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Wisconsin engineer. Vol. 71, No. 6 March 1967

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

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wisconsin engineer

Solar Energy

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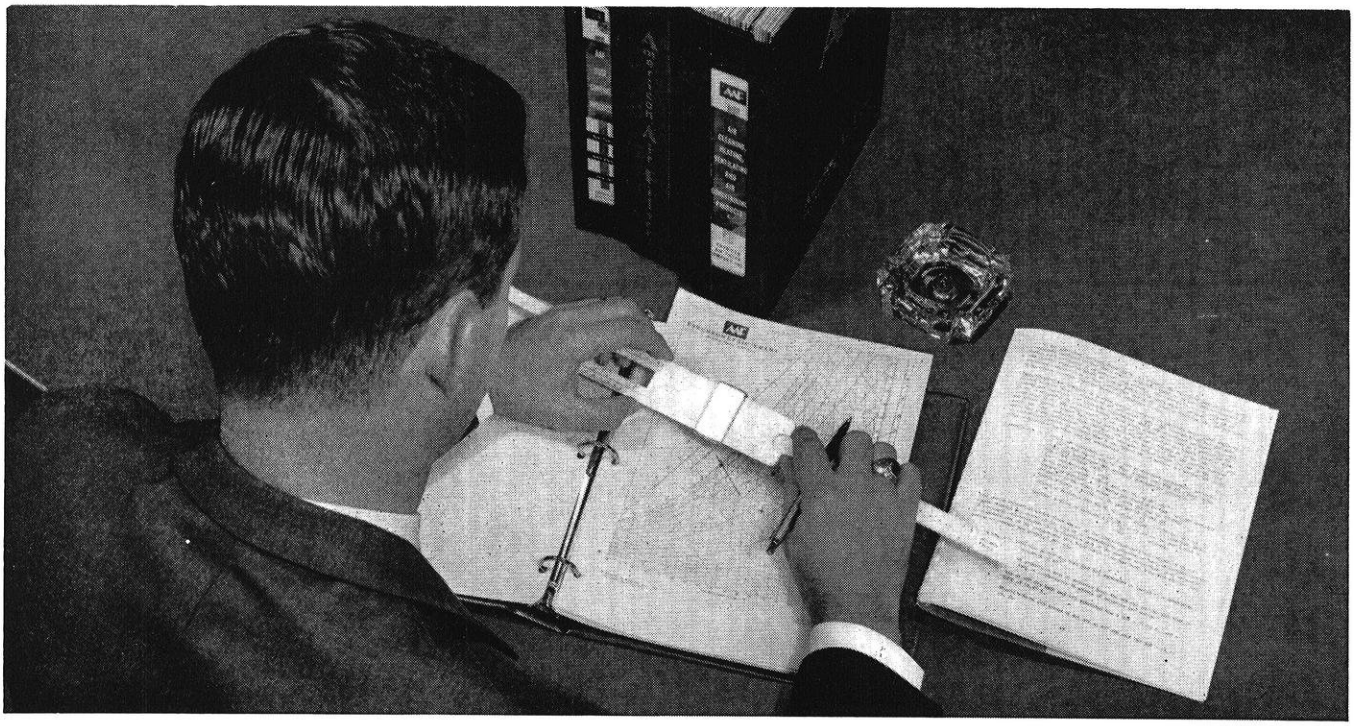

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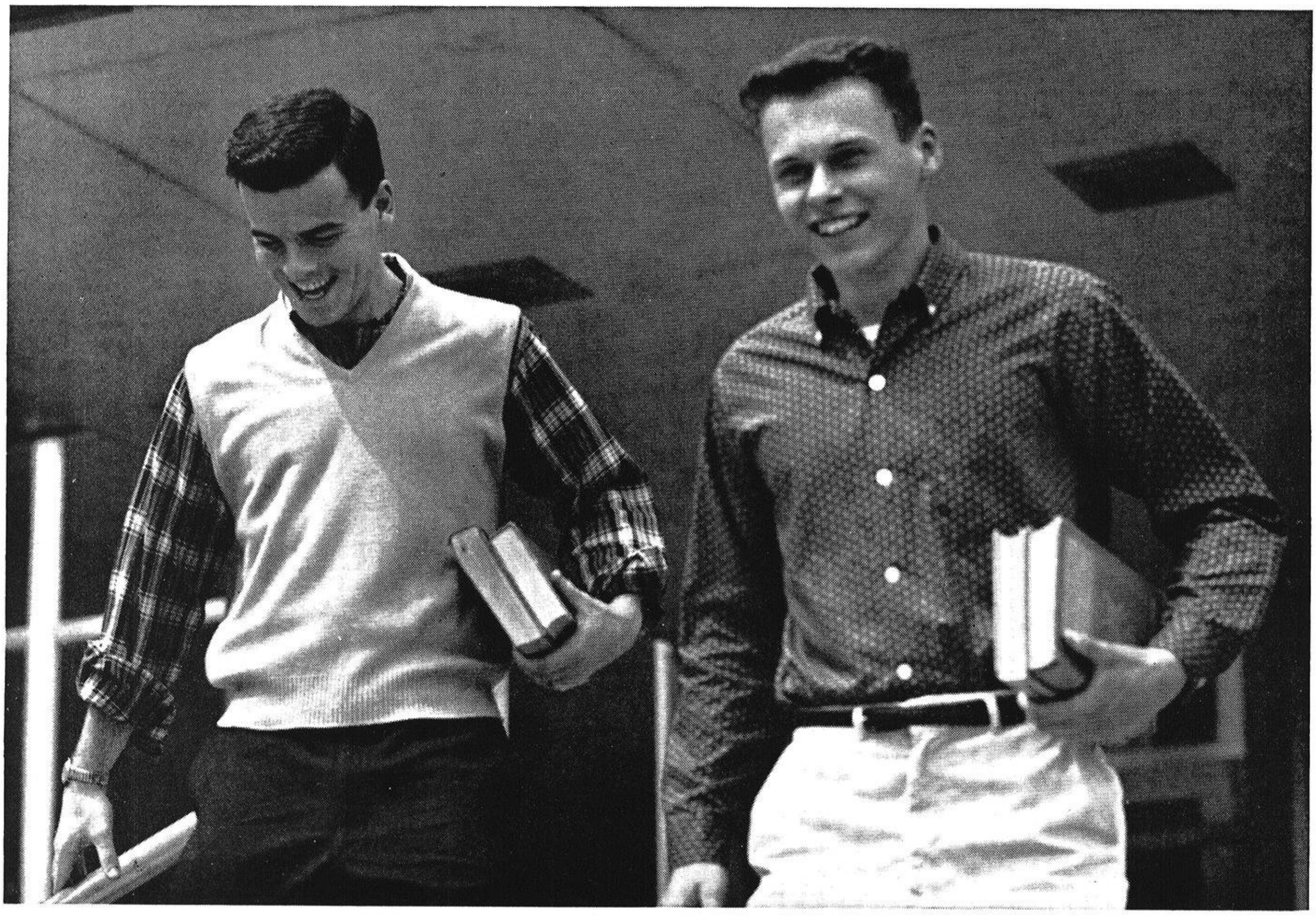
Second Class Postage Paid at Madison, Wisconsin, under the Act of March 3, 1879. Acceptance for mailing at a special rate of postage provided for in Section 1103, Act. of Oct. 3, 1917, authorized Oct. 21, 1918.

Published monthly from October to May inclusive by the Wisconsin Engineering Journal Association, 333 Mechanical Engineering Building, Madison, Wisconsin 53705. Editorial Office Hours 11:00–12:00 Monday, Wednesday and Friday. Office Phone (608) 262–3494.



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EDITORIAL

ABOLISH ST. PAT'S ? ? ?

LET'S abolish St. Pat's, the Exposition, the societies, in fact any engineer-oriented events. After all, the Exposition had to "pull teeth" to get people to enter exhibits, the St. Pat's dance could have had a better attendance, the societies have to work hard just to get their members to attend a meeting, much less work on anything.

These are strong words, and I don't mean them. I am merely emphasizing the seemingly "camp" attitude—student apathy.

You want to be individuals, right? So traditional activities such as these don't serve any purpose, and besides, you've got too much homework! Any extra time you have, you want to spend in the bar, where at least you don't have to think and no one requires you to be involved. I predict that if this is the case, you'll probably spend the rest of your life coming home to a beer and your color T.V., and you'll deserve the beer belly and the nagging wife you end up with.

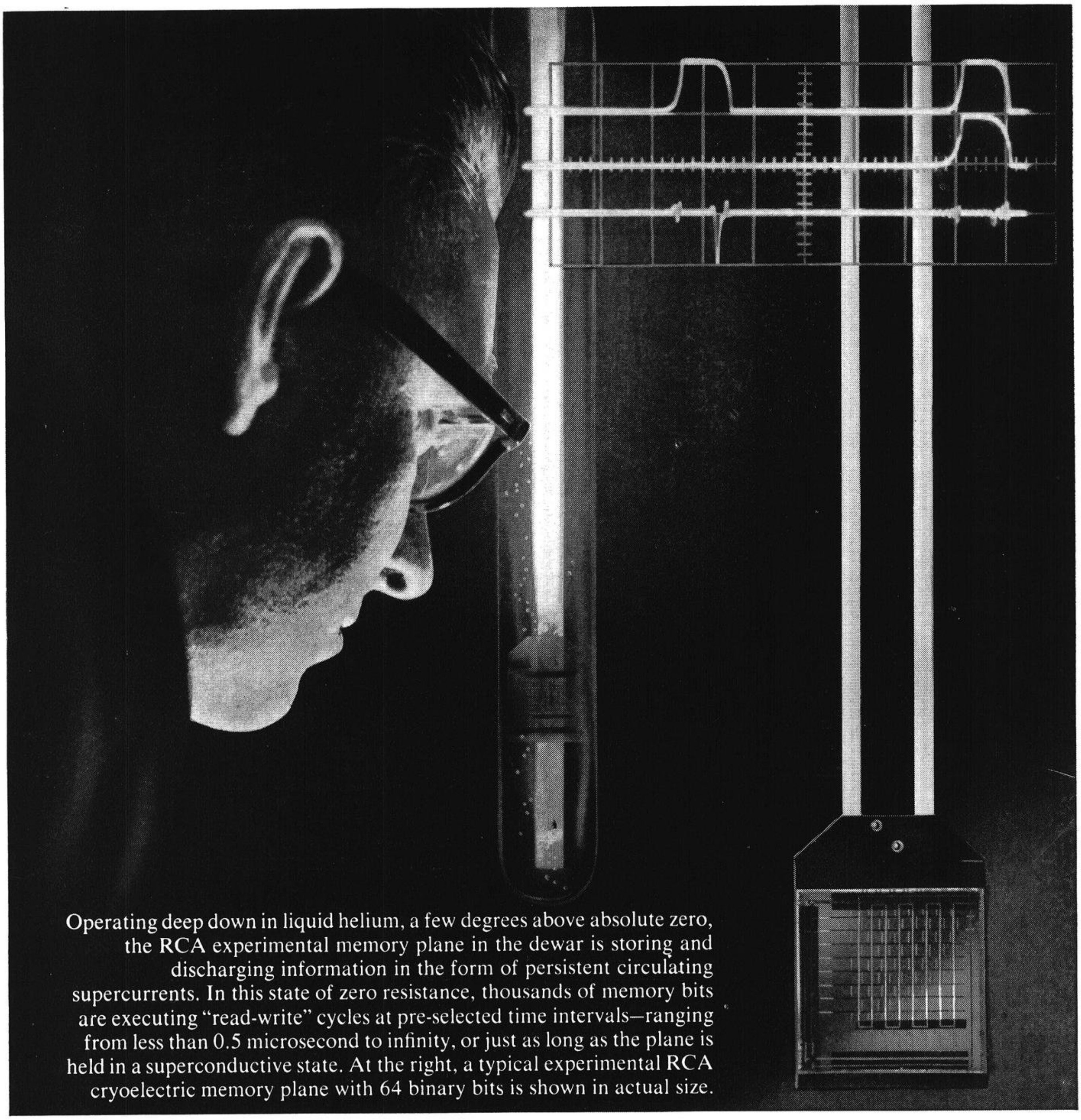
The fact remains, if you plan on being *anybody,* in business or personally, you have to become involved.

The value of these activities here on campus differs for each man—training in leadership, in organization, in following orders, or perhaps just meeting others in your field—but the value is there.

And why, you ask, these particular events? My answer is simply that no one has taken the time to come up with some new traditions. We are all proud of Wisconsin's College of Engineering. We are proud of it because it has excellent teachers, a good reputation, etc., but most of all, we're proud because it's *our* school. Becoming involved on campus in the traditions and the new projects can make this college truly your school, as the *Wisconsin Engineer* has made it mine.

So, what's my point? Simply that no matter what involvement will mean to you—a learning process or just some memories—it has a value for each of us. Being an undergraduate happens only once—you *could* remember it all your life!

Mary E. Ingeman



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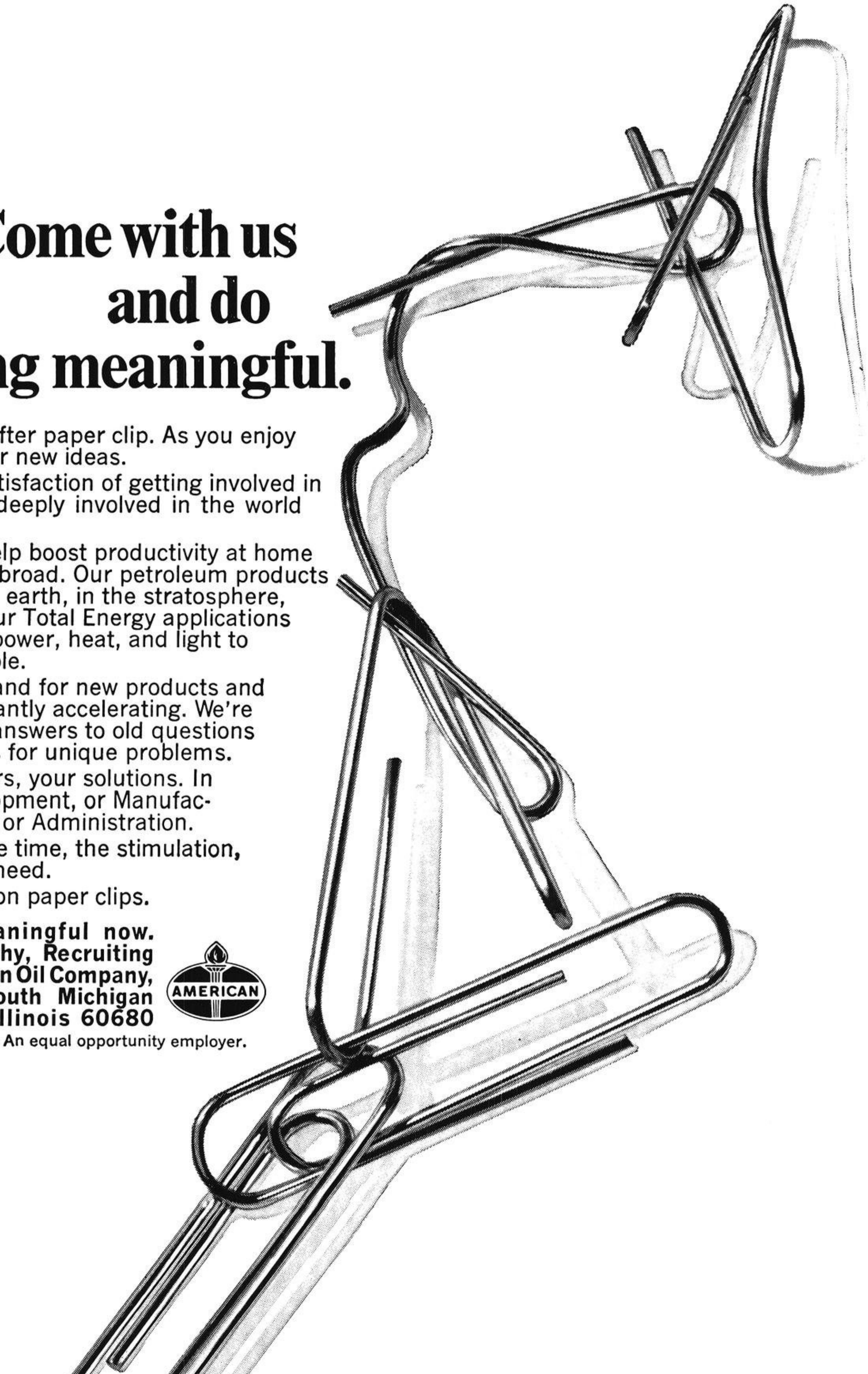

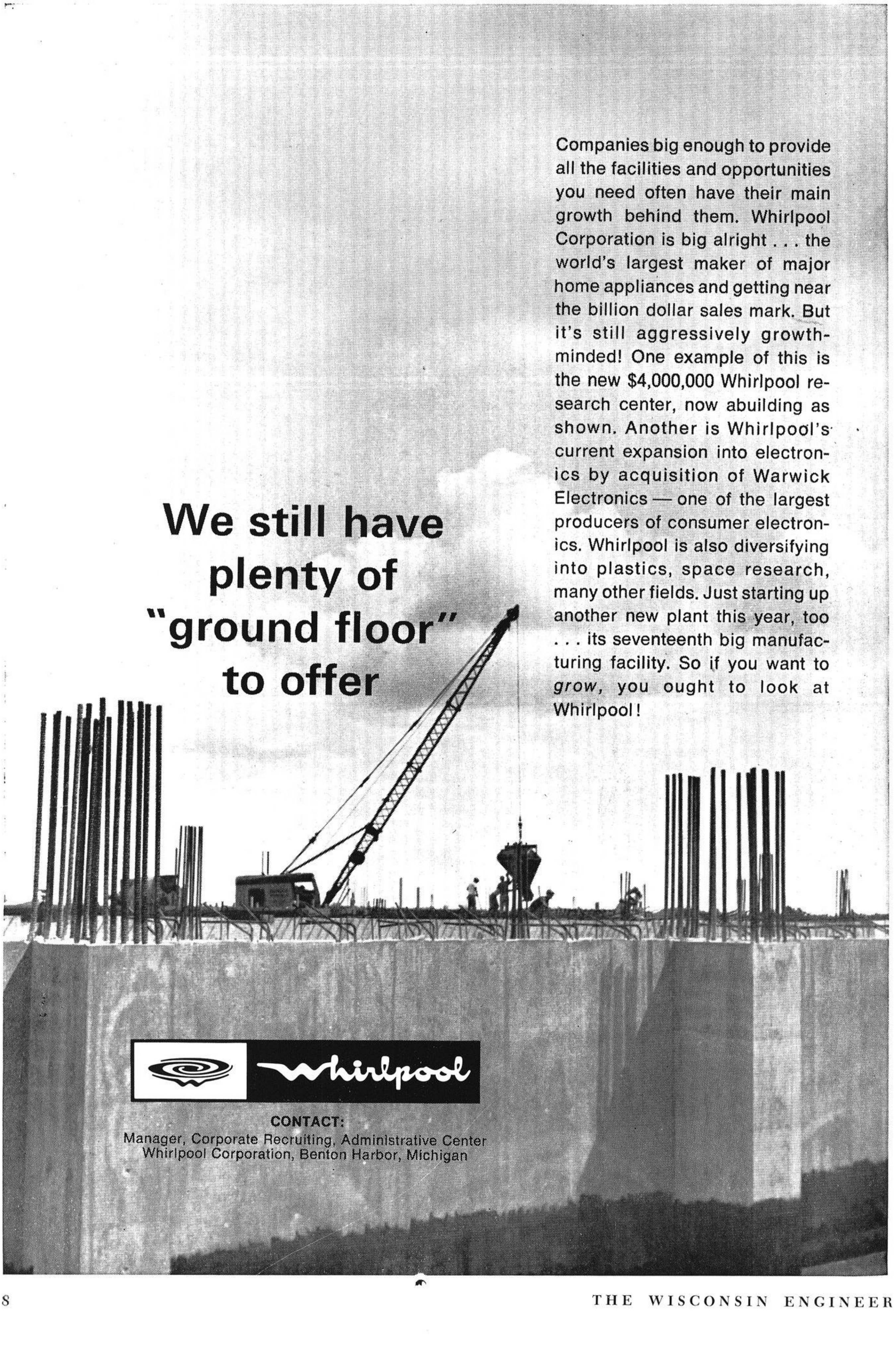
Companies big enough to provide all the facilities and opportunities you need often have their main growth behind them. Whirlpool Corporation is big alright . . . the world's largest maker of major home appliances and getting near the billion dollar sales mark. But it's still aggressively growth-minded! One example of this is the new $4,000,000 Whirlpool research center, now abuilding as shown. Another is Whirlpool's current expansion into electronics by acquisition of Warwick Electronics — one of the largest producers of consumer electronics. Whirlpool is also diversifying into plastics, space research, many other fields. Just starting up another new plant this year, too . . . its seventeenth big manufacturing facility. So if you want to grow, you ought to look at Whirlpool!
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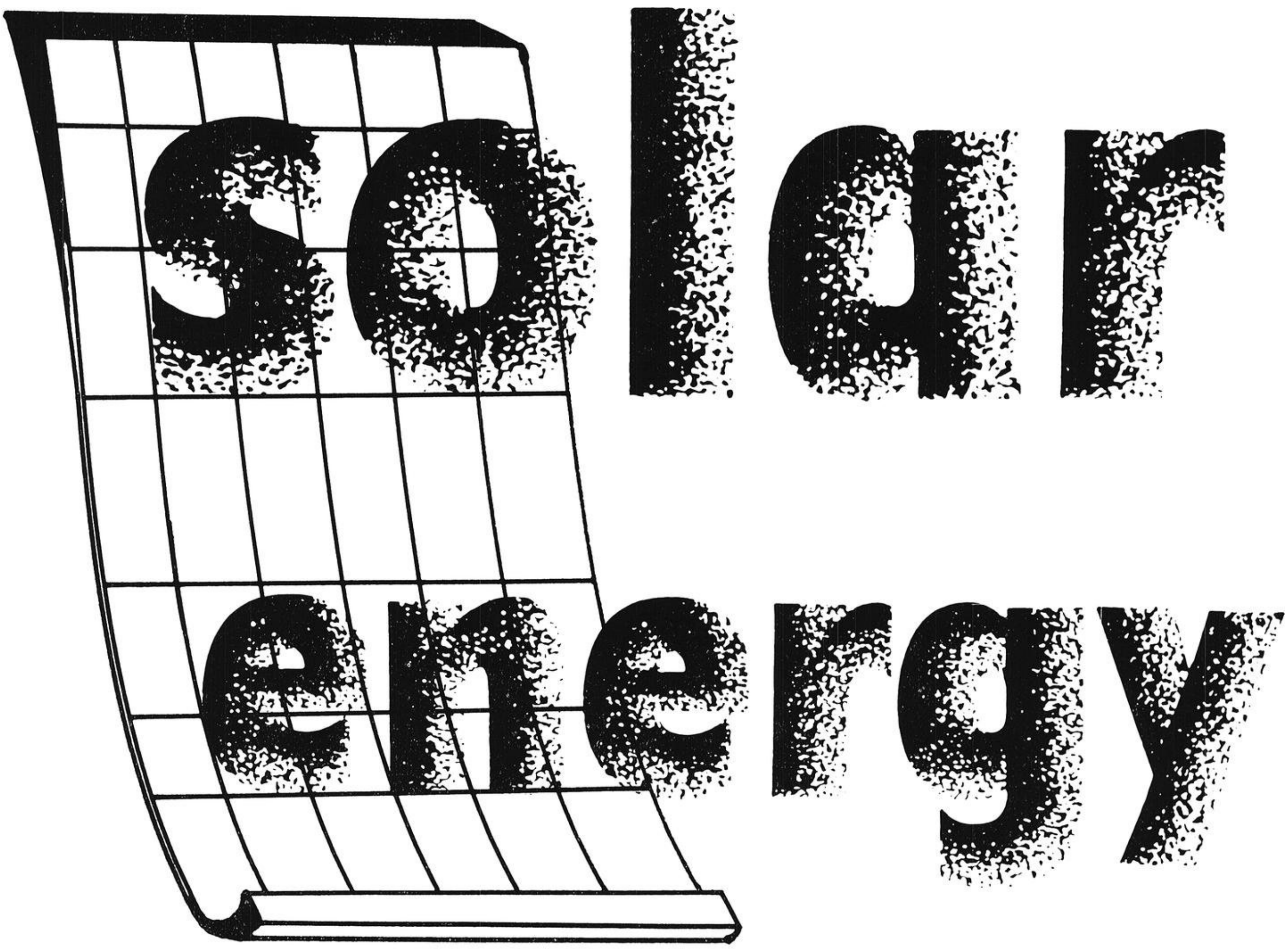
COVER STORY: BY DON MYERS



THROUGH the past two decades of scientific and architectural development on the application of solar energy, the term "solar house" has gained several meanings. In the scientific area, the name "solar house" means a house that absorbs and stores radiant energy from the sun. This energy is then used as it is needed to heat or cool the air within the house. Builders and architects define "solar house" more generally as any home designed to reduce winter heating costs by directly using the sun's rays. Such designs include large double-glaze windows in the south walls of homes located in the nothern hemisphere. These large south-facing windows are best referred to as *solar windows,* due to their primary function of transmitting sun light and heat into a house. The purpose of this article is to summarize the many factors which are of significance in the design of such solar windows. It is hoped that such a summary will some day lead to the organization of a complete handbook on solar window design for use by architects and engineers.

SOLAR HEATING CALCULATIONS

To compute the efficiency of a solar window, the amount of heat absorbed from incident solar and diffuse radiation must be compared to the amount of heat lost from the building during the time solar radiation is available. Such calculations require a knowledge of solar mechanics and radiation measurements.

Solar Mechanics

Solar mechanics—the study of time-position relationships of the sun with respect to earthly objects—determines the time and angle at which sunlight strikes a window which is free of shade and cloud interference. Graphical analysis using a sun path diagram is the most rapid method of finding solar altitude and azimuth angles.

Solar Radiation

Radiation measurements determine the amount of direct and diffuse solar energy that falls on

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a given surface. Olgyay and Olgyay have developed a "Radiation Calculator" by assuming the direct, diffuse, and total radiations for any orientation to be functions of solar altitude and angle of incidence. Incident radiation data (Fig. 1) are charted on spherical projection overlays (Fig. 2) and superimposed on a sun path diagram to obtain time varying readings for any date at the given latitude.

Hutchinson's Equation

When the incident radiation and the transmissivity of the window glass are known, the amount of heat passing into the house during a time increment may be calculated according to Hutchinson's equation:

$$Q = F \left[\sum_{n=x}^{n=1} \overline{V}_n \right] - (U_c - U_w)\ (t_i - t_o')\ (x)$$

Q = Seasonal solar heat gain in Btu.

$F = \dfrac{\text{Actual hours of incident radiation}}{\text{Maximum possible hours of radiation}}$

$\overline{V}_n$ — Solar term

U_c — Coefficient of heat transfer for the window

U_w = Coefficient of heat transfer for surrounding wall

t_i = Indoor temperature

t_o' = Average outdoor temperature

x = Number of hours in the heating season

The solar term V_n is dependent on the solar conditions—sun angle and radiation—which in turn are affected by time, weather, and location. This variability defies integration, so a graphical summation must be used. The time increment, X— called the heating season—is usually taken to be from October 1 to May 1 in areas with north latitudes of 30 to 50 degrees. To relieve the tediousness of summations over such a long time, Hutchinson provides tabular values of V_n for several combinations of latitudes and window types.

Heating Efficiency

The efficiency of a solar window is found by dividing the solar heat gain, Q, by the denominator of F—the maximum number of possible hours of radiation—in Hutchinson's equation. To arrive at the percentage of the annual heating load which is provided by the solar window, the solar heat gain, Q, must be divided by the total heat loss of the house over the heating season. The total heat loss is computed by the standard design temperature difference method, which may be found in the manual of the National Warm Air Heating and Air Conditioning Association or in any other authoritative heating and ventilating handbook. When the total heat loss is subtracted from the solar heat gain, the remaining quantity represents the annual heating load which must be supplied by supplementary heating equipment.

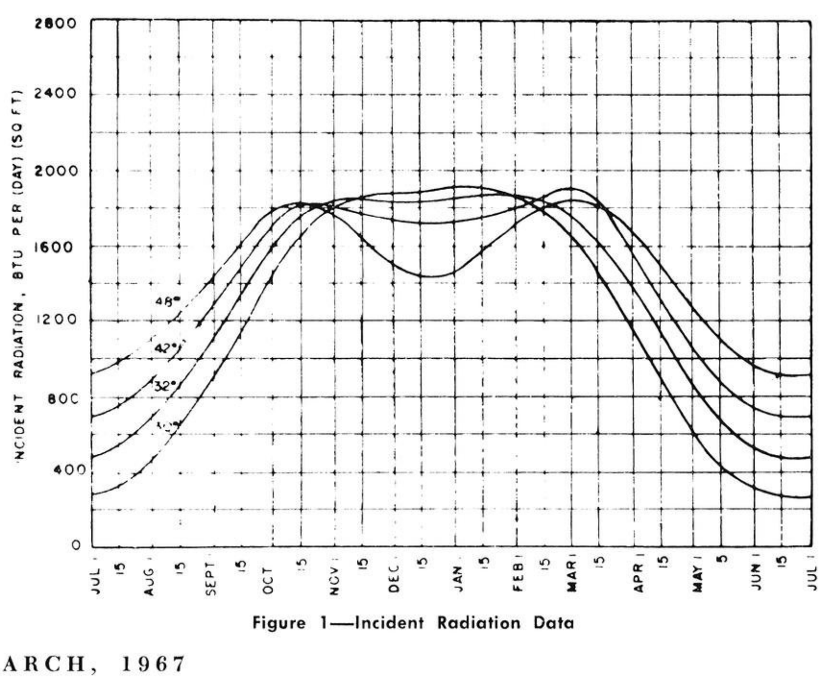

Figure 1—Incident Radiation Data

SOLAR SHADING CALCULATIONS

As the average outdoor temperature rises near the end of the heating season, the design balance of the solar window is upset an the house becomes overheated. To prevent overheating throughout the summer, an effective shading device must be found to limit the amount of solar and diffuse radiation falling on the glass.

Window Reflection

The natural change in the path of the sun from winter to summer does a great deal to limit the transmission rate of radiation on an unshaded window. As shown in Figure 3 the winter rays strike within 22° of "normal" to the glass surface. The sun's altitude angle, which is also the angle of incident radiation, α, increases to a maximum on June 21. This increasing angle increases the amount of radiation that is reflected by the glass. The rise in solar altitude increases reflection enough to cut the amount of radiation transmitted in June to one-third the amount transmitted by the same window in December. However, in the 30–50 degree latitude range, the summer average outdoor temperature is very close to the desired indoor temperature and little, if any, heat gain from a solar window is desirable. To minimize the summer heat gain, some type of shading structure—which is complementary to the architecture of the building but does not reduce the winter efficiency of the solar window—must be placed near the window.

Structural Shading Design

Inside Shades. Inside shades or venetian blinds have proved less successful than outside shading de-

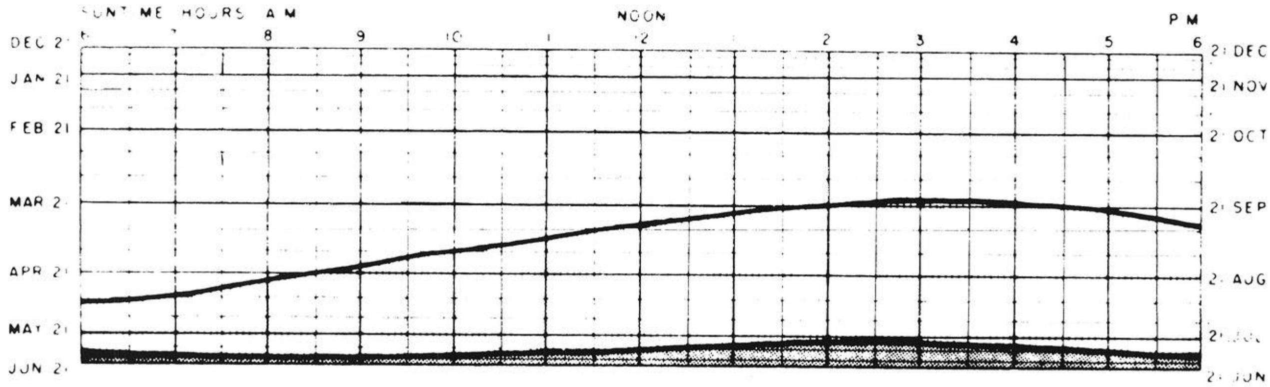

Figure 2—Sunlit Hours

vices because when they are installed, the heat is allowed to enter the room before it is blocked or reflected by the blinds. The heat that is absorbed by the blinds remains in the room and is radiated as a heat gain, even though the room appears to be shaded.

Outside Shades. Awnings and roof overhangs have been the most common types of shading devices on residential buildings. However, architects are experimenting with other methods, such as outside venetian blinds, vertical louvers, free standing walls, and shrubbery planting. Since the angle of the sun changes with latitude as well as with time, the shading problem at each latitude requires a separate graphical time solution which is similar to the solutions for sun angle and radiation value.

Graphical Shading Solutions. The "Shading Mask" is an overlay device which may be superimposed on a sun path diagram to mark the periods when a wall is shaded by objects placed between the sun and the wall. For solar window design, the sun path diagram is masked in relation to the radiation data obtained with the Radiation Calculator. The mask is drawn over the sun path at the areas where radiation would cause overheating. This mask may then be projected by the equidistant method to arrive at a suitable design for a shading device.

Another method developed, by Olgyay and Olgyay, to determine the capacities of existing shading devices is the "Shade Dial." This instrument may also be used to find optimum positions for predesigned shading devices. The Shade Dial is placed near a model of the building tnd its shading devices. When the model is placed in sunshine at a given angle, the shadow of the bead on the dial will show the date and time when the sun will strike the building at the given angle. If the dial is already calibrated with the overheated period, the model may be set up and the shading devices move to cover the solar window during this period. Not only is the Shade Dial a useful design tool, but it works equally well as a checking device for other methods of shading design.

CONCLUSIONS AND RECOMMENDATIONS

Solar window design as it now stands is a very laborious and time consuming task for most architects and consulting engineers. Much work is being done in the field, but as shown by the diagrams for sun path, radiation, and shading presented here, the work is necessarily localize to a particular latitude and climate. It is obvious that a unifying device—perhaps a committee under the direction of the Association for Applied Solar Energy—is needed to organize present information and promote further research at latitudes at which radiation and shading diagrams have not been made. A handbook of such information for solar orientated design would be of great benefit to all practicing architects and engineers.

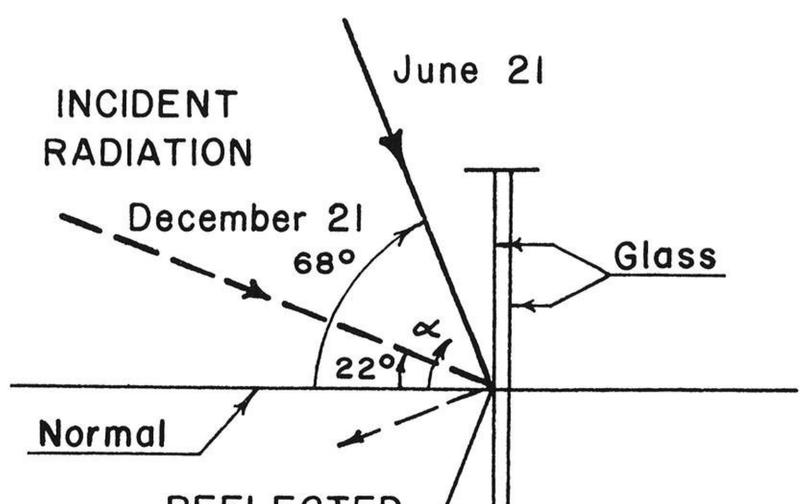

Figure 3—Angle of Incident Radiation

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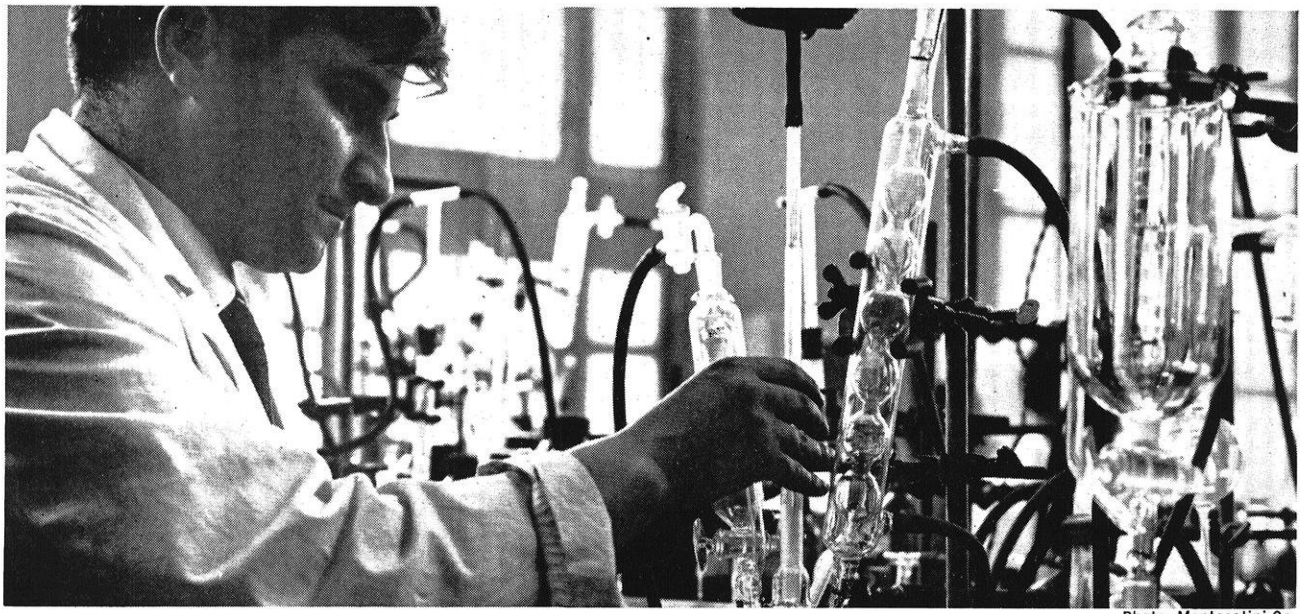

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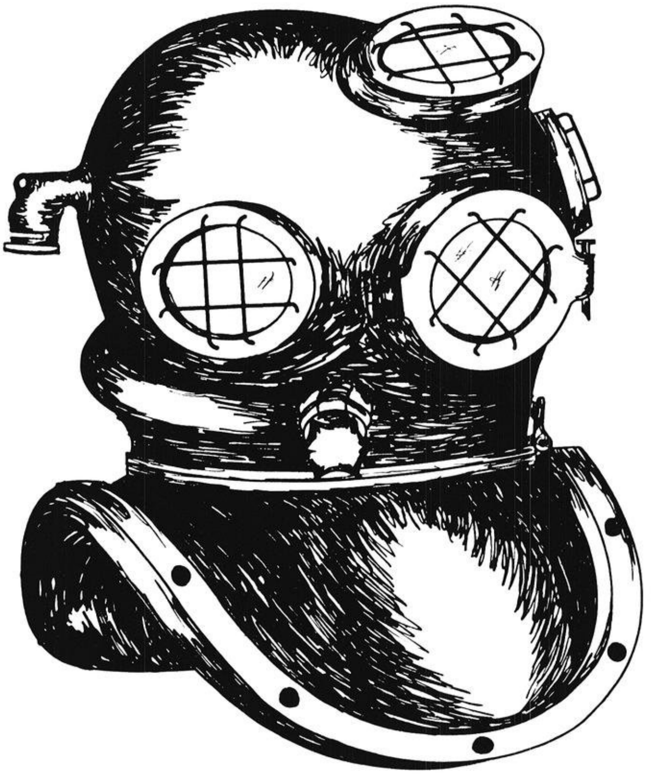

DIVING

By WM. KRALOVEC

HARD helmet diving can be a means of underwater salvage, construction, and even pleasure. It is an operation where human safety depends upon reliability of equipment and a sound understanding of the sources of possible dangers.

This article will take the reader from the equipment employed to the actual dive, with the major part being spent on the equipment needed for a safe descent. At various points, information will be presented concerning the actual construction of a diving helmet. Since a helmet was actually constructed, specific problems encountered and their solutions will be mentioned at various points in the report.

BACKGROUND

The primary advances made in the field of hard helmet diving have been accomplished by the United States Navy. In time of war the techniques that have been developed are indispensable for examining sunken ships, wrecks, and underwater docking facilities. Divers are summoned to repair existing docking facilities and vessels and destroy the enemies' moorings and vessels. All of these operations have contributed to the technique of hard helmet diving and underwater salvage.

Today, because of the lucrative nature of the salvage business, many commercial diving companies have also contributed to the techniques of diving. Articulated diving shells have been devised to probe sunken wrecks and salvage their cargoes. Better pumps, safety devices, and air mixtures have been developed to permit the diver to work at depths exceeding 350 feet of water in safety. As this century closes, very few sunken wrecks will be out of the reach of modern salvage operations.

EQUIPMENT

When a diver makes a descent into cold water, there are certain pieces of equipment that must be utilized. First there is the equipment that must be brought below with the diver: his suit, breast-

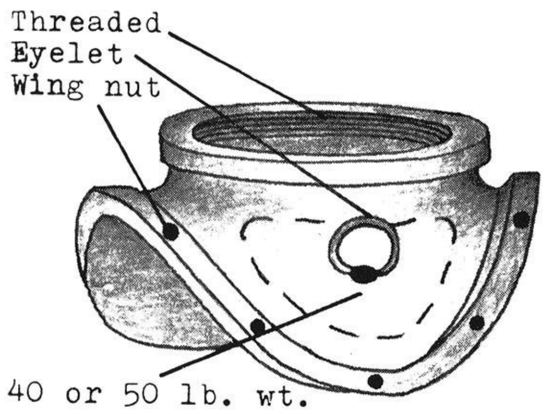

Fig. 2 Breastplate

plate, helmet, weights, insulated underwear, and surface connectors. Secondly, there is his air supply which could be either a piston pump, hand pump, or compressed air container. The third major group of equipment is the equipment that is either fastened to the ship or hung from it.

Diver's Equipment

The total weight of the diver's equipment when he is making his descent is usually in excess of 180 pounds. It is proportioned as follows:

80 lbs.	breastplate weights
32 lbs.	two shoes
70 lbs.	helmet
182 lbs.	total

This weight keeps the diver's buoyancy negative. Without it the diver would not be able to walk on the bottom.

The first piece of equipment a diver puts on is his insultated underwear. This is ordinary heavy underwear, which serves to keep the diver from being chilled, and also protects him from being chafed by his diving suit.

Next the diver puts on his diving suit, which is usually made of heavy rubber-impregnated canvas. The suit must have moderate strength because it has to withstand punctures and tears, and slight pressure differentials. The wrist cuffs of the suit are made of tight-fitting elastic material to prevent the leakage of water. The feet are made integral with the suit to prevent water leakage by otherwise necessary added seams.

Around the periphery of the hole for the diver's head there are placed metal studs which permit the suit to be attached snugly to the breast plate by wing nuts. (See Fig. 4)

After a diver is helped into his suit, a large rubber washer, bounded with holes to match the studs on the suit, is placed over the studs to form a seal between the suit and the breast plate. The breastplate is a large, hoop-shaped piece of metal that is contoured to fit the diver's shoulders. (See Fig 2) The breastplate is positioned on the diver's suit with the studs in the suit projecting through their respective holes in the breast plate. Wing nuts are then placed on the studs and tightened.

The breastplate has two functions: (1) it serves as a mounting fixture to which the helmet is fastened, and (2) it serves as a fixture to which dead weights may be attached. These dead weights are usually two 40- or 50-pound masses of lead—one being fastened to the front of the breastplate and the other to the rear. The breastplate extends about half way down the diver's chest, firmly seated on the diver's shoulders.

Next the diver puts on his shoes, which usually weigh about 16 pounds each. They are generally made out of thick canvas and resemble an oversized ski boot. (See Fig. 3) The soles are of thick lead, which give the shoes their weight. The large weight of the shoes is very important because it keeps the diver upright on the bottom. At times, through poor adjustment of the bleeder valve, an excess of air is present in the diver's suit. If the large weights of the shoes were not present, the diver could be inverted by the weight of his helmet and breastplate. This situation would probably disorient the diver enough to prove fatal.

The last piece of equipment, other than a belt containing miscellaneous items—such as a depth gage, knife, and writing slate—is the helmet. The helmet usually weighs about 70 pounds and is made of brass or copper (See Fig. 4). The helmet is the single most important piece of equipment to the diver because it contains all his air control equipment. It is attached to the breastplate by placing its threaded base in the corresponding threaded collar of the breastplate and giving it a one-eighth turn, and then locking it with a latch. The helmet has either two, three, or four viewplates which are made of glass and protected by steel bars fastened to the helmet. At the rear of the helmet is the air intake fitting which has a built-in non-return valve (See Fig. 5 for a cross section view of a non-return valve). A non-return valve is a spring-operated, plunger-like assembly which permits air flow in only one direction. The purpose of the non-return valve is to eliminate the danger of air suddenly leaving the suit if something were to happen to the air supply hose.

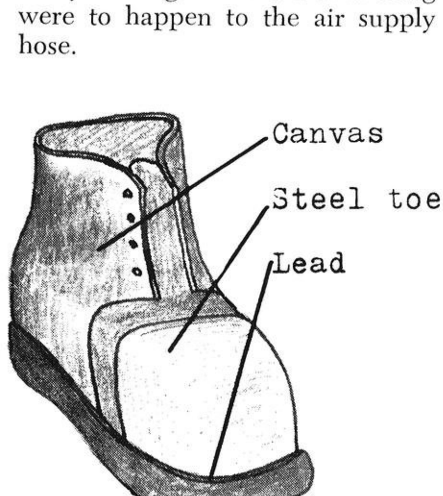

Fig. 3 Diver's Shoe

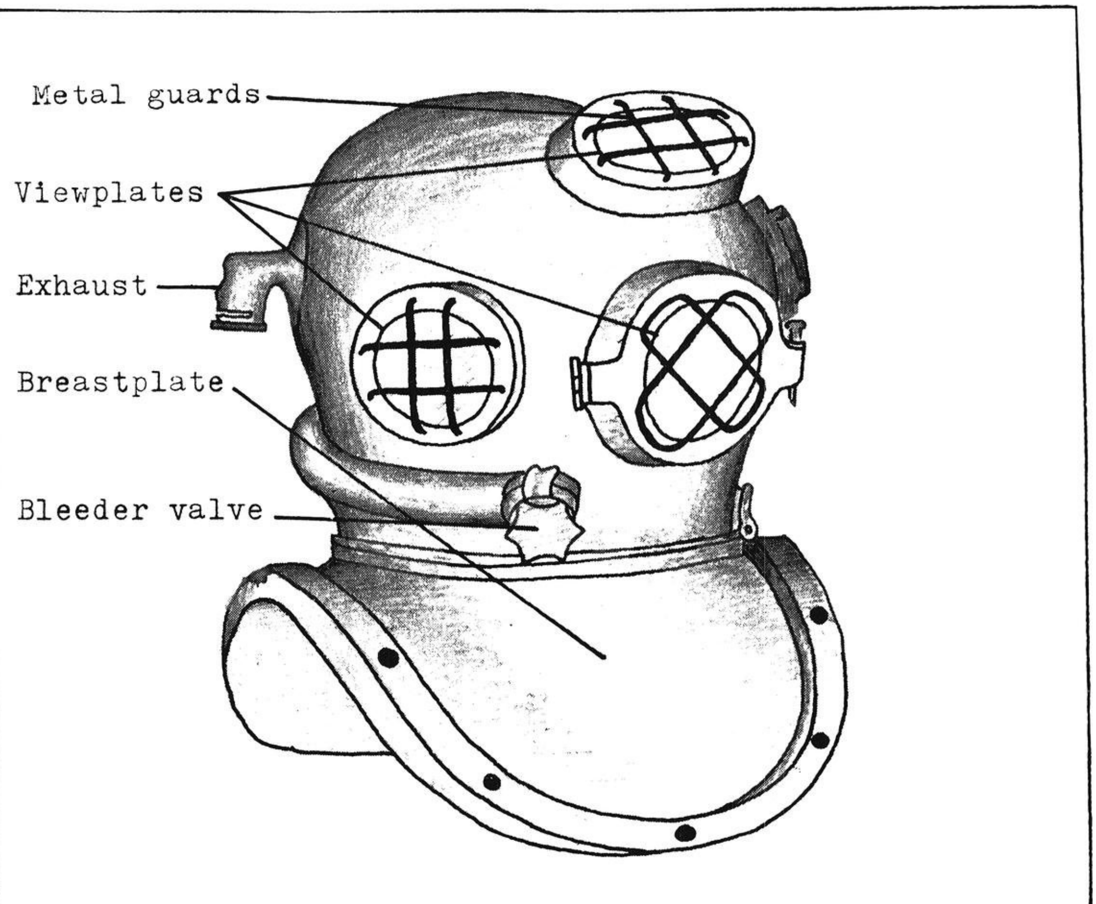

Fig. 4 Diver's Helmet

On the right side of the helmet is a bleeder valve, which can be adjusted to maintain any desired suit pressure at any depth. It accomplishes this by expelling air through a number of holes, anyone of which may be covered by adjusting a knurled sleeve. A simple bleeder valve is sketched in Fig. 6.

On some commercial diving helmets there is also a small valve to permit taking in water to flush the inner surface of the faceplate. This flushing washes condense moisture off the faceplate, improving visibility.

CONSTRUCTION OF A HELMET

The helmet constructed is not nearly as sophisticated in design as is a Navy or commercial diving helmet. Its relative simplicity is possible because it is not used below 30 feet, and components which are necessities at greater depths may be either eliminated or simplified.

The major portion of the helmet was flame-cut out of a hot water tank. Many other types of containers could be used, but this was found to be the best because of the dimensions and strength present. A step description of the construction now follows:

1. Obtain a hot water tank from a salvage company.
2. Lay out the contours to be flame-cut.
3. Grind all flame-cut areas and drill 1/8 inch holes one inch apart around shoulder contours. (Fig. A)
4. Construct the air inlet out of pipe fittings. (Fig. B)
5. Slit a heavy hose (1/2 inch heater hose) from end to end and place it around the contour for the diver's shoulders. Then, using light galvanized wire, attach the hose to the helmet by wrapping the wire around the hose and threading it through the holes drilled in the helmet (See Fig. C).
6. Obtain a 13″ × 9″ × 1/16″ piece of plexiglas for the viewplate. An easy way to shape the

(Continued on page 25)

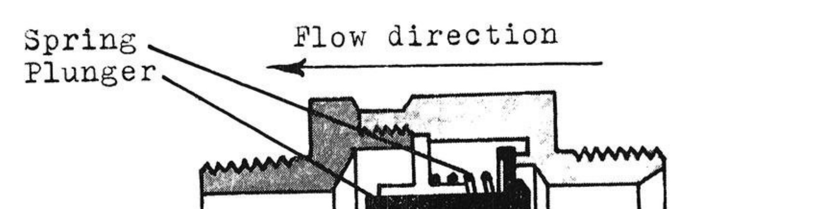

Fig. 5 Cross Section of a Non-Return valve

the day you start here is the day we start helping you outgrow your job

The way we look at it (not only here at Electric Boat Division, but in General Dynamics as a whole) good employes—properly placed, trained and motivated—are our fastest growing asset. So, right from the start, we'll be doing everything in our power to help you develop your full potential through a strongly-implemented management-sponsored program that makes your professional development a matter of planning, not chance.

This program, called "people development", is designed to spot your special capabilities—to help you move, to progress, even to change your product area or technical discipline if that's what it takes to increase the certainty of your success. Part of the program is a philosophy that charges each supervisor, whatever his level, with developing his own replacement. And our supervisors are adept at recognizing individual achievement and calling appropriate attention to it. Part of it, too, is one of the most extensive and far-sighted educational, study and post graduate programs ever offered by any company, to encourage continued academic proficiency. Hundreds of people in our Division participate each year.

But the thing that gives this approach of ours real point is the challenge and excitement of the field you'll be working in—Oceanology—a field as new as the Aerospace industry was new a dozen years ago, and as promising; a field that encompasses every means of undersea operation and exploration known to man.

And here, whether you're working on a deep diving research vehicle or an atomic sub, the opportunities for innovation (as well as growth for the innovative) are endless. For instance, every atomic submarine we build is treated as a new and different problem. Even ships in the same class differ since each succeeding one is, in fact, the state-of-the-art at the time we're building it. Within any sub, advances might occur in nuclear shielding design; in heat transfer efficiency; in sound and vibration control; in new materials; in chemically based life support systems; or in a dozen other areas. And because of the close collaboration among men of many different technical disciplines, your thinking might spark a new idea in any one of them. Just as their thinking might spark yours.

Living and working in Groton, Connecticut is a rewarding experience in itself. For in this unique nautical community you are not only close to the men and women who build and sail submarines, but to all the abundant pleasures of the sea. (Not that you're far from more metropolitan pleasures if that's your preference.)

So, if you've missed our on-campus interviews, but would like to know more about how we will help you outgrow job after job here at Electric Boat, write to Mr. Donald K. Whynott. Ask for our new informative brochure.

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PICTORIAL:

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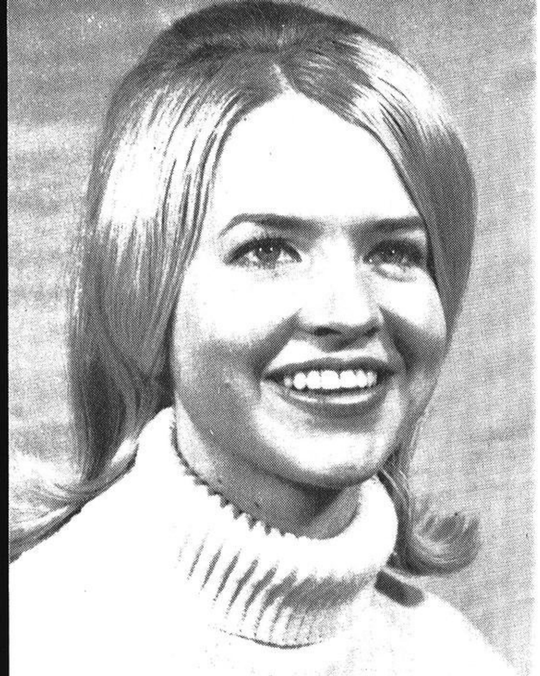
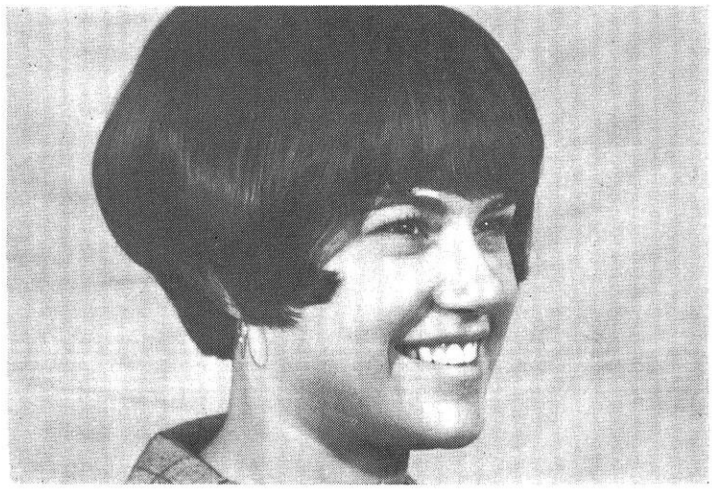
—queen of the 1967 engineering exposition—

MISS GWEN GERLAND—DELTA GAMMA

Go EXPo' '67



BETH BORSUM
Alpha Chi Omega



MARGARET HANSIS
Delta Gamma

Exposition Host

ROBIN COHEN
Alpha Epsilon Phi

We are happy to present the twelve girls picked as hostesses for the 1967 biennial Engineering Exposition to be held April 7–9. The girls were chosen on the basis of charm, poise, and personality to represent their sorority. They will work at the information booth sponsored by the *Wisconsin Engineer* on Friday afternoon, Saturday, and Sunday.

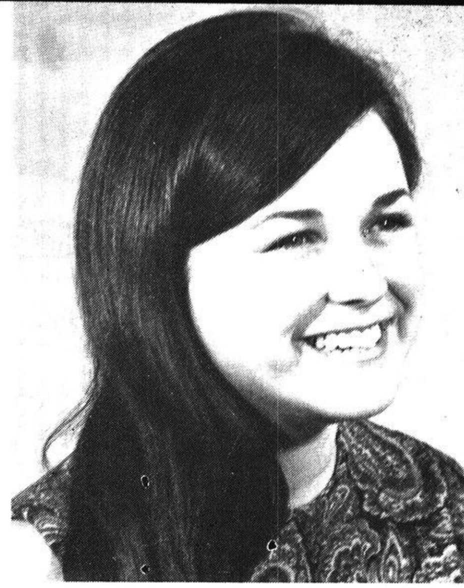
Over fifty girls entered the competition, judged by Dean F. O. Liedel, Assistant to the Dean R. S. Hosman, Professor Howard Schwebke, and several of the *Engineer* staff.

The Exposition is a combination of student and industrial exhibits sponsored by Polygon Board. Ten thousand people from around the state are expected to attend.

The hostesses, the Exposition Committee, Polygon Board, and the staff and advisors of the *Wisconsin Engineer* join in a cordial invitation to YOU for The 1967 Engineering Exposition.—D. C.

LIBBY ROWE
Alpha Phi

CANDY KIDD
Kappa Kappa Gamma



JO MARY HENDRICKSON
Chi Omega

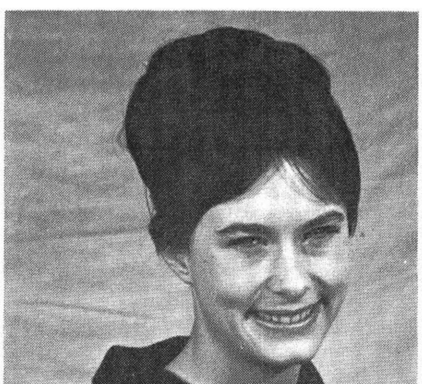
LANA GAULKE
Tri Delta

s’

HERYL HUDSON
Chi Omega

SUSAN RISCH
Tri Delta

EVELYN ALEXANDER
Gamma Phi



MARY BRADY
Kappa Kappa Gamma

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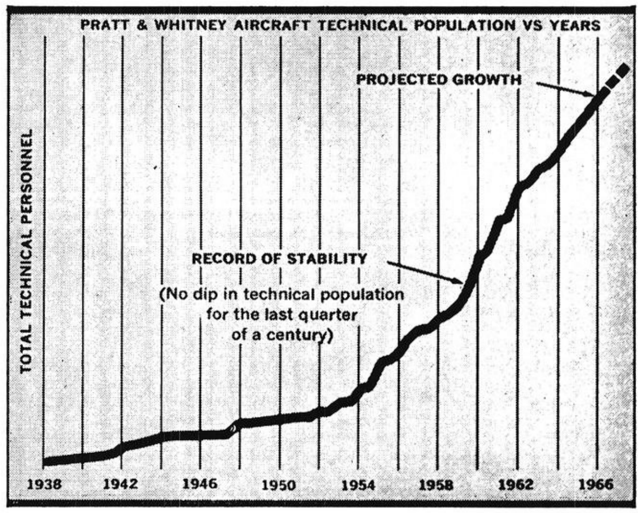
Continued expansion of our military and commercial business provides openings for virtually **every technical talent.**

As you contemplate one of the most important decisions of your life, we suggest you consider career opportunities at Pratt & Whitney Aircraft. Like most everyone else, we offer all of the usual "fringe" benefits, including our Corporation-financed Graduate Education Program. But, far more important to you and your future, is the wide-open opportunity for professional growth with a company that enjoys an enviable record of stability in the dynamic atmosphere of aerospace technology.

And make no mistake about it . . . you'll get a solid feeling of satisfaction from your contribution to our nation's economic growth and to its national defense as well.

Your degree can be a B.S., M.S. or Ph.D. in: **MECHANICAL, AERONAUTICAL, CHEMICAL, CIVIL (structures oriented), ELECTRICAL, MARINE, and METALLURGICAL ENGINEERING • ENGINEERING MECHANICS, APPLIED MATHEMATICS, CERAMICS, PHYSICS and ENGINEERING PHYSICS.**

For further information concerning a career with Pratt & Whitney Aircraft, consult your college placement officer—or write Mr. William L. Stoner, Engineering Department, Pratt & Whitney Aircraft, East Hartford, Connecticut 06108.



Take a look at the above chart; then a good long look at Pratt & Whitney Aircraft—where technical careers offer exciting growth, continuing challenge, and lasting stability—where engineers and scientists are recognized as the major reason for the Company's continued success.

SPECIALISTS IN POWER . . . POWER FOR PROPULSION—POWER FOR AUXILIARY SYSTEMS. CURRENT UTILIZATIONS INCLUDE MILITARY AND COMMERCIAL AIRCRAFT, MISSILES, SPACE VEHICLES, MARINE AND INDUSTRIAL APPLICATIONS.

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We made a raincoat for a bee.

Not just an ordinary raincoat either.

It's a skintight plastic coat so thin you would never know it's there. Yet it covers the bee completely, right down to the individual hairs on the bee's knees. It was done to protect specimens in a natural history museum.

But we didn't spend 12 years on a new plastic just to protect bees. We developed parylene to protect things like bees—fragile, complex things so intricate in shape they are next to impossible to coat.

For instance. Each tiny grain of a highly reactive chemical can be protected to provide stability in the presence of gases or moisture. Tiny electronic capacitors, just one-fifth the size of previous types, can be insulated with a coating as thin as eighty-millionths of an inch.

Union Carbide finished the initial development work on parylene in February 1965. Until then, there was no comparable way to encapsulate delicate objects.

Parylene is one of the latest, most sophisticated new plastics to result from the exploring, researching and discovering that is always going on at Union Carbide. The same scientific inventiveness that has put Union Carbide into a greater variety of plastic products than anyone else. Ever.

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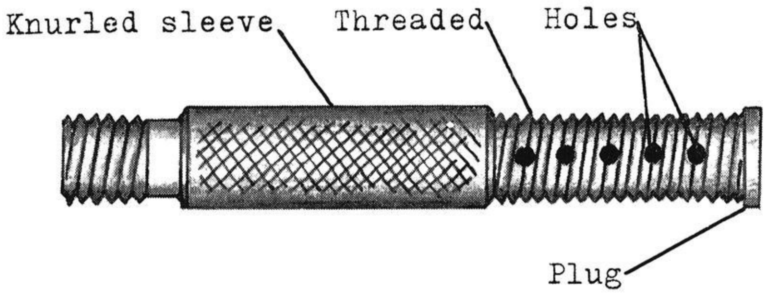


Fig. 6 Bleeder Valve

(Continued from page 17)
plate is to heat it in an oven set at 300°F until it becomes soft, then place it around a cylinder of the same diameter as the helmet and let it harden in that shape. To fasten the plexiglas to the helmet, position the plexiglas plate over the view hole cut in the helmet, then lay ½″ × 1/32″ strips of soft iron around the periphery of the plexiglas and drill ⅛ inch holes one inch apart along the centers of the iron strips. Now remove the strips and plexiglas, and place a thin coat of liquid rubber on the area that the plexiglas will come into contact with when fastened to the helmet. The plexiglas and iron strips may now be fastened to the helmet by ⅛ inch round head bolts. Do not tighten the bolts until all of them have been positioned. This makes the job easier and also prevents stress build-ups in the plexiglas (See Fig. F).

7. Weight the helmet. An easy way to weight the helmet is by trial and error. Calculate the displacement and then compensate for the displacement with lead positioned as in Fig. G. After mounting the weights, place the helmet in water and check its buoyancy. The helmet should be buoyant by about three pounds. If the helmet's buoyancy is negative drill holes in the weights until it becomes positive. When lead is removed from the weights make sure it is not taken off in locations that will drastically unbalance the helmet.

8. Obtain the air hose and non-return valve. Many types of non-return valves may be used, depending on how much money is available. The one employed on the helmet described was a ½ inch air hammer non-return valve. Place the non-return valve between the helmet and the air supply as shown in Fig. H.

9. Paint the helmet. A good coat of primer followed by a quality automotive paint finishes the helmet. A good color scheme is a yellow helmet with black weights, because if it is lost on the bottom, yellow is quite easy to spot. Fig. I Finished Helmet.

Before the diver descends, the various surface connectors are attached to the diver—a life line to an eyelet in the front of the breastplate and a combination air hose-telephone line to the helmet.

The life line is a strong rope which the diver uses as a signaling device and the surface crew uses to haul the diver up in time of distress. The life line is threaded under the diver's right arm to lessen his chance of being yanked off his feet if the line were jerked.

The air hose is attached to the rear of the helmet and then tied by a square knot to a metal eyelet in the front of the breastplate. From the eyelet the hose is run under the diver's left arm and then to the surface.

Diver's Air Supply

Next to the helmet, the most important pieces of equipment are the compressors that supply the diver with air. They can be diaphragm compressors, hand pumps, billows pumps, or compressed-air cylinders. What a diver decides to use is determined by numerous factors, such as: duration of dive, depth of dive, equipment available, capital available, and type of job. The units can be run by gasoline engines, electric motors, or hand, depending upon the diving situation.

An easy way to solve the air supply problem for a homemade diving unit is to obtain an old refrigerator compressor and rebuild it. A two-cylinder compressor with about a 1¼ inch bore is fine. Clean it out with any powerful oil solvent and check all valves while it is disassembled. Make sure to get all oil and solvent out of the unit before reassembling, because when oil is volatilized during compressor operation it becomes noxious. Refill the crankcase to the

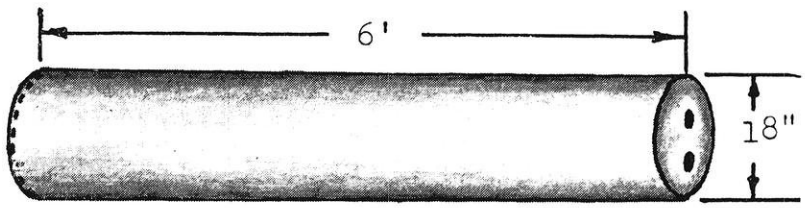
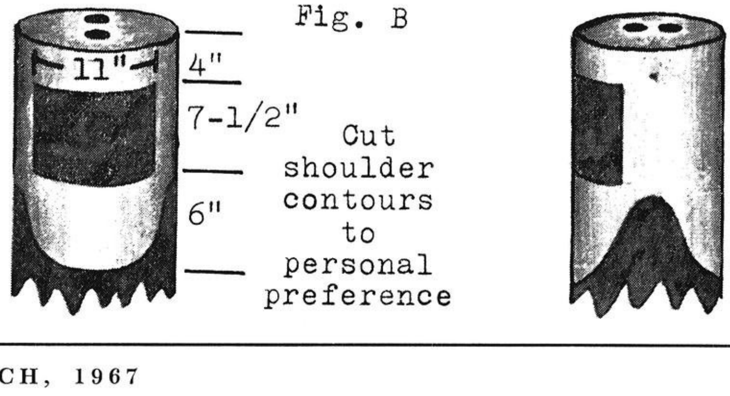


Fig. A

Fig. B



The Air Force doesn't want to waste your college education any more than you do.

Are you afraid of becoming part of the woodwork on a job? Your career stunted by boredom? Few promotions in sight?

You didn't go to college for that.

And it needn't happen, either. Because you can pick the United States Air Force as your employer. Career opportunities are so vast... you'll get a better chance to specialize where you want...in the forefront of modern science and technology.

Suppose, just for example, you wanted to be involved in Electronics. This area alone includes Communications-Electronics, Missile Electronics, Avionics, and others. And these, in turn, involve administrative, research, and other technical aspects.

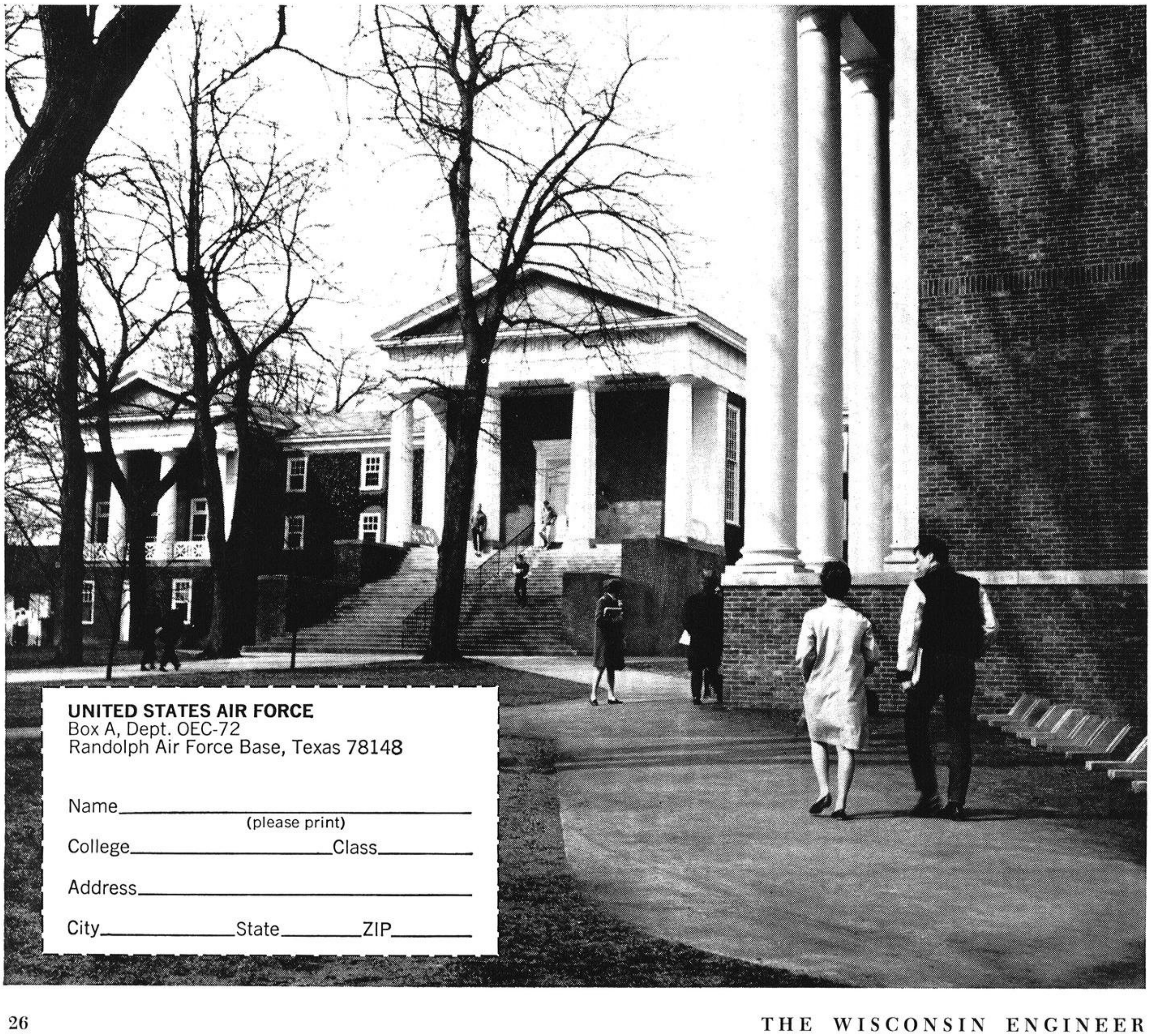
That's just a tiny part of the whole Air Force picture. Just one brilliant opportunity area among many.

You'll enjoy good pay, promotions, chance to travel, active social life, fine retirement benefits. And you'll be serving your country, too.

Or maybe you want to fly? That's great. The Air Force is certainly the place to do it.

As a college graduate you want something extra out of life—to aim at an exciting goal. So send in this coupon.

Make sure you don't get stuck where nothing much is happening.



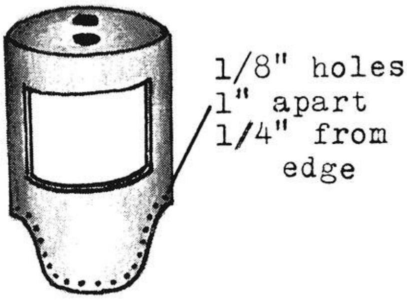


Fig. C

proper level with olive oil. Olive oil is used because if it is inhaled in the vapor state it can be absorbed by the lungs with no ill effects.

A good power source for the homemade unit is a small gas engine because it gives the unit portability.

Ship's Equipment

In addition to the equipment attached to the diver, and the air supply equipment, many pieces of apparatus are located on board the diver's attending ship. Some large, well-equipped ships carry a decompression chamber.

A decompression chamber is a strong, airtight steel enclosure large enough to contain several men at one time. Its purpose is to offer a means by which a diver can be subjected to the maximum pressures reached during a dive. This recompression is necessary to allow the nitrogen, which is desolved in the blood at high pressures, to slowly escape the blood at a reduced pressure. If this precaution were not taken the diver would probably get a disease called the bends.

For lowering the diver into the water, some sort of plat-form is generally employed. Divers can lower themselves by a rope and buoyancy control, but this is dangerous. Platforms can be almost anything, from a simple perch-like chair, to a large rectangular shaped metal grating. No matter which is employed, a derrick of some sort is used to lower the diver and platform to the bottom.

Some other equipment that might be found on a typical diving vessel are auxiliary compressors, helium air mixtures for great depths, pontoons and pontoon equipment, underwater cutting equipment, excavating equipment, cement guns, pneumatic hammers, and tongue groove lumber for cofferdams.

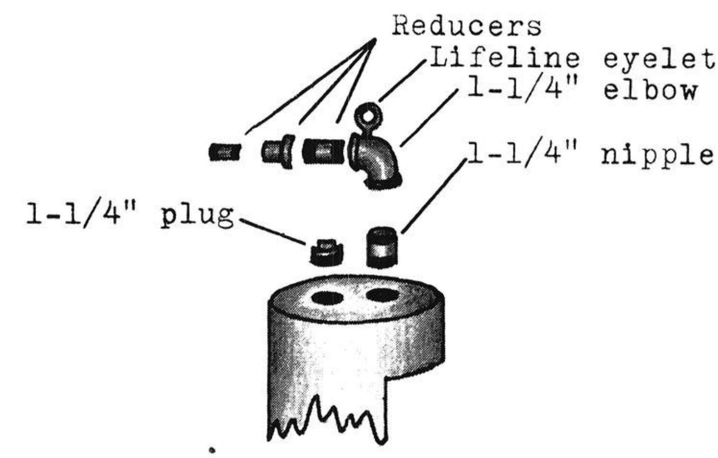


Fig. D

TRAINING

Diver's Schooling

No matter how good or how safe the equipment for a dive is, the success of a dive many times rests on the shoulders of the diver.

To become either a commercial diver or a diver in the armed forces, one must pass a physical exam. The men disqualified from diving for physical reasons are generally trained as topside crew members.

The primary physical requirement is that the individual be able to equalize pressures on his ears at 44½ psi, which represents a 100 foot depth.

The next step is to have the man make an actual dive to about 40 feet. During these shallow dives the diver gets the feel of the equipment. After these shallow dives more screening takes place, and those not passing are trained as topside crew members.

The remainder of the course is as follows:

1. Diving signals.
2. Construction and design of air control, exhaust, and non-return valves.
3. Study of all parts of diving dress, as well as maintenance and repairs.
4. Cause and treatment of air emploism, caisson disease, and squeeze.
5. How a diver handles himself in a diving dress under water.
6. Diving planning and arranging. The setup of air system.
7. Communication system.
8. Diving mathematics—volumes and pressures.

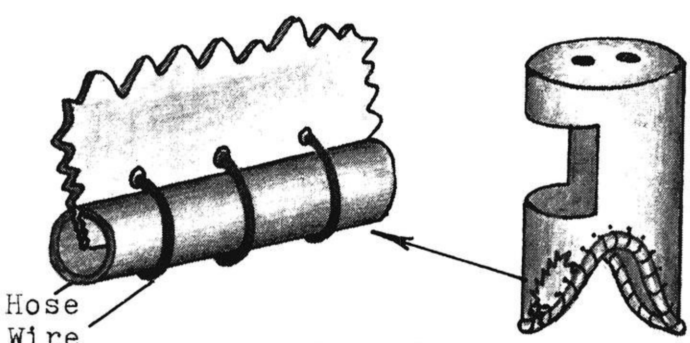


Fig. E

Welcome to the cold, cruel world.

Of course, if your father's a millionaire, or you're about to marry an heiress, then you have no problems. But, if not, then there's only one sensible thing to do. Come to work at Allison Division of General Motors.

There's nothing cold or cruel here. Just the opposite. Particularly if you're an engineer with big ideas. Aerospace projects? Allison's got them. Turbofan. Turbojet. Turboprop. Turboshaft. Military and commercial applications right across the board.

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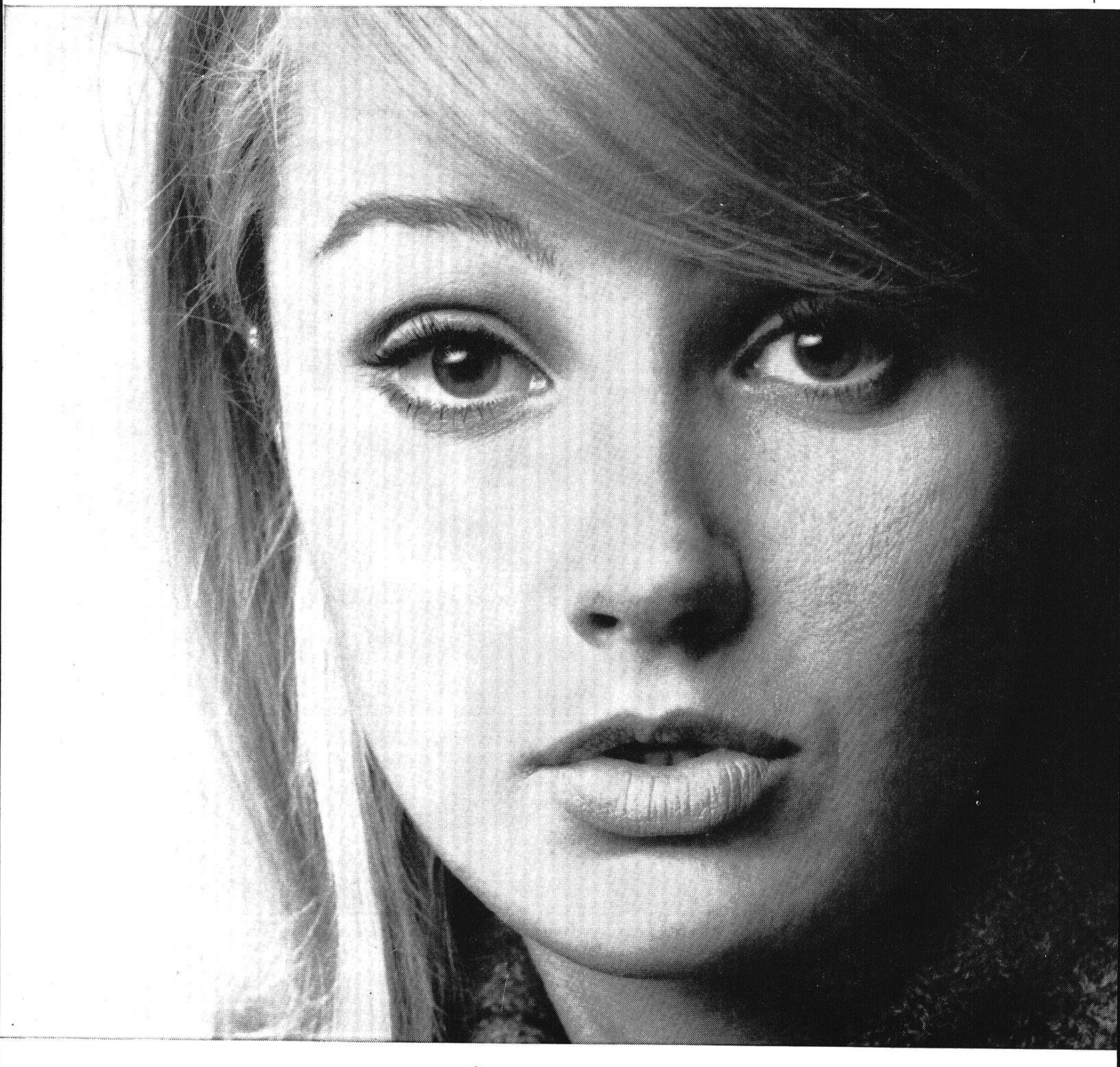
GM
MARK OF EXCELLENCE



Allison

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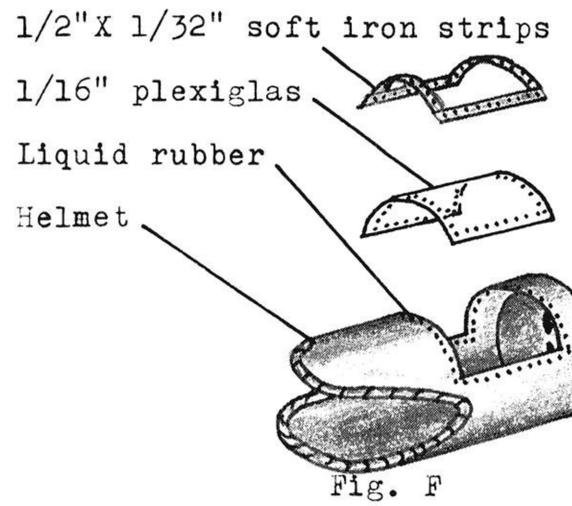


Fig. F

9. Blue print reading to aid in underwater work.
10. Underwater work, including study of patchs, templates, buoyancy, and displacement.
11. Review and examination." (From—Thompson Frank E., "Diving, Cutting and Welding in Underwater Salvage Operations."

After this study list is completed, the diver goes through a period of actual underwater work. He learns how to operate air tools, operate cutting torches, pour cement, and to generally become more accustomed to the underwater environment.

Dangers Below

During the diver's training he is constantly being briefed on the possible dangers that he may confront below the surface. The most common are air embolism, the bends, suffocation, bleeding from the nose and lungs, blowing up, exhaustion, oxygen poisoning, and the squeeze. These dangers are explained quite well in the named book by Frank E. Thompson Jr.

If one is planning to do only shallow water diving with a homemade helmet, a course in S.C.U.B.A. diving should be taken. The course will familiarize the diver with his equipment and will also brief him on the prevention of shallow water accidents.

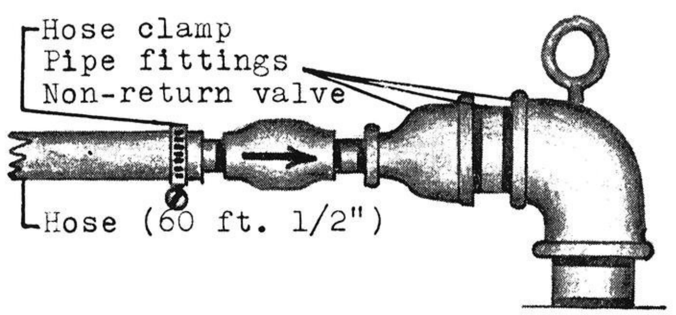


Fig. H

MODERN ARTICULATED DIVING SHELL

The primary disadvantage present in diving dresses utilizing a canvas suit is that the diver can only remain on the bottom a limited period of time. When he is working below, he is working under increased pressure, which causes rapid exhaustion and also the ever present danger of the bends on his ascent.

The modern articulated diving shell solves this problem by eliminating it. The shell is composed of very strong arched components which permit standard air to be breathed by the diver. The diver can stay below for any period of time without stage decompression on his ascent. The time this saves during diving operations is very great.

The major disadvantage of the articulated diving shell is that the diver's movements are limited because of the few joints present in the shell (See Fig. 6 for sketch of articulated suit).

CONCLUSION

There is much research to be done in the field of hard helmet diving. The articulated diving shell solved the problems of decompression but introduced a mobility problem. Research is being done on helium-air mixtures and other gas-air combinations to permit divers to remain below for extended periods of time. Maybe the solutions lie in a completely mechanical robot diver, thus eliminating the human limitations. These problems will have to be solved before many of the wrecks on the ocean bottom can be salvaged.

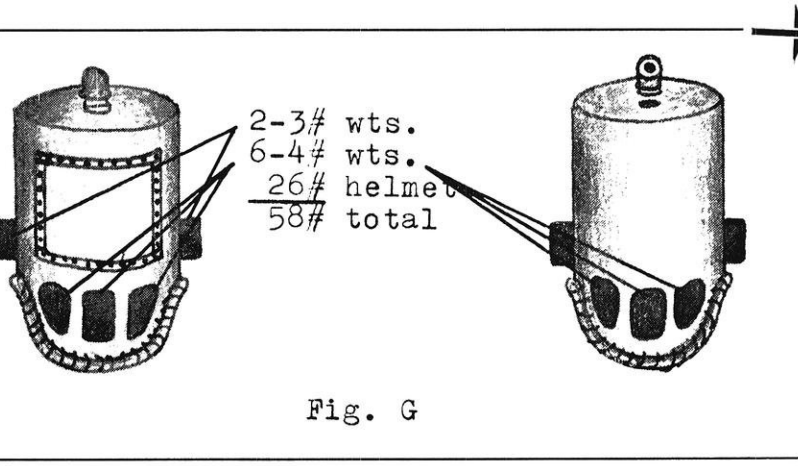


Fig. G

TEASERS:

– WHAT'S UP BYRD? –

With but a few pinfeathers ruffled and some minor mechanical malfunctioning in his lift off, soar away, and drop out (Mistake #1—sorry Leary, meant drop down), the Byrd has recovered from his annual St. Pat's Day hang-over in time to add to those inner frustrations all attempt to release, in one way or another, during Spring Vacation. As an aid to those still wondering how to unfrustrate themselves, the Byrd calls your attention to a group which specializes in such cases. The Slightly-Demented Society (Mistake #2—talking too loud) holds frequent gatherings for just those extremely "out" students.

This month's puzzler (Mistake #3) is one long hard haul to make up for last month's quick, disquieting quizzers.

As the Hill Students eagerly attacked their books, and most of us typical college students left Madison to take a final breath of fresh air in the form of Spring Vacation, a small minority still left in outlying dorms grew increasingly despondent and, casting decency aside, huddled together to play a stimulating game of Hearts. One luckless ME was forced to merely watch for one game. Lest he too might become addicted to the sport, he began concentrating on the number of cigarettes devoured during the game. Becoming fascinated at frequent relationships between the game and cigarettes, he immediately called the Byrd, who had just winged his way South, to tell him of his discovery. Unfortunately the phone connection was bad, allowing the Byrd to hear only sporatic discharges of information. Suddenly the Byrdbrain went into action. These pieces of info would provide a perfect puzzler for the next issue of the Wisconsin Engineer.

Given that five people: Bowden, Brown, Berry, Bilkin, and Bosch were playing cards and that each had a pack of smokes, Camels, Luckies, Old Golds, Chesterfields, and Raleighs, containing 20, 15, 8, 6, and 3 cigarettes, not in that order; which person had which brand of cigarettes, and how many?

Since the above gave only raw facts, the Byrd has decided those pieces of disconnected info might help. The Byrd proudly presents them below.

At the beginning of the hand, Berry received three bad cards.

Bilkin had smoked half of his supply, one less than Bowden.

The Chesterfield smoker originally had two and a half times the number of weeds he had at the end of the game.

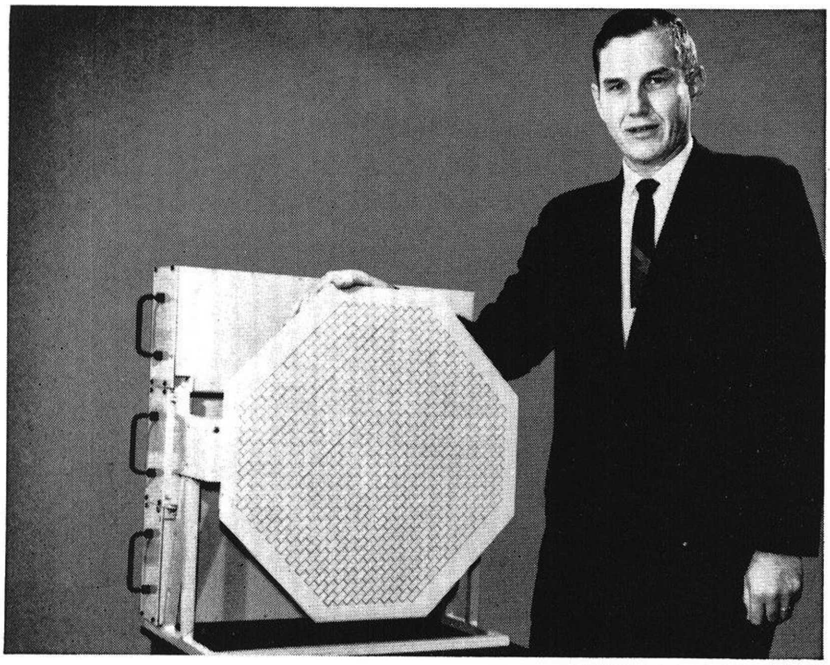
One of the players almost shot the moon and in the excitement, lit the tipped end of the tenth cigarette.

The Luckies smoker had smoked more than anyone else, including Berry.

Brown drew as many aces as he originally had cigarettes.

The Camel smoker asked Bilkin to pass Brown's matches.

At the end of the game no man had finished all of his cigarettes, except the Old Gold smoker, who smoked the same number as Bilkin.



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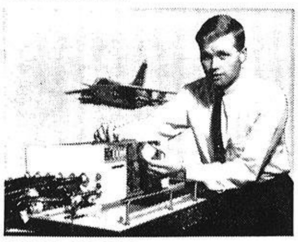
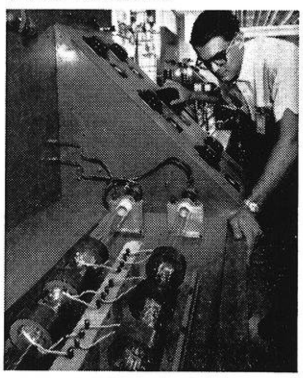
TI ALSO MOVES AHEAD FAST IN . . .

SPACE SYSTEMS

SIGNAL PROCESSING

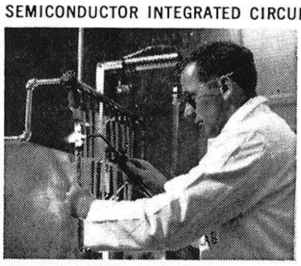


DIGITAL SYSTEMS

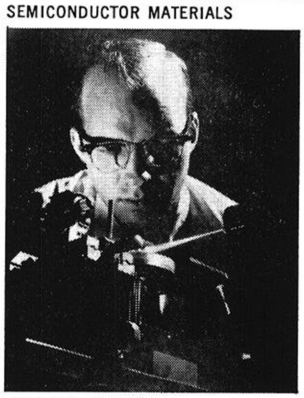


SEMICONDUCTOR MATERIALS

SEMICONDUCTOR INTEGRATED CIRCUITS



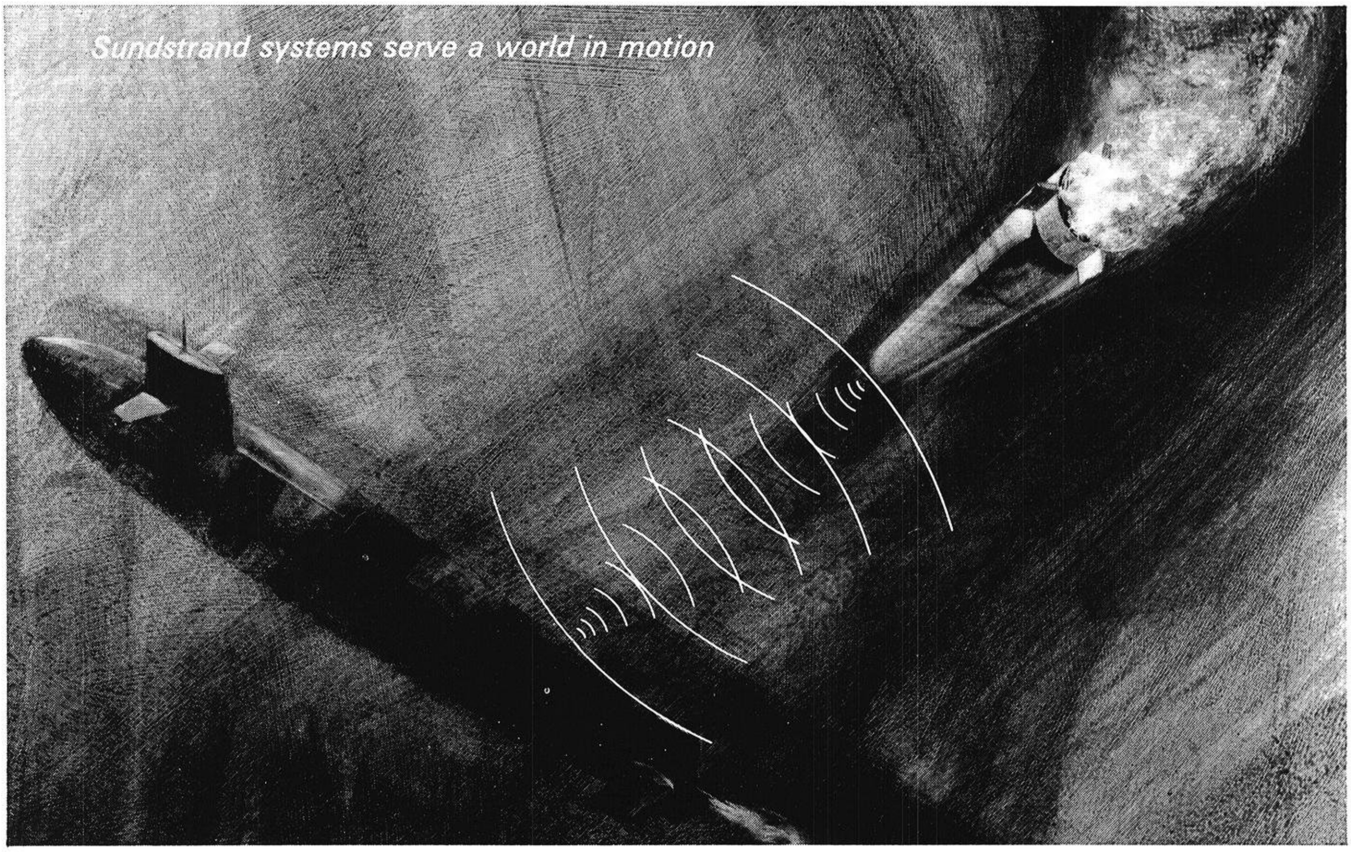
METALLURGICAL MATERIALS

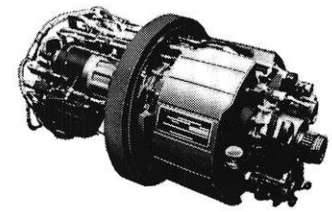


COHERENT OPTICS

Microelectronic radar is a radically new kind of airborne radar now being developed by TI. Called MERA, it will operate far more reliably than the most advanced conventional radar and will provide new performance capabilities as well. The MERA concept profits from long experience in radar design and manufacture. More important, it is a creative design program drawing key scientific and engineering personnel from a number of diverse technologies including systems design, digital systems, semiconductor design, and materials science. As a result, this new radar needs no high-power microwave source and has no moving parts — a creative problem solution that never would have resulted from a conventional approach. Coordinated management of many technologies, such as those illustrated here, is one reason TI has doubled in size about every three years for the past 20 years. This growth and diversity offer exceptional opportunities for outstanding college graduates at all degree levels and in many disciplines. For a free brochure about radar technology at Texas Instruments — or any other technology illustrated here — write Jack Troster, indicating your area of interest. To obtain information about current professional openings, consult your college placement director, or send your confidential resume to Jack Troster, Dept. C-487, P. O. Box 5474, Dallas, Texas 75222. An equal opportunity employer.

TEXAS INSTRUMENTS
INCORPORATED





Home in on torpedo propulsion at Sundstrand

The challenge of torpedo propulsion at Sundstrand includes design, development, qualification, and initial production of sophisticated propulsion systems for advanced design torpedoes. These programs involve high-speed turbo-machinery for both open- and closed-cycle systems, and experimental work with the latest high-performance fuels suitable for torpedo propulsion.

Sundstrand offers excellent career opportunities. Sundstrand engineers work on a variety of projects under excellent working conditions, enjoy definite project responsibility and follow-through. Consistent emphasis on engineering results in a sizable investment in research and development. Our new special test facility in Rockford, Ill., provides unmatched capability for R&D and production testing of Otto-fueled, open-cycle torpedo propulsion systems; closed-cycle organic Rankine-cycle power systems; miniature missile power units burning hydrazine propellants.

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Bearing design
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Application engineering
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Manufacturing engineering

Now that you know something about us, how about letting us know something about you?

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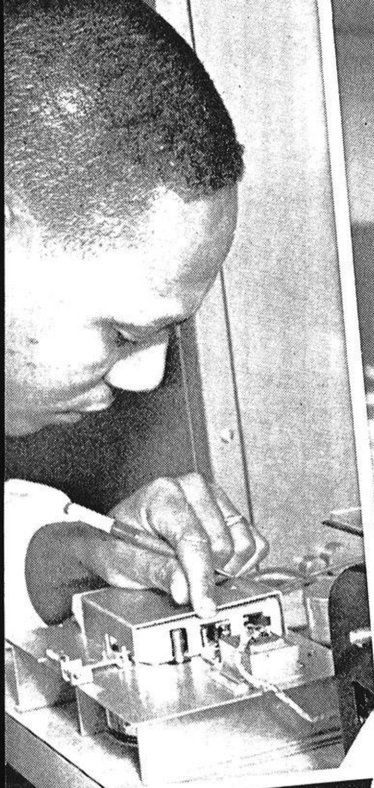
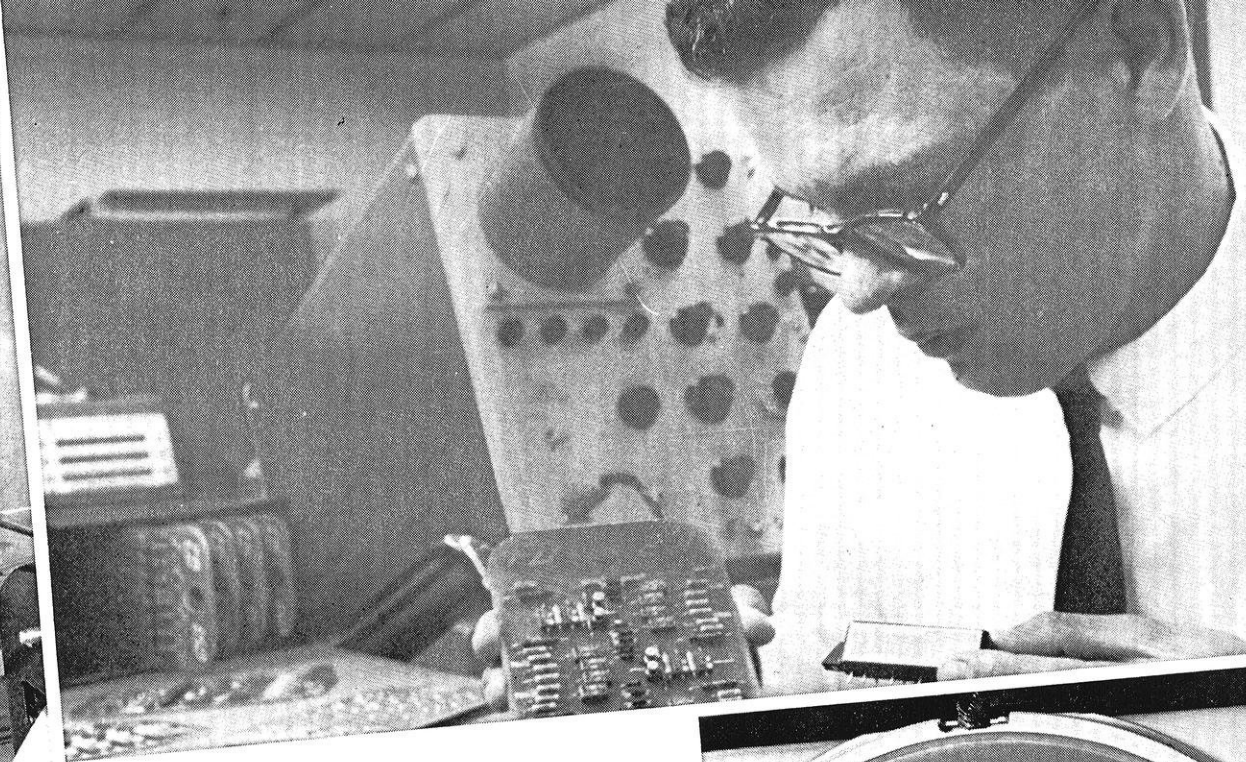
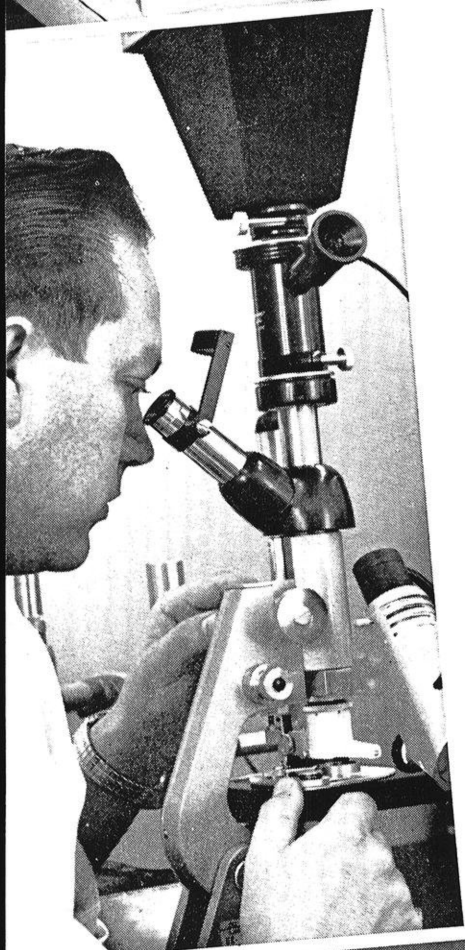
PICTORIAL:

PHYSICS ANYONE?







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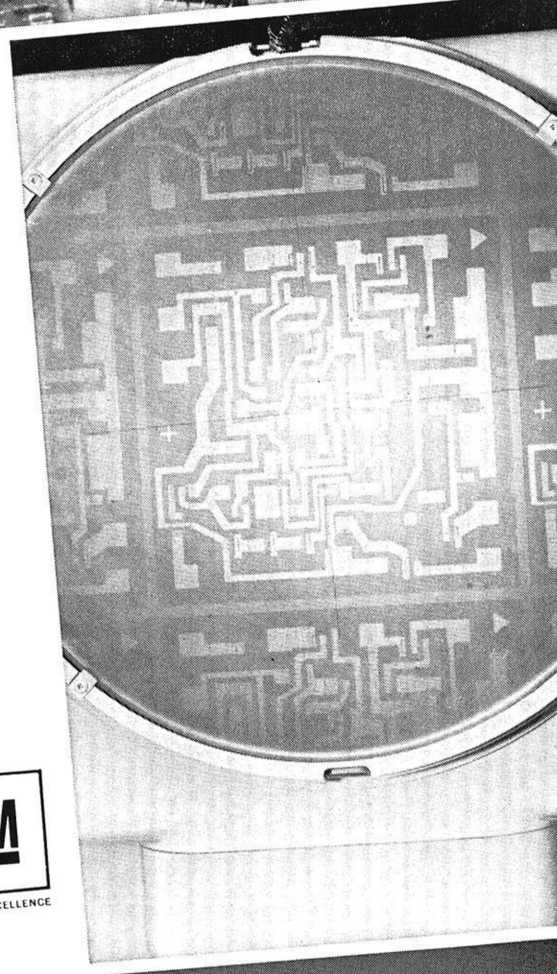
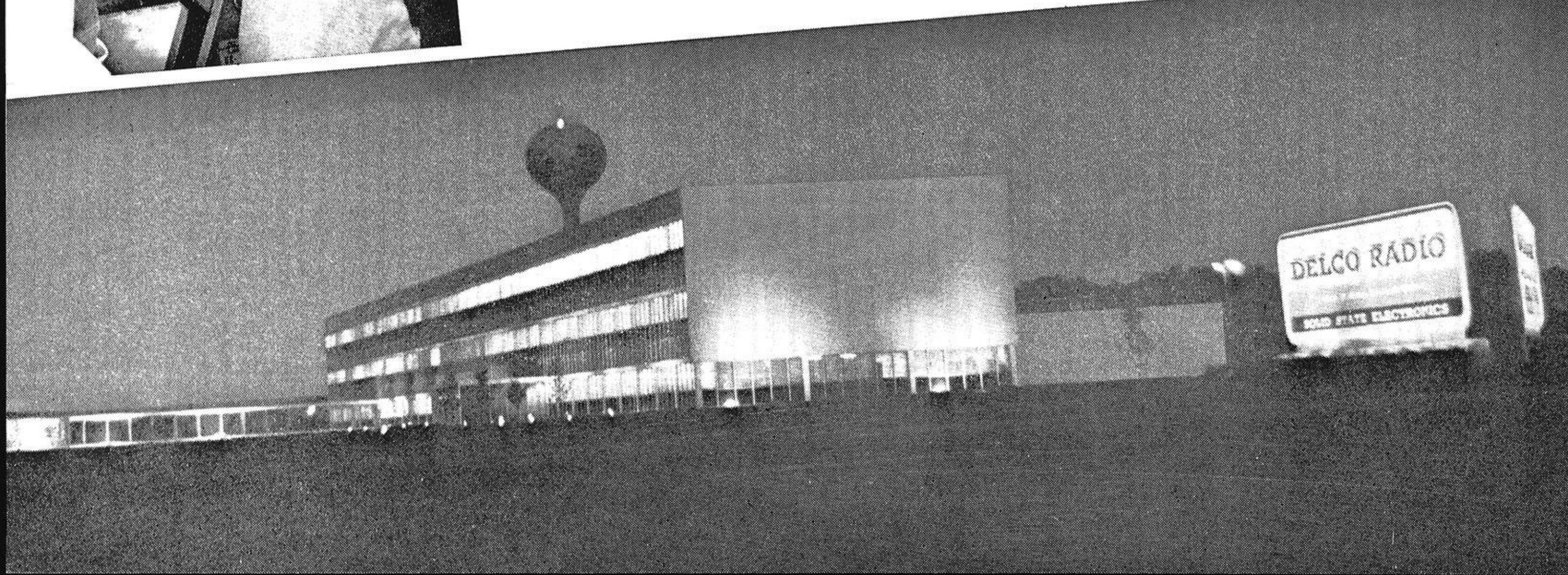




CONSUMER PRODUCTS ★ COMMUNICATIONS ★ SEMICONDUCTOR PRODUCTS ★ GOVERNMENT ELECTRONICS ★ AUTOMOTIVE PRODUCTS ★ CONTROL SYSTEMS

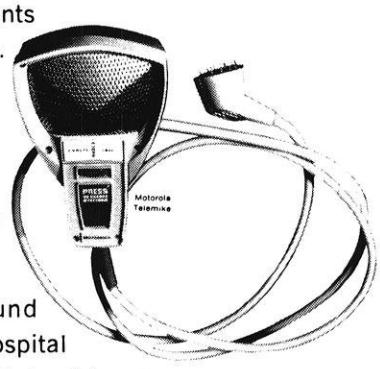
SECURITY IS NOT A BLANKET...

. . . when you're a patient in a hospital. It's knowing that help is just an instant away.

That's security—packaged by Motorola as a total communications system—for hospitals anywhere in the country.

For the patient, this system means a handy Telemike near your pillow. With it you can talk to the nurse, operate the TV, or tune in a closed circuit chapel service.

For the nurse, Motorola's hospital communications means a central control board at her station. Now she can be secure knowing that each of the patients is within the sound of a voice. Instantly.



For the doctor, it's a Radio Pager keeping him in constant touch anywhere inside the hospital; outside, it's another Radio Pager to reach him in an emergency as far as 30 miles away.

Linking people through sight and sound . . . bringing security to the sick . . . hospital communications is but one measure of Motorola's concern for people.

TRUST THIS EMBLEM WHEREVER YOU FIND IT

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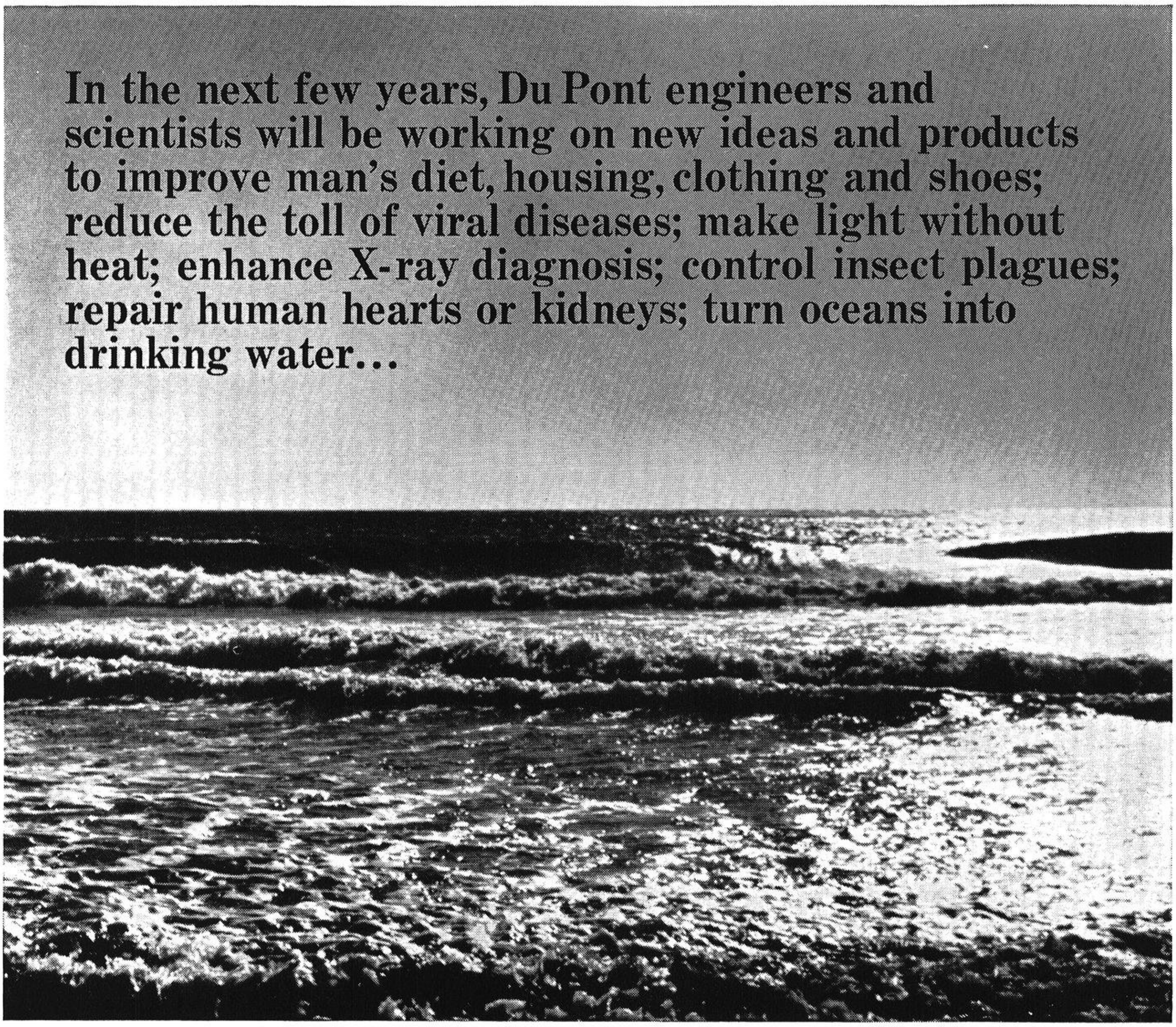

and anything else that you might think of.

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HUMOR:

FILEABLES CONTINUED . . .

Ode to a Lab Report

When I grow old and even older,
I'll never forget that manila folder,
Bane of existence, object of hate
And never less than three weeks late.
Title, object, method, theory—
The clock strikes one, my eyes are bleary.
If I could have my preference
I'd never write a reference,
Never compute efficiency
For reading numbering eight-three,
But many like that have I cone,
At least infinity plus one,
Many to tell the dullest dullard
That graphs are labeled and curves are colored.
Engineers arise—storm the fort;
And abolish forever the lab report.

—Unanimous

° ° °

The unusually high birthrate in a suburb near our city was recently explained to us. Every morning at 6:15 the Express comes roaring through town blowing its whistle.

It's too early to get out of bed and too late to go back to sleep.

° ° °

A young woman with adventure in her soul joined a circus. Anxious to do everything right, she asked her employer for a few tips.

"I don't want to make any beginner's mistakes," she asked.

"Well, for one thing," replied the manager, "don't ever undress around the bearded lady."

It was New Year's Eve. A Salvation Army lassie was standing on the corner testifying. "I was a sinner," she said, "who flitted from dance hall to dance hall. I drank liquor every night. I smoked constantly. I did everything bad. But I was saved, and now I don't dance, I don't drink, I don't smoke, I don't sin any more at all. In fact, I don't do a darn thing, but hang around here and beat this lousy drum."

° ° °

Four Marines were playing bridge in a hut on a South Pacific island during World War II. A sailor burst in shouting: "The enemy is landing a force of about 400 men on the beach."

The Marines regarded each other wearily. Finally one said: "I'll go. I'm dummy this hand."

° ° °

Four year old: "Daddy, are there any skyscrapers in Heaven?"

M.E. Dad: "No, son, C.E.'s build skyscrapers."

° ° °

A general and a colonel were walking down the street. They met many privates, and each time the colonel returned their salute he would mutter, "The same to you." The general's curiosity soon got the better of him, and he asked, "Why do you always say that?" The colonel answered, "I was a private once and I know what they are thinking."

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

"What goes on here?" asked the foursome.

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

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

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

° ° °

College boy, pouring drinks: "Say when."

College girl: "Right after this drink."

° ° °

An industrial engineer who was father of triplets was being congratulated by a friend. "Oh yes!" he said, "we are divinely happy and it was really wonderful, because you know it only happens once out of 15,876 times."

"Well isn't that just too remarkable," said his friend, "but to save my life I just can't see how you kept up with your studies."

FILEABLES

A motorist was once driving in the country when suddenly his car stopped. He got out of the car and was checking the spark plugs when an old horse trotted up the road.

"Better check the gas line," the horse said, and trotted on.

The motorist was so frightened that he ran to the nearest farm house and told the farmer what had happened.

"Was it an old horse with a flopping ear?" asked the farmer.

"Yes, yes!" cried the frightened man.

"Well, don't pay any attention to him," replied the farmer, "he doesn't know a darn thing about cars!"

* * *

A pink elephant, a polka dot bear and a three-legged snake walked into the bar.

"You're early boys," said the bartender. "He ain't here yet."

* * *

We heard about a musician who worked all week on an arrangement—and then his wife didn't go out of town after all.

* * *

Drive-in theatre: Where a guy goes to shut off his ignition so he can try out his clutch.

* * *

The legend is told that in the days of ancient Rome an officer, called away to the wars, locked his beautiful young wife in armour and gave the key to his best friend with the admonition: "If I don't return in six months, use this key. To you, my dear friend, I entrust it."

Ten miles away from home, he saw a cloud of dust approaching and waited.

His friend, on horseback, galloped up saying: "You gave me the wrong key."

* * *

Oliver Wendell Holmes once mistook an insane asylum for a college. Realizing his mistake, he explained to the gate-keeper and commented humorously: "I suppose there's really not much difference."

"Oh yes there is," replied the guard. "In this place you have to show an improvement before you can get out."

Wife (to mechanical engineering student reading): I want to do some shopping if the weather permits. What does the paper forecast say?"

Hubby: "Rain, hail, sleet, snow, thunder, lightning, and fierce tornado winds."

* * *

A drunk C.E. was trying to walk down the street with one foot in the gutter.

"Come along, buddy, you're drunk," growled a cop.

"Thank heavens," said the C.E., "I thought I was crippled."

* * *

What they mean when they say:

See me after class—(it has slipped my mind).

Pop quiz—(I forgot my lecture notes).

I will derive—(formula has slipped my mind).

Closed book quiz—(memorize everything including the footnotes).

Open book quiz—(oil your slide rules and wind your watch).

Honor system—(alternate seats).

Do odd numbered problems—(the even numbered problems will be on test).

Briefly explain—(not less than 1000 words).

* * *

"Young man," said the professor to the student who kept on interrupting, "are you trying to instruct this class?"

"Certainly not, sir, " said the student.

"Well, then, don't talk like an idiot."

* * *

Little boy: "What do you repair shoes with?"

Cobbler: "Hide."

Little boy: "Why should I hide?"

Cobbler: "Hide. The cow's outside."

Little boy: "So what? Who the hell's afraid of a cow?"

* * *

Probably the reason God made woman last was that he didn't want any advice while creating man.

Fraternity Brother: "Did you know that we maintain seven homes for the feeble-minded?"

Pledge: "I thought you had more chapters than that."

* * *

Two hillbillies were sitting in front of the general store philosophizing about Bible stories.

"That Solomon," Zeke drawled, "must have been a go-getter. With all them wives and concubines he had, beats me how he fed them all."

"That don't bother me none," Zeb replied, "but—I'd give a purty to know what he et hisself."

* * *

Once a King, always a King,
But once a night is enough.

* * *

Parson Brown phoned the local Board of Health to ask that a dead mule be removed from in front of his house.

"I thought you ministers took care of the dead," answered a young clerk who thought he'd be smart.

"We do," replied the parson, "but first we get in touch with their relatives."

* * *

Two burly cannibals caught a beautiful young girl and brought her before their chief. He casually looked her over and yawned while muttering, "I believe I'll have breakfast in bed this morning."

* * *

She: "Have you heard the horrid things they have been saying about me?"

Engineer: "Why do you think I came over?"

* * *

Q: What do you get if you throw a canary in an electric fan?

A. Shredded tweet.

* * *

The difference between a man and a woman buying a tie is about two hours.

* * *

We know a falsie manufacturer who lives on the flat of the land.

* * *

Jim: "Are you free tonight?"

Sally: "No, but I am relatively inexpensive."

Some say that the campus has become too academic to meet industry's engineering manpower needs.

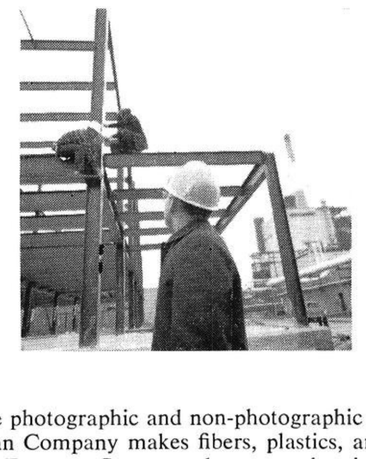
That's nonsense.

Or is it?

Semiconductor catalysis
Diffusion rates in molecular sieves
Surface diffusion of chemisorbed species
Interaction of antagonistic polyelectrolytes
Polyelectrolyte complex films as reverse osmosis membranes
Rheology of non-Newtonian fluids
Blood flow in the microcirculation
Mass and momentum transfer in a boundary layer

Above are a few of the research projects under way in the chemical engineering department of one of the prestigious science universities. Once upon a time that institution was considered an engineering school. *Now* look at it.

The reason we print the list is that it happens to name some topics for which we need chemical engineers to solve some all too real problems of our photographic business.



We would be less than candid, however, if we implied we require all our chemical engineers to be academically minded. We have rewarding work for many types of minds. That simple fact is the payoff (to the individual chemical, mechanical, electrical, or industrial engineer) from our size and diversification. He gets *choice*.

The first job he chooses may seem to represent his personal bent. It may represent nothing more than a direction in which he has been pointed by his professors. A few years of actual experience may show a young engineer that he is less "thing"-oriented than he thought he was and more interested in relating "things" to people than he was taught to be—supervision, marketing, technical liaison, etc.

To offer choice at the outset and choice later fits in well with our principle that a man or woman isn't just part of a department or project but is working for a far more important entity known as Eastman Kodak Company, which had better make the biggest possible personal success of him or her if it wants to realize a fair return on its investment.

By the way, you may not realize that we are involved in a lot more than photography (which hasn't stopped booming for 80 years) and find the other businesses pretty good, too.

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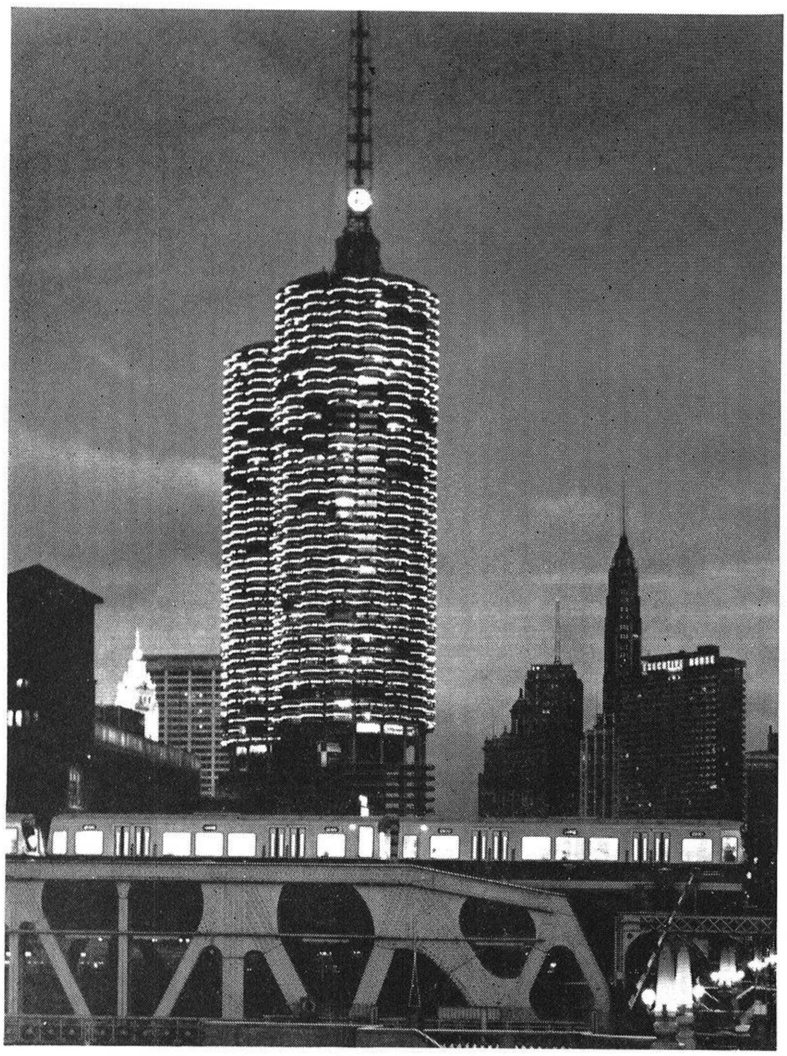
like beautiful cities



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Inquisitive minds in research and advance development at G.E. are evolving many concepts to give our cities a clean, all-electric look. Design engineers are translating concepts into components and systems, while manufacturing engineers are developing the methods and machines that bring designs into being as useful products.

Technical marketing specialists are working with electric utilities and city planners to give mushrooming urban landscapes like Phoenix, Atlanta and Chicago, a bright, all-electric face.

Urban living has already begun to change as a result of the contributions made by General Electric engineers and scientists, contributions like air and water purification systems, underground power equipment to preserve nature's beauty, all-electric heating facilities, rapid-transit systems, and a hundred more.

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