

## **The Wisconsin engineer. Volume 69, Number 1 October 1964**

Madison, Wisconsin: Wisconsin Engineering Journal Association,  
[s.d.]

<https://digital.library.wisc.edu/1711.dl/7P3DBZ6M5SIJV8I>

<http://rightsstatements.org/vocab/InC/1.0/>

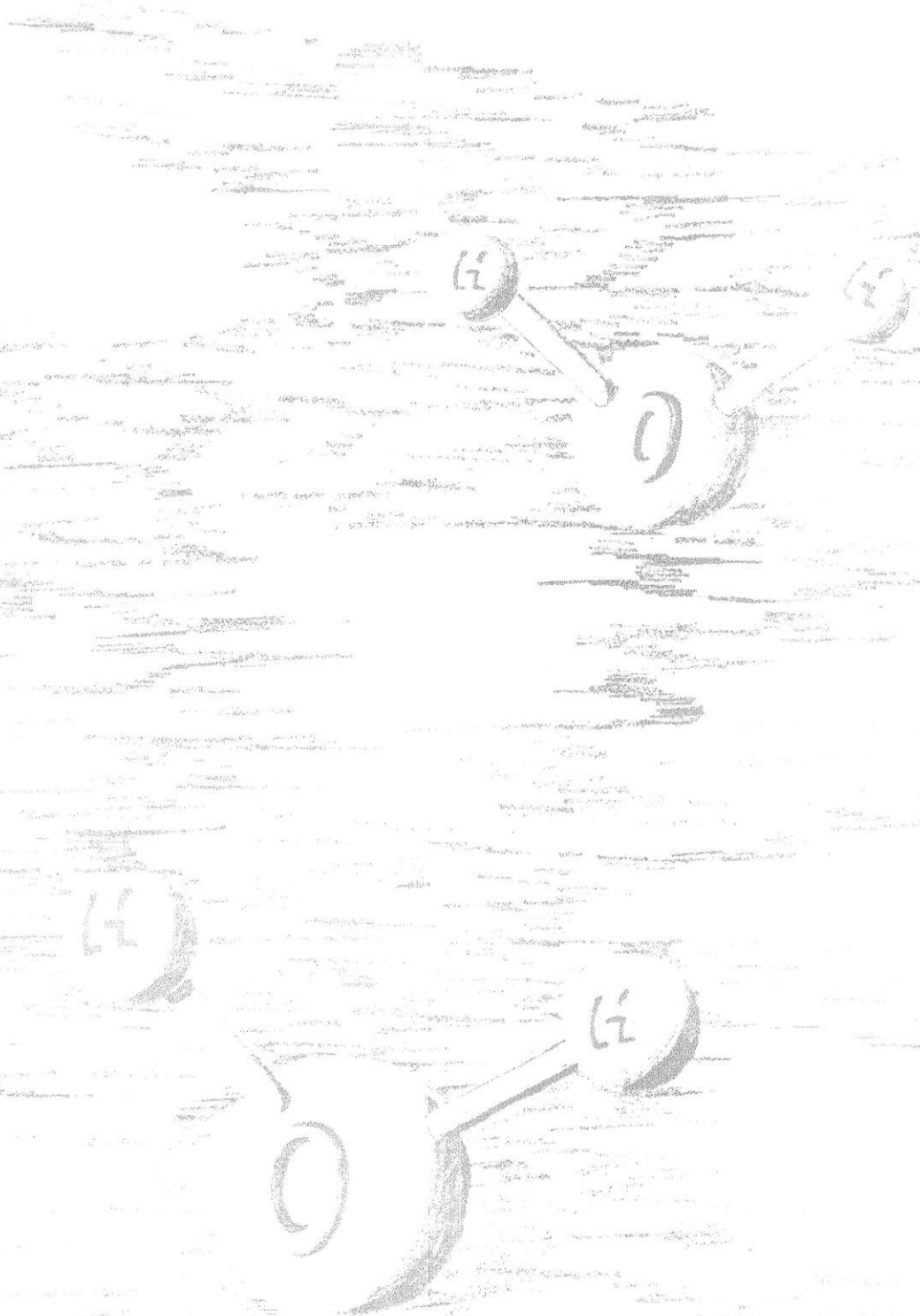
The libraries provide public access to a wide range of material, including online exhibits, digitized collections, archival finding aids, our catalog, online articles, and a growing range of materials in many media.

When possible, we provide rights information in catalog records, finding aids, and other metadata that accompanies collections or items. However, it is always the user's obligation to evaluate copyright and rights issues in light of their own use.

# THE WISCONSIN ENGINEER

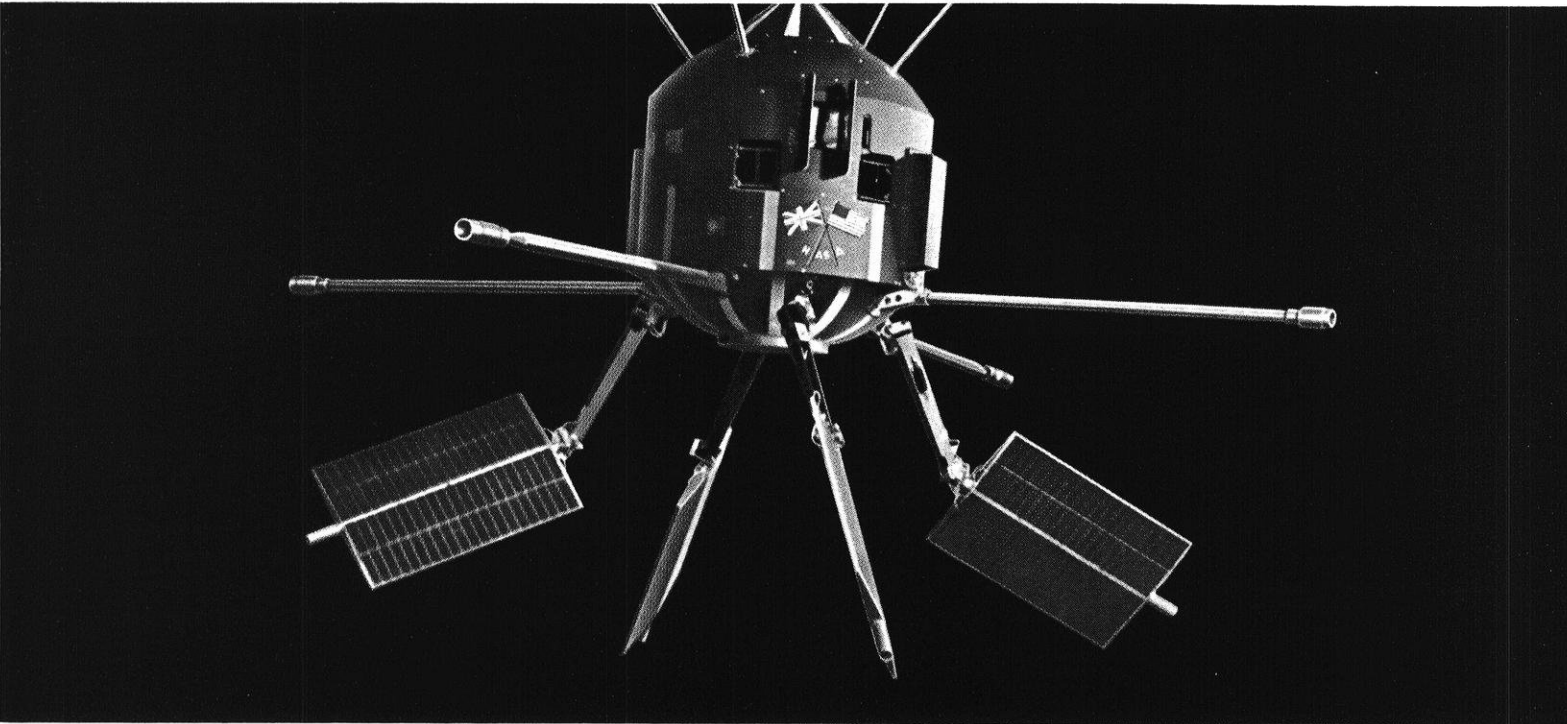
OCTOBER 1964 • 25 CENTS

MEMBER E. C. M. A.





**Scientists are listening to sounds from the stars**



**through a satellite built by Westinghouse**

Almost all we know about deep space we learned by studying light . . . the faint, flickering light from distant stars. Now, suddenly, a whole new universe is opening up to us through *sound* from the stars. It comes via a satellite in which the British Government, NASA's Goddard Space

Flight Center and Westinghouse each had a share.

This sound comes from millions of stars which we never knew before, because they emit no light. We couldn't hear them, either, because the earth's atmosphere shut off these noises, but now we can.

The satellite, Ariel II, also tells us how the earth's heat balance affects weather and how micrometeoroids erode space ships.

The British developed the scientific experiments. Westinghouse built the satellite and integrated the system. NASA launched it.

**You can be sure if it's Westinghouse**



For information on a career at Westinghouse, an equal opportunity employer, write L. H. Noggle, Westinghouse Educational Department, Pittsburgh, Pa. 15221.

# October in Brief

Congratulations for having a copy of the *NEW Wisconsin Engineer* in hand. You may have already noticed that some changes have been made in our format and content. Look for something new and different every month as we continue to enact a never-ending improvement program. Stand forewarned that we may make a few format changes from one month to another as we practice our creativity and steal ideas from other magazines. Complaints and/or compliments? Write to the editor or join the staff!

## ON THE INSIDE . . .

You'll find this page here every month, introducing you to a variety of interesting articles and features. We'll tell you about the authors, items you'll want to turn to first, and generally ramble about the pages beyond. This month we'll briefly introduce you to some of our new and revived features, in addition to previewing the bill of fare which you've always read in the *Engineer*.

Letters to the Editor will appear monthly. We'll try to select those of general interest and give you an answer when applicable.

In its familiar position, immediately preceding the lead article, is the editor's complaint and suggestion department, "Across the Editor's Desk," always provocative and this year maybe indicative of a rebel at the big desk in 333 M.E. The controversy will be kept confined to issues pertinent to the engineering student here at UW, although we heard something about Au H<sub>2</sub>O the other day.

Barry Jens, a June '64 grad in M.E., attempts to determine the validity of water-witching in what we think is a comprehensive analysis, "Water-Witching, Magic or Malarkey?" You'll be fascinated by this seldom heard of art (or science?), starting on page 12. Don Christopher, a Senior Civil, relates to us yet another method used to obtain fresh water from the sea.

In our Science Highlights section we will continue to report interesting new developments in industrial product research.

Furnished to us by the Engineering Placement Office is the tentative schedule of companies interviewing prospective graduate engineers on campus. While cleaning our office this summer we started to browse in our "archives" and got engrossed in some of the pioneer issues of the magazine you are reading. You'll find a few of the interesting items reprinted under the "Engineer of Yesteryear" title. Close behind that feature you'll find some assistance in building your professional library, a monthly review of recently published books.

Now, to get down to explaining ourselves for what is missing, and what we know that you know is missing, because you turned to where it should have been as soon as you picked up the magazine, our famous Female Foto Features. Before you cancel your subscription be informed that we'll have at least one pretty coed for each season of the year.

And of course the jokes. Since the staff has a hard enough time staying in school anyway, we can't take the risk of publishing the jokes we heard over the summer. Besides, we resent the fact that high school libraries always rip a page out of our magazine. Should a demand for our brand of anecdotes persist however, chances are that we'll resume the feature.

Cliff Fonstad came back from summer vacation with a whole briefcase of headaches and brain-twisters and is still trying to give away our money through his "Mental Maze" column. Try 'em, and then tell us that your courses are hairy!

In short, welcome Freshmen and welcome back others! Good luck in the coming year.



# Scan your next horizon...with us

Remember looking forward as a Freshman to graduation? Seemed distant, didn't it? But now that you're there you realize that the longest journeys are taken one step at a time—and that once you've reached the top of the hill, you look out upon the next horizon.

If you have travelled the road wisely, you are now equipped with a certain amount of skill, a larger view of life, and an indefinable urge to answer a new challenge. In short,

you are the man we're looking for.

At Phillips, horizons of greater opportunity are always open to the talented college graduate. Our products are diverse, ranging from fine petrochemicals and plastics to agricultural, automotive, aviation and marine products. Our resources are plentiful, our facilities excellent.

Here's the proposition: Whether your interests lie in research, production or sales, or one of a myriad of other facets of the petroleum in-

dustry, we supply the challenge and the room to grow—you supply the brains and determination. We find it's an unbeatable combination. Ask your campus placement office about arrangements for an interview or write to us today.

## PHILLIPS PETROLEUM COMPANY

EMPLOYEE RELATIONS DEPARTMENT  
BARTLESVILLE, OKLAHOMA 74004  
AN EQUAL OPPORTUNITY EMPLOYER



A PHILLIPS REPRESENTATIVE WILL BE ON THE CAMPUS OF UNIVERSITY OF WISCONSIN ON NOV. 11-12





## Would you make a good catalyst?

With us, creative technical employees are natural catalysts. They cause reactions. Good ones.

For example, they helped us double our sales to \$2.4 billion in the past 12 years. In the past 28 years alone, their research efforts helped us develop new products that created 40,000 new career positions. At this writing they're ironing the wrinkles out of 200 completely new products, with more on the way.

Technical men and women are happy at Du Pont, too. They get a chance to move around—to actually change jobs without changing companies and without losing their accrued benefits. Their future bursts with promise, because they know we fill important positions from within.

Would you make a good catalyst at Du Pont? Learn all the facts by letting us send you more information. Write us a letter now (or clip and mail our coupon).



BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

An equal opportunity employer

### Technical men we'll especially need from the Class of '65

Chemists                      Mechanical Engineers  
Chemical Engineers        Industrial Engineers

E. I. du Pont de Nemours & Co. (Inc.)

2531-B Nemours Building  
Wilmington, Delaware 19898

When I'm graduated, I'll be a \_\_\_\_\_.  
(List profession)

Please send me more information about how I might fit in at Du Pont.

Name \_\_\_\_\_

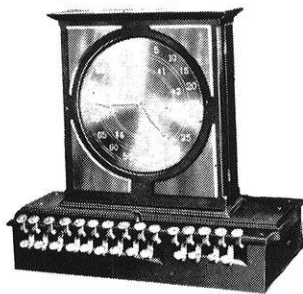
Class \_\_\_\_\_ Major \_\_\_\_\_ Degree expected \_\_\_\_\_

College \_\_\_\_\_

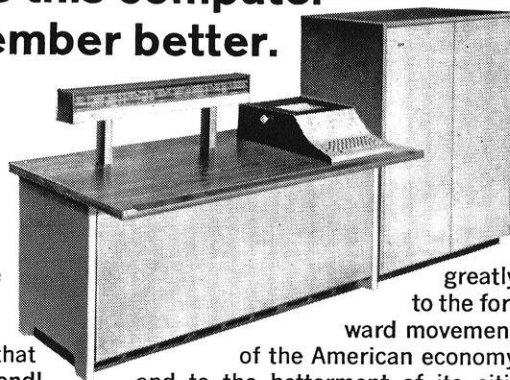
My address \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

**80 years ago the first  
cash register helped  
shopkeepers remember.**



**Today NCR's new  
thin-film rod memory  
helps this computer  
remember better.**



NCR's job for 80 years has been to make things easier and more profitable for businesses of all kinds and sizes. How? By producing the most complete and efficient line of record keeping and data processing equipment obtainable. We began by marketing the first cash register—the first automated system for handling sales and cash! Today NCR continues to make things easier for government, industry, business and banking with a full

line of equipment to handle everything from original entry to final report. Latest is a rod memory computer that cycles in billionths of a second!

Equally as important as the development of the total system concept of record keeping are the many research and development programs which NCR has in progress. Important advances in encapsulation, photochromism, thin-film and laser technology have contributed

greatly to the forward movement of the American economy and to the betterment of its citizens. If you would like to be considered for positions that are now opening for qualified persons at NCR, write to T. F. Wade, Technical Placement, NCR, Dayton, Ohio 45409. All correspondence will be treated confidentially. An equal opportunity employer.

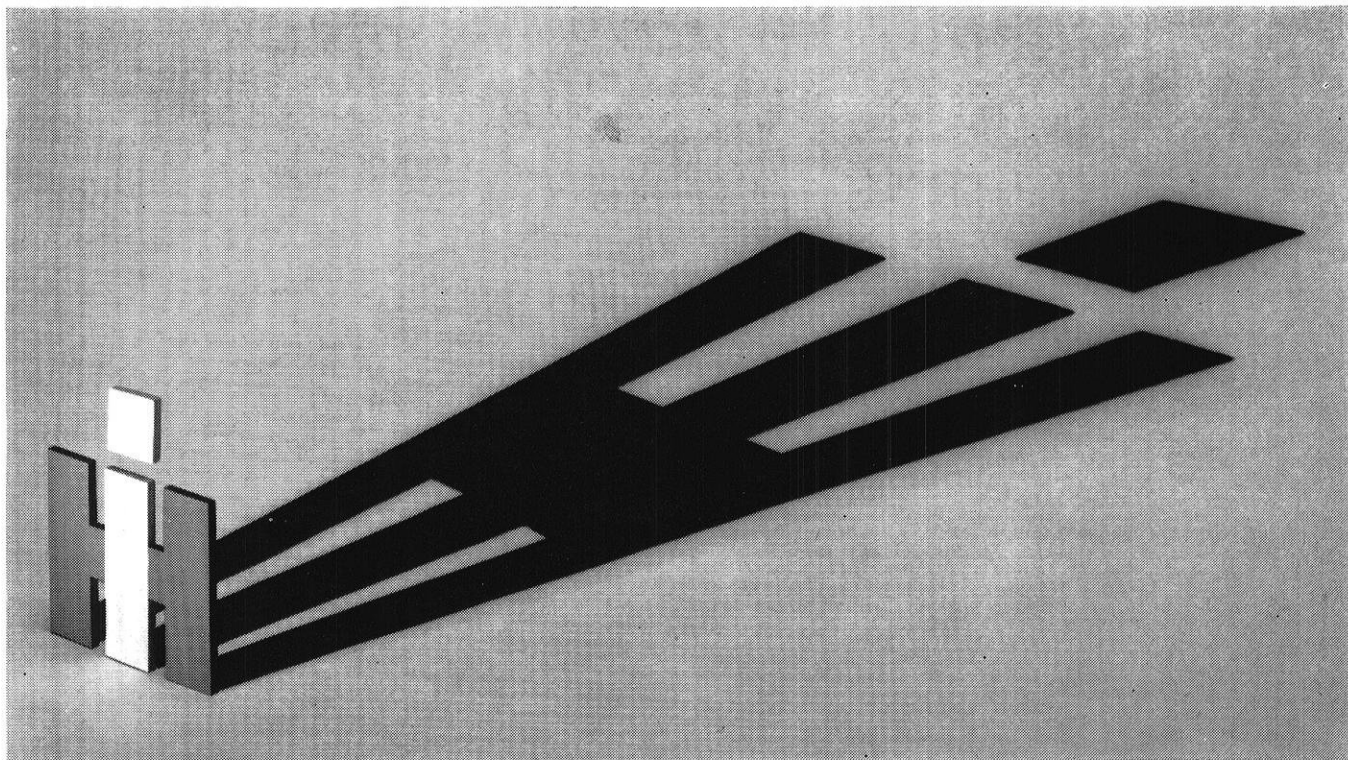
**N**

**C**

**R**

BE SURE TO VISIT THE NCR PAVILION AT THE N. Y. WORLD'S FAIR.

THE NATIONAL CASH REGISTER COMPANY ®



# What is so different about International Harvester?

The difference lies in diversification. International Harvester manufactures motor trucks, farm equipment and construction equipment—as well as gas turbines, aerospace equipment, industrial tractors and steel. We offer career opportunities in each of these fast-growing fields . . . a choice of careers in design, development, engineering, testing, manufacturing or sales of over a thousand products.

Few companies have changed as much as International Harvester in the past decade. We are now setting up new manufacturing plants throughout the free world. All of our many product lines are growing vigorously. And growth means a better future for those who join us today.

We are now interviewing students in many different fields—mechanical, electrical, industrial, metallurgical or agricultural engineers, liberal arts, accounting, chemistry, business or math majors. Check with your Placement Officer now for a date to see an IH representative when he visits your campus. If interviews are not yet scheduled, write directly to the Supervisor of College Relations, International Harvester Company, 180 North Michigan Avenue, Chicago 1, Illinois.



**INTERNATIONAL HARVESTER**

*An Equal Opportunity Employer*



## LETTERS

### ENGINEER:

Is it really true that you are going to start printing a full-color, 3-page centerfold, just like another leading national magazine? And don't answer, "of what?"

Interested Reader  
Madison

*You must have been talking to the Photo Editor at the H-T after finals last spring.*



### ENGINEER:

How do I apply for a position on the staff of the *Wisconsin Engineer*?

Engineer  
Madison

*Stop in at 333 M.E. or call us at 262-3494 between 2:30 and 4:30 Tues. and Thurs., and any other time you can catch us in the office.*



### ENGINEER:

I drive my car to school each day, since I live 3 miles out and can't catch a bus nearby. Being an undergraduate, I can't buy a parking permit and have difficulty in finding a parking place. Any suggestions?

Hill Student  
Madison

*You and 10,000 other people! Try Lot 60 until everyone has read our editorial (page 11). (Letters should be signed (name withheld on request) and less than 250 words.)*

## EDITORIAL STAFF

Editor-in-Chief ..... Robert Smith, cie3  
Associate Editor ..... Patrick Meagher, bs4  
Articles Editor ..... Robert Stoelting, bs3  
Regular Features ..... Clifton Fonstad, Jr., ee4  
Harold Weber, me3  
Layout ..... Gerald Malotke, cie3  
Artist ..... James Tyndall, bs3



## BUSINESS STAFF

Manager ..... Robert Margraf, ee4  
Circulation ..... Mary Baker, amp3  
Advertising ..... John Altmann, ee4



## BOARD OF DIRECTORS

Assoc. Prof. George R. Sell ..... Chairman  
Asst. Prof. Howard J. Schwebke ..... Faculty Advisor  
Assoc. Prof. John L. Asmuth ..... Electrical Engineering  
Asst. Prof. Raymond B. Esser ..... Mechanical Engineering  
Prof. David J. Mack ..... Minerals & Metals Engineering  
Prof. Wayne K. Neill ..... Chemical Engineering  
Asst. Prof. Charles G. Salmon ..... Civil Engineering

### MEMBER OF ENGINEERING COLLEGE MAGAZINES ASSOCIATED

*Chairman:* GALE CHUMLEY, Louisiana Tech. Engineer, Ruston, Louisiana.

*Publishers Representatives:* LITTELL-MURRAY-BARNHILL, INC., 369 Lexington Avenue, New York, New York 10017.

Second Class Postage Paid at Madison, Wisconsin, under the Act of March 3, 1879. Acceptance for mailing at a special rate of postage provided for in Section 1103, Act of Oct. 3, 1917, authorized Oct. 21, 1918.

*Published monthly from October to May inclusive by the Wisconsin Engineering Journal Association, 333 Mechanical Building, Madison, Wisconsin 53706. Editorial Office Hours 2:30-4:30 Tuesdays & Thursdays. Office Phone (608) 262-3494.*

THE WISCONSIN ENGINEER

ARTICLES

*Water Witching—Magic or Malarkey?* ..... page 12

*Freeze Desalting of Saline Water* ..... page 18

# THE WISCONSIN ENGINEER

*The Student Engineer's Magazine Founded in 1896*

FEATURES

*October in Brief* ..... page 1

*Letters* ..... page 6

*Across the Editor's Desk* ..... page 11

*Science Highlights* ..... page 24

*Interview Schedule* ..... page 32

*Books on Parade* ..... page 36

*Engineer of Yesteryear* ..... page 41

*Mental Maze* ..... page 44

THIS MONTH'S COVER

*Jim Tyndall depicts the basis of our articles, water.*



SUBSCRIPTION PRICE

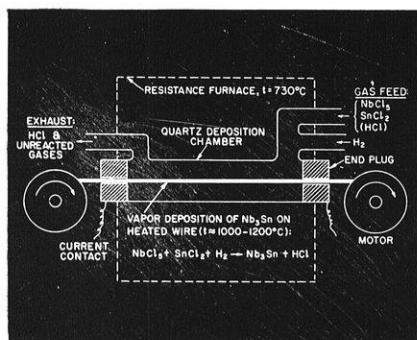
\$4.00 FOR FOUR YEARS

\$1.25 FOR ONE YEAR

SINGLE COPY 25¢

# Superconductivity at RCA Laboratories

## Vapor Deposition of Nb<sub>3</sub>Sn



Apparatus for continuous vapor deposition of niobium stannide on ribbon.

Very-high-field solenoids capable of generating fields of 100,000 gauss now made with copper winding require about 100 tons of equipment and dissipate more than one megawatt of power as heat. Some superconductors, in particular the compound Nb<sub>3</sub>Sn, can carry large electric currents with zero power dissipation even at high magnetic fields.<sup>1</sup> Hence, they can be used for the construction of light weight solenoids.

In the past, Nb<sub>3</sub>Sn was prepared by metallurgical sintering techniques, which resulted in a porous and extremely brittle material not suitable for widespread use. In 1960, scientists in the Materials Research Laboratory, David Sarnoff Research Center, developed a vapor-phase transport process for preparing this compound for the first time in a dense crystalline state—and in forms suitable for widespread use in both research and application. It consists of a simultaneous reduction of gaseous mixed chlorides of niobium and tin by hydrogen at 900 to 1200°C.<sup>2</sup>

Based on this process, an apparatus was developed for continuous coating of refractory metal and ribbon with Nb<sub>3</sub>Sn. The Nb<sub>3</sub>Sn coated ribbon has both electrical and mechanical properties desirable for solenoid construction. It is very thin (typical cross section is 2 x 90 mil, thickness of deposit about 0.3 mil) and hence sufficiently ductile to wrap around diameters as small as 3/8 inch and it can support enormous current densities: 1 x 10<sup>6</sup> amp/cm<sup>2</sup> at zero field, 3 x 10<sup>5</sup> amp/cm<sup>2</sup> in a transverse DC field of 92,500 gauss and 1.5 x 10<sup>5</sup> amp/cm<sup>2</sup> in a pulsed longitudinal field of 170,000 gauss. By comparison, copper can carry only 1 x 10<sup>2</sup> amp/cm<sup>2</sup> safely. Hence, superconductive solenoids approaching a field of 200,000 gauss appear feasible.

Reference—<sup>1</sup>J. E. Kunzler, et al. *Phys. Rev. Letters* 6, 89 (1961).

<sup>2</sup>J. J. Hanak, "Vapor Deposition of Nb<sub>3</sub>Sn," *Proceedings of AIME Conference on Advanced Electronic Materials*, August 1962.

## Parametric Amplifier

Experiments at RCA Laboratories show that superconducting films exhibit a nonlinear inductance at frequencies extending well into the millimeter-wave range. Frequency conversion was observed in tin films cooled below their critical temperature. Now amplification and oscillation have also been demonstrated. A superconducting "paramp" has been operated at 6 kmc with 11 db of net gain. Parametric oscillations at about the same frequency were also effected.

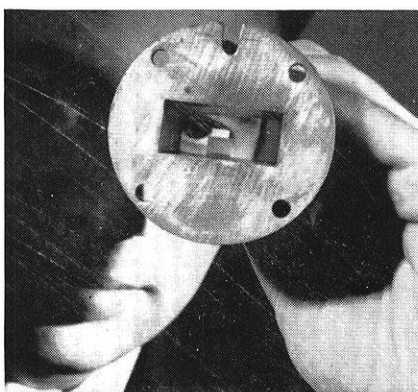
The superconducting film and the varactor differ markedly in many respects; hence, their circuit needs also differ. A study of the characteristics of superconducting films and parametric device requirements resulted in the concept of the "modified dielectric resonator." The resonator, which was used to demonstrate amplification, consists of a very low-loss, high-permittivity, dielectric cavity modified at one of its boundaries by a superconducting film.

The unit is placed in a waveguide where power is coupled to it with a movable short-circuit. The resonant frequency of the cavity is a function of its dimensions, the permittivity of the dielectric and the impedance of the film.

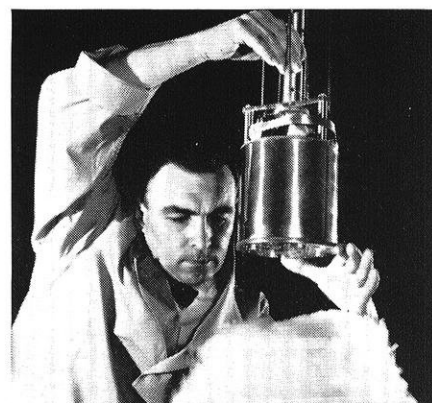
While it may be premature to speculate on the eventual role of the superconducting "paramp", it should be noted that the device, in principle, offers an outstanding set of features not to be found in the varactor or any other device. First, the frequency limit of superconducting films may extend into the sub-millimeter wave range. Secondly, it is expected that the noise performance of the device can match that of the maser. Furthermore, superconductors can be pumped with considerably lower power and at a lower frequency than either the varactor or the maser. Finally, since one can fabricate large-area films (as compared with lumped varactors), wide-band truly distributed traveling-wave parametric amplification may become possible.

Reference—A.S. Clorfeine, *Applied Phys. Letters* 4, No. 7, 131 (1964).

A.S. Clorfeine, *Proceedings of the IEEE*, Vol. 52, No. 7, July 1964.



## Superconductive Magnet



Recently RCA developed a superconductive magnet believed to be the most powerful in the world, in a practical form that can revolutionize many aspects of solid-state electronics and high-energy physics research.

Success of this magnet and the attainment of zero current degradation using magnetic field stabilization followed research in superconductive degradation phenomena.

The device generates a magnetic field of 107,000 gauss. When commercially available, it will enable scores of small and medium-sized research laboratories to carry out experiments that now require large multi-million-dollar facilities in order to generate the immense magnetic fields needed for solid-state, atomic, and related areas of research.

Test data obtained under a NASA study contract played a significant part in RCA's development of the 107,000-gauss magnet. The present experimental unit has a bore of one inch, offering for the first time in a superconductive magnet a working area large enough for practical laboratory experiments. The company is continuing its work for NASA, exploring the feasibility of a 150,000-gauss superconductive magnet with a one-foot bore, designed for experiments in space propulsion techniques.

The experimental 107,000-gauss unit was built at the RCA Laboratories by an advanced development group of the RCA Electronic Components and Devices organization.

The experimental RCA magnet weighs 26 pounds and is about the size and shape of a half-gallon paint can. It is made superconductive by immersion in liquid helium and is started with the output of 6-volt storage batteries. By contrast, nonsuperconductive magnets developing similar magnetic fields require almost 1.5 million watts of power and enormous water-cooling systems.

Reference—Schrader, Freedman, Fakan, *Applied Physics Letters*, March 15, 1964.

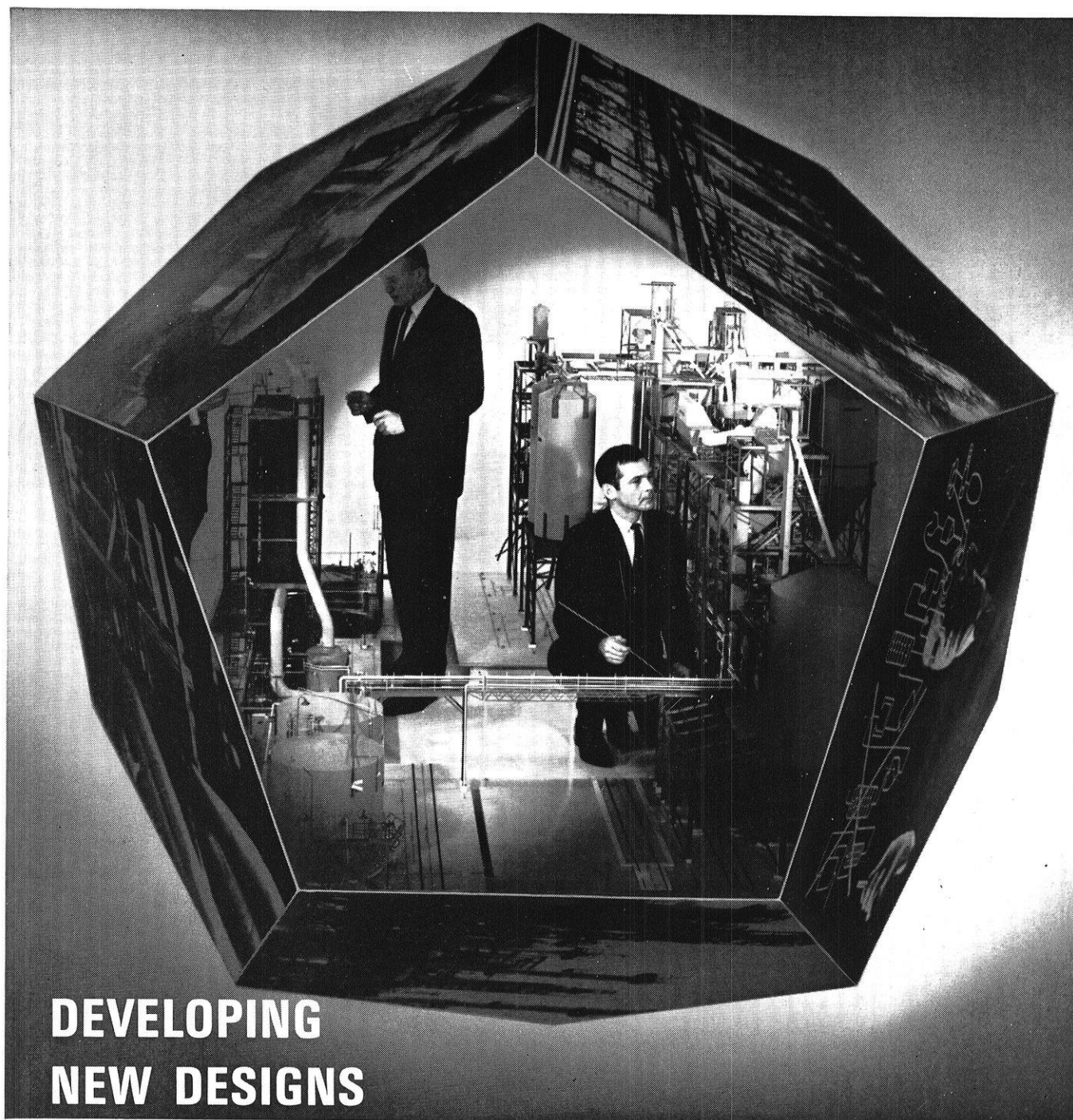
Schrader, Kolondra, *RCA Review*, Vol. (25), No. 3, 1964.

In addition to work in superconductivity, the David Sarnoff Research Center conducts a broad range of research projects requiring new concepts and ideas in materials, devices and systems. To learn about the many scientific challenges awaiting the advanced degree candidate in Physics, Electrical Engineering, Chemistry and Mathematics, please meet with our representatives when they visit your campus; or write to the Administrator, Graduate Recruiting, Dept. RL-9, RCA Laboratories, David Sarnoff Research Center, Princeton, N.J.



**The Most Trusted Name in Electronics**

*An Equal Opportunity Employer*



## DEVELOPING NEW DESIGNS

### *Another of your future's many facets at Monsanto*

With a company growing as fast as Monsanto (annual sales quadrupled to a hefty \$1.2 billion in little more than a decade), design of new plants, equipment and systems has never been so important. Engineers are needed to apply their skills and knowledge . . . in known and unknown areas . . . to help us manufacture the new and improved products that move Monsanto ahead—500 new products in the last 10 years.

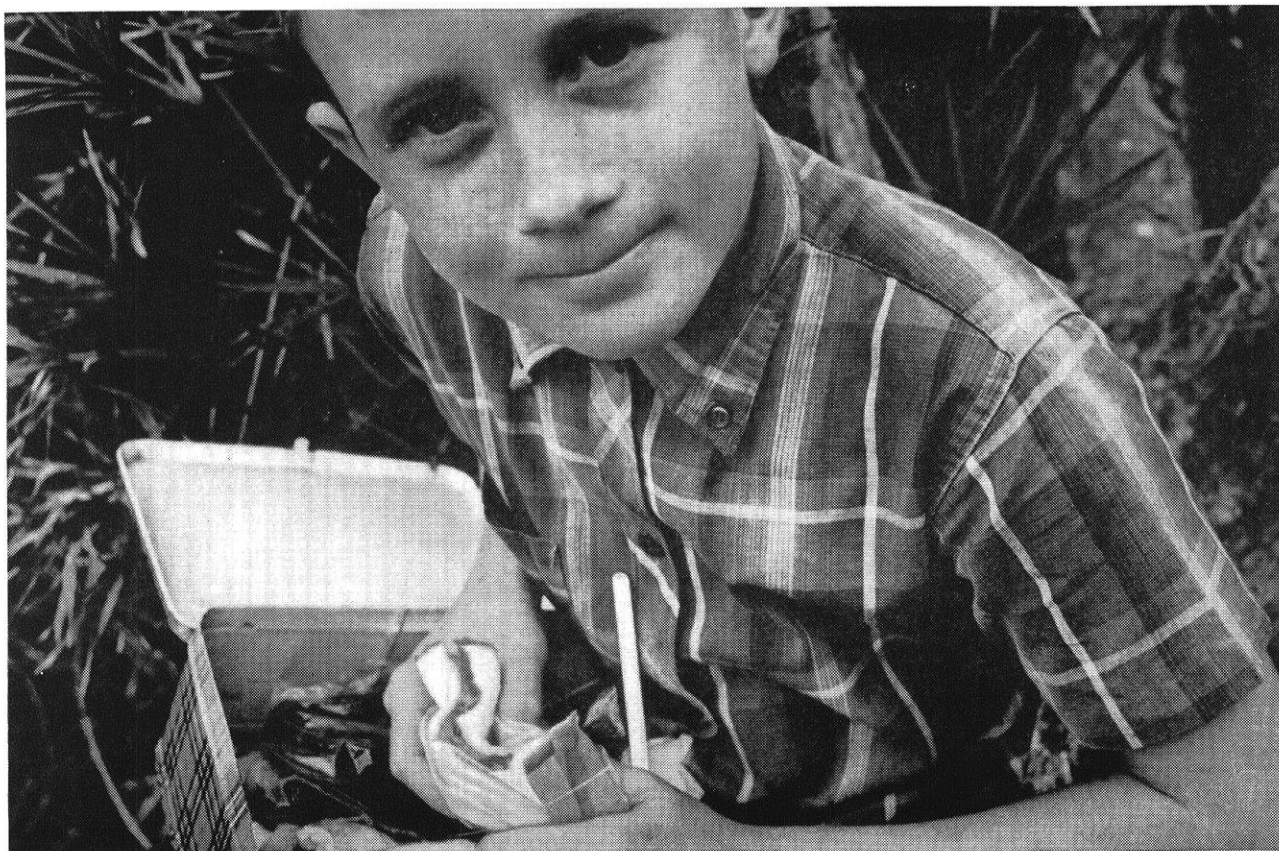
We can show you what this means in terms of increased professional opportunity . . . how Monsanto's continuing expansion affords more and interesting growing room for you.

See your Placement Director to arrange for an interview when we visit your campus soon. Or write today for our brochure, "Your Future and Monsanto," to Manager, Professional Recruiting, Dept. CM 64, Monsanto, St. Louis, Missouri 63166.

*An Equal Opportunity Employer*







## Is it possible that a leading maker of jet engine turbine blades had a hand in giving Pat Deegan a fresh sandwich today that was made last night?

It's perfectly logical to assume that the nation's leading producer of alloying metals like chromium, manganese, tungsten, and vanadium could become an expert on their use in new forms of steel. One result is the development of a new kind of stronger stainless steel.

Nor would it be surprising that the nation's pioneer and leading producer of plastic raw materials would be selling plastic food bags with a new kind of fold-lock top that locks in freshness. They're called "Glad" Bags, and they keep Pat Deegan's lunch fresh even though it was packed the night before.

But you'd have every reason to doubt that two such unlike activities could come from the same company. Provided you didn't know about Union Carbide.

In fact, you'll come across lots of diversifi-

cations at Union Carbide. It's one of the world's largest producers of chemicals, and it makes ingredients for textiles, paint, and urethane foam for cushioning. It is one of the most diversified private enterprises in the field of atomic energy. As a world authority in super-cold fluids, it produces tons of liquefied hydrogen, oxygen, and nitrogen for fueling space vehicles. It's a leader in carbon products and makes exhaust nozzle liners for rockets, brushes for electric motors, and electrodes for electric arc furnaces. And its consumer products include world-leading "Prestone" anti-freeze.

In fact, few other corporations are so deeply involved in so many different skills and activities that will affect the technical and production capabilities of our next century.

The next century starts with Pat Deegan's lunch.



UNION CARBIDE CORPORATION, 270 PARK AVENUE, NEW YORK, N. Y. 10017. IN CANADA: UNION CARBIDE CANADA LIMITED, TORONTO  
Divisions: Carbon Products, Chemicals, Consumer Products, Food Products, International, Linde, Metals, Nuclear, Olefins, Ore, Plastics, Silicones and Stellite

# Across the Editors Desk

## WELCOME

You have been attending the University of Wisconsin for well over a month. Veterans of the battle of the books have renewed old friendships and finished swapping lies about summer activities. The time has come to settle down, slide rule in hand, resolving to study harder and pull better grades. Maybe it is the absence of some of our former classmates that instills this in us; this dwindling of class sizes is truly a down to earth example of the survival of the fittest.

The *Engineer* reminds you however, that *all* work and nothing else will not make you a desirable engineer to industry and government. It is our firm conviction that at least one extra-curricular activity in which you actively participate is worth much more than the time you put into it. Naturally and obviously, you have your choice, but our advice is to look first to the society of engineers whose field is common to yours. Besides having an excellent opportunity to chat informally with faculty members, you may gain valuable leadership experience and maybe even learn something!

## DO UNTO OTHERS AS YOU WOULD HAVE THEM DO UNTO YOU

You've all heard the "Golden Rule" for as long as we can remember. Sometimes we wonder if anyone remembers it or applies it. Our complaint may seem trite, but to a large number of engineers, it is a problem that can be solved or at least alleviated somewhat.

Frustrations in the "wee hours" (like 7:45) of the morning are plentiful, as we have all learned from long experience. For those students who find it necessary to drive their cars to school, Breese Terrace and vicinity is not a pleasant or encouraging sight. What irks them most is that numerous students want to be assured of a fast getaway and consequently leave a space not quite long enough for a compact car both ahead of and behind their vehicles. Were these discourteous students a bit more thoughtful and in not quite so great a hurry, parking for at least a dozen more cars would be available. Maybe one would be yours!

## TAXATION WITHOUT REPRESENTATION

As the years roll on by and the value of the dollar rolls

soon down, the cost of an education increases. More and more students are forced to engage in part-time employment (at ridiculously low wages to begin with in many cases, considering the training and education of the employee) in addition to spending their summer earnings, all to obtain a diploma. On these wages they pay taxes at the same rate levied on non-students. Many of them are not yet old enough to cast a ballot towards getting a fair deal through favorable legislation.

This group (a sizable one indeed) of under-21 working students has no elected representatives but in fact contributes to the salaries of the representatives of others. Their voice in obtaining legislation to inaugurate a refund system on the basis of educational costs is weak, but nevertheless existent.

We would like to see a mass letter-writing campaign to legislators and obtain a "break" for students who care enough about getting an education to work for it. These are the leaders of tomorrow, becoming better informed and more worthwhile to the community by the day.

# WATER WITCHING: Magic or Malarky?

By Barry A. Jens

**W**ATER witching, dowsing, or divining is estimated to be as old as 7000 years. Moses has been called the first water witcher because of the Biblical reference (Numbers 20: 9-11) to finding water by use of a rod. Scattered references are made to it by Marco Polo in his travels and supposedly it was used in ancient Russia, Malaya, and the Orient for religious and superstitious practices. In 1518 Martin Luther condemned it as a violation of the First Commandment.

The first actual written account occurred in 1556 and described the use of a divining rod for locating mines in the mining areas of Bohemia in southeastern Germany. Beginning in 1558, German miners with divining rods were apparently "imported" by England for use in English mines. By 1700 the practice had spread to all of Europe and first arrived in America about 1775. During this period, it also spread throughout the world because of the colonization being done by the countries of Europe.

In 1692 a dowsing rod was used to track down a criminal in a rather unusual chase which covered a good part of France. When the rod finally caught up with the criminal he confessed.

Water witching was probably not found among any Africans or American Indians before they learned it from Europeans. Discounting early Asian references, it was probably entirely a European invention, coming from the mining districts of southeast Germany (today Czechoslovakia).

Today in Europe there are many dowsing clubs and associations where people dowse as a hobby, or in some cases, as a profession. Various members of these clubs have offered some rather exotic "scientific" papers giving their own theories of explanation. There are a few such associations in this country but they are considerably less popular.<sup>1</sup>

In addition to those already mentioned, there are several other terms found in this country describing the practice. The most common are water seeking, doodlebugging, wishing rod, striking rod, and various European descriptions. The fact that the names seem to follow a nationality pattern implies that the practice was brought to this country from several sources rather than from a single one. Only in this country is it called witching. This can be traced to the witch-burning hysteria that occurred in the New England region in the early days of the country. However, a similarity occurs in France where a dowser is referred to as a "sourcier", meaning spring finder. Note the similarity to the English word sorcerer, which is of French extraction.

<sup>1</sup> "A large fresco of a water dowser decorates a wall of the city hall of Oslo, Norway, where water dowsing is accepted as a necessary and highly appreciated part of life. The Norwegians know that water supplies can't be found without water dowsers, . . . So in Norway water dowsing is honored, along with Norway's other arts, professions, and callings on the walls of the city hall of the capitol."

Today it is estimated that there are 25,000 diviners actively plying their trade in the United States. There also are as many "experts" on the subject today as there are people. This can very easily be verified by asking *anyone* whether water witching works or not. Usually an absolute "answer" will be readily ventured. These answers will fall into definite patterns or groups. First, there are those people for whom a well was successfully witched. These people are practically unanimously convinced of the authenticity of water witching. This same belief applies somewhat to people who have a neighbor whose well was successfully witched. At the other extreme are people who have never had any actual contact with water witching. Because such things as this do not happen in the twentieth century and because of the connotation that the word witching carries, these people are generally convinced that it is a hoax. Between these two extremes are several other attitudes such as: "I have an open mind about such things, but I don't see how it could possibly work"; or "I don't know how it works, but by golly it does".

Much has been written about the phenomenon of water witching; at the same time, very little has actually been said. Many scientific proofs both for and against have been offered. Many problems and disagreements have resulted. The ability to witch appears to vary considerably in degree from one person to another. Consequently, there are many dowsers



of questionable ability "diluting the results". Another problem and source of error lies in the definition of success and failure. The criteria for success or failure are very important and can mean a great deal of difference in analyzing the results of a test. An added source of difficulty is in the establishment of an accurate testing procedure. It is difficult and expensive to test a dowsing when the only verification can be made by actually digging a well. To accurately confirm anything means a considerable amount of well digging. On the other hand, when a dowser's claim is to find underground water, it is unreasonable to ask him to submit to laboratory tests such as "which bottles contain gin and which contain water?" or "Which envelopes contain quarters and which envelopes contain nickels?"

#### Some Present Day Dowsers

Following are discussions of three people who have gained considerable fame as a result of their witching activities. The first concerns Miss Evelyn M. Penrose, who in 1931 was employed by the government of British Columbia, Canada, as the official water diviner for that province. She was English and created quite a storm of controversy throughout the province although her results were apparently quite successful. Little is known about Miss Penrose, but she is introduced here because of an important reference to follow.

The second subject is Mr. Jerry Smith of Barstow, California. Mr. Smith is a mechanical engineer and district manager for the California Electric Power Co. He has been with this company for twenty years and has been dowsing for the last sixteen years. He has had 1000 successes in 1000 attempts (although success is not defined). In this especially dry region of our country, Smith is able to locate water sources and predict accurately both the flow and depth. The best example of Smith's ability concerns a witching expedition to San Luis, Mexico where 400 dry wells had been drilled previously. Mr. Smith witched several good spots of which two were actually drilled. Both wells yielded 2000

gpm. This is a tremendously high figure for any well, anywhere.

The third and most important person is Mr. Henry Gross of Biddeford, Maine. Mr. Gross is mentioned in *Who's Who*: "Gross, Henry, water dowser . . . Located Bermuda's first fresh water underground springs, . . .". Mr. Gross is the subject of three books, (*Henry Gross and His Dowsing Rod*, 1951; *The Seventh Sense*, 1953; and *Water Unlimited*, 1957) all by the late Mr. Kenneth Roberts who turned from historical novels such as *Northwest Passage*, to documentary accounting of Gross and his exploits. Gross, a retired Maine game warden, was only a second rate dowser until he came under the tutelage of Roberts. They incorporated as Water Unlimited, Inc., and became quite a controversial topic throughout the northeastern region of this country. Robert's three books describe in detail their adventures and accomplishments as professional dowsers. Throughout these books Roberts attempted to leave the impression of not being motivated by desire for money, but rather, motivated by an obsession to prove to the world that water witching actually works. Under the guidance of Roberts, Gross discovered that he had tremendous and fantastic powers. He was able to determine where underground flowing water existed, where it went to, where it came from, what the quantity of flow was, what the depth was, what the quality was, and what the quantity of flow was during the driest part of the year. Not only was he able to locate these points by standing over them, but he could also roughly locate them from a distant hill or high spot. He was also able to locate these points from several thousand miles away just by witching over a map. The reader will probably have the typical reaction here: "I could possibly be made to believe that a dowser could find water when it's under his feet; but don't expect me to believe that he can find it from a distance, or by just looking at a map. That's going too far!"

One classic example of Mr. Gross' dowsing is worthy of discussion here. Roberts had done some of his historical novel writings while living in Bermuda and

was aware of the critical water situation that existed there. The island's entire supply of water came from trapped rain water; either by roof tanks, catch basins, or scattered underground drainage discoveries. When a drought occurred, the island's water had to be imported. This seemed to be an ideal spot for Gross to show his stuff, as geologists were practically unanimous in agreeing that there was positively no fresh water anywhere on the island of Bermuda. Gross witched four spots on the map of Bermuda while in Maine, and then later pinpointed them during a trip to Bermuda. At this point Gross and Roberts decided to dig the wells and persuaded the local government to finance the operation. They met with considerable red tape, faulty equipment, and inefficiency, but finally succeeded in digging three of the four wells, the results being very close to those predicted. The fourth well was not drilled because Gross witched it as unfit to drink.

By coincidence, during the drilling of these wells, Roberts "finally located" Miss Penrose (the former official dowser of British Columbia) and sent her maps of Bermuda which she distance dowsed (from Australia) and returned. Roberts states: "Her findings, roughly speaking, correspond to Henry's (Gross), and make this Bermuda adventure, to my way of thinking, the greatest dowsing experiment on record. Two water dowsers, working from opposite ends of the earth and using two different methods, (Miss Penrose witched over a map with only her hands instead of the conventional dowsing rod) have come up with the same answers concerning a small and supposedly waterless island in the middle of the Atlantic!"

#### Use in Oil Industry

Recently dowsing has become quite popular in the oil well drilling industry. H. E. Thomas (who is Branch Area Chief, Pacific Area, Ground Water Branch, Water Resources Division, U. S. Geological Survey, Menlo Park, California) states in a publication approved by the Director, U. S. Geological Survey: "The petroleum industry,



which has developed methods of scientific divination to a high degree (without, however, adopting the term 'divination' as pertinent to those methods) has conclusive evidence that those methods produce a higher proportion of successful wells than are obtained by alternative methods. In the decade 1946-55, about 55,000 new-field wildcats (holes in unproved areas) were drilled in the United States. Of those located by scientific techniques 12.3% were successful; the proportion rose to 15.5% for those using geological, geophysical, and geochemical techniques to the utmost (this means dowsing). By contrast, only 4.1% of the holes located on non-scientific bases were successful. From this record it is easy to see why 19 out of 20 wildcats for oil are now located on the basis of scientific 'signs'."

This use of divination in the oil industry is generally called doodlebugging. Kansas farmer Walter Nelson has become moderately wealthy because of his oil-finding ability. Nelson, relying chiefly on his doodlebug, has drilled nine holes in the past two years, has struck oil in all of them, and all but one are now producing profitably.

## VARIOUS WITCHING METHODS

### The Forked Stick

There are several methods used for witching. In this country the most common is the forked stick. The type of wood used for the rod does not appear to be very important and apparently is decided by the varieties of trees most common to an area. The rod may also be made from baling wire, coat hangers, copper wire, or, in an emergency, poison oak will do.

The palms-up grip is the standard method used for holding the forked stick in America. This means grasping the two branches of the forked stick, one in each hand, palms up, with the neck (or bottom of the "Y") pointing away from the body somewhere between horizontal and skyward at 45°. A considerable amount of tension is then applied to the rod.

When the forces are applied to the rod as in Figure 1, it can easily

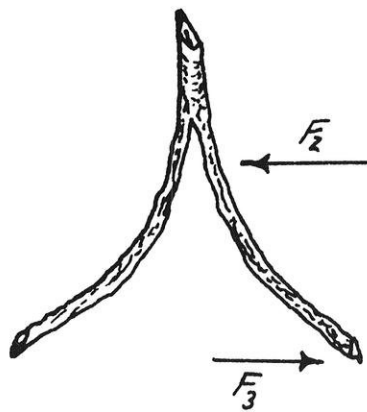


Fig. 1. Forces applied to a dowsing rod.  $F_3$  must be larger than  $F_2$  to maintain equilibrium.

be shown that only a very slight movement of the wrists is necessary to make the tip of the rod deflect either up or down.

In an actual dowsing, the dowser will pace back and forth over the property until the tip of the rod begins to quiver. Then he will slowly move about this spot until the rod goes down (sometimes up). The rod will twist downward with such force that the bark may peel off. If the rod is held tightly enough, the skin on the dowser's hand may well peel off. For Mr. Smith, when the rod goes down, his whole body shakes and trembles. Miss Penrose states: "... the actual finding of water is exhausting. It is as if some power or virtue goes out of one's self ... Sometimes, when finding large quantities of water, and more especially when finding oil or minerals, I have been seized with violent physical sickness, which I have finally had to call in a doctor to stop ... The first indication I get of oil is a violent stab through the soles of my feet like a red-hot knife. When over the oil itself, the action of the rod is so violent that I am turned and twisted about like a doll on the end of a string, and can hardly keep my feet."

### The Pendulum

A second dowsing method, the pendulum, entered the picture in the early 1800's. Today this device is more commonly found in Europe than in America. Sometimes it is used in conjunction with the forked stick. Various pendulums are: keys suspended from books (usually the Bible), watches

attached to strings or chains, spools on strands of thread, pennies on the ends of wire, and quicksilver or water in a bottle suspended from strings. When a pendulum is employed, its gyrations as it is suspended from the diviner's fingers are the clues to the presence or absence of water.

Many other methods are used. In fact, anything that can be held so that it will move or change movement in a diviner's grip can be, and probably has been, used as a divining rod. Some of the more exotic items found are horse-whips, shovels, pitchforks, welding rods, baling wire, and swiveling rods. Apparently swiveling rods are commonly used throughout the country for finding underground pipes or leaks in buried pipes. Some people profess to be able to find water by using their hands only. It is also thought to be possible to transfer the power of dowsing from a dowser to a non-dowser simply by making physical contact between the two people.

There is wide use of the "like attracts like" principle. If a pendulum is used, it consists of a string and a jar, the jar containing the item being searched for. If the rod is used, the tip is first dipped into the substance to be searched for.

Some dowsers try to estimate depth and quantity. The most common method of estimating depth is by the amount of pull on the rod. A second theory is that the "rays of force" are emitted at a 45° angle from the water vein as in Figure 2. This means that the distance covered by the dowser, from where the rod just starts to pull until it stops pulling, is equal to twice the depth to water. An-

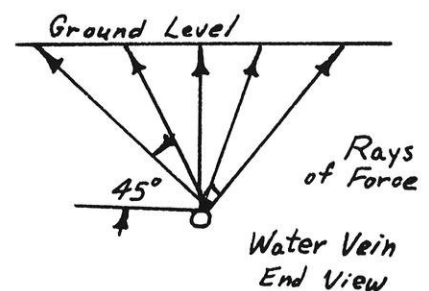


Figure 2. Rays of force emitted from a water vein.

other method is counting the oscillations of a pendulum. A method found commonly in this country is that of holding a piece of baling wire horizontally at one end between thumb and fore-finger. The rod begins to nod up and down and then stops. Each nod indicates a foot of depth. In Europe, the same technique is used, but each bob is taken to mean one meter of depth. Sometimes the number of bobs is translated into gallons per minute. All of these techniques are found in Europe. Even the long-distance dowsing over a map, as Henry Gross practices it, is strictly a European import.

## ANALYSIS

### Force of "Magnetic" Attraction

It is very obvious, to anyone who has seen a dowser in action, that the rod actually moves. Therefore, for this report, the question will be, "Why does it move?" and not "Does it move?". The first theory is that there exists some kind of force of electricity, magnetism, or chemistry between the rod and underground water. The leading exponent of this theory was the late Mr. Roberts. Mr. J. J. Grullemans (owner of the Wayside Gardens nursery in Ohio which is one of the largest and most famous nurseries in this country) had his property witched by Gross and Roberts and relates the following: "In your book I read that some of the critics are inclined to believe that motion of the stick is due to involuntary muscular action. Henry (Gross) had mentioned at the time that an ordinary blade of grass would work quite satisfactorily in his hands. With that thought in mind, I cut two or three leaves of what is commonly known as ornamental or pampas grass. These leaves are three to four feet long, and very flexible and arching. I took one of these leaves, bent it in two and gave it to Henry to use. I would say that the legs of the 'V' were probably eighteen inches long. Henry held the grass upright, pinching the ends between thumb and finger, and walked over one of the veins he had located. The moment he was at the right spot, the grass-

blade, from a point about one and one-half or two inches above the thumb and finger, curved gracefully forward; then snapped straight down from the force of the pull. If his muscles had been working on the grass-blade, it would have bent at the points where it was held. I had him repeat this three times with three different blades of pampas grass, and the results each time were exactly the same. Involuntary muscular action never could have done this trick unless muscular action can crawl two inches up a blade of grass!" This appears to be a logical explanation and possibly could be accepted except for the fact that Roberts fails to account for the location of the force of attraction between a dowsing rod and a map when distance dowsing is employed. Roberts and others also state that the attraction is different between stationary underground water and moving underground water. The force of attraction and the reactions to it appear to vary greatly between dowsers.

*Difference in Geological Beliefs:* At this point, the difference in geological beliefs between dowsers and geologists should be explained. The geologist states that all usable water is part of a vast circulatory system—the hydrologic cycle—which includes vapor, surface water, soil moisture, and ground-water phases; and involves the processes of precipitation, infiltration, percolation, seepage, and evapo-transpiration, by means of which water moves from one phase to another of the cycle. Renewability of the water resource is inherent in the hydrologic cycle, in which the fresh water on the continents receives increments periodically from precipitation. This implies that there can only be a certain amount of water in any area and that quantity will be a function of the rainfall. The water table represents the top of the water that has accumulated on top of a layer of impermeable material. The water table usually represents a subdued replica of the surface topography.

The dowser believes that shallow underground water occurs in "veins", like the veins in your

body. These veins may vary in magnitude from the size of a pencil to underground rivers. In his *Notebooks*, Leonardo da Vinci, hundreds of years ago, insisted again and again that underground water flowed in veins everywhere. The dowser's task is to locate one of these veins. From ancient times the only real innovation to this theory of underground veins is the "discovery" by Mr. Gross of "domes" of water which come up vertically from deep underground reservoirs and feed water into veins that branch off the domes. Gross and Roberts explain that domes are "single spouts of water rising from deep underground", which may occur on high land, "far above the so-called water table". From these domes emerge veins of flowing water which spread out in all directions. The veins may flow through a layer of gravel, or a geologic fault, or apparently, just about anything. A vein that comes to the surface is a spring. A vein may be crushed by pressure from above; when this happens, the water turns off and makes a new channel in another direction. It may be pushed out of its course by the concussion of a drill, but this diversion is only temporary as the flow supposedly resumes its original course with the first heavy rains. This vein crushing idea causes some temporary failures and may damage the reputation of the dowser. It is also used as an excuse for failures.

While the idea of water veins bears some relationship to the cracks and crevices from which shallow underground water is obtained in crystalline rocks and also to the underground streams that are sometimes found in limestone country, the diviners apply the same idea to all areas of the United States. Roberts claims to have considerable knowledge of classroom geology but still believes in veins and domes. He states: "Scores of veins have been cut and exposed on my Maine farm—scores of underground rivulets running north, south, east and west from central domes in periods of severe drought; yet water geologists insist that these things cannot be." He also cites parts of a book,

*Geology and Man*, written by two geology professors at the University of Michigan, in which they describe veins and domes in somewhat the manner that they are described by dowsers.

Although there is some difference in the description of underground water described by men of science and those not of science, the two ideas appear to be parallel enough to find room for both in the final analysis.

### "Geiger Counter" Theory

A second explanation offered as proof of the validity of dowsing is that the human mind is analogous to a geiger counter reacting to radiation fields. It is thought that the human mind is sensitive enough to record changes in the electric field of the earth and this is in turn amplified through subconscious muscular reactions to make a witching stick turn down. A Dutch geology professor, Professor S. S. Tromp (who worked for the Technical Assistance Administration of the United Nations—1951) explains this theory in his book *Psychical Physics* (1949). His theory of dowsing is essentially as follows: There exist certain regions which he defines as "dowsing zones". These are regions in which there exist sharp variations in electric or magnetic fields, which can actually be measured by the appropriate electrical or magnetic instruments. Tromp believes that a dowser is so sensitive to these physical variations that they are somehow perceived by his unconscious mind and transmitted to the dowsing rod in the form of unconscious muscular contractions. In entering an actual dowsing zone, there is a jump in skin potential, as measured between certain points on a dowser's body. There appears to be no place in Tromp's theory for distance dowsing or for the nurseryman's explanation.

A group of curious electrical engineers from New York attempted to test this theory in April and July, 1952, working with Gross and a Canadian of comparable dowsing ability. Using a copper rod instead of wood, they insulated his left handgrip, so that the voltmeter could be connected across from the left-hand portion

of the rod to a metal foil wrapped around Henry's left wrist. No significant changes were found using distance dowsing. However, changes in skin potential of from 100 to 200 millivolts were obtained when Henry or Desrosiers (the Canadian) walked across the vein . . . The non-dowsers imitated the physical actions of the dowsers as closely as possible when crossing the vein. The non-dowsers did everything in their power, through muscular contortions and through forcing the stick downward while over the vein, to duplicate the large changes in skin potential that were recorded for the dowsers. The highest jump in skin potential that could be obtained by a non-dowser in this manner was 30 millivolts. Apparently, any bonafide sudden change in the skin potential to the amount of 100 to 200 millivolts would be indicative of a highly abnormal emotional state such as might occur in an epileptic convulsion. These results indicate an extraordinary deviation from the usual, whatever the cause.

### The Power of Suggestion and Muscular Reactions

The "last word" on water witching (1959) is *Water Witching USA*, a technical book by Evon Z. Vogt and Ray Hyman, in which they attempt to disprove, once and for all, the practice of water witching. Most of the work on this book was done at Stanford and Harvard Universities. To obtain a sample representation, one-sixth of the county agricultural extension agents in this country were asked to fill out questionnaires on the subject. Vogt and Hyman conclude that the rod turns because of unconscious muscular reactions caused by the power of suggestion or guessing. Since dowsers generally have been quite successful, they conclude that the water witcher is in reality, a very good amateur water geologist, and the rod turns because of a flip of experience.

The major portion of their book is devoted to experiments on, and explanations of, unconscious muscular reactions. In one of these they determined how a horse was able to talk. In 1904 a horse named

Hans was found in Germany that had the power to answer questions by tapping out the answers with his hoof. The abilities of Hans were amazing as he was able to answer questions of any type. Even when Hans' trainer was absent, he was still able to answer most of the questions put to him. An investigator found after a series of tests that the horse, in the process of being trained, had learned to react to small unconscious muscular movements on the part of the trainer simply by tapping his hoof. Hans also learned that if he stopped tapping after another small muscular movement, he was frequently rewarded with sugar or oats. It seems that it is impossible for a person to ask a question without giving some unconscious muscular reaction. The same holds true when the horse has tapped the desired number of times.

Vogt and Hyman applied this same idea to mind readers. They found that a certain mind reader was able to determine whose name was written in a sealed envelope, by certain clues of muscular movements on the part of the writer. They found that unconscious muscular movements were the clues generally used by most mind readers. The mind readers denied this so vigorously that Vogt and Hyman concluded that the mind readers were actually subconsciously reacting to these subconscious clues of others.

Vogt and Hyman applied this principle further to a successful dowser who volunteered to be tested. He was a minister and had forty-five years of very successful dowsing experience supplemented with documents and testimonials. The results of all their tests were negative except one: The pastor claimed that his rod could estimate the depth at which a box of metal objects was located. The box was placed at different levels on a ladder which was one floor below the pastor. The pastor's rod had little trouble in differentiating the step of the ladder on which the box was as long as the pastor knew which step it was on. When the experiment was run without the pastor being informed, then

(Continued on page 26)

**ASCE**

**SAE**

**ANS**

**IEEE**

**ASME**

**AIChE**

**Polygon Board**

**READ ABOUT**

**THESE AND OTHER**

**UW ENGINEERING ORGANIZATIONS**

**IN FORTHCOMING ISSUES**

Society correspondents are reminded to have schedules and news copy in 1 month prior to desired publication date.

---

## **MAKE YOUR FREE TIME COUNT**

Applications are now being taken for trainees for most staff positions. Those students accepted will be in line for promotions as vacancies exist. This is considered excellent journalism experience and will be an asset to your record.

To learn more about the opportunities, stop in or call our office, 333 Mechanical Engineering, Phone 262-3494. Regular office hours are 2:30-4:30 p.m., Tuesdays and Thursdays.



# Freeze Desalting of Saline Water

*By Donald D. Christophor*

**A**T THE present time the population and the amount of industry in the United States is growing very rapidly. Along with this rapid growth there is an increasing need for potable water. In 1961 about 300 billion gallons of water were being consumed per day. It is predicted that by 1980 600 billion gallons of water will be consumed per day. The ocean is the only source of this large amount of water, but before it can be used, it must be desalinated.

Water which is consumed by humans has a salinity of about 500 parts per million (ppm) and an upper limit of 1000 ppm. 1000 ppm represents 1 gram of salts per kilogram of water.)

The salinity specifications for industry ranges from very low salinity to common ocean water, depending on the products manufactured.

Water used in agriculture needs to have a salinity below 2000 ppm. Above this value the growth of plants decreases. Twenty-six gallons of water per square foot per year are needed by agriculture so here is a great need for pure water.

Since ocean water salinity is about 35,000 ppm it must be desalinated considerably and this must be done economically. Conversion processes now being investigated are distillation, membrane processes, separation by freezing, and other chemical, electrical, and physical conversion methods.

The freeze desalting process will be discussed here. Since research on this process is fairly new, the actual data and results are scarce at the present time. Some of the facts presented here are based on actual runs in demonstration plants, but most are based on theoretical data.

## THE BASIC PRINCIPLE

Separating salt from sea water by freezing is based on a principle known to metallurgists for a long time. The principle is equilibrium freezing in an operating range between 25°F to 28.2°F. In this range there results a liquid-solid solution of pure ice and concentrated brine. Outside of this temperature range impurities freeze out with the ice.

There are many methods which can be employed to freeze salt water but some are not feasible because of their low efficiency.

## FREEZING PROCESSES

### Indirect Freezing

The indirect freezing process has the sea water and refrigerant separated by coils. Because of the low heat transfer through the metal, this process is very unfeasible and will not be considered further.

### Direct Freezing I

Direct freezing by using the cooling effect of vaporization of water is shown in Figure 1. In this process the incoming sea water is first deaerated. This is done to remove all air from the water which would cause an undesirable pressure increase in the freezing chamber. The water is next cooled in a heat exchanger and sprayed into a chamber where the pressure is maintained at about 3 to 4 mm. of mercury (about .005 atm.). This is below the vapor pressure of water so the water rapidly vaporizes. The heat of vaporization of water is about 540 kcal. per kg. and the heat of fusion is 80 kcal. per kg. so about 7.5 kg. of ice will be formed for every kg. of water vaporized. A solution of 50% fine

ice and 50% brine results from this process. The ice and brine are then separated in a countercurrent washer and the brine is discharged as waste while the ice is transferred to the melter.

The water vapor formed in the freezer must be pumped out to maintain the vacuum. At 32°F the volume of saturated vapor is 206,000 cubic meters per ton of water. To move this large volume of vapor, rotary fans and blowers are used. This vapor could be pumped to the atmosphere, but to compress this vapor to 1 atmosphere of pressure would take too much work. Instead it is compressed to about 5 mm. of mercury pressure and brought in contact with the ice. As the vapor pressure of ice in contact with water is low, this can be done at this low pressure without any vapor emitting from the ice. In principle, one kg. of vapor can melt 7.5 kg. of ice. But heat is added to the vapor by the pumps so the vapor must be cooled before it comes in contact with the ice. This is done to maintain the pressure and low temperature in the freezer.

After the ice is melted a portion of the water is recirculated in the washer and the other portion is circulated in the heat exchanger and then taken off as fresh water ready for use.

### Direct Freezing II

This process is the same as the process explained above except, instead of using a compressor to transfer the water vapor, it is absorbed in an absorbent, then moved. A suitable absorbent is lithium chloride because of its very low vapor pressure (below that of water) and its hygroscopic properties. Lithium chloride is sprayed

into the water vapor and the vapor is then absorbed. During the absorption process a temperature of 12 to 15°C. must be maintained in the chamber to prevent an increase in water vapor pressure and a subsequent decrease in absorption. Heat is given off during this absorption process so the lithium chloride must be cooled to maintain the chamber temperature of 12 to 15°C. The ice is passed through this chamber so that as it melts the low temperature is maintained. The lithium chloride-water vapor mixture is heated in a heat exchanger while the lithium chloride which is going to the absorption unit is being cooled. The lithium chloride-water vapor mixture is then boiled by steam to remove the water vapor. The water vapor is condensed and sent out as product water and the lithium chloride is recirculated to the absorption unit.

### Direct Freezing III

This process as shown in Figure 2 eliminates the necessity of transporting large volumes of water vapor. A refrigerant which has a vapor pressure higher than water and is immiscible in water must be used. Isobutane has these properties and is used. Isobutane has a boiling point of  $-5^{\circ}\text{C}$ . at atmospheric pressure, that is, very near to the freezing point of water. The freezer is kept at a pressure slightly below atmospheric pressure, but above the pressure at which isobutane boils. The isobutane is sprayed directly into the freezer and boils deriving its heat of vaporization from the freezing water. The isobutane boils at  $-3^{\circ}\text{C}$ . and has a heat of vaporization of 91 kcal. per kg. Since its heat of vaporization is low, 1 ton of isobutane produces only 1.15 tons of ice. Compared to the freezing principle of the other two processes explained, this ratio of ice to refrigerant is high. Though this ratio is high, other advantages of this process outweigh this ratio. The ice and brine are then washed in a countercurrent washer. The brine is discharged as waste and the ice is brought to the melter. The isobutane vapor is compressed and allowed to come in contact with the ice. Heat from the con-

densing isobutane is absorbed by the melting ice. The isobutane then rises to the top of the water and is removed. The water is removed, some to the washer and the remainder is product water.

The processes described above all have a countercurrent washer, a relatively new development. These processes all have problems of feasibility and economics in common among themselves and with other freezing methods.

### WASHING OF ICE

A big problem encountered in the freezing process is separation of the brine from the ice. There are two methods being used at the present time. Centrifugation is being used in Japan and countercurrent washing is being used in the United States.

When ice is formed by the processes mentioned above without much control of the rate of freez-

ing, the size of the ice crystals is small. They are flat and about .1 to .4 mm. in the larger dimension and about 1/5 this length in the smaller dimension. With ice crystals this size the countercurrent method of washing does a much better job of separating ice and brine than does centrifuging. For this reason only the simpler countercurrent washing method will be explained.

The countercurrent washer shown in Figure 3 has clean water entering at the top and the ice and brine slurry entering in the bottom. The ice slowly rises to the top. As the ice rises, the brine concentration decreases and finally there is pure water flowing around the crystals as it reaches the top. The ice is then scraped off the top and brought to the melter. The resulting purity of the water is about 500 ppm.

The principle of hydraulics is used to cause the ice to rise in the

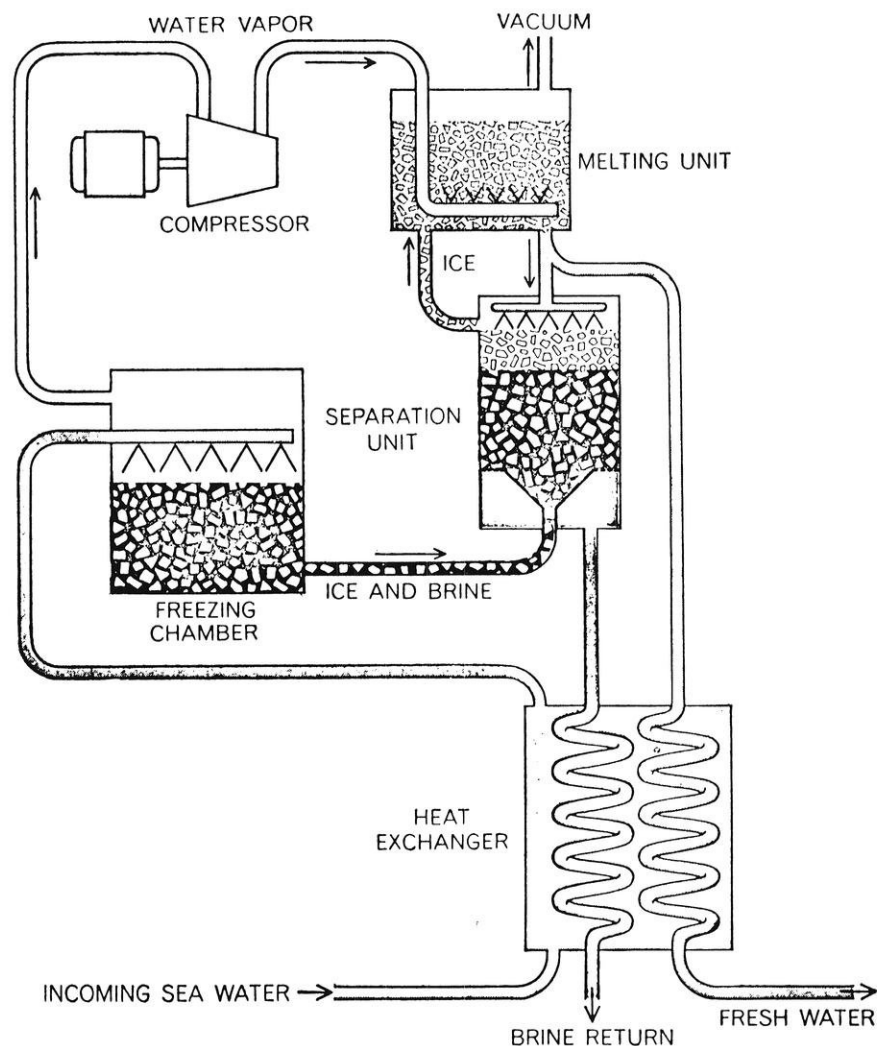


Figure 1. Direct refrigeration using the cooling effect of vaporization of water.

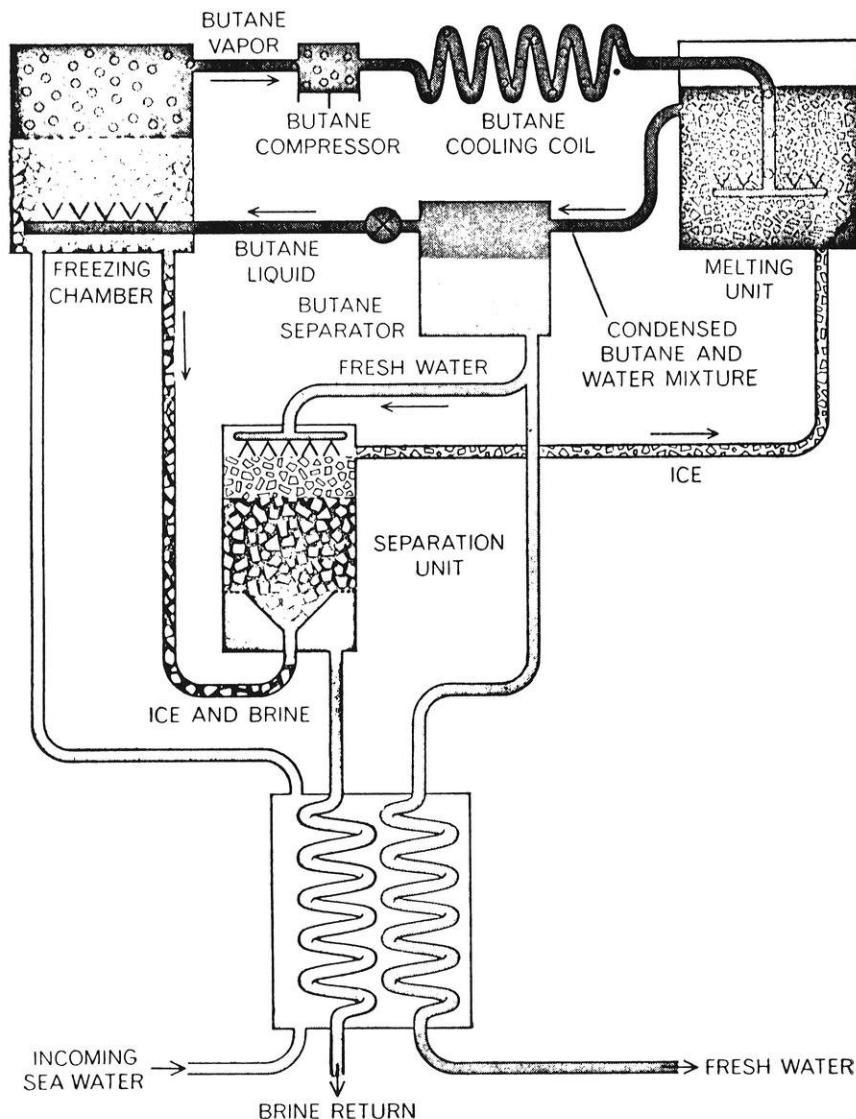


Figure 2. Direct refrigeration using the "butane method."

washer. As shown in Figure 5 the height,  $t$ , is such that the pressure drop is sufficient to cause the ice to go up at the same rate as the slurry comes in. The buoyant force of the ice must equalize the friction forces plus the weight. The side of the washer is lined with plastic to minimize the friction forces.

The problems of feasibility are of applied research. They are separating the ice and brine, improving the heat transfer, and making the process continuous. With these problems solved, the freeze desalting method is a very feasible process of desalting ocean water. It is the economics of the process which must be studied to bring the costs down.

## ECONOMICS

The biggest problem encountered in freeze desalting is making the process economical. There is much work being done in this area to reduce costs. To solve this problem, the minimum energy requirements are determined to find the minimum cost the process can operate at.

### Energy Requirements

The minimum amount of energy needed to freeze sea water is found mathematically by using an ideal process. The amount of energy is proportional to the absolute temperature as in a Carnot cycle. The work needed for this process is equal to  $p_v$ . When this

is calculated, it results in about 2.8 kwhr per 1000 gallons of potable water or about 4.5 cents per 1000 gallons of potable water. This is for a cycle efficiency of 100%, which is impossible. The best efficiency which can be attained at the present time is about 20%.

It may erroneously be assumed that energy requirements for freezing should be lower than for distillation because of the difference in the heat of vaporization (540 calories per gram) and heat of fusion (80 calories per gram). This would be true if there was no energy recovery. In actual practice it takes more energy to remove 1 calorie from water in the freezing process than adding a calorie of heat to the vapor in the distillation process.

Since losses are very high, much power is needed to freeze and pump the water. Engineers at Fairbanks Whitney Corporation estimated that in a large scale plant using the freezing process:

"about 10 per cent of the total electric power consumed will provide the minimum energy need for separating salt from water, about 60 per cent will be used to make up thermodynamic losses and about 30 per cent will be needed for operating  
(Continued on page 34)

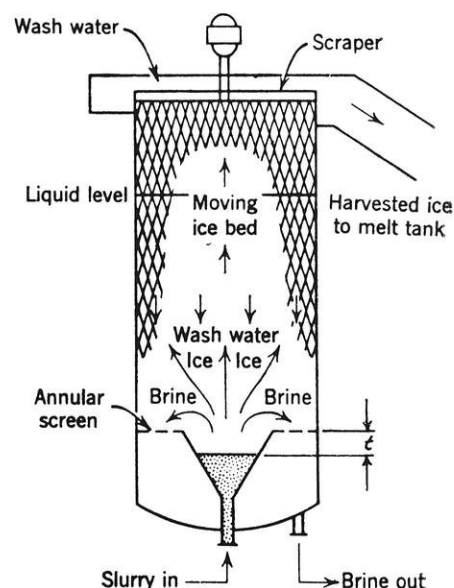


Figure 3. Moving bed wash column for ice slurry.

**FRESHMEN**

**CiE, ChE, EE**

**SOPHOMORES**

**ME, MME, ME**

**JUNIORS**

**EM, AMP**

**SENIORS**

**Others**

**GRADS**

**FACULTY**

Are you missing the technical knowledge, humor, book reviews, campus news, and just good reading? You need not!

CLIP,  
COMPLETE  
AND  
MAIL

## **SUBSCRIBE NOW**

**DON'T MISS A COPY OF THE 1964-65  
WISCONSIN ENGINEER**

The Wisconsin Engineer  
333 Mechanical Engineering Bldg.  
Madison, Wisconsin 53706

Name .....

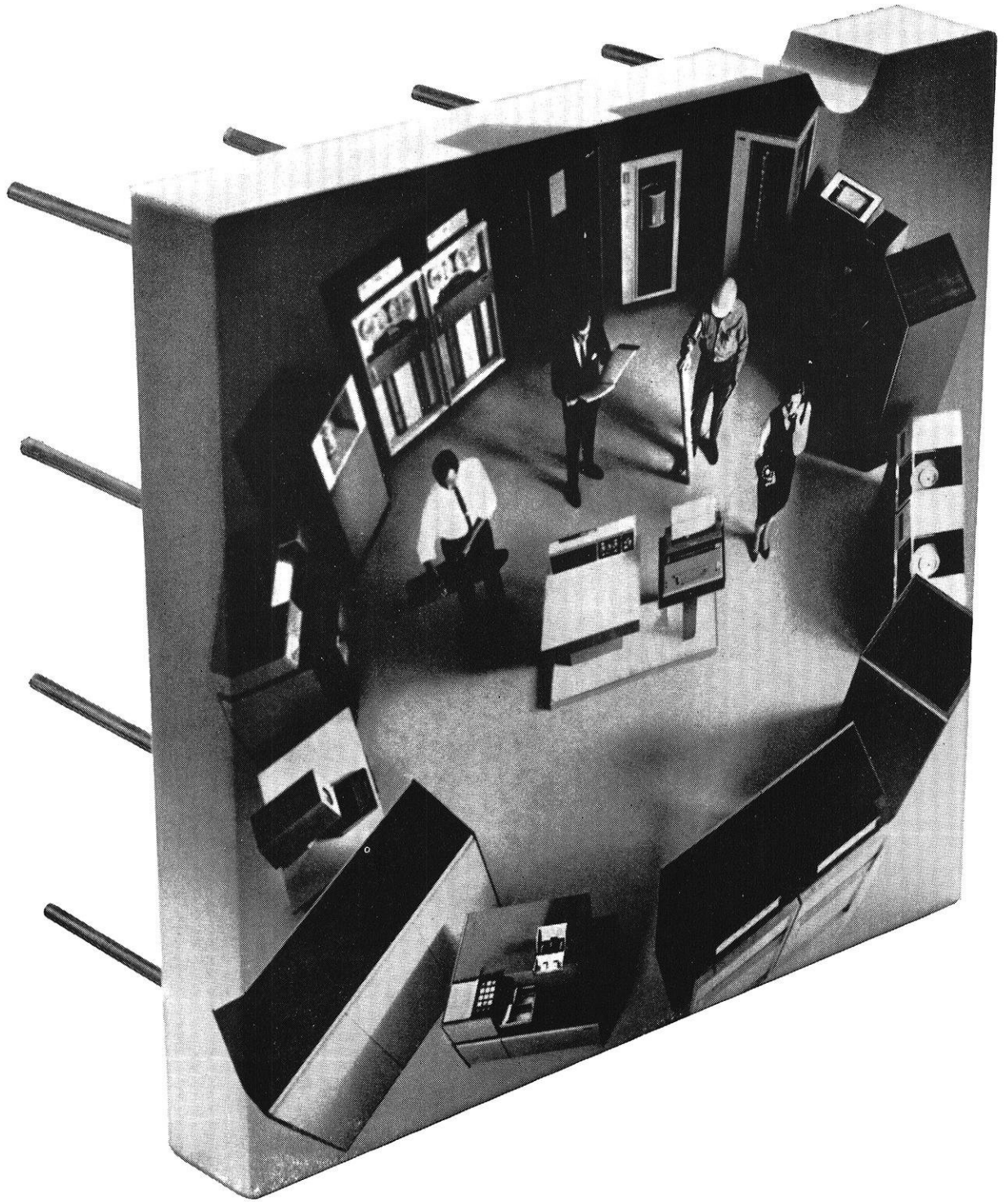
Street .....

City, State and Zip Code .....

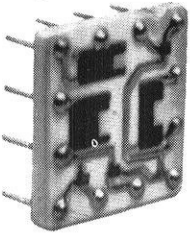
1 year \$1.25 ☐

4 years \$4.00 ☐





**From  
little chips  
great  
computers  
grow...**



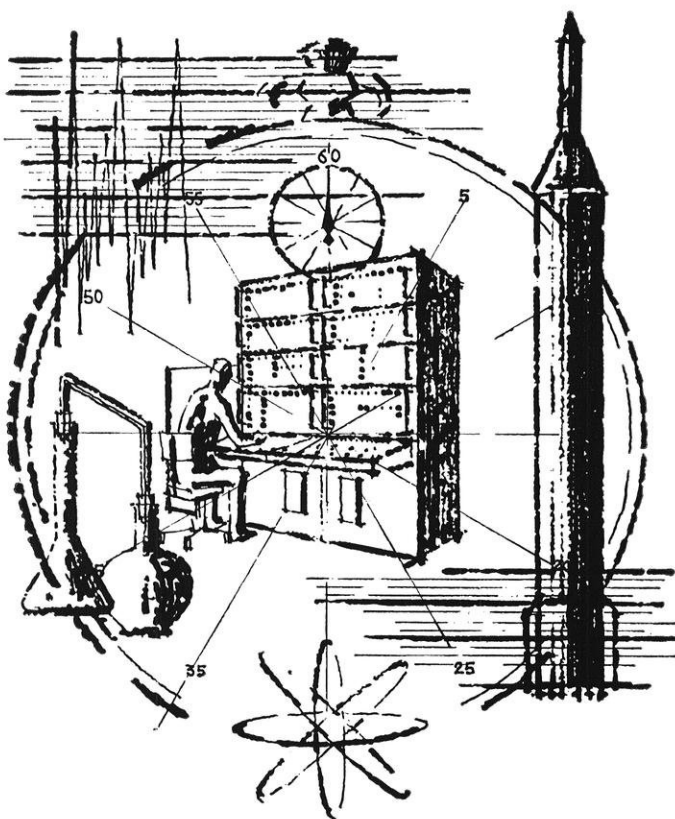
**You'll  
learn how  
at IBM**

You don't have to know anything about computers to start work at IBM. But you do have to know your basic technologies. At IBM you will expand your basic skills, and learn about computer systems such as the new IBM System/360.

IBM's new Solid Logic Technology has helped give the System/360 wide flexibility. This all-encompassing system can be used by many different customers on a variety of problems—business and scientific. It takes a lot of hard work and ingenuity to arrive at developments like microelectronic circuit modules, and chip transistors and diodes.

Your college placement officer can help determine where your skills best fit in at IBM. Or, if you prefer, write for information directly to Manager of College Relations, Dept. 915, **IBM**® Corporate Headquarters, Armonk, New York 10504. IBM is an Equal Opportunity Employer.

Applied Mathematics, Applied Mechanics,  
Data-Communications, Digital Computers,  
Guidance Systems, Human Factors,  
Industrial Engineering, Information Retrieval,  
Marketing, Manufacturing Research,  
Microwaves, Optics, Programming,  
Reliability Engineering,  
Servomechanisms, Solid State Devices,  
Systems Simulation and related areas.



# SCIENCE HIGHLIGHTS

*By Harold Weber, me'66*

## CONTACT-BEND-STRETCH METAL ROLLING PROCESS

A major innovation in the technology of metal rolling, invented at the General Electric Research Laboratory, will be developed further by the U.S. Steel Corp. The new process, in which metal strip is squeezed, bent, and pulled simultaneously, is called Contact-Bend-Stretch" (C-B-S) rolling.

The technique is the result of fundamental studies of the effects of cyclic plastic strain on metal, carried out by Dr. Louis F. Coffin, Jr., in General Electric's Research Laboratory. Coffin discovered that metal strip could more easily be made thinner and longer if plastic bending was added to the forces of pressure and tension that are usually applied in a rolling mill.

In conventional rolling, the metal is deformed by the contact pressure of two rolls, while the strip is pulled between them under tension. This operation might be described as "contact-stretch" rolling. If the metal is bent plastically at the same time, "contact-bend-stretch" rolling takes place.

In C-B-S rolling, the easier deformation of the strip, with the

smaller forces that are involved, may make it possible to use smaller, lighter, less expensive mills. In addition, larger reductions in thickness can be achieved on each pass through the rolls, or stronger—or wider—or thinner materials rolled than on conventional mills. The process was first described in a speech last year before the American Iron and Steel Institute.

A variety of metals have been rolled with the C-B-S technique including carbon and alloy steels, Rene 41 and other nickel-base alloys, copper, and molybdenum. Since C-B-S rolling permits greater reductions in thickness without intermediate annealing, the process appears especially advantageous in rolling materials that harden in working, such as stainless steel.

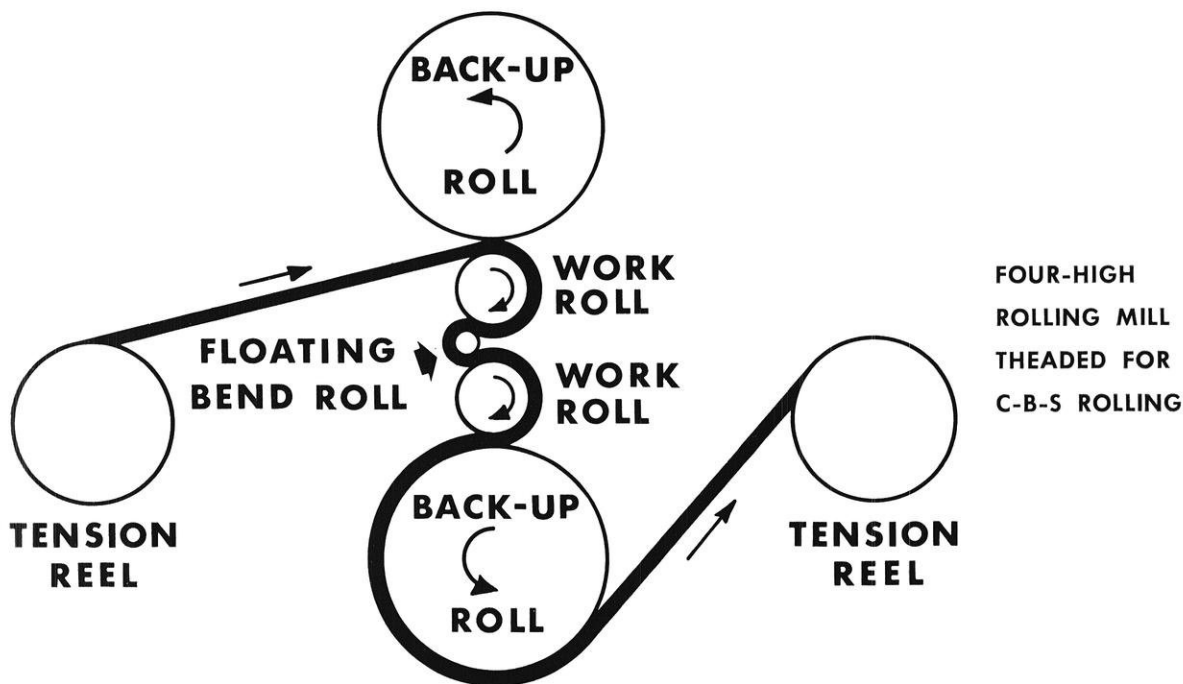
"This new rolling process is one of the major innovations in the field in a century," Dr. Guy Suits, General Electric vice president and director of research, said in announcing plans for further development of the process. "It was 1866 when the first reversing rolling mill was introduced. Modifications have been made since then, of course,

such as the Sendzimir mill, but the basic principles have remained the same: contact pressure alone, or contact-plus-tension. Now C-B-S takes the two traditional forces and adds plastic bending.

The effect of the fundamental principles is now well established but a certain amount of development work remains to be done. This can best be done by a firm that is experienced in the technology of metal working, such as United States Steel."

Dr. James Austin, administrative vice president, research and technology of United States Steel, said "The proposed concept of rolling, which is one of our most important operations, opens up many interesting possibilities. These we intend to explore as we develop the basic work of General Electric into a new technology."

In one form of C-B-S rolling, a small roller with strip wrapped around it lies in the "saddle" between two work rolls. The latter revolve in the same direction, rather than in opposite directions, as in conventional rolling mills. Folds in the entry strip can't be drawn in and crushed between



rolls, thus roll damage from "cobbling" is avoided.

Strip up to 12 inches wide has been rolled during later stages of the development of the process. During a reduction of Type 301 stainless steel, thickness was reduced from 0.090 inch to 0.012 inch in four passes without intermediate anneals. With conventional rolling mills, about a dozen

passes and several intermediate anneals would generally be required.

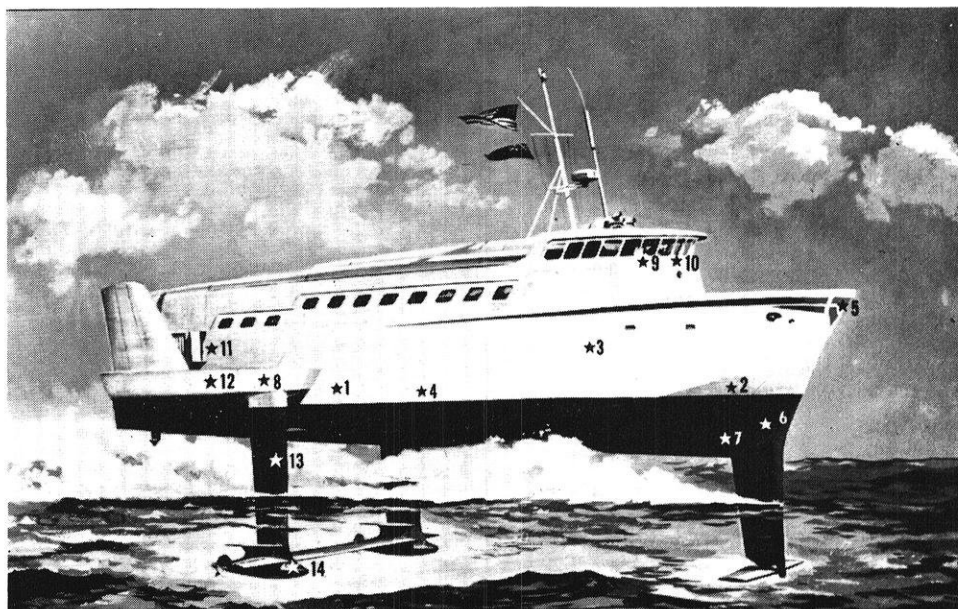
#### BOAT BITES PLANE

It's not news that airlines have captured a major share of over-water passenger miles from ships, but it is news when a ship plans to compete with an airline timetable. And that's just what is going

to happen in Seattle, Washington next Spring.

The ship is the new 75-passenger hydrofoil ferry, *H.S. Victoria*. First of its kind in the U.S., the *Victoria* will provide four round-trips daily between the business districts of Seattle and Victoria, B.C. The 75-mile run will be made in 90 minutes—about 10 minutes less than flying time plus airport commut-

THE H.S. VICTORIA,  
FIRST U.S.  
HYDRO FOIL FERRY.  
IT WILL BE USED  
BETWEEN SEATTLE  
AND VICTORIA, B. C.



1. AFT HEAVE ACCELEROMETER
2. FORWARD HEAVE ACCELEROMETER
3. CONTROL COMPUTER
4. RATE GYRO & VERTICAL GYRO ASSEMBLY
5. HEIGHT SENSOR TRANSDUCER
6. FORWARD FOIL ACTUATOR
7. BOW RUDDER ACTUATOR

8. STARBOARD FLAP ACTUATOR
9. PILOT CONTROL PANEL
10. COMPASS SYSTEM INDICATOR
11. LM-100
12. GEAR & TRANSMISSIONS
13. STRUT
14. NACELLE



ing time. The fare, too, will be about 50% less than present air fare.

Taking a note from airline operation, the *H.S. Victoria* will have a Captain, a First Officer, and a Stewardess. Like the airlines, refreshments will be served during the "flight".

In physical characteristics too, the *Victoria* reveals her aircraft ancestry. Her fixed, horizontal tripod foils utilize aerodynamic principles; flaps, rudder, trim tabs, autopilot and servomechanisms will react and perform functions similar to those of an aircraft; and the "pilot" will operate the vessel with aircraft-type controls.

The high power to weight ratio of the 65-foot vessel is the key to her practicality. Two G-E turbo-shaft engines—adaptations of General Electric's reliable T-85 helicopter gas turbines—will deliver 1850 SHP yet weigh only 640 lbs. Aluminum hull construction and a unique lightweight transmission system that transmits power around corners also contribute to the fact that the craft displaces only 40 tons. The *Victoria* will have a top speed of 43 K, cruise at 37 K and "lift off" (become foil borne) at 18 K.

General Electric is supplying the propulsion, transmission and control systems as an integrated package. The automatic pilot system, similar in many respects to that of an aircraft, presented General Electric engineers with some interesting design parameters. The "flying" height range of the foils must be maintained within  $\pm$  six inches of a set value over a Sea State range from Calm to Sea State 4 (20 K average winds, 4-8 foot waves). Pitch and roll attitude must be maintained within  $\pm$  one degree from the vertical while foil-borne in the maximum Sea State, and the direction control loop must hold the foilborne craft to within  $\pm$  one degree of the course setting.

#### INSTANT COLORED GLASS

A Corning Glass Works scientist has disclosed the invention of glass which darkens on exposure to light and clears again when the light fades.

Dr. S. Donald Stookey, director of fundamental chemical research

at Corning, described a series of new light-sensitive materials at the annual meeting of the American Physical Society—American Association of Physics Teachers in New York City.

Corning emphasized that these unique glasses are still in the laboratory stage; they are not available commercially. The company is engaged in an aggressive research and development program to adapt the materials to practical products.

Dr. Stookey and Dr. William H. Armistead, a Corning vice president and director of the company's Technical Staffs Division, are co-inventors of the new glass compositions.

In his Society paper, Dr. Stookey said to his knowledge the glasses are the first photochromic materials which retain indefinitely the ability to darken quickly and then clear. In previous materials, the reversibility quality wore off or the color change took a long time.

The Corning glasses have not deteriorated during two years of day and night outdoor exposure or through thousands of darkening-clearing cycles in the laboratory, Dr. Stookey reported.

Wavelengths that produce the darkening in the Corning glasses are typically the near ultraviolet. Effect of other wavelengths varies with glass composition.

The Corning scientist said that sunlight darkens some glasses in a few seconds. Almost instant darkening results from an intense ultraviolet light source.

A typical glass darkens in daylight, but remains clear under normal indoor lighting.

Some glasses recover transparency in minutes; others require hours, Dr. Stookey reported.

Before darkening, the glass is as clear as a window pane. It darkens to a neutral gray, a brown or a purple. Some samples have become so dark that only one per cent of the light comes through.

The Corning materials were described as "true glass compositions" with the advantages of transparency, corrosion and abrasion resistance, rigidity, impermeability, and hardness and smoothness of surface.

Photochromic glasses are melted and formed by conventional glass-making methods. Dr. Stookey said

the materials are silicate glasses which contain submicroscopic silver halide crystals. The crystals are precipitated in the manufacturing process and give the glass its ability to react to light.

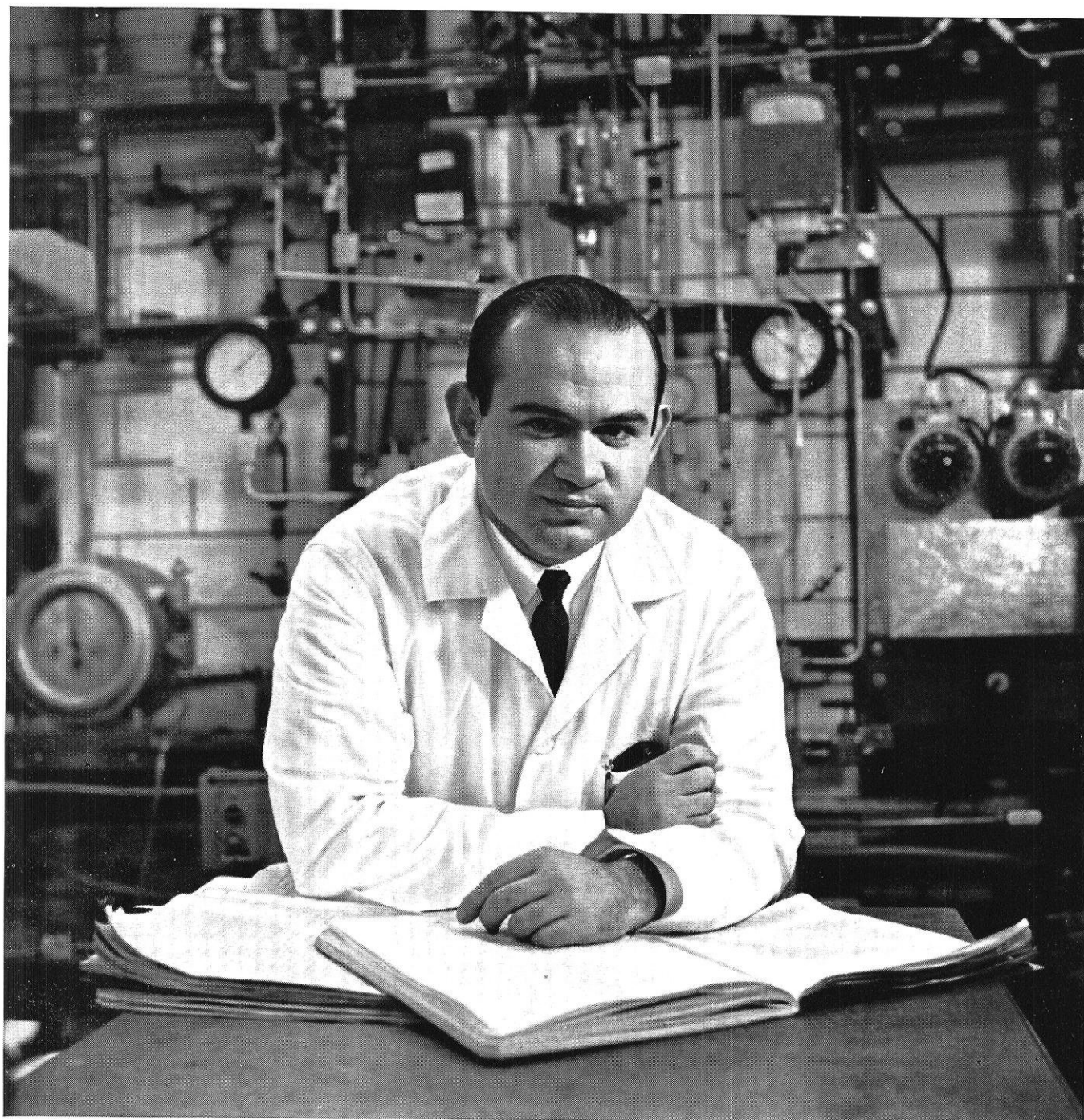
#### Water Witching

(Continued from page 16)

the rod's performance went down to a chance level. Finally, the experimenter reran the test, this time providing an audience of six spectators. These spectators were placed on a landing so that they could simultaneously see the experimenter's placing of the box on the ladder and the pastor with his rod one floor above. Under these conditions, the pastor's performance was significantly better than chance. The conclusion was that the minister was unconsciously reacting to unconscious clues of others. This idea of reacting unconsciously seems to be a legitimate conclusion because the dowzers found by Vogt and Hyman were generally honest hard-working country folk who were only trying to help their neighbors. They also found that generally dowzers do not charge for their services. Except for a few isolated examples, those who charge for their services do so only on a pay-for-time basis.

Vogt and Hyman also refuted all of the standard arguments offered by backers of dowsing. They found that dowsing is a characteristic found only in certain people. Yet, they found that no one had discovered this characteristic himself. In all cases the dowser had first discovered his "ability" after seeing another dowser in action. They found that successful dowzers were very, very unsuccessful when tested in the laboratory. They proposed that the shaking and trembling and intense concentration of a dowser are only extensions of this theory of the power of suggestion. They found that the dowser was reacting to his own theories as to where to find water, and, through muscular reaction, to the theories of the property owner. They proposed that the extension of the dowsing power from a dowser to a non-dowser through touch was, in reality, only another argument for the

(Continued on page 34)



## *Anyone for hydrodesulfurization?*

How about it? Want to hydrodesulfurize? Hydrodesulfurize oil, that is. Fuel oil. Dr. James Mosby, Purdue, '64 does. He experimentally optimizes the commercial procedure for removing sulfur. He's been working on hydrodesulfurization ever since he joined the American Oil Company as a chemical engineer last January. That's his pilot plant behind him.

Even if you'd rather not hydrodesulfurize, there are

literally scores of other science and engineering opportunities at American Oil. If you're interested in a career in the petroleum industry, write to J. H. Strange for information. His address: American Oil Company, P. O. Box 431, Whiting, Indiana.

**STANDARD OIL DIVISION**  
**AMERICAN OIL COMPANY**



*“Are there any  
East Coast labs doing  
Organic Research?”*

**“What’s  
available  
in R & D  
around  
New York?”**

“How  
about  
a sales  
assignment  
in the  
Chicago  
area?”

**“DO YOU  
HAVE ANY  
MANUFACTURING  
FACILITIES  
IN THE  
SOUTH?”**

*“Could I start  
at a location with  
nearby graduate  
schools?”*

“Any chance of  
moving around the country?”

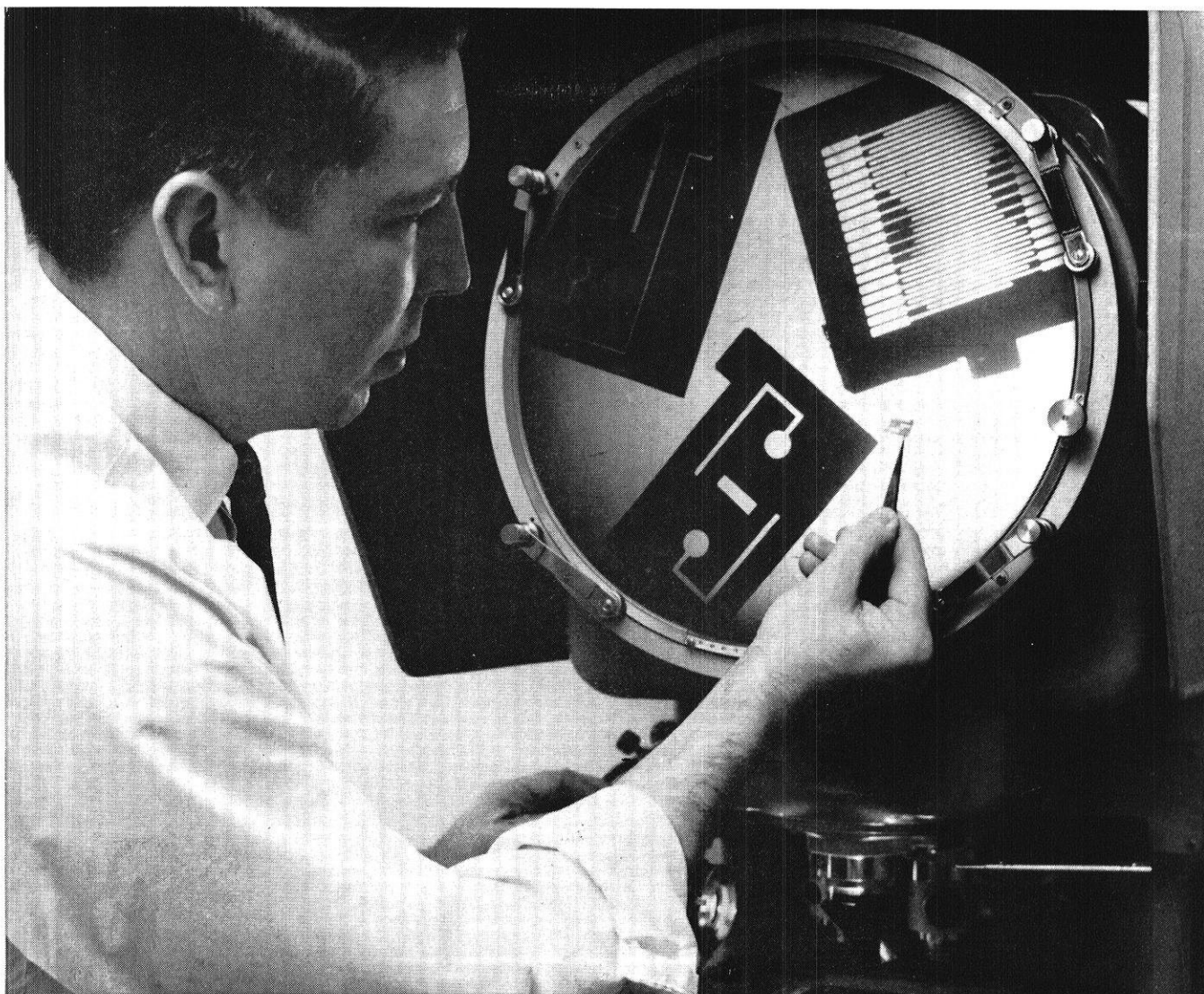


IF LOCATION is important to you in choosing your first job, why not talk to the company that has 130 plants and research centers throughout the U.S.A., as well as scores of sales offices from coast to coast? Your placement office can tell you when our interviewer will be on campus.

AN EQUAL OPPORTUNITY EMPLOYER

DIVISIONS: BARRETT • FIBERS • GENERAL CHEMICAL • INTERNATIONAL • NATIONAL ANILINE • NITROGEN • PLASTICS • SEMET-SOLVAY • SOLVAY PROCESS • UNION TEXAS PETROLEUM





## FROM CAMPUS TO CAREER WITH DELCO RADIO

Five years ago Gene Wampole came to Delco Radio with a BS in Science from Ball State University and an MA from Indiana University.

Today, Gene Wampole is a Senior Project Engineer at Delco—well on his way to a longtime, satisfying career with this electronics division of General Motors Corporation.

Gene is pictured here at an optical comparator, used for making highly accurate measurements of the very precise dimensions of metal masks for such devices as light dependent resistors. Techniques and equipment for fabricating these metal masks were developed for Delco's extensive microelectronics program. These

techniques have proved applicable to a wide variety of problems in metal fabrication.

As a young graduate engineer you, too, could soon be on your

way to a challenging and rewarding career with Delco Radio. You'll find opportunities in such areas as silicon and germanium device development, ferrites, solid state diffusion, creative packaging of semiconductor products, development of laboratory equipment, reliability techniques, and applications and manufacturing engineering.

Our brochure detailing the opportunities to share in forging the future of electronics with this outstanding Delco-GM team is yours for the asking. Watch for Delco Radio interview dates on your campus, or write to Mr. C. D. Longshore, Dept. CR, Delco Radio Division, General Motors Corporation, Kokomo, Indiana.

*An equal opportunity employer*



**DELCO RADIO DIVISION  
OF GENERAL MOTORS**  
Kokomo, Indiana



The man who said  
 "you can't take it with you"  
 was born a long time before Garrett  
 started making life support systems.



As a matter of fact, unless man *does* take his earthly environment with him into space, he hasn't got a chance.

For here is a world that has no oxygen, no pressure, no gravity.

To live and work for weeks and months in orbital flight — a need dictated by urgent space projects now in progress — man must have the most sophisticated life support system ever built.

It has to provide him with oxygen, water, pressurization — complete climate control.

It has to guard him against temperatures that range from near absolute zero to the re-entry heat of thousands of degrees.

It has to be a miracle package.

The question becomes: Who is now building such an environmental system?

The answer is, of course, Garrett.

As long ago as 1941, Garrett management saw that man could go no higher, no faster, without pressurization of aircraft. When Garrett's AiResearch division delivered the first systems, suddenly the ceiling was off the world.

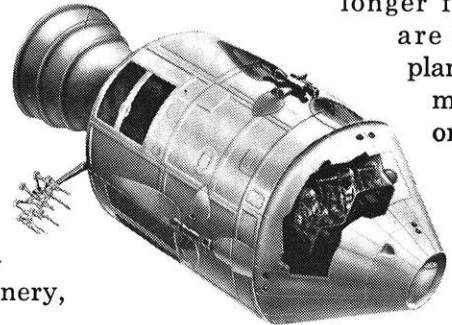
Today over 90% of the free world's aircraft carry Garrett environmental systems. Millions of hours of operation have been accumulated by heat transfer equipment, turbomachinery, controls.

This experience led Garrett to build the life support systems that protected our astronauts on the recent Mercury flights.



The same know-how is now at work supplying "shirtsleeve" environments for Gemini and Apollo. These systems will keep man alive for weeks in space. Now

longer flights are being planned — manned orbiting



laboratories and space stations. Garrett already knows how to solve life support problems for months in space. Much of the system work is completed and components built. What are the reasons for this unique capability?

The most experienced men are Garrett men. The most advanced facilities are Garrett. The only applied system for outer space is Garrett built.

When the problem is environmental, the solution comes from Garrett because...

**Garrett  
 is experience**

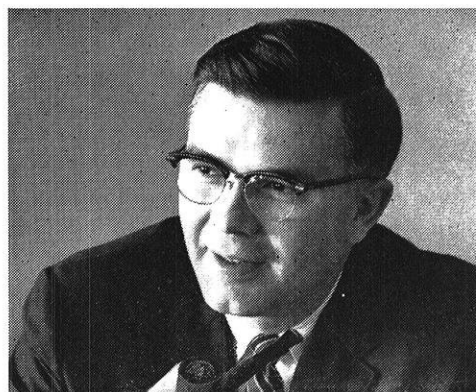


Los Angeles • Phoenix

For further information about many interesting project areas and career opportunities at The Garrett Corporation, write to Mr. G. D. Bradley at 9851 S. Sepulveda Blvd., Los Angeles. Garrett is an equal opportunity employer.

# STEP FORWARD WITH FORD MOTOR COMPANY

*An Open Letter to the 1965  
College Graduate  
from Donald N. Frey,  
Assistant General Manager,  
Ford Division of  
Ford Motor Company*



Donald N. Frey was awarded a bachelor's degree in metallurgical engineering by the University of Michigan in 1947 and a doctorate in 1950. One year later, he joined Ford Motor Company as manager of the Metallurgical Department in the Scientific Laboratory. In 1962, Dr. Frey was appointed assistant general manager of the Ford Division with responsibility for all engineering, product planning and purchasing activities. He is 41 years old.

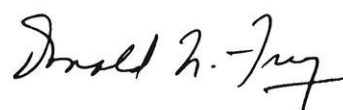
America's automobile industry is in the midst of a challenging era, with prospects of an even more exciting and demanding tempo in the years to come. Ford Motor Company is determined to achieve leadership in all phases of its operation. This leadership promises to bring lasting success to the company, its employees and its stockholders.

It will take people to accomplish this objective. Engineering, finance, styling, marketing, product planning, sales—all require people with the knowledge, judgment and personal drive to avail themselves of the unprecedented opportunities offered by a great industry.

The automobile business is growing. More cars are being bought now than ever before. With increases in population and consumer buying power, even more will be bought in the future. Realizing this, Ford Motor Company seeks to attract college graduates who have the capacity to grow with the company and the market.

Right now, our plans call for employing about a thousand of the best 1965 graduates we can find, with all types of educational backgrounds. We need specialists, but we also need persons with broad liberal-arts training who can handle a wide variety of assignments. Actually, in our company, many graduates grow into jobs totally unrelated to their degrees. They have discovered that Ford offers intellectually challenging opportunities for those with the ability to seize them. We invite you to make the same discovery.

Contact your Placement Office and arrange to see our representative.



**MOTOR COMPANY**  
The American Road, Dearborn, Michigan

*An Equal Opportunity Employer*

# CHRONOLOGICAL LISTING OF COMPANIES INT

(As of September 21)

*Interviews held in Rooms 1148 A-M, unless otherwise noted. (Specific room assignments will be posted on the day of the interview on the Placement Office bulletin board, which is located between Rooms 1144 and 1148.)*

*NOTE: This list is subject to change. Be sure to check the Engineering Placement Office bulletin boards for latest information. Notices will be placed on these bulletin boards one week in advance of a company's visit. Company folders likewise are placed in the racks in the Engineering Placement Office, Room 1150, one week in advance of their visit.*

## Monday, October 12

All Steel Equipment  
Anheuser Busch (A.M.)  
Armour Pharmaceuticals (A.M.)  
DoAll Co.  
Hudson Sharp Plant (FMC Corp.)  
Gisholts  
Ingersoll Research Center  
Johnson Service  
Kohler Co.  
Liquid Carbonic (A.M.)  
Litton Systems (Guidance & Controls)  
(1st of 2 days)  
Pittsburgh Plate Glass (Chemicals Div.)  
Stauffer Chemicals  
U. S. Steel  
Warner Electric Brake

## Tuesday, October 13

American Motors  
Armour Ind. Chemical Co. (P.M.)  
Automatic Electric  
Barber Colman  
Douglas Motors  
Goodman Mfg. (P.M.)  
Fabritek  
Goodyear Tire & Rubber (Aerospace)  
PhD's  
Illinois Tool Works  
Institute of Paper Chemistry (P.M.)  
Libby McNeill & Libby (P.M.)  
Litton Systems (Guidance & Controls)  
(2nd day of 2 days)  
Pure Oil Co.  
Raytheon Co. (1 of 2 days)  
Socony Mobil Oil

## Wednesday, October 14

Battelle Memorial Institute (P.M.)  
Bendix Corporation  
DuPont (3rd day of 5 days) (PhD's)  
Fairbanks Morse  
Iowa Illinois Gas  
Ladish Co. (P.M.)  
Nekoosa Edwards Co.  
Raytheon Co. (2 of 2 days)  
Raytheon Co. (PhD's)

## Thursday, October 15

American Can  
Collins Radio (1 of 2 days)  
Consumers Power (A.M.)  
Corning Glass (1 of 2 days)  
General Mills (1 of 2 days) (Corporate  
& Research Divs.)  
Hamilton Standard (1 of 2 days)  
Oilgear  
A. O. Smith

## Friday, October 16

American Appraisal (P.M.)  
Amoco Chemicals (A.M.)  
Belle City Malleable Iron (P.M.)  
California State Government  
Collins Radio (2 of 2)  
Corning Glass (2 of 2)  
General Mills (2 of 2)  
Hamilton Standard (2 of 2)  
Hooker Chemical  
Inland Steel Co.  
Koehring Co.  
Perfect Circle (A.M.)  
Republic Steel  
Whirlpool Corp.

## Monday, October 19

American Oil (Mfg.)  
Deere & Co.  
Douglas Aircraft  
Gulf Research & Development (P.M.)  
Motorola (1 of 2 days)  
Pittsburgh Plate Glass Co.  
Richfield Oil Co.  
Sinclair Research (1 of 3 days)  
Sinclair Refining  
Sunbeam Corporation  
Bureau of Reclamation (1 of 2)  
Coast and Geodetic Survey (A.M.)

## Tuesday, October 20

American Oil & Amoco Chemical  
DeSoto Chemicals (P.M.)  
General Dynamics  
General Tire & Rubber Co.  
Motorola (2 of 2)  
Newport News Shipbuilding  
Sinclair Research (2 of 3)  
Underwriters Labs  
U. S. Rubber Research (A.M.) (PhD's)  
Bureau of Reclamation (2 of 2)

## Wednesday, October 21

The Boeing Co. (1 of 2)  
Dayton Power & Light Co. (P.M.)  
Dow Chemical (1 of 3)  
Illinois Dept. of Public Works & Bldg  
Ingersoll Rand (1 of 2)  
Los Angeles Co.  
McDonnell Aircraft  
Seeburg Corp.  
Uarco  
Union Carbide—Silicones Div. (A.M.)  
Upjohn Co.

## Thursday, October 22

The Boeing Co. (2 of 2)  
Cabot Corp. (P.M.)  
California Research (1 of 2)  
Patrick Cudahy Incorp. (P.M.)  
Dow Chemical (2 of 3)  
Ingersoll Rand (2 of 2)  
International Nickel—Huntington Alloy  
Products Div.  
International Nickel—N.Y.  
Link Belt Co.  
Merck & Co. (P.M.)  
Northern States Power Co.  
Owens Illinois Glass  
Raychem Corp.  
University of Illinois—Graduate School  
of Business

## Friday, October 23

Allied Chemical  
Beloit Corp.  
Dow Chemical (3 or 3) if needed  
Dow Chemical International (P.M.)  
Eastman Kodak (PhD's)  
Falk Corp.  
Fox River Paper Co.  
Globe Union  
Hupp Corp.—Richards Wilcox Div.  
(A.M.)  
Interstate Power (P.M.)  
S. C. Johnson & Son Incorp.  
Kelsey Hayes  
M. I. T. Lincoln Labs (P.M.)  
Mead Johnson (A.M.)  
Sunray DX Oil (A.M.)  
Vanity Fair Mills (P.M.)  
California Research (2 of 2)

## Saturday, October 24

Parker Hannifin (A.M.)

## Monday, October 26

Allen Bradley  
Dow Corning  
Emerson Electric  
Goodyear Tire & Rubber (1 of 2)  
Goodyear Tire & Rubber (Aerospace  
Division)  
Institute of Paper Chemistry (P.M.)  
International Harvester Co.  
Parker Pen Co.  
Sundstrand Corp. (1 of 2)

## Tuesday, October 27

Bell System (1 of 2)  
ATT&T Long Line  
Bell Labs  
N.Y. Telephone  
Sandia  
Western Electric  
Wisconsin Telephone & Illinois Bell  
DuPont (1 of 4) (P.M.)  
Esso Research & Engr. (1 of 4)  
Goodyear Tire & Rubber (2 of 2)  
Sundstrand Corp. (2 of 2)  
U. S. Rubber  
U.S.D.A.—Soil Conservation (P.M.)

# LEADING ON CAMPUS, FIRST SEMESTER, 1964-65

## Wednesday, October 28

Bell System (2 of 2)  
ATT&T Long Lines  
Bell Labs  
N.Y. Telephone  
Sandia  
Western Electric  
Wisconsin Telephone and Ill. Bell  
Amphenol Borg  
Container Corp. of America (A.M.)  
DuPont (2 of 4)  
Esso Research & Engr. (2 of 4)  
Wisconsin Public Service Co.

## Thursday, October 29

DuPont (3 of 4)  
Esso Research & Engr. (3 of 4)  
B. F. Goodrich Co.  
Honeywell (1 of 2)  
Procter & Gamble (1 of 2)  
Shell Companies (1 of 2)  
Torrington Co.  
U. S. Army Engr. District

## Friday, October 30

American Cyanamid  
Amsted Industries  
Central Illinois Electric & Gas  
Cornell Aeronautical (P.M.)  
Dravo Corp.  
DuPont (4 of 4) (if needed)  
Honeywell (2 of 2)  
Procter & Gamble (2 of 2)

Shell Companies (2 of 2)  
Shell Development (PhD's)  
West Bend Co.

## Monday, November 2

Archer Daniels Midland  
Argonne Labs (P.M.)  
Ethyl Corp. (1 of 2)  
Firestone Tire & Rubber Co. (1 of 2)  
Fischer Governor  
General Telephone  
Int'l. Minerals & Chemicals  
Scott Paper Co. (1 of 2)  
Socony Mobil Oil  
Union Carbide Chemicals (1 of 2)  
Wisconsin Power & Light Co.  
Youngstown Sheet & Tube (Res. & Dev.)  
U. S. Naval Ordnance Test

## Tuesday, November 3

Louis Allis  
Ethyl Corp. (A.M.) (2 of 2)  
Firestone Tire (2 of 2)  
Heil Co.  
Mallinckrodt Chemicals  
Marathon Corp. (1 of 3)  
Scott Paper Co. (2 of 2)  
Standard Oil of Calif. (1 of 4)  
Swift & Co. Research  
Union Carbide Chemicals (2 of 2)

## Wednesday, November 4

A. C. Spark (1 of 3)  
Corning Glass Works (MS/PhD)

Ford Motor (1 of 2)  
General Foods  
General Motors (2 of 4)  
Int'l. Business Machines (1 of 2)  
Jostens Incorp.  
Std. Oil of Calif (2 of 4)  
Snap on Tools  
Marathon Corp. (2 of 3)

## Thursday, November 5

A. C. Spark (2 of 3)  
American Electric Power  
Commonwealth Edison (P.M.)  
Ford Motor (2 of 2)  
General Motors (3 of 4)  
Eli Lilly & Co. (P.M.)  
Int'l. Business Machines (2 of 2)  
Marathon Corp. (3 of 3) (A.M.)  
Std. Oil of Calif. (3 of 4)  
Union Carbide—Carbon Products Div.  
(1 of 2)  
Walker Mfg.

## Friday, November 6

A. C. Spark (3 of 3)  
General Motors (4 of 4) Plus All Divisions  
Manitowoc Engineering  
John Oster Mfg. Co. (P.M.)  
Std. Oil of Calif. (4 of 4)  
Union Carbide—Carbon Prods. (2 of 2)  
(To be continued in the Nov. issue of Wisconsin Engineer.)

## CIVIL ENGINEERS:

Prepare now for your future in highway engineering...get the facts on The Asphalt Institute's new computer-derived method for determining structural design of Asphalt pavements for roads and streets

Today, as more and more states turn to modern Deep-Strength\* Asphalt pavement for their heavy-duty highways, county and local roads, there is a growing demand for engineers with a solid background in the fundamentals of Asphalt technology and construction.

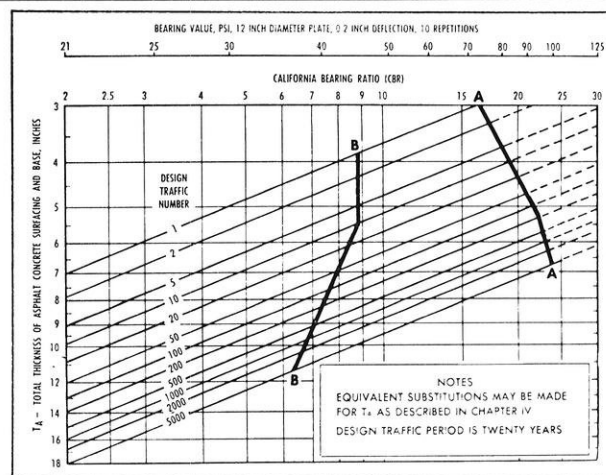
Help to prepare yourself now for this challenging future by getting the latest information on the new Thickness Design Method developed by The Asphalt Institute. Based on extensive statistical evaluations performed on the IBM 1620 and the mammoth IBM 7090 computers, accurate procedures for determining road and street structural requirements have been developed.

All the facts on this new method are contained in The Asphalt Institute's Thickness Design manual (MS-1). This helpful manual and much other valuable information are included in the free student library on Asphalt construction and technology now offered by The Asphalt Institute. Write us today.

\*Asphalt Surface on Asphalt Base

### THE ASPHALT INSTITUTE

College Park, Maryland



Thickness Design Charts like this (from the MS-1 manual) are used in this new computer-derived method. This chart enables the design engineer quickly to determine the over-all Asphalt pavement thickness required, based on projected traffic weight and known soil conditions.

### THE ASPHALT INSTITUTE College Park, Maryland

Please send me your free student library on Asphalt construction and technology, including full details on your new Thickness Design Method.

Name \_\_\_\_\_ Class \_\_\_\_\_

School \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_



## Water-Witching

(Continued from page 26)

strength of the power of suggestion. They showed how people, after seeing a dowsing incident, will generally tell others what they wanted to see, rather than what they actually saw. With this argument, they discounted the "first hand accounts". They found that dowsers, (or anyone) without any noticeable muscular movements, could make a rod turn up or down or completely around. They also showed how two rods held simultaneously, could be made to turn in opposite directions without any noticeable muscular movements.

They concluded that water witching is another example of magical folklore enjoyed by many people in many different occupations, and of many different educational backgrounds. They compared it to the Ouija board and reincarnation such as the Bridey Murphy incident.

They also found that a very practical advantage had occurred through the use of water witching in the development of this country. It seems that a farmer when presented with a well digging problem, would usually receive a very absolute answer from a dowser, thereby encouraging the farmer to dig his well immediately and get on with his farming. When geologists were consulted, the answers obtained were only opinions and not definite. This had the effect of discouraging the farmer from immediate action.

### IS IT LEGITIMATE?

All writings seem quite insignificant when compared with the works of Roberts and Vogt and Hyman. However, there are many inconsistencies in the works of these people which are observable after careful analysis.

As science marches on, many of the "old wives tales" and other "quaint superstitions" of the world have actually been found to have some scientific basis. A few months ago it was found that some people have a certain degree of color sensitivity in their finger tips. This is an extension of the sense of touch and may well be the same extension of the sense of touch as proclaimed by some advocates of

dowsing. Roberts arbitrarily defines it as the "seventh sense". Or, it may be that dowsing is somehow related to other uncertain phenomena such as extra-sensory perception, or faith healing, or sense of direction in animals specifically birds and salmon.

Apparently there is something to water witching. There is a huge cloud of suspicion surrounding this subject; but, through this cloud the high degree of results obtained by some established dowsers is readily observable. This cloud is so heavy that a qualified dowser would probably have a better chance if he claimed he could actually see underground water, or perhaps smell it, than if he tried to convince the world of his powers with a dowsing rod.

It seems possible that water witching may never be definitely proven one way or the other. As urbanization and scientific farming become more predominant, dowsing becomes less important and the art may well be lost just as animals living underground eventually lose their sense of sight. It has been thoroughly discredited by the federal government since 1917, and it does not appear likely that any Senator or Congressman would jeopardize his job by trying to appropriate federal funds for further research on the project. Unless a critical nationwide water shortage appears, or unless more wealthy curious people with an obsession like Roberts' develop, it appears unlikely that anything will ever be done to find some concrete scientific proof on the subject.

## Freeze Desalting

(Continued from page 20)

pumps and auxiliary equipment of all kinds."

Since 60 per cent of the energy is needed to make up thermodynamic losses it is readily seen that this process must be made more efficient.

Even with this low thermal efficiency the cost of electric and steam energy for freezing as compared to distillation is \$.74 per 1000 gallons of water to \$.965 per 1000 gallons of water. Though cost is lower, the overall operating costs are higher. Capital costs are also higher for the freezing process.

Capital costs for the freezing method are \$1.21 per 1000 gallons of water and for the distillation method are \$.76 per 1000 gallons of water. From this it is seen that more research must be done to lower capital costs.

Cost comparisons for water supplies for various daily capacities are made between natural sources and processing plants. The results show that the willingness to pay for water must increase or the cost of the water must be decreased much more. It also must be kept in mind that these are cost estimates and not actual costs. From the many different methods of purification, freezing and multi-effect distillation are the most promising methods.

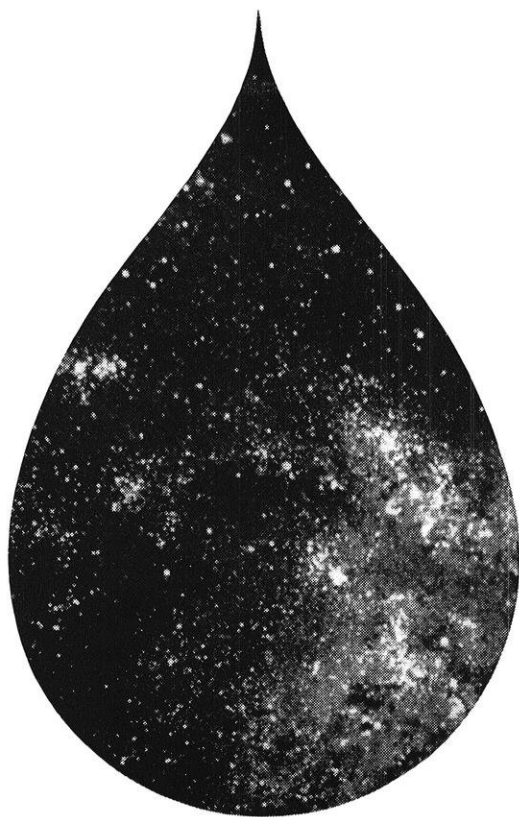
There is a choice, among the processes mentioned in this report, to be used in production. There will be modifications to these processes before the cheapest process is chosen, but more research must be done.

Using the countercurrent washer, small ice crystals can be washed reasonably clean. This can save on time and extra expense by eliminating the need for closely controlled freezing so the ice crystal is enlarged.

Many of the problems of feasibility are solved and some processes are being improved. The heat transfer is directly between liquid and liquid, the process is continuous, and the countercurrent method of separating ice and brine is almost perfected.

The cost of the freezing method is high. Capital costs are highest of all costs. These could be lowered by using cheaper materials to build the various components. Cheaper materials can easily be used because there is no problem of corrosion as in the distillation method. It will be possible to lower costs by building a plant with a very large output of potable water.

The "butane method" of freezing should prove itself feasible and economical, because, since the pressure is nearly atmospheric, the chambers wouldn't need to be carefully built to withstand high pressure or high vacuum and temperatures are low so there is no corrosion and lower grade steel can then be used.



**How to be  
more than a drop  
in the bucket**

To make a splash these days, you have to grow after graduation. That's where Douglas comes in. We offer work on an array of aircraft, space and defense programs going up to and far beyond today's technology...also cheek to jowl association with top men in your chosen field. At hand you'll have the finest lab and research support. Close by are universities offering evening courses toward advanced degrees. And Douglas has a fine scholarship program. Many young graduates have become supervisors here in only a few years. So if you're a budding talent seeking an atmosphere that furthers optimum growth, let's get together. We are an equal opportunity employer.

Send your resume to  
S. A. Amestoy, Box 691-X  
Corporate Offices  
Douglas Aircraft Co., Inc.  
Santa Monica, California



# BOOKS ON PARADE

**Architectural Engineering—New Structures.** By Robert E. Fischer, Senior Editor (Engineering), *Architectural Record*. 212 pages plus index; over 675 illustrations; 8 9/16 x 11 5/8; McGraw-Hill; \$10.00. Publication date: June, 1964.

"Architectural Engineering—New Structures" provides complete coverage of the most up-to-date structural systems likely to be used for many years. It gives a broad perspective on the appropriateness of different structural systems for various architectural problems in buildings varying widely in size, shape, and complexity.

Subjects covered in the book range from precast and prestressed concrete through thin shells; composite construction, plastic design, suspension structures, and space frames in steel; and lamella roofs through stressed-skin panels in wood. Newly developed design theories are presented, and personal design approaches of well-known engineers are included.

The structures are not treated as isolated entities but in context with the total building design problem—how prestressing, composite construction, and suspension structures provide longer spans and freedom from column interference; how off-site construction offers greater economy; how structures can be designed to provide more space for, and greater freedom in, the location of mechanical services; how the trend toward greater efficiency in structural performance is manifested in the changing appearance of buildings; and how

unique structural systems have served as principal visual elements of important buildings. Drawings, photographs, and text have been coordinated to make structural systems more understandable.

The first part of a two part revision of "Architectural Engineering" (McGraw-Hill 1955), "Architectural Engineering—New Structures" provides the latest developments and detailed specific information on structures for which there is current professional demand. The six sections of the book are: Thin Shells; Space Structures; Rectilinear Frames; Suspension Structures; Component Systems; and Design Philosophy, Theory.

Robert E. Fischer, who has been engineering editor of *Architectural Record* for 15 years, has authored numerous articles and delivered many lectures on structural systems, design, and theory. He is a member of countless engineering society groups.

**Machining Principles and Cost Control.** By Robert G. Brierley, Tool Application Specialist, Metallurgical Products Department, General Electric Company, and H. J. Siekmann, Vice President, Marketing, Martin Metals Company, Division of Martin Marietta Corporation. 250 pages plus index; 218 illustrations; 6 3/8 x 9 1/4; McGraw-Hill; \$11.00.

"The constantly increasing costs of labor, machine tools, and materials and growing competitive activity, both domestic and foreign, are placing new challenges before the metal cutting industry. Metal forming by the chip-produc-

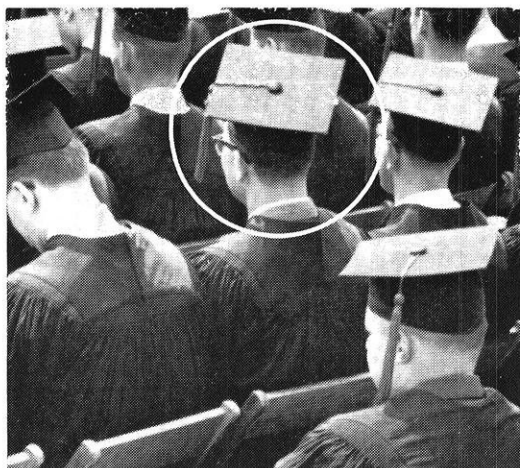
ing methods must be done, not only faster but at a lower unit of cost, if a profit is to be realized. Inefficiency in machining practices has been tolerated or disregarded by many for years because no real squeeze was felt. The era of such complacency has ended for most, and time is rapidly running out for the few remaining."

With this opening paragraph, Brierley and Siekmann launch their book, "Machining Principles and Cost Control," published by McGraw-Hill this month.

"The application of efficient machining standards, practices, and techniques," the authors maintain, "is contingent on a knowledge of the fundamentals of tool design, application and maintenance of the basic tool, machine and operating relationships. The establishment of machining conditions which will produce parts at minimum cost or at maximum rate requires the elimination of causes of unpredictable tool life."

"Machining Principles and Cost Control" was written with these considerations foremost. It includes only those subjects having direct bearing on the practical application of tools and the means by which optimum economic results may be realized. Theory is kept at a minimum. A special feature of the book is the Hi-E concept and the inclusion of a unique slide rule called the Hi-E Calculator which makes it possible to solve minimum costs and maximum production cutting speeds without resorting to complex mathematical calculations.





## Tom Thomsen wanted challenging work



## He found it at Western Electric

T. R. Thomsen, B.S.M.E., University of Nebraska, '58, came to Western Electric for several reasons. Important to him was the fact that our young engineers play vital roles right from the start, working on exciting engineering projects in communications including: electronic switching, thin film circuitry, microwave systems and optical masers.

The wide variety of Western Electric's challenging assignments appealed to Tom, as did the idea of advanced study through full-time graduate engineering training, numerous management courses and a company-paid Tuition Refund Plan.

Tom knows, too, that we'll need several thousand experienced engineers for supervisory positions within the next few years. And he's getting the solid experi-

ence needed to qualify. Right now, Tom is developing new and improved inspection and process control techniques to reduce manufacturing costs of telephone switching equipment. Tom is sure that Western Electric is the right place for him. What about you?

If you set the highest standards for yourself, enjoy a challenge, and have the qualifications we're looking for—we want to talk to you! Opportunities for fast-moving careers exist now for electrical, mechanical and industrial engineers, and also for physical science, liberal arts and business majors. For more detailed information, get your copy of the Western Electric Career Opportunities booklet from your Placement Officer. And be sure to arrange for an interview when the Bell System recruiting team visits your campus.

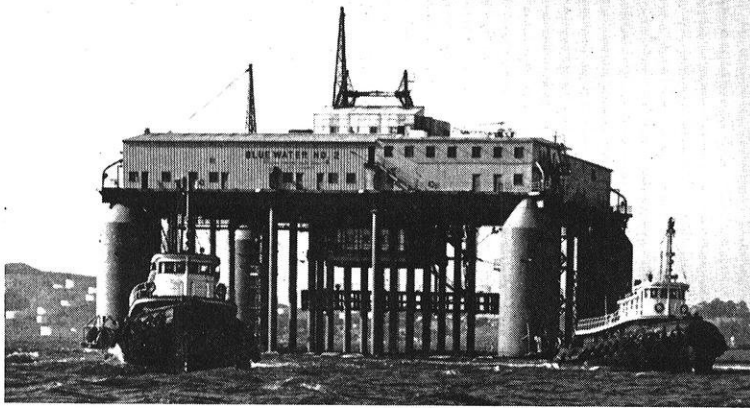
**Western Electric** MANUFACTURING AND SUPPLY UNIT OF THE BELL SYSTEM

AN EQUAL OPPORTUNITY EMPLOYER

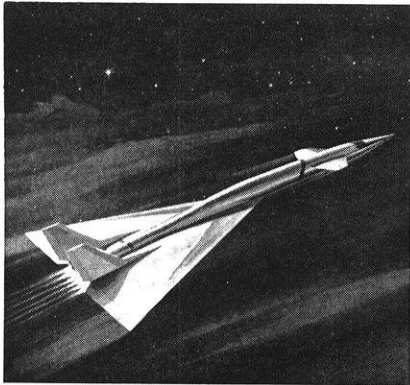
Principal manufacturing locations in 13 cities ☐ Operating centers in many of these same cities plus 36 others throughout the U.S.  
Engineering Research Center, Princeton, N. J. ☐ Teletype Corp., Skokie, Ill., Little Rock, Ark. ☐ General Headquarters, New York City



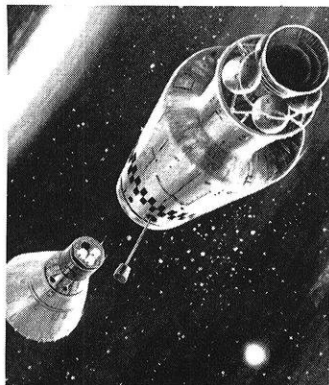




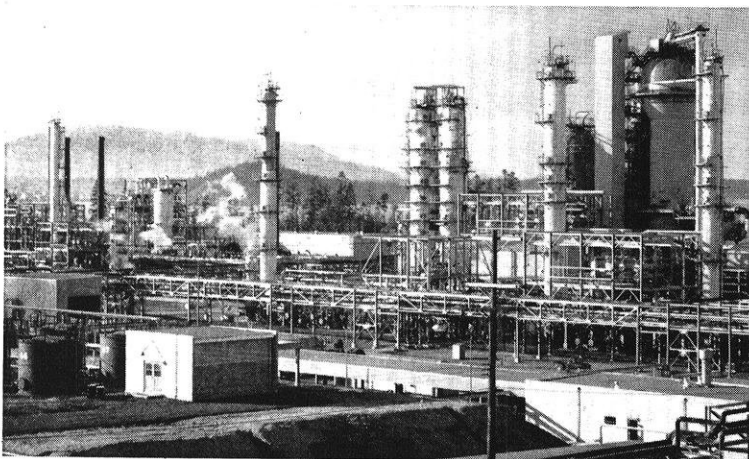
**PROBLEM:** Design new equipment and find new methods to tap undersea oil reservoirs, such as this giant floating drilling platform that can withstand waves 30 feet high.



**PROBLEM:** Make chemical adhesives to bond wing structures of jet aircraft designed to travel 2,000 mph.



**PROBLEM:** Develop unheated catalysts for rocket fuels for space rendezvous and docking.

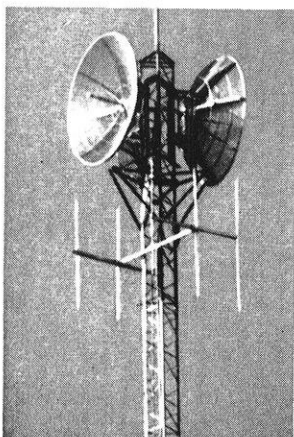


**PROBLEM:** Design, construct, maintain and operate complex oil and chemical processing units, utilizing the latest developments in engineering and materials.

**PROBLEM:** Develop new marketing facilities, such as this 16,450-gallon delivery truck.



**PROBLEM:** Engineer pipe line microwave systems for remote control of oil shipments.



## TOUGH PROBLEMS INSPIRE TOP PERFORMANCE

The problems facing Shell are diverse and tough. And Shell's scientists, engineers and other professionals prefer it that way. They know that their individual achievements and the success of the company are determined by the size of the problems they tackle and solve. They have set for themselves the highest standards of performance.

These standards have enabled Shell to excel in offshore exploration and production, new manufacturing processes in oil and chemicals, new products, and efficiency in distribution and marketing. As a result, Shell is one of the nation's most dynamic and progressive companies.

Shell's continuing dedication to excellence assures a variety of rewarding careers for graduates who have also set for themselves the highest standards of performance. Opportunities exist for graduates in engineering, chemistry, geology, geophysics, physics, mathematics and business administration.

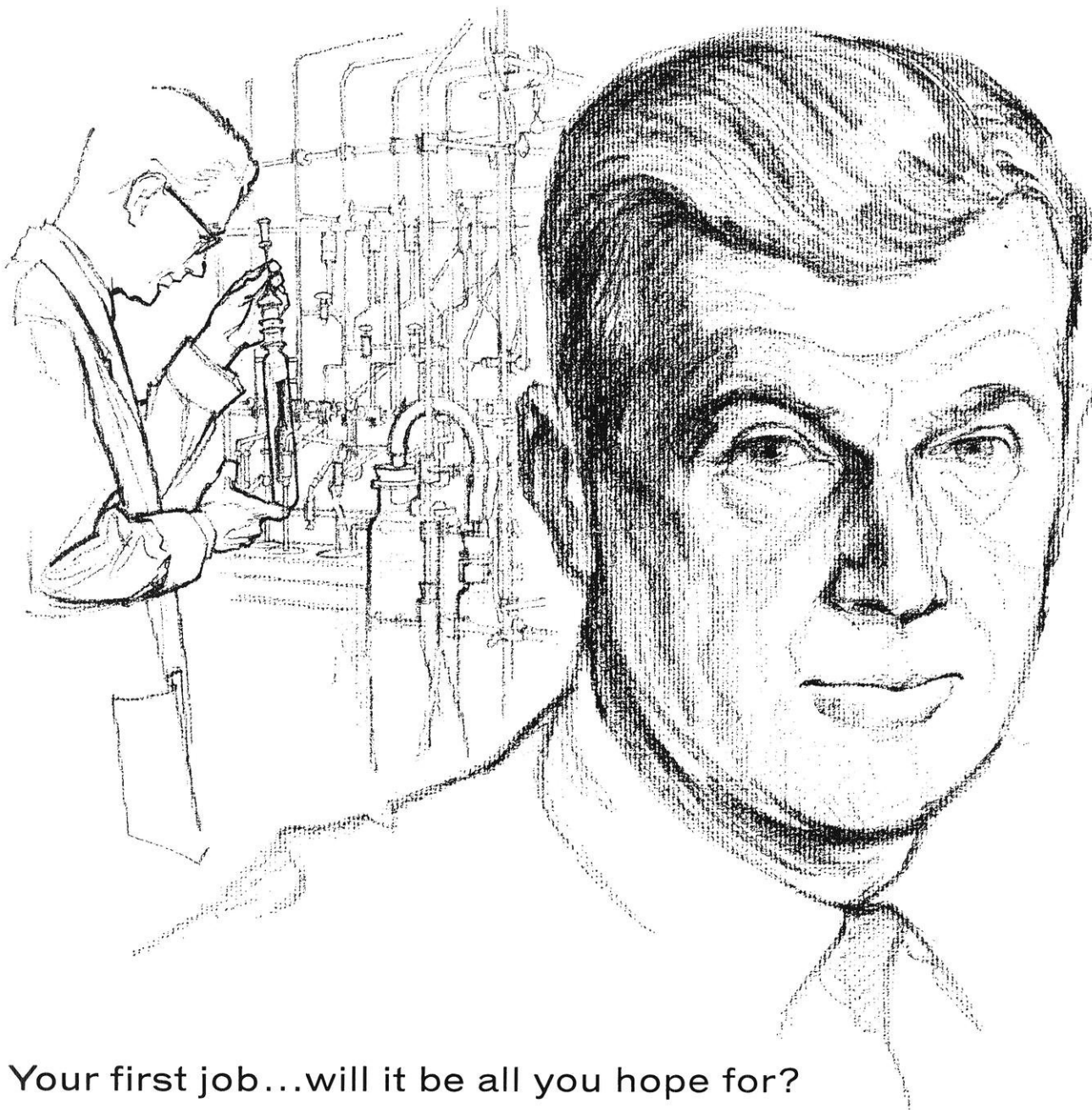
Shell representatives will be pleased to tell you more about the Shell Companies when they visit your campus. Or a résumé sent to Manager, Recruitment Division, Dept. E, The Shell Companies, 50 West 50th Street, New York, N. Y., 10020, will receive full consideration. Candidates whose qualifications and interests match Shell opportunities will be invited to visit Shell installations.

### THE SHELL COMPANIES



Shell Oil Company  
Shell Chemical Company  
Shell Development Company  
Shell Pipe Line Corporation

*An Equal Opportunity Employer*



## Your first job...will it be all you hope for?

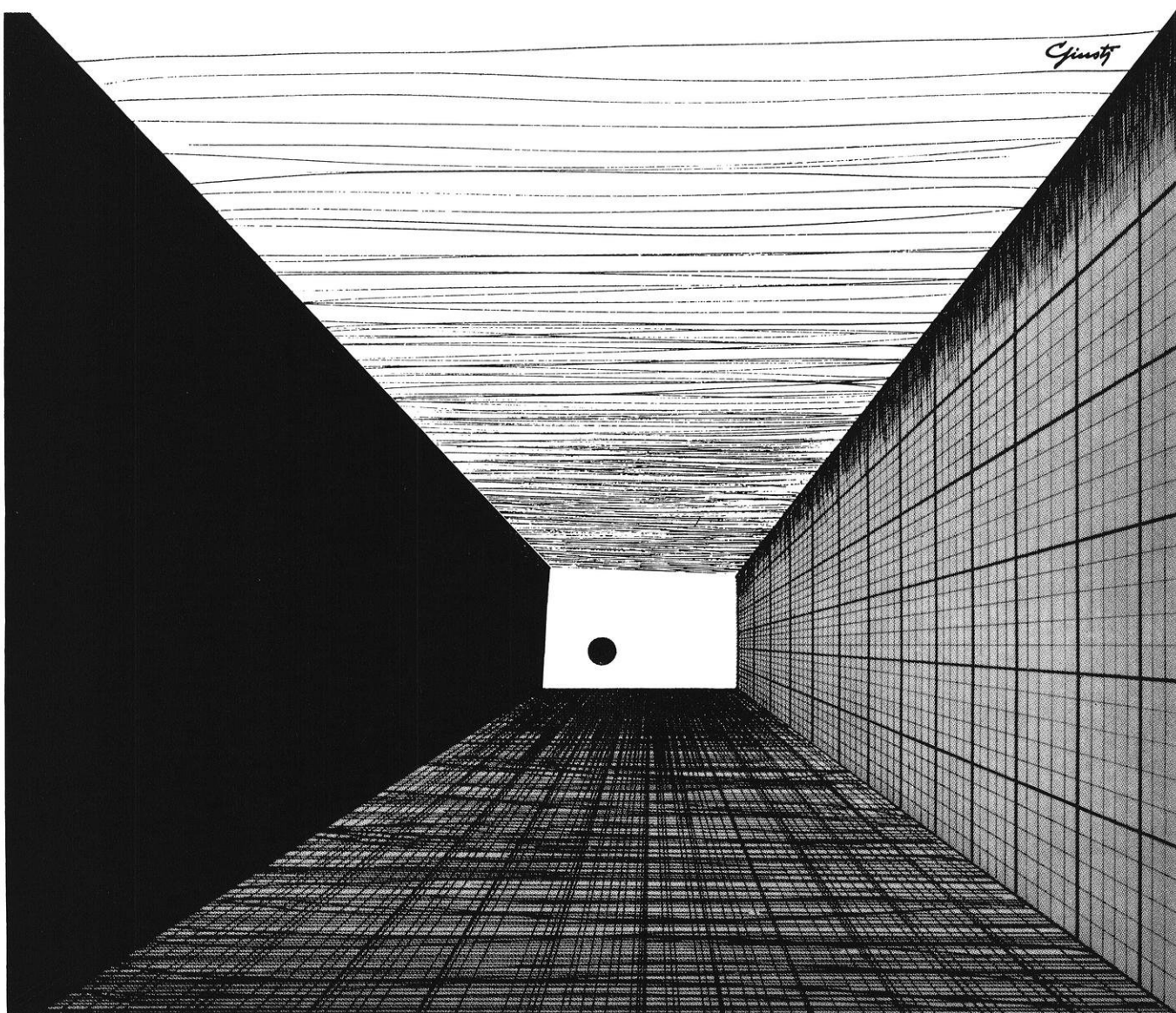
**MINE WAS**, and it has never ceased to be. I joined United States Rubber as a chemical engineer right after my graduation in 1952, and the years since have held a series of stimulating challenges. Why U.S.? A lot of things influenced my choice. I knew there'd be a variety of projects there, the programs you'd find only in a large company with great diversification. I'd heard that U.S. encouraged individual responsibility in an atmosphere of freedom. I knew of the Company's record for leadership in technical advances. At U.S. Rubber I've learned that the Company regards men of industry and imagination as their most valuable asset.

**HOW ABOUT YOURS?** We hope that you, too, will find the opportunity you're looking for at United States Rubber. If so, you'll be part of a team that, in the last five years, obtained over 500 patents—more than our two largest competitors combined. You'll join a select group of 2,000 engineers and research personnel, working for one of America's largest industrial companies operating 74 plants at home and abroad. You'll join a company that makes 33,000 products. Less than half of our business is in tires, and U.S. is one of the nation's largest producers of textiles and chemicals. You'll join a Company that, more than 100 years ago, made the first manufactured vulcanized rubber product and where, today, we contribute our resources and skills to atomic research, oceanography, the latest designs in space stations and hundreds of other exciting projects.

**UNITED STATES RUBBER** 1230 Avenue of the Americas, New York 20, N.Y.

An Equal Opportunity Employer

**THE FIELD IS WIDE** "U.S." offers a comprehensive variety of career opportunities to **Chemical, Electrical, Mechanical, Industrial and Textile Engineers** as well as to those with degrees in **Physics, Mathematics and Chemistry**. Contact your placement office to determine when a U.S. Rubber recruiter will visit your campus. Before you decide on your first job, have a talk with him.



## “From the hayloft a horse looks like a violin”

The ability to view the familiar differently is a highly marketable commodity. Like Newton's apple or Archimedes on Saturday night.

Imagination and scientific discipline, when simultaneously applied, can yield spectacular results. In engineering. In science. In careers.

At Celanese, scientists and engineers are encouraged to inquire, to challenge, and to innovate within the framework of the disciplines of organic and polymer chemistry.

It is this coupling of freedom and discipline that underlies our dramatic rise to chemical industry prominence.

In this exciting environment individual excellence is demanded. In return, you will receive professional recognition, ever increasing responsibility and material gain.

If you are trained in chemical engineering, electrical engineering, mechanical engineering, chemistry or physics, we hope you will discuss Celanese with your faculty or College Placement Officer and see our representative when he visits your campus.

Or write to: Mr. Edmond J. Corry, Supervisor of College Relations, Celanese Corporation of America, 522 Fifth Avenue, New York, New York 10036. Celanese®

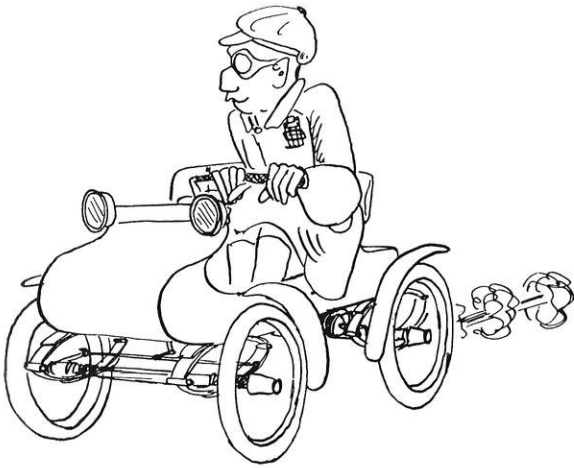
AN EQUAL OPPORTUNITY EMPLOYER

*Celanese*

CHEMICALS, PLASTICS, FIBERS, FOREST PRODUCTS

THE WISCONSIN ENGINEER





# THE ENGINEER OF YESTERYEAR

## 50 YEARS AGO IN THE WISCONSIN ENGINEER

(From the *Wisconsin Engineer* of October, 1914 (Volume 19, No. 1))

To get in a bit of soft-selling to begin with, let us remind you that the price of our magazine 50 years ago was \$1.00 per year or 20¢ per copy. (Our point is that it's still a big bargain!)

The College Book Store, Lake at State (where the main Co-op now stands, offered a 20% discount (rebate) on all texts and supplies, collectible any Saturday. Not quite like the 4 and 5 percent rebates of 1964, was it? Now we know what they mean when they say "The Good Old Days."

Out of another article we obtained some astonishing figures. "The average engineering graduate may reasonably expect an income of \$2000 8 years after graduation, \$3,000 15 years after graduation and \$5,000 20 years after graduation. Starting salary: \$763."

"This year will bring the twentieth anniversary of the University of Wisconsin Engineers Club, which is the oldest organization in the Engineering College. Membership is open to any engineer regardless of the course he is taking, and although the number is limited, the graduation of members last spring has left plenty of room for new ones.

"The society meets every Friday evening for the discussion of papers given by the student members or visitors. The manner of delivery is closely observed, for it is the purpose of the society to develop a man's ability to deliver a paper or discuss a proposition, as well as to train him to be (sic) good mixer among the men of his profession.

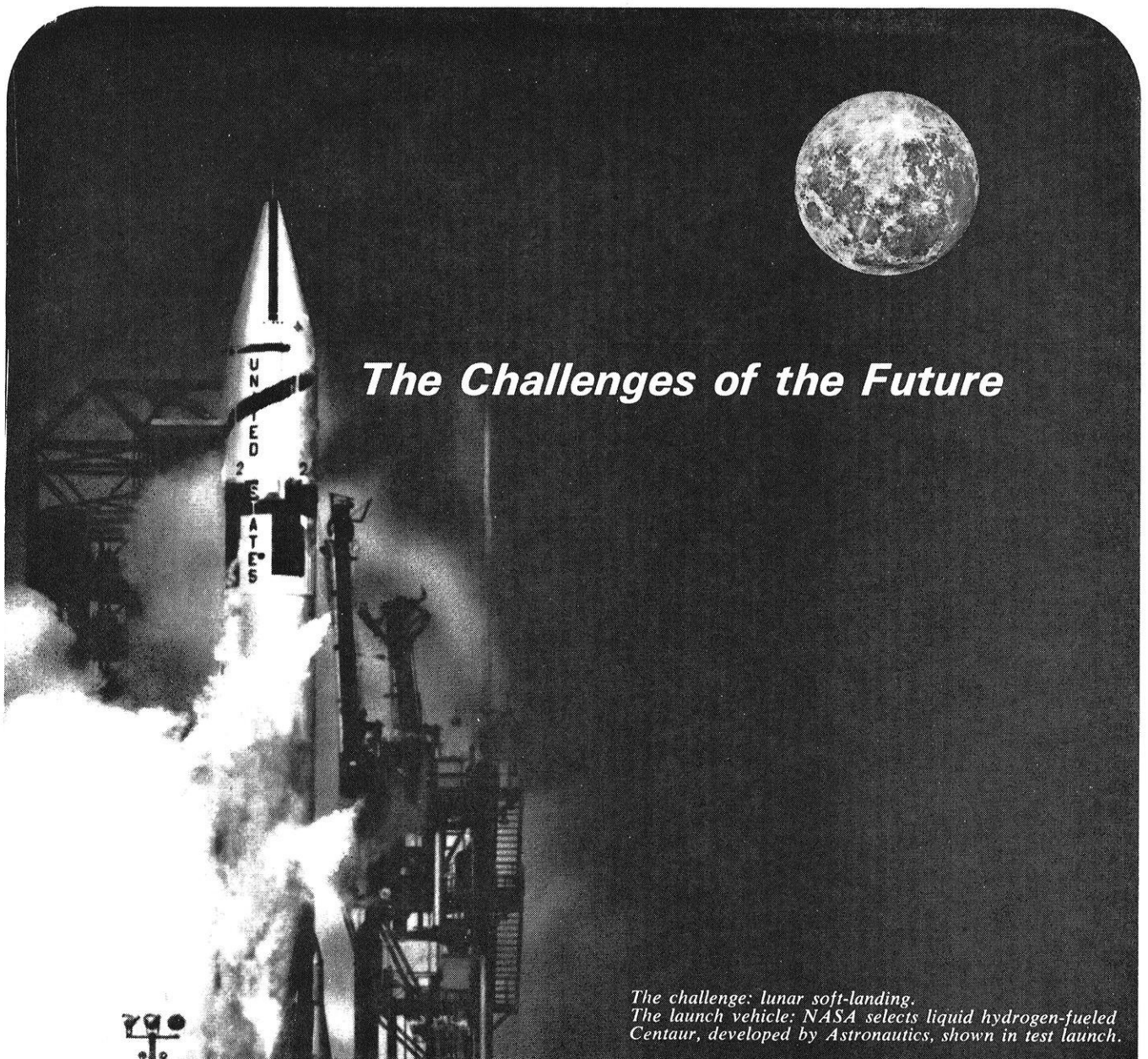
"There are many plans on foot for social affairs, and the old members hope that the new ones will hurry in to help them celebrate their twenty-year birthday party. Visitors are always welcome to any programs given by the society, a notice of which is always posted on the bulletin board a week beforehand.

## ALUMNI NOTES

William C. Ackermann (CiE '35), chief of the Illinois State Water Survey recently returned from Washington after a year's service as special adviser on the White House staff. He was on special assignment on water resources research in the Office of Science and Technology under both the late President Kennedy and President Johnson. His office was largely responsible for focusing public attention upon and accelerating programs of water research, planning and development. Some of the year's accomplishments included:

- New legislation in the field of water resource research which sets up new research institutes for each state, in addition to comprehensive river basin studies.
- Pending legislation amending water pollution laws.
- Acceleration of work in the area of converting sea water to fresh water.
- Better coordination and organization between the 25 federal bureaus which have water programs.





## *The Challenges of the Future*

*The challenge: lunar soft-landing.  
The launch vehicle: NASA selects liquid hydrogen-fueled Centaur, developed by Astronautics, shown in test launch.*

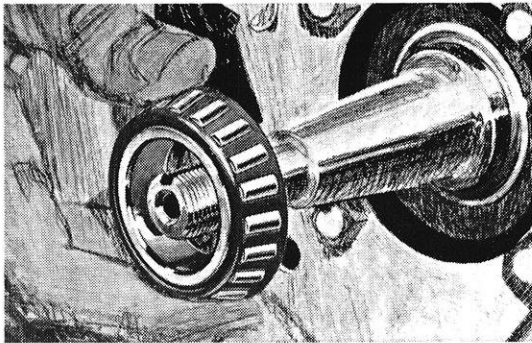
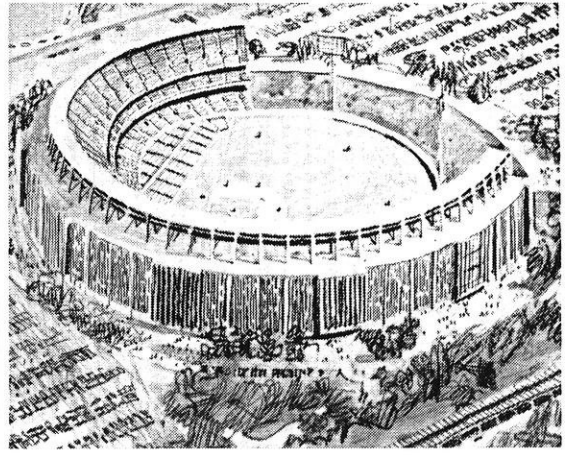
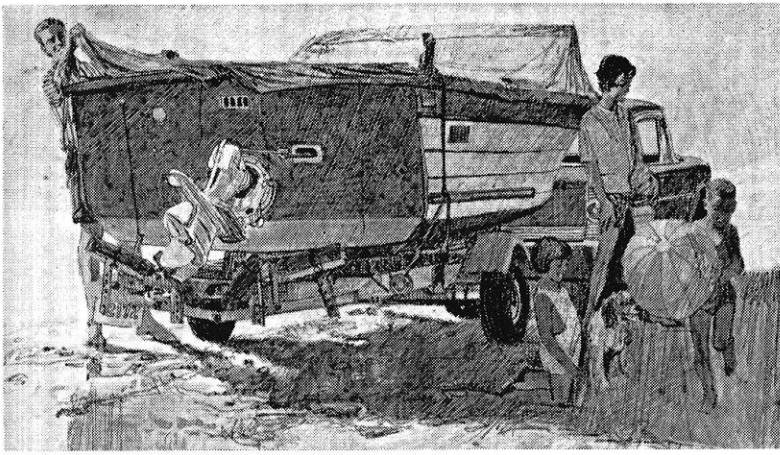
**ENGINEERS & SCIENTISTS:** General Dynamics|Astronautics offers you the challenges of the future — today. As the space-oriented division of the great General Dynamics Corporation, Astronautics has a heritage of leadership in the development of our nation's current space capabilities. We continue to build on this strong background as we design and develop new systems and devices that will help to shape the future course of space technology. Your alert response to the fascinating challenges we offer will establish guidelines for your successful career at Astronautics.

Scientific and technical opportunities exist at all degree levels in activities that include RESEARCH, DESIGN, DEVELOPMENT, TEST, COMPUTER PROGRAMMING, RELIABILITY, and ADMINISTRATION.

For General Dynamics|Astronautics career information, see your placement officer and watch for campus interview schedules, or write to Mr. B. L. Dobler, Chief of Professional Placement and Personnel, Dept. 130-90, General Dynamics|Astronautics, 5899 Kearny Villa Road, San Diego, California 92112. An Equal Opportunity Employer.

**GENERAL DYNAMICS | ASTRONAUTICS** 

*We Will Visit Your Campus November 20*



**You can  
have a lot of  
fun on Timken®  
Bearings**

**INBOARD WITH AN OUTDRIVE.** This new Chrysler-Dana Drive 90° offers boating buffs big power in a small space. Dock your boat at home? The outdrive tilts up 55° for easy trailering. Timken® bearings keep the prop and drive shafts rigid as a Marine.

**SEATS IN MOTION.** New York's new Shea Stadium stands move to accommodate 10,000 fans in two blocks of 5,000 seats. They roll on Timken bearings from the first and third baseball foul lines to the football sidelines.

**NO PLAY FOR BEARINGS.** Timken bearings work hard to make your world more leisurely. They're made of nickel-rich steel for long life—even when loads and conditions become unsportsmanlike.

**FORE? NO, THREE.** Three wheels for the golfer who'd rather swing than walk. This new Cushman Golfster is a smart way to cover the links. Eight Timken bearings were chosen for the drive, axle and wheel applications. They're precision-made and case-hardened to take shock loads. The Timken Roller Bearing Company, Canton, Ohio. Also makers of Fine Alloy Steel and Rock Bits.

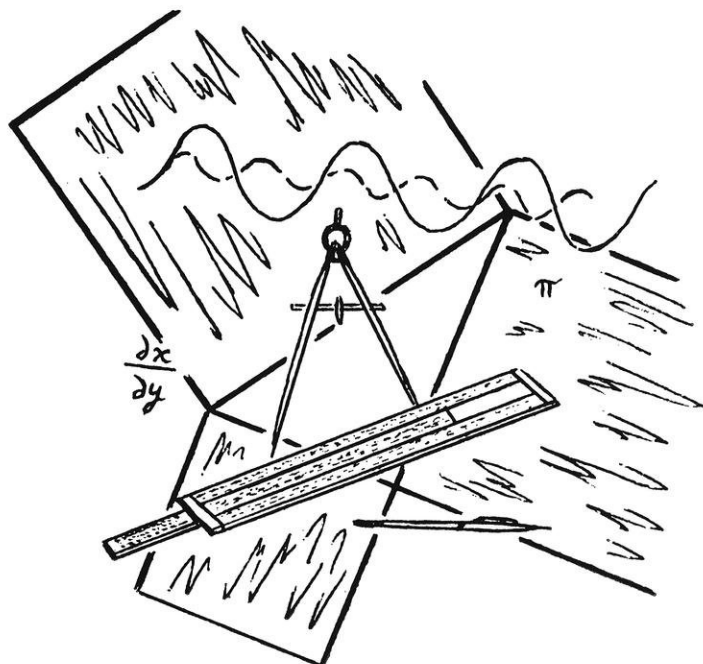


**QUALITY TURNS ON  
TIMKEN®  
TAPERED  
ROLLER BEARINGS**

Learn More About the Timken Company, an Equal Opportunity Employer. Send for Career Booklet.

# THE MENTAL MAZE

By Clifton Fonstad, Jr. ee4



**W**ELCOME to the Mental Maze for this school year.

This is the second year of the Maze and as it begins there is evidence that the first year was successful for now there is a second mental maze on the University of Wisconsin campus. This one is for liberal studies majors; more precisely those taking courses scheduled to meet in the new Engineering Building. To these "Hill" students trying to find their classrooms and to engineers trying to help them find their classrooms the building is one big mental maze. But it is a maze with a solution as several EE's discovered. When a male student or "so-so" girl asks directions, point him or her in the right direction with a long list of instructions; when a real beauty asks for help give her a personal escort to the class or, if your class schedule permits, to some more secluded spot.

The rest of the puzzles this month you will have to solve yourself. We are still giving five dollars for the correct answers—see the "answers"—so let's get started on the first puzzle—the first turn in this month's Mental Maze.

1. First, for a quick refresher course in inequalities. How many positive integers,  $n$ , satisfy the inequality:

$$\frac{1}{15 - 2n} < \frac{1}{4 + n}$$

Which ones, if any, are they?

2. Now, for a doodle puzzle. If the larger of two concentric circles has twice the area of the smaller, what is the smallest number of sides that a polygon inscribed in the larger circle can have without having any points in common with the smaller circle? You get 20 seconds.

3. We made several attempts last year to unmask mathematics as a complete hoax but our proofs contained errors. Finally success has been attained. Check through the following equations and see if you don't agree:

a. Notice that there are many numbers,  $x$  and  $y$ , such that  $x^2 - 8x = y^2 - 8y$  and  $x \neq y$ .  $x = 3$ ,  $y = -5$  are one example.

b. Choose two such numbers,  $x$  and  $y$ ,  $x \neq y$ .

$$x^2 - 8x = y^2 - 8y$$

c. Add 16

$$x^2 - 8x + 16 = y^2 - 8y + 16$$

d. Thus

$$(x - 4)^2 = (y - 4)^2$$

e. and

$$x - 4 = y - 4$$

f. Therefore

$$x = y$$

Only the elementary rules of algebra have been used, yet there is an obvious contradiction when  $x \neq y$  implies  $x = y$ . Has the world of mathematics finally been humbled?

4. We heard of a physics major the other day who has what he feels is the ideal way to study his six courses—four physics and two history—without getting into a boring pattern. He studies a physics course first, another, then one history course, then the other history course, he then switches back to physics, and ends with the last physics course. In addition to thus splitting the physics studying up with the history he doesn't study the courses in the same order every night. How many different study orders, keeping the history courses in the middle, can this physics student use before he repeats?

5. For our last problem let's go to the "logic" file. On one hot day last summer four couples went on a picnic and drank 44 bottles of pop (they weren't engineers). Kathy drank 2 bottles, Louise 3, Mary 4, and Nancy 5. Allen drank exactly as many bottles as his date, George drank twice as many as his date, Carl 3 times, and Steve 4 times. What is the first name of Steve's date?

**ANSWERS:** The answers for this month's Mental Maze will appear next month. You are invited to send your solutions to the puzzles to The Mental Maze, Wisconsin Engineer, 333 Mechanical Engineering Bldg., University of Wisconsin, Madison, Wisconsin. The first correct set of answers received before the next issue will win an award of five dollars. So, hurry and write.





## We give Ch. E.s modern tools and a chance to stick out their necks

Some of our chemical engineers work on fabrics for ladies' coats, some on lunar orbiters, some on raising the hatchability percentage of turkey eggs. The assortment runs on and on too long for easy credibility. The assortment of engineering disciplines that we use besides chemical also gets too long.

We do not deny, however, that sensitized film and paper remain our largest single business. Instead of waning they are waxing. High-order chemical engineering is our secret. This is a nice secret to know. We want to teach it to upcoming chemical engineers endowed with enough mental flexibility to recognize that mathematical model-building

which correlates dollars with millionths of an inch of accuracy in superimposing color emulsion layers can be as exciting a practice of their profession as calculating the diameter of pipe with which to feed a still.

In addition to the upcomingness, the flexibility, and the professionalism, one further characteristic can elevate the possessor above a merely good, satisfactory career: a feeling that "the company" really means "me" rather than some vague "them," a feeling which on fortunately rare occasions becomes so strong that he is willing to wage a stiff battle for a good idea.

Drop us a note if we interest you.

**EASTMAN KODAK COMPANY,**

Business and Technical Personnel Department, Rochester, N.Y. 14650

An equal-opportunity employer offering a choice of three communities:

Rochester, N.Y., Kingsport, Tenn., and Longview, Tex.

**Kodak**



# Advancement in a Big Company: How it Works

An Interview with General Electric's C. K. Rieger, Vice President and Group Executive, Electric Utility Group



C. K. Rieger

■ Charles K. Rieger joined General Electric's Technical Marketing Program after earning a BSEE at the University of Missouri in 1936. Following sales engineering assignments in motor, defense and home laundry operations, he became manager of the Heating Device and Fan Division in 1947. Other Consumer-industry management positions followed. In 1953 he was elected a vice president, one of the youngest men ever named a Company officer. Mr. Rieger became Vice President, Marketing Services in 1959 and was appointed to his present position in 1961. He is responsible for all the operations of some six divisions composed of 23 product operations oriented primarily toward the Electric Utility market.

**Q. How can I be sure of getting the recognition I feel I'm capable of earning in a big company like G.E.?**

A. We learned long ago we couldn't afford to let capable people get lost. That was one of the reasons why G.E. was decentralized into more than a hundred autonomous operating departments. These operations develop, engineer, manufacture and market products much as if they were inde-

pendent companies. Since each department is responsible for its own success, each man's share of authority and responsibility is pinpointed. Believe me, outstanding performance is recognized, and rewarded.

**Q. Can you tell me what the "promotional ladder" is at General Electric?**

A. We regard each man individually. Whether you join us on a training program or are placed in a specific position opening, you'll first have to prove your ability to handle a job. Once you've done that, you'll be given more responsibility, more difficult projects—work that's important to the success of your organization and your personal development. Your ability will create a "promotional ladder" of your own.

**Q. Will my development be confined to whatever department I start in?**

A. Not at all! Here's where "big company" scope works to broaden your career outlook. Industry, and General Electric particularly, is constantly changing—adapting to market the fruits of research, reorganizing to maintain proper alignment with our customers, creating new operations to handle large projects. All this represents opportunity beyond the limits of any single department.

**Q. Yes, but just how often do these opportunities arise?**

A. To give you some idea, 25 percent of G-E's gross sales last year came from products that were unknown only five or ten years ago. These new products range from electric tooth brushes and silicone rubber compounds to atomic reactors and interplanetary space probes. This changing Company needs men with ambition and energy and talent who aren't afraid of a big job—who welcome the challenge of helping to start new businesses like these. Demonstrate your ability—whether to handle complex technical problems or to manage people, and you won't have long to wait for opportunities to fit your needs.

**Q. How does General Electric help me prepare myself for advancement opportunity?**

A. Programs in Engineering, Manufacturing or Technical Marketing give you valuable on-the-job training. We have Company-conducted courses to improve your professional ability no matter where you begin. Under Tuition Refund or Advanced Degree Programs you can continue your formal education. Throughout your career with General Electric you'll receive frequent appraisals to help your self-development. Your advancement will be largely up to you.

FOR MORE INFORMATION on careers for engineers and scientists at General Electric, write Personalized Career Planning, General Electric, Section 699-11, Schenectady, N. Y. 12305

**GENERAL  ELECTRIC**

*An Equal Opportunity Employer*