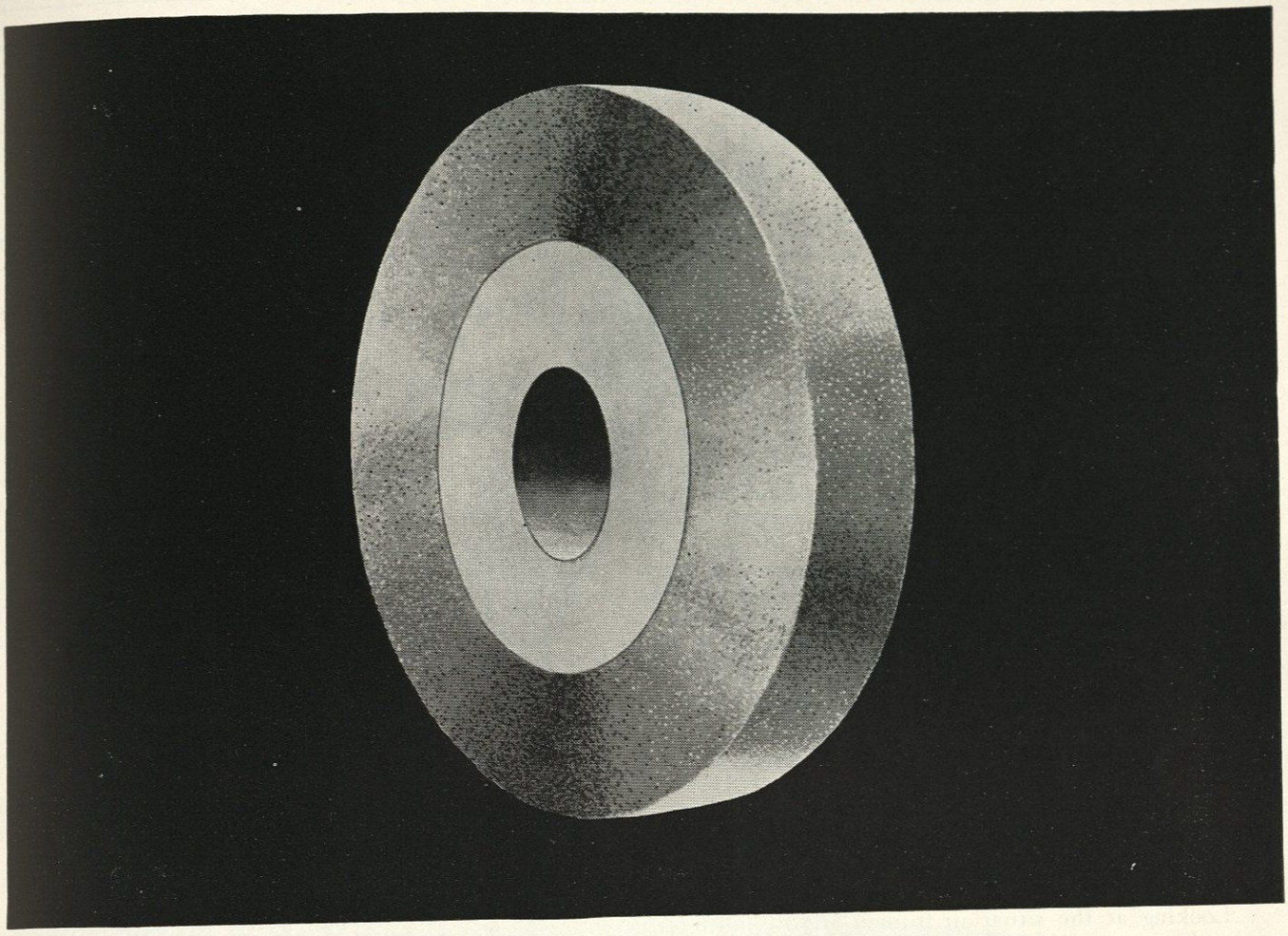

HIDDEN HENCHMAN . . .

Early man used Nature's rocks and stones to shape and sharpen his crude tools and weapons. Today, industry has at its command abrasives that will do in seconds jobs that formerly required days of tedious toil.

Yet relatively few people know or appreciate the vital labor-saving, back-stage role which abrasives play in the production of practically all mechanically finished articles.

MAN-MADE MINERALS . . .

Through the centuries man's ceaseless search for better abrasives has paralleled progress in production. Wheel-shaped sandstones replaced rocks . . . only to give way to emery and corundum, which were sieved, sized, glued to paper and cloth or bonded in pottery mixtures to form artificial grinding wheels.

But it was by the discovery of silicon carbide and crystalline fused alumina—man-made minerals from the electric furnace—that the grinding wheel became a high speed, precision production tool.

AMERICA WORKS LIKE THAT . . .

Industry's insatiable desire to improve its products and make them available at lower cost has sparked the specialized skills and knowledge of a myriad of men . . . has led to the development of thousands of different styles and types of abrasive products for innumerable industrial applications.

America can work like that because it has an all-seeing, all-hearing and reporting Inter-Communications System.

THE AMERICAN INTER-COM SYSTEM . . .

Complete communication is the function, the unique contribution of the American business press . . . a great group of specially edited magazines devoted to the specialized work areas of men who want to manage better, design better, manufacture better, research better, sell better, buy better.

COMMUNICATION IS OUR BUSINESS . . .

Many of the textbooks in which you are now studying the fundamentals of your specialty bear the McGraw-Hill imprint. For McGraw-Hill is the world's largest publisher of scientific and technical works.

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HEADQUARTERS FOR TECHNICAL AND BUSINESS INFORMATION

McGRAW-HILL FOR BUSINESS

A STUDY OF STUDENT HABITS

by PAUL BARDELL

Recently, the editors of the Around the Campus section undertook a survey of how the engineering students spend their time. A questionnaire was circulated which included such items as time spent in part time employment, studying, classes, and extra-curricular activities. The results represent the habits of about 4 per cent of the enrollment of the College of Engineering. Since this is a small percentage, the statistics shown here may be somewhat misleading. They will, however, give an indication of some of the habits of engineering students.

Some of the questions asked included:

QUESTION: How much time per week do you spend in part-time employment?

ANSWER: Freshmen: 3.8 hr.
Sophomores: 8.7 hr.
Juniors: 7.4 hr.
Seniors: 4.9 hr.

Looking at the situation from a slightly different angle, the average time that working students spend at their jobs, is indicated by the following statistics:

Freshmen: 25.0 hr.
Sophomores: 23.3 hr.
Juniors: 20.0 hr.
Seniors: 11.0 hr.

These figures in conjunction with the ones presented above, indicate that as students progress through their four years, a larger percentage of them each year hold down part-time jobs, while the hours involved go down slightly.

QUESTION: How many hours do you spend during the week in lectures, classes and labs?

ANSWER: Freshmen: 28.0 hr.
Sophomores: 25.8 hr.
Juniors: 26.8 hr.
Seniors: 23.9 hr.

QUESTION: How many hours on the average do you spend studying and preparing for classes?

ANSWER: Freshmen: 32.8 hr.
Sophomores: 21.9 hr.
Juniors: 26.5 hr.
Seniors: 23.6 hr.

The above two sets of figures indicate that the freshman spends more time in class than the other three classes do, primarily because so much of his time is spent in the drawing lab. In addition, the frosh spends a great deal of time studying because of the adjustment that he must make coming into college from high school. The sophomore has a bit lighter course load and spends considerably less time studying than the freshman, probably because of improved study habits. The junior carries a slight increase of class work compared to the sophomore. Also the junior's study time goes up sharply as he goes more into his major field and the highly technical aspects of engineering. The time spent in class by a senior drops off some from his junior year, and consequently so does his study time, but the two stay at about the same ratio to each other.

QUESTION: On the average, how many movies do you see per month?

ANSWER: Freshmen: 2.0
Sophomores: 2.6
Juniors: 3.1
Seniors: 2.2.

QUESTION: If single, how many dates did you have last semester, exclusive of Christmas and vacations?

ANSWER: Freshmen: 12.0
Sophomores: 16.6
Juniors: 26.2
Seniors: 30.0.

The above two questions were intended to be a measure of leasure time activity since they include the two major sober relaxation pastimes. The figures seem to show that the freshman does not see as many movies nor does he have anywhere near as much social life as the venerable senior who has four years of campusology under his belt. It seems normal that as the student spends more time on the campus he should have an increasing number of dates and should find time for more movies.

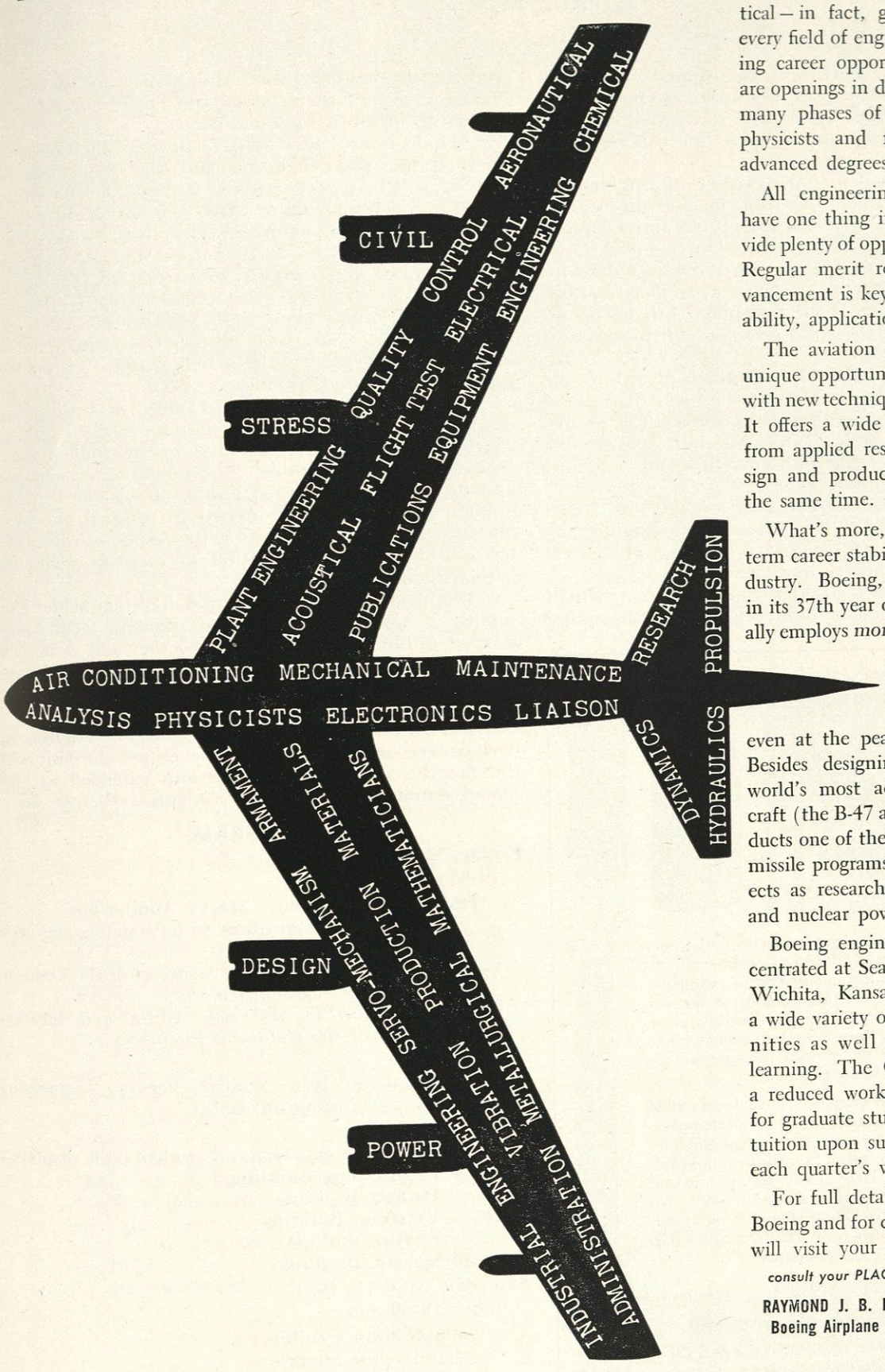
QUESTION: How many hours on the average do you spend on extra-curricular activities per week?

ANSWER: Freshmen: 6.9 hr.
Sophomores: 6.1 hr.
Juniors: 8.8 hr.
Seniors: 4.7 hr.

This last question indicates perhaps that the freshman tends to throw himself into activities in a head-long fashion while the sophomore plans his activities more so as to better utilize his time after his experience as a freshman. The junior is way out in front in activities probably because he is more interested and hence more active in the various departmental organizations such as A.S.C.E., A.I.E.E., etc. The abrupt falling off of senior participation can perhaps be attributed to "seniorittus" —a lack of interest in school affairs common to many seniors.

In conclusion, let it be reinterated that the figures in this report may be misleading because of the small sample of information obtainable. However, for the most part, the findings presented here show some interesting facts about the engineering student here at the University of Colorado.

Engineers of virtually EVERY type are needed on the Boeing team



Mechanical, electrical, civil, aeronautical – in fact, graduates in virtually every field of engineering–find rewarding career opportunities here. There are openings in design, research, in the many phases of production, and for physicists and mathematicians with advanced degrees.

All engineering careers at Boeing have one thing in common: they provide plenty of opportunity to get ahead. Regular merit reviews are held. Advancement is keyed to your individual ability, application and initiative.

The aviation industry offers you a unique opportunity to gain experience with new techniques and new materials. It offers a wide range of application, from applied research, to product design and production, all going on at the same time.

What's more, you can expect long-term career stability in the aviation industry. Boeing, for instance, is now in its 37th year of operation, and actually employs more engineers today than even at the peak of World War II. Besides designing and building the world's most advanced multi-jet aircraft (the B-47 and B-52), Boeing conducts one of the nation's major guided missile programs, and such other projects as research on supersonic flight, and nuclear power for aircraft.

Boeing engineering activity is concentrated at Seattle, Washington, and Wichita, Kansas – communities with a wide variety of recreational opportunities as well as schools of higher learning. The Company will arrange a reduced work week to permit time for graduate study and will reimburse tuition upon successful completion of each quarter's work.

For full details on opportunities at Boeing and for dates when interviewers will visit your campus,

consult your PLACEMENT OFFICE, or write:

RAYMOND J. B. HOFFMAN, Admin. Engineer
Boeing Airplane Company, Wichita, Kansas

BOEING

ENGINEERS' DAYS

by PAUL McMATH

Engineers' Days, 1954, will be ushered in on the campus of the University of Colorado at 10:40 a.m., Friday, May 14, when classes are disrupted and the College of Engineering annual open house is officially started.

Students and faculty of the College of Engineering will congregate in Macky Auditorium for the annual Engineering Honors Convocation at 10:45 a.m. Clarence L. Eckel, Dean of Engineering at the University of Colorado, will present achievement awards and scholarships to outstanding engineering students, as well as recognition keys to the officers of the Combined Engineers and staff members of the *Colorado Engineer* for meritorious service.

The Colorado Engineering Council Award to the outstanding senior engineer is to be presented by a representative of that organization to one of three seniors chosen by students and faculty for their exceptional achievements in the fields of leadership and academic endeavor as undergraduates.

Guest speaker at the convocation will be Alfred Ryan, head of the Alfred Ryan Consulting Engineering firm of Denver, who will deliver a message of general interest to students, faculty, and visitors.

Friday afternoon activities will include softball games and other contests culminating interdepartmental rivalries of the past year, and giving the students a chance to forget their books and enter into the good fellowship of mutual association.

"Open house" of all the facilities of the College of Engineering, ROTC units, and the Department of Physics, will be held from 7:00 to 10:00 p.m. on Friday, May 14, and from 9:00 to 12:00 a.m. on Saturday, May 15. Laboratory equipment as well as special student-built exhibits may be seen in operation, and all interested persons are cordially invited to attend and take part in this as well as all of the activities of Engineers' Days.

The Colorado State high school track meet will also take place Saturday at the University stadium. Colorado's best prep athletes will perform in competition for awards and trophies.

In conjunction with the College of Engineering, the Engineering Experiment Station is again offering five four-year tuition scholarships to outstanding seniors in Colorado high schools. A competitive examination will be given to interested applicants. Those with the highest grades are to be invited to personal interviews on Saturday morning, May 15, the results of which will be used in the final selection of those to whom the scholarships will be offered.

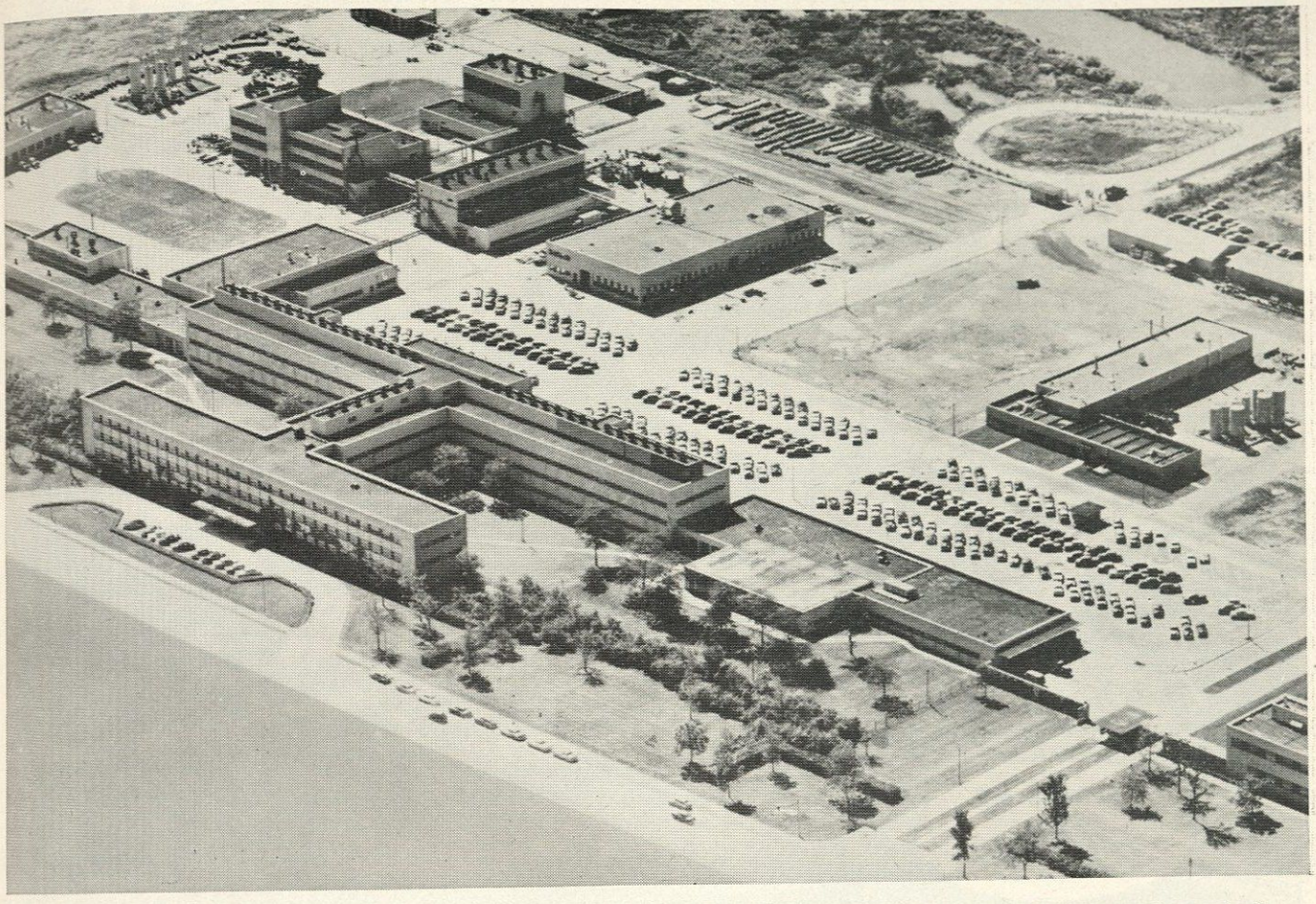
Engineers' Days is an annual tradition at the University of Colorado, giving the students, faculty, and general public a chance to get together and review the educational processes and facilities which have helped to train the men and women in one of society's most important and respected professions—Engineering.

Dean C. L. Eckel and the College of Engineering invites everyone to attend all the events and visit with the faculty, with special invitations extended to high school seniors and parents of students.

PROGRAM

Friday, May 14, 1954
10:45 a.m.
Honors Convocation - Macky Auditorium
Awards and recognitions to outstanding engineering students.
Presentation of the new members of the Combined Engineers Committee.
Presentation of the new editor and business manager of the *Colorado Engineer*.
Afternoon:
Softball and other contests between engineering students - intramural fields.
7:00 - 10:00 p.m.:
Open house exhibits and student-built displays—
Engineering Building I
Hunter Building
Ketchum Building
Physics Building
Service Building.

Saturday, May 15, 1954
9:00 - 12:00 a.m.:
Open house exhibits
Scholarship interviews
High School Welcoming.
Afternoon:
State High School Track Meet.



MOST OF THE RESEARCH WORK that led to the development of Ultraforming—a more efficient and economical refining process—took place in the Whiting research laboratories of Standard Oil, above. Extensive studies in seventeen research-scale units demonstrated the merits of cyclic regeneration.

Standard Oil scientists develop **Ultraforming--** the latest in catalytic reforming

After several years of research, Standard Oil scientists have developed a new and important refining process—Ultraforming.

The process is a better way of improving the low-octane straight-run gasoline found in crude oil. To make such gasoline suitable for present day cars, refiners must change it into an entirely different material, which gives good anti-knock performance. The change is known as reforming.

Ultraforming is the last word in catalytic reforming. It gives greater yields of higher octane gasoline than were previously possible and gets good results even with poor feed stocks. In addition, it raises the yield of hydrogen, an increasingly valuable by-product of catalytic reforming.

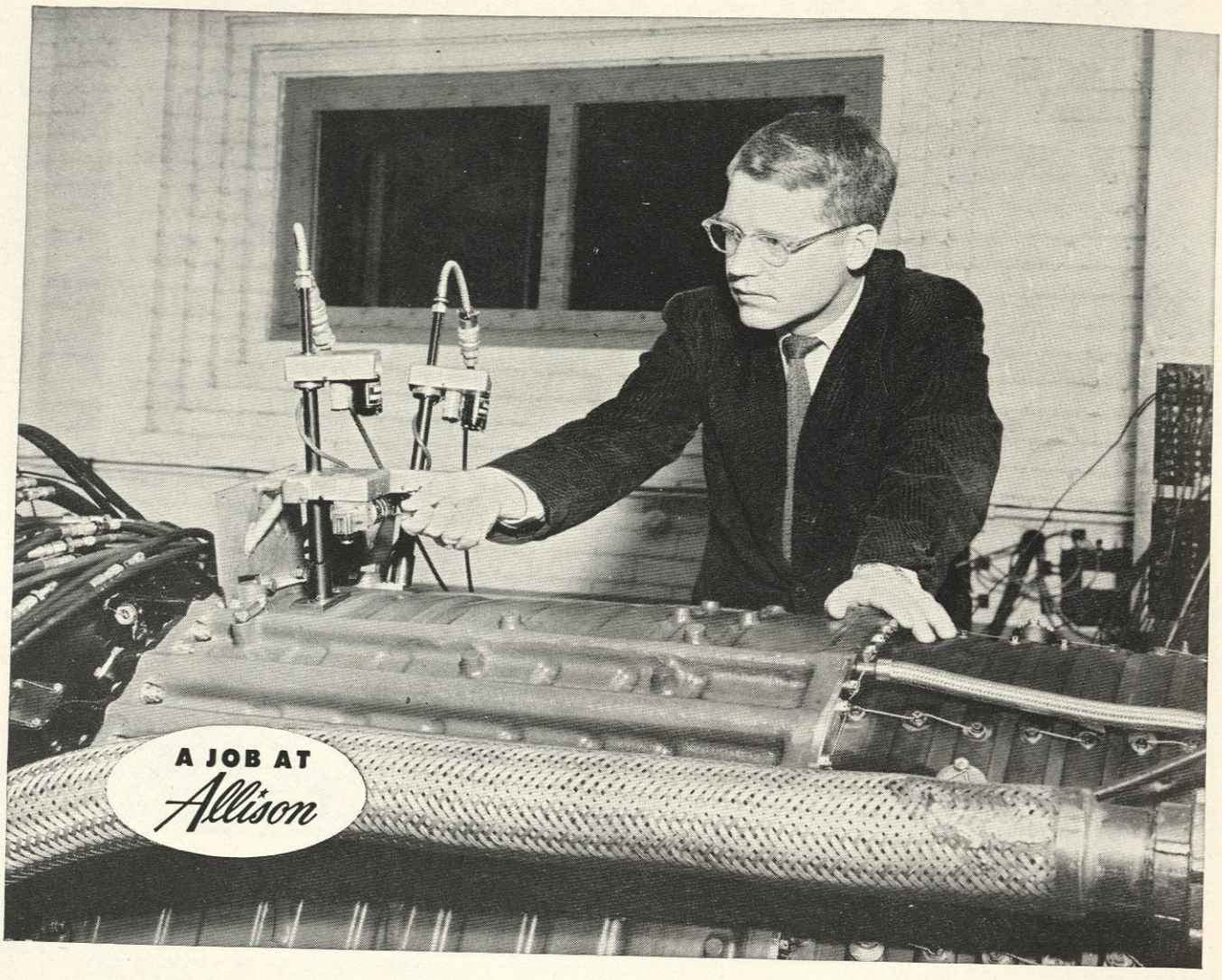
Ultraforming units do not have to be shut down when the catalyst begins to lose activity through use. By a new technique, an improved platinum catalyst is regenerated to maintain peak performance.

The advantages of Ultraforming over previous methods are so great that Standard Oil and its subsidiary companies are building units at four refineries. They will start operating this year. The new process, of course, is available to the petroleum industry through licensing arrangements.

At Standard Oil, young engineers and chemists work with the stimulating knowledge that they are participating in important and lasting contributions to the oil industry and to their country.

Standard Oil Company

910 South Michigan Avenue, Chicago 80, Illinois



● Donald L. (Don) Dresser was a Physics Major at Beloit, class of '50. He was a member of Sigma Chi; played basketball, and shot golf in the 70's. He received his Masters from the U. of Wisconsin in 1951.

Before coming to Allison something over a year ago, Don was recalled to military service and served another 16 months in the Navy.

Now, he is a specialist in the instrumentation and electronics group at Allison. Don was assigned a problem in studying the air flow through jet engine compressors with a hot wire anemometer. It was his job all the way, working with the vendor in supplying necessary equipment which was developed to study rotating stall in axial flow compressors.

Don is shown making an adjustment on one of the probe actuators of the anemometer on a jet engine in a test cell. Cables from the anemometer lead to the control room panel where results are recorded and studied.

The very nature of Allison business continually presents a variety of challenging problems to the engineering staff, which—along with the Mechanical Engineers, Aeronautical Engineers, Electrical Engineers, Metallurgical Engineers, Chemical Engineers and Industrial Engineers—includes quite a few majors in Math and Physics like Don.

Allison needs more technically trained people, especially young graduate engineers to help handle the increasing work load in a field where future development is unlimited. Why not plan NOW for your engineering career at Allison, the only manufacturer whose jet engines have accumulated over three million hours in the air!

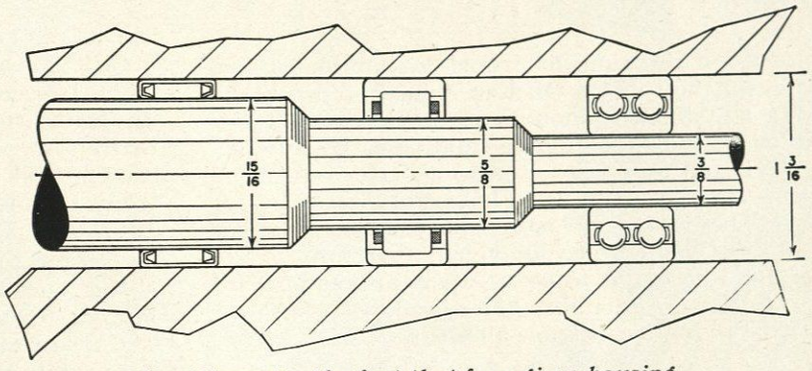
For further information about YOUR engineering career at ALLISON, discuss it with your Placement Counselor and arrange for an early interview with the ALLISON representative the next time he visits your campus. Or, write now for further information: R. G. Greenwood, Engineering College Contact, Allison Division, General Motors Corporation, Indianapolis 6, Indiana.

Allison **DIVISION GENERAL MOTORS CORPORATION • Indianapolis, Ind.**

Design, development and production—high power TURBINE ENGINES for modern aircraft . . . heavy duty TRANSMISSIONS for Ordnance and Commercial vehicles . . . DIESEL LOCOMOTIVE PARTS . . . PRECISION BEARINGS for aircraft, Diesel locomotives and special application.

The Torrington Needle Bearing
is designed for high radial loads

The many lineal inches of contact provided by the larger number of small diameter rollers give the Torrington Needle Bearing an unusually high load rating. In fact, a Needle Bearing has greater radial capacity in relation to its outside diameter than any other type of anti-friction bearing.

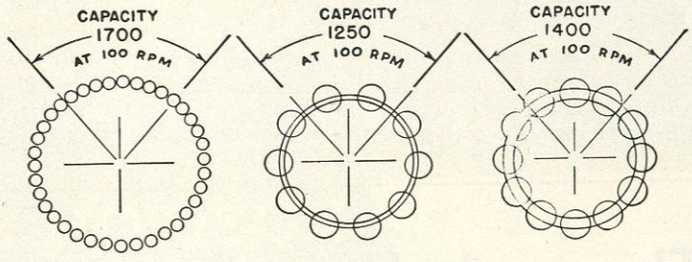


1. *Illustrates the fact that for a given housing bore size, a larger and, therefore, stiffer shaft can be used with Needle Bearings than with a roller or ball bearing.*

Precision Manufacture and Unique Design

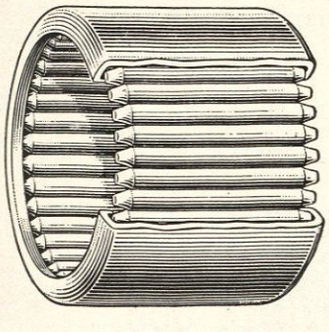
The exceptional load capacity of the Needle Bearing is the result of proper selection of steels, precision workmanship to close tolerances, and the application of modern anti-friction principles.

The one-piece shell, which serves as the outer raceway and retains the rollers, is accurately drawn from carefully selected strip steel. After forming, it is carburized and hardened. There is no further grinding or other operation that might destroy the wear-resistant raceway surfaces. The full complement of thru-hardened, precision-ground rollers is retained by the turned-in lips of the one-piece shell.



2. *Shows the greater number of lines of contact in the load zone of a Needle Bearing compared with a ball or roller bearing.*

The small cross section of the Needle Bearing allows a large shaft which permits a rigid design with minimum shaft deflection, a factor of utmost importance to good bearing design.



THE TORRINGTON COMPANY
Torrington, Conn. • South Bend 21, Ind.
District Offices and Distributors in Principal Cities of United States and Canada

TORRINGTON NEEDLE BEARINGS

NEEDLE • SPHERICAL ROLLER • TAPERED ROLLER • CYLINDRICAL ROLLER • BALL • NEEDLE ROLLERS

OIL CAN

THE HONORARY SOCIETY OF LUBRICATION ENGINEERING

DOWN WITH FRICTION

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

by GRAEME LOGAN and JON LIEBMAN

Once again the time has come to nominate some candidates for the coveted Oil Can Award. This month we have a few dillies of nominations, but we still feel that the majority of the eligible candidates go unrecognized. Surely you would not want to deprive your friend or student of a chance to be so honorably rewarded for his efforts. There is but one more issue this year in which credit for prize boners may be given; therefore, if you know of one who ought to be set up as an example for others to follow in order that "Friction shall not thrive unopposed," please let us know about it.

★ ★ ★ ★

Asked to define an auto transformer in his mechanical equipment of buildings course (Arch. 330), John Eatwell brightly came up with the information that "An auto transformer allows the current from the generator to be used for lights, cigaret lighters, radios, etc."

★ ★ ★ ★

And Dan Lundberg earns a little recognition with his definition of an inverse cam on a kinematics daily. "An inverse cam," he said, "is where the follower rides in a slot while the cam goes up and down."

Mr. Tovani tried to end the first semester one day early. It seems that his 1:30 calculus class sat for ten minutes waiting for him on the day before finals started. Finally some enterprising soul went up to Mr. Tovani's office to find him sitting there in oblivion, having completely forgotten the class.

★ ★ ★ ★

George Halpin deserves a brightly polished Oil Can for this one. Prof. DuVall was lecturing to his class in contracts on the selection of a jury, and in passing he asked if anyone in the class knew what a jury wheel was. George inquired if perhaps it might be the foreman!

★ ★ ★ ★

We feel obligated to mention ourselves in this column this month, only to show that we, too, do our best to supply a little entertainment for others. In the last issue of the *Engineer* we managed to spell Mr. Carlin's name with a K instead of a C. We are quick to claim credit for this mistake before the printer can.

★ ★ ★ ★

Bring your Oil Can items to the *Colorado Engineer* office, Ketchum 135.

BEYOND THE HORIZON....

Higher and higher the speeds; greater and greater the stresses.

To match needs which are still beyond the horizon, the engineer is increasingly urging the metallurgist to supply new materials.

The more efficient engines of today rely upon the use of temperature-resisting molybdenum-containing alloys; the jet engines of the future, with still greater stresses and higher temperatures, must rely even more upon Molybdenum.

Climax furnishes authoritative engineering data on Molybdenum applications.

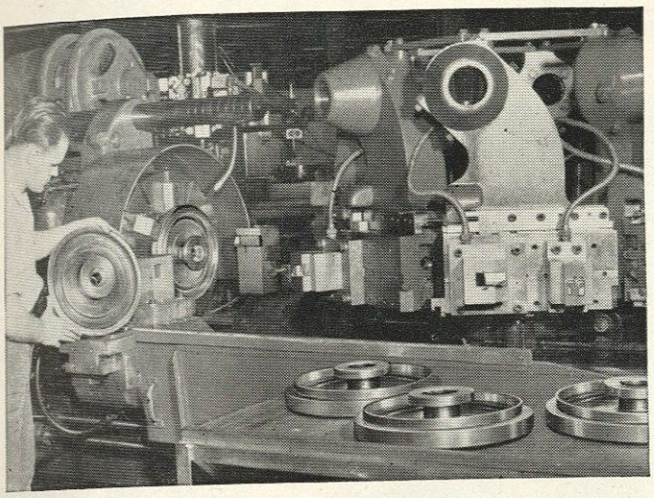
Climax Molybdenum Company

500 Fifth Avenue · New York City 36 · N.Y.

MOLY

C 18

Another page for **YOUR BEARING NOTEBOOK**

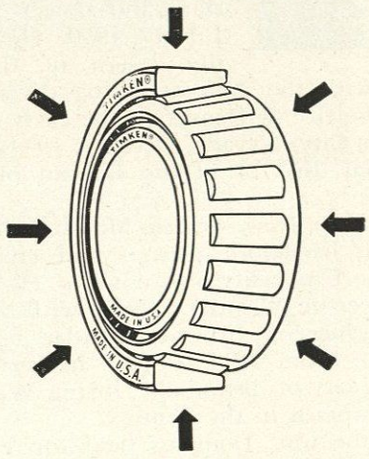


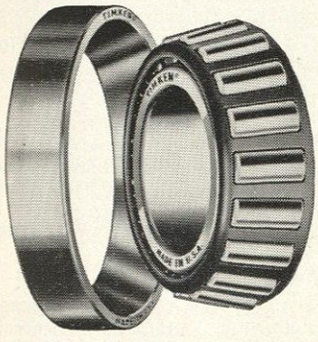
How to speed production of high precision jet engine parts

Engineers had the problem of designing a turret lathe that would machine a stainless steel jet engine part having a very complicated shape. And the part had to be produced in volume—yet with extreme precision. Naturally, they had to be sure the lathe spindle would be held rigid. To solve their problem, they mounted the spindle and gear train on Timken® tapered roller bearings, eliminating spindle vibration and chatter, insuring high precision.

Here's how TIMKEN® bearings maintain spindle rigidity

Timken bearings hold spindles in rigid alignment because line contact between rollers and races gives spindles wide, rigid support. Because the tapered design of Timken bearings lets them take radial and thrust loads in any combination, deflection is minimized, end-play and chatter eliminated. Spindles maintain their accuracy, year after year.

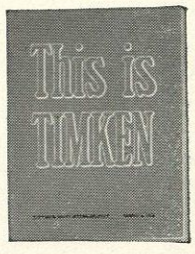




TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS

Want to learn more about bearings or job opportunities?

Many of the engineering problems you'll face after graduation will involve bearing applications. For help in learning more about bearings, write for the 270-page General Information Manual on Timken bearings. And for information about the excellent job opportunities at the Timken Company, write for a copy of "This Is Timken". The Timken Roller Bearing Company, Canton 6, Ohio.



NOT JUST A BALL ○ NOT JUST A ROLLER ⬭ THE TIMKEN TAPERED ROLLER ⬭
BEARING TAKES RADIAL ⓪ AND THRUST →⓪← LOADS OR ANY COMBINATION ⓪

ALUMNI NEWS

by TOM MOSHER

"I'm a mechanical. Will I be able to get a good job?" "I'm a civil. Is there a good place for me in construction?" "I'm an electrical. What about radar?"

Encouraging answers to these questions are found in the records of former engineering graduates. Excellent positions are being held in civilian life my many of our former students, and the armed forces are finding immediate and practical use for the talents of others. If the records of these alumni are indicative of the opportunities, the outlook is a pleasant one.

1928

L. R. Douglass, director of power of the Bureau of Reclamation's Boulder Canyon project, will retire from Federal service March 31 following a distinguished career of 21 years as a Bureau of Reclamation engineer and administrator.

Douglass has been in immediate charge of Hoover Dam and power plant since July 17, 1950. He worked on the design of this project when he was with the dam designing division of the chief engineer's office at Denver in the early 1930's. He went to Boulder City, Nevada, October, 1944, to become assistant regional director of the Bureau of Reclamation's Region 3.

Born in Gallup, New Mexico, March 2, 1888, Douglass received his bachelors, masters and civil engineer degrees from the University of Colorado. He started his engineering career in 1909 as a rodman with the Danford & Sanderson engineering firm at Trinidad and Walsenburg, Colorado. From 1914 to 1917 he served as city engineer for the city of Trinidad. During World War I he served as a captain in the Army.

Following the war, Douglass held top engineering positions successively with the Dearborn Realty & Construction Co., and Douglass, Corey and Fish, engineers with offices in Denver, Trinidad, and Walsenburg, Colorado.

He has a life membership in ASCE and belongs to the Teknik Club of Denver, Chi Epsilon, the Masonic Order, Boulder City Rotary Club, American Legion, and Sigma Nu.

Douglass and his wife, Norma, reside at 512 Avenue K in Boulder City, Nevada.

1925

LESTER C. SIMPSON, B.S. (E.E.), vice president of the American Gas Accumulator Co., 724 Mills Building, Washington 6, D.C., visited the campus last semester.

1929

ROLLO P. LEBARON, B.S. (C.E.), who was associated with the Folsom Construction Company, now operates the LeBaron Construction Company at 40 West Louisiana Avenue, Denver 19, Colorado.

1932

A. G. BUCK, B.S. (E.E.), visited the campus recently and is now with Ames Aeronautical Lab., at Moffatt Field, California.

1936

FRANKLIN G. LAUCOMER, B.S. (C.E.), is senior partner in the firm of Laucomer and Manser Co., 7310 Woodward Avenue, Detroit, Michigan. His daughter, Joan, recently graduated from the University.

1948

Primarily responsible for the acquiring of the new electric analog computer for the College of Engineering was Wellwood Beall, senior vice president of the Boeing Aircraft Company. He not only arranged for prompt delivery of the computer but personally contributed additional equipment which greatly increased the value of the computer.

A computer of this type solves problems that would take long periods of time with machine calculators and would be almost imposible to do by hand.

Beall was born in Canon City, Colorado, October 28, 1906, and attended the University of Colorado from 1924-28. He then attended New York University where he received his bachelor's degree in mechanical and aeronautical engineering. On the basis of his professional record the University of Colorado in 1948 awarded him the professional degree of aeronautical engineer.

Beall has held such positions as assistant chief aeronautical engineer for Walter M. Murphy Co., instructor in the Boeing School of Aeronautics, sales engineer for Boeing Aircraft, both in the United States and China, and chief engineer for Boeing.

He was the designer of the Yankee Clipper flying boat (model 314) and was in charge of the design of the stratoliners (model 307), flying fortresses B-17, superfortresses B-29, stratocruisers (model 377) and stratofreighters C-97.

Listed in *Who's Who in America*, Beall was elected president of the Institute of Aeronautical Scientists in 1951. He is also a member of the Society of Automotive Engineers, Sigma Chi, Quiet Birdman and was a former officer in the U. S. Naval Reserve.

1946

ROBERT BLENSLY, B.S. (C.E.), visited the campus last year while a delegate to the annual convention of western states of the American Association of State Highway Officials. Mr. Blensly is assistant planning survey engineer with the Oregon State Highway Department.

1948

CARLTON GRIFFITH KNOWLES, B.S. (Ch.E.), is in charge of the polyethylene plant of the Carbide and Carbon Chemicals Company at Texas City, Texas.

1949

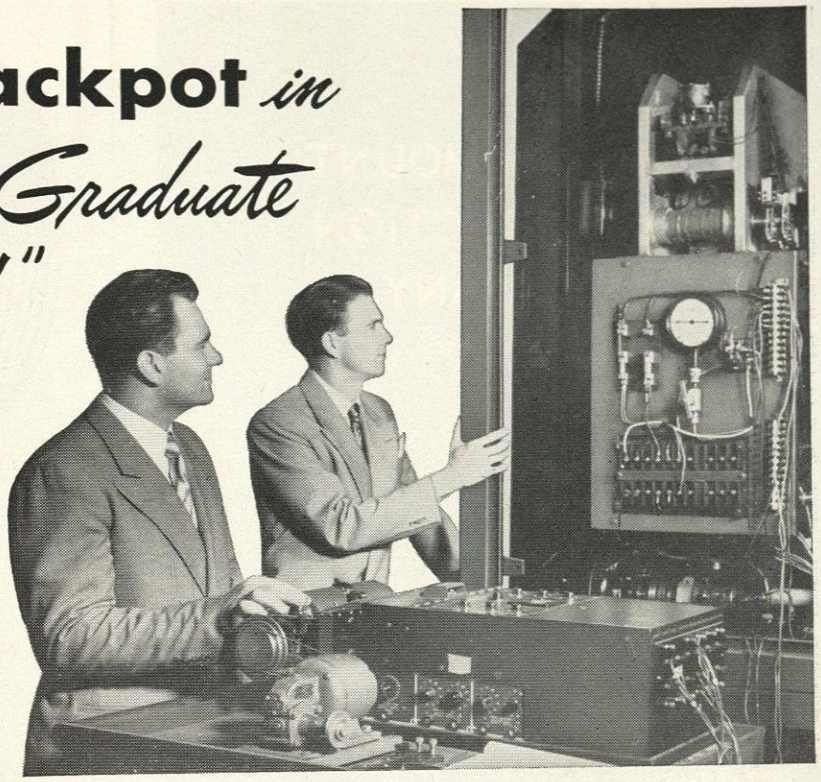
ERIC A. ANDERSON, B.S. (M.E.), is a sales engineer for the E. C. Coley Co., 625 Market Street, San Francisco, California.

GEORGE F. WOODWARD, B.S. (E.E.), is assistant supervisor of the advanced engineering program, conducted by the General Electric Company at Schenectady, New York.

1953

WILLIAM L. COX, B.S. (Ch.E.), has left his position with General Electric to enter the Air Force as a second lieutenant.

"We Hit the Jackpot *in* Allis-Chalmers Graduate Training Course!"



say N. W. MORELLI

Oregon State College, B.S.,M.E.—1950

and

E. R. PERRY

Texas A. & M., B.S.,E.E.—1950

WHILE taking the course, two engineers developed a revolutionary new circuit breaker mechanism.

"Our experience shows what *can* happen if you work with people open to suggestion. We found men of this kind at Allis-Chalmers, and it has given us a special pleasure in our job.

"We started out like most other graduates with a hazy idea of what we wanted to do. After working in several departments, we requested that part of our training be at the Boston Works of Allis-Chalmers, where circuit breakers are made."

New Design Principle

"Circuit breakers soon became an obsession with us, and we got the idea of designing a hydraulic operator and triggering mechanism for these breakers. Most operators for big breakers are pneumatic.

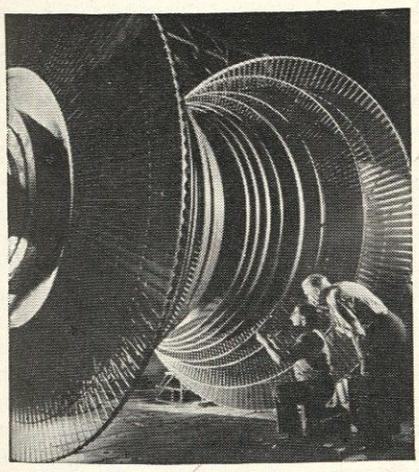
"Unsuccessful attempts had been made in the past by all circuit breaker manufacturers to build hydraulic operators. The important thing is that no one at Allis-Chalmers said, 'Don't try it—it won't work.' "

Start New Era

"To make a long story short, our study of the problem led us to the hydraulic accumulator and high speed valves being used by the aircraft industry. These had not been available when earlier attempts were made to build a hydraulic operator. With these highly developed devices to work with, we were able to build an operator that combined the best features of pneumatic and hydraulic operation. We call it the *Pneu-draulic* operator. Engineers are saying it starts a new era in circuit breaker actuation.

"This fact is important to us, but it is even more important to know that Allis-Chalmers Graduate Training Course is full of opportunity . . . and as we found out, there's opportunity right from the start."

Pneu-draulic is an Allis-Chalmers Trademark.



Low-pressure spindle for a 120,000 kw steam turbine generator. Said to be one of the largest ever built in the United States, this spindle is nearing completion in the Allis-Chalmers West Allis shops.

Facts You Should Know About the Allis-Chalmers Graduate Training Course

1. It's well established, having been started in 1904. A large percentage of the management group are graduates of the course.

2. The course offers a maximum of 24 months' training. Length and type of training is individually planned.

3. The graduate engineer may choose the kind of work he wants to do: design, engineering, research, production, sales, erection, service, etc.

4. He may choose the kind of power, processing, specialized equipment or industrial apparatus with which he will work, such as: steam or hydraulic, turbo-generators, circuit breakers, unit substations, transformers, motors, control pumps, kilns, coolers, rod and ball mills, crushers, vibrating screens, rectifiers, induction and dielectric heaters, grain mills, sifters, etc.

5. He will have individual attention and guidance in working out his training program.

6. The program has as its objective the right job for the right man. As he gets experience in different training locations he can alter his course of training to match changing interests.

For information watch for the Allis-Chalmers representative visiting your campus, or call an Allis-Chalmers district office, or write Graduate Training Section, Allis-Chalmers, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

C-5675

ENGINEERING ABROAD . . . .

by NARENDRA JAIN

HELICOPTERS TO PROSPECT FOR INDIA'S OIL

For the first time in India, helicopters ("flying egg-beaters" as their pilots sometimes call them) are to be used to help in the search for subterranean oil prospects. Three of these wingless planes have come from the United States to take part in a new three-way program of geophysical surveys over 4,000 square miles of the Brahmputra Valley in Assam.

Assembled and tested in Calcutta they have been flown up to the oil town of Digboi. From Digboi they will carry geophysical parties and instruments on a scientific exploration for favorable geological structures.

The helicopters will soon be joined by ordinary aircraft equipped with the latest type of aerial surveying instruments. This part of the survey program is designed to "feel" the rocks hidden beneath the alluvium of the Brahmputra Valley. As this alluvisum—the sand and silt laid down by rivers in valleys and deltas—conceals all evidence of burried rocks under a thick "blanket," surface observations alone are of no value. However, modern geophysical instruments, such as the magnetometer, seismometer and gravimeter, can sometimes "see" what lies under the blanket.

If the presence of favorable geological structures is indicated, wells may be drilled to put the scientific findings to the test. Only then will the answer be known to a vital question: Is there a posssibility of finding "new" resources of petroleum in India to augment the supply from Digboi—the nation's only proved oil field?

INDIA'S AIR FORCE AND THE JET AGE

The recent addition of Ouragan jet fighters to India's air force is an indication that India appreciates the significance of the newly dawned Jet Age and is adapting herself to the present epoch-making trends in aviation.

Three years after the end of World War II, when jet-propelled aircraft were put on the market, the Indian Air Force acquired four Vampires from Great Britain. India thus became the first Asiatic country to possess jet aircraft.

More of the modern jets followed to augment the country's fighter-defense strength. Although used to piston-drive machines, IAF pilots took to the jets with incredible enthusiasm and ease.

Last October, a token flight of four Ouragans arrived at the Bombay airport. The IAF pilots who safely ferried these aircraft along the 5,000-mile homeward journey from France, proved the airworthiness of the new fighting equipment. Three weeks later, a larger number of Ouragans came on board the French naval aircraft carrier Dixmude. More are expected in the near future.

By no means the very latest, the Ouragan is certainly among the better jets available. Capable of touching 600 miles per hour with a righ rate of ascent, having a pressurized cockpit with a jettisonable pilot's seat, fitted with long-range fuel tanks and armament to fire rockets, bullets and bombs, it is a versatile aircraft which will be employed as a ground-attacker or as a fighter-intercepter.

Aware of the onset of the Jet Age, India is doing her best to meet the challenge.

THE HYDROSTATIC TEST

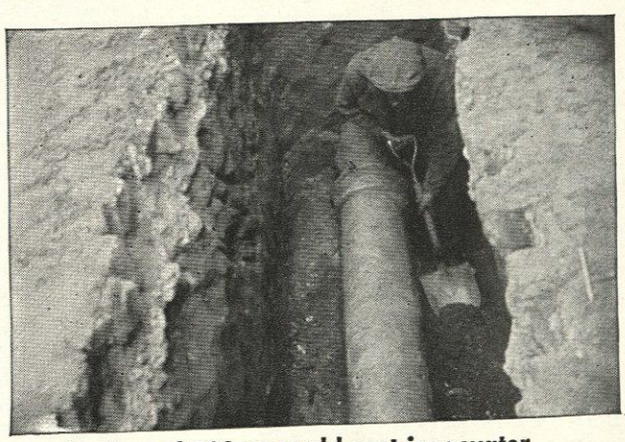
Nobody can buy a length of cast iron pipe unless it has passed the Hydrostatic Test at the foundry. Every full length of cast iron pipe is subjected to this test under water pressures considerably higher than rated working pressures. It must pass the test or go to the scrap pile.

The Hydrostatic Test is the final one of a series of routine tests made by pipe manufacturers to assure that the quality of the pipe meets or exceeds the requirements of standard specifications for cast iron pressure pipe.

Few engineers realize the extent of the inspections, analyses and tests involved in the quality-control of cast iron pipe. Production controls start almost literally from the ground up with the inspection, analysis and checking of raw materials—continue with constant control of cupola operation and analysis of the melt—and end with inspections and a series of acceptance and routine tests of the finished product.

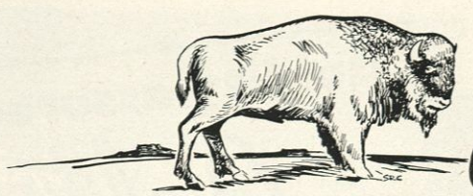
Members of the Cast Iron Pipe Research Association have established and attained scientific standards resulting in a superior product. These standards, as well as the physical and metallurgical controls by which they are maintained, provide assurance that cast iron pipe installed today will live up to or exceed service records such as that of the 130-year-old pipe shown.

Cast iron pipe is the standard material for water and gas mains and is widely used in sewage works construction. Send for booklet, "Facts About Cast Iron Pipe." Address Dept. C., Cast Iron Pipe Research Association, T. F. Wolfe, Engineer, 122 So. Michigan Ave., Chicago 3, Illinois.



Section of 130-year-old cast iron water main still in service in Philadelphia, Pa.

CAST IRON PIPE SERVES FOR CENTURIES



Chips

Into every life, let there come humor.

A mousey little man was frightened silly of his boss. One day he told a fellow worker that he was sick.

His friend said, "Why don't you go home?"

"Oh, I couldn't do that!"

"Why not?"

"The boss would fire me."

"Don't be silly, he'll never know. He's not even here today."

Finally the man was convinced, and went home. When he got there he looked in the window, and there was his boss, kissing his wife. So he ran all the way back to the office. "A fine friend you are!" he said to his friend. "I nearly got caught!"

★ ★ ★ ★

A bathing suit—like a barbed wire fence—is designed to protect the property without obstructing the view.

★ ★ ★ ★

Prof. Buck looked toward the next green, waggled his driver confidently and declared, "That's good for one long drive and a putt." He gave his club a mightly swing, blasted up about two inches of sod, and managed to get the ball about three feet from the tee.

The caddy stepped forward, handed him the putter, and suggested, "Now for one helluva putt."

★ ★ ★ ★

Minister (playfully pinching little boy's knee): "And who has nice chubby legs?"

Little Boy: "Betty Grable."

★ ★ ★ ★

A foursome was playing golf when suddenly a pretty girl with no clothes on ran across the fairway with four men in hot pursuit. The last of the four was somewhat behind, and the golfers noticed he carried a pail of sand in each hand.

"What goes on here?" asked the foursome.

The caddie said, "Oh, she's an inmate of the sanitarium and she gets out almost every day. Those men chasing her are the attendants. They have to catch her and put her back."

"But what about the fourth man? How come he carries two pails of sand?"

"That's his handicap," said the caddie. "You see, he caught her yesterday."

★ ★ ★ ★

So you bought a home in the country?"

Yes. Five rooms and a path."

★ ★ ★ ★

Imagine the newpaper boy's embarassment when he opened the wrong door in the depot waiting room and yelled: "Extra paper."

★ ★ ★ ★

Visitor addressing an employee of the Oak Ridge plant, "What do you make here at Oak Ridge?"

Employee: "Horses heads."

Visitor: "What do you do with them?"

Employee: "Send them to Washington for final assembly."

★ ★ ★ ★

Never milk a cow during a thunderstorm. She may be struck by lightning and you'll be left holding the bag.

Out of the wild and wooly West comes this hazardous adventure. It seems that a grizzled old prospector was reminiscing for a bunch of New England tenderfoots. "There I was," he drawled, "trapped in a narrow draw with a hungry ole grizzly not twenty yards away behind a tree. Th' only way I could figger to bag the crittur was to ricochet a ball off th' canyon wall to th' right. Now bein' a champeen shot like I am I just gauged th' wind, judged the lead of the barrel and th' rate of twist, th' hardness of th' rifle ball and th' angle of yaw it'd have bein' smacked out of shape agin th' wall, and I figgered my chances of nailin' thet bar were about 70-30. A one rail bank shot. A controlled ricochet. So I let fly."

The old man paused. Softly one of the tenderfeet gasped, "Did you get him?"

"Nope," replied the prospector. "Missed th' wall."

★ ★ ★ ★

"Hey, you, are there any sharks around here where I'm swimming?"

"No, they're afraid of the crocodiles."

★ ★ ★ ★

"Use Lumpo Soap. Doesn't lather. Doesn't bubble. Doesn't clean. It's just company in the tub."

★ ★ ★ ★

The wind howled in maddening crescendos. Driving, biting bullets of snow battered the farmhouse unmercifully. A door was thrown open to the stormy wilderness. Stern faced, with upthrown arm and pointing fingers, the unforgiving father bade his oldest daughter go. Out, out, out into the teeming tempest of a fearful, freezing blizzard. The poor girl grazed longingly back at the warm cherry fireside where sat her sobbing and helpless mother. She hugged the little bundle closer to her maidenly breast, and, head down, plunged into the gale. . . . The bundle was corn; she had forgotten to feed the hogs.

★ ★ ★ ★

Use Mishmash Shaving Cream—no brush, no lather, no rub-in-no rub-off, no soap, no box, no nothing—just blood.

★ ★ ★ ★

"Do you have any physical defects?" the army doctor asked.

"Yes, sir!" the draftee answered promptly. "No guts."

★ ★ ★ ★

On a sight seeing bus through Detroit a guide was pointing out places of interest: "On the right we have the Dodge home."

"John Dodge?" asked an inquisitive old lady.

"No, Horace Dodge. And on this corner," he continued, "is the Ford home."

"Henry Ford?"

"No, Edsel Ford. Now that building on the left is the Christ Church."

Came a voice from the rear of the bus: "Go ahead, lady, you can't be wrong every time."

★ ★ ★ ★

Then there's the one about the girl they called "Switchboard" because when she walked all her lines were busy.

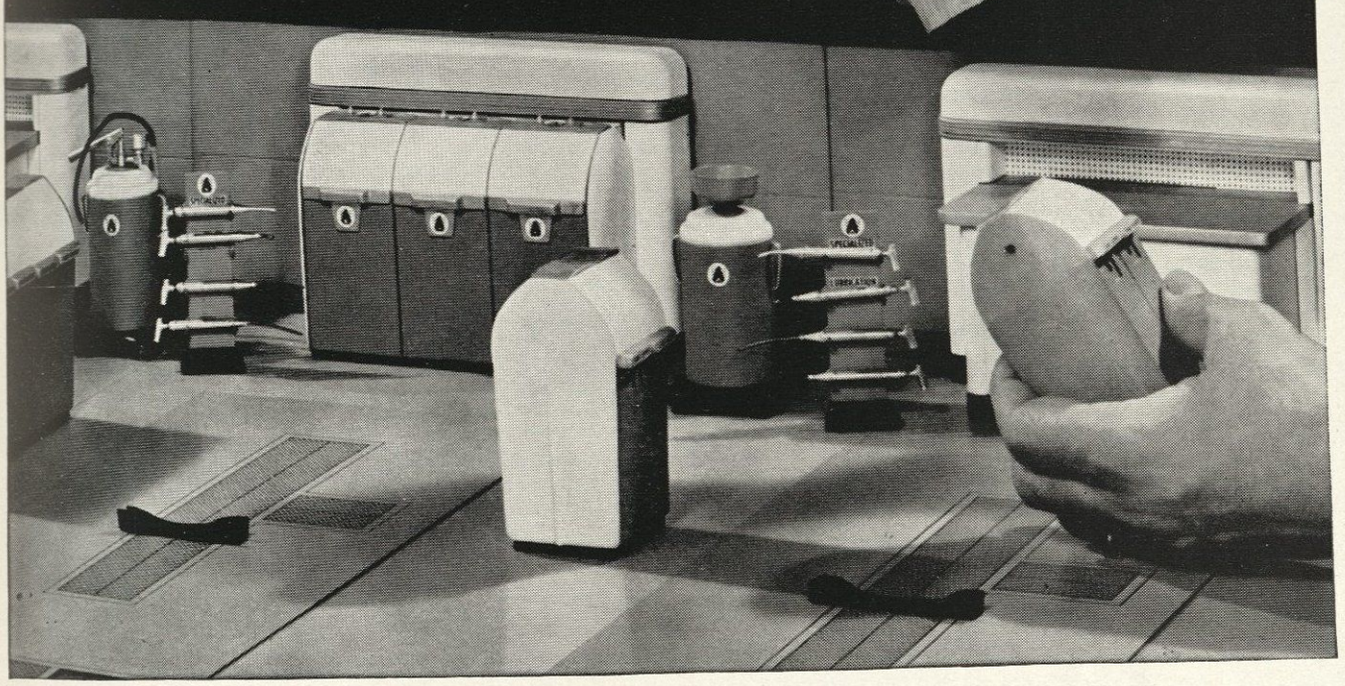
ADVERTISING INDEX

PHOTOGRAPHY AT WORK—No. 8 in a Kodak Series

Kodak
TRADE-MARK

Photography shows prospects

how their new service stations are going to look and operate



Alemite sets up scale models of their service station equipment on the customer's own floor plan—photographs them—and portrays the new custom-built station ready for action

SALESMEN don't just pull lube racks, grease pumps and other service station equipment out of a sample case. They're far too big—far too bulky. Besides, final location and arrangement count heavily in how well they are going to work out.

The Alemite Division of Stewart-Warner solves the problem with photography. Prospects see new service station equipment virtually right in their own premises.

It works this way. The salesman sends in a rough sketch of the space available, with windows and columns marked. Experts fit exact replicas of racks, lifts, and other equipment to the plan, then put the camera to work. The customer pictures his new station—modern, efficient, handsome—and the sale is well on its way. It's an idea for any company with bulky products to sell. Photography is a great salesman for any business, large or small. And it's very much more. It works in all kinds of ways to save time, cut costs, reduce error and improve production.

Graduates in the physical sciences and in engineering find photography an increasingly valuable tool in their new occupations. Its expanding use has also created many challenging opportunities at Kodak, especially in the development of large-scale chemical processes and the design of complex precision mechanical-electronic equipment. Whether you are a recent graduate or a qualified returning service man, if you are interested in these opportunities, write to Business & Technical Personnel Dept., Eastman Kodak Company, Rochester 4, N.Y.

Eastman Kodak Company, Rochester 4, N.Y.