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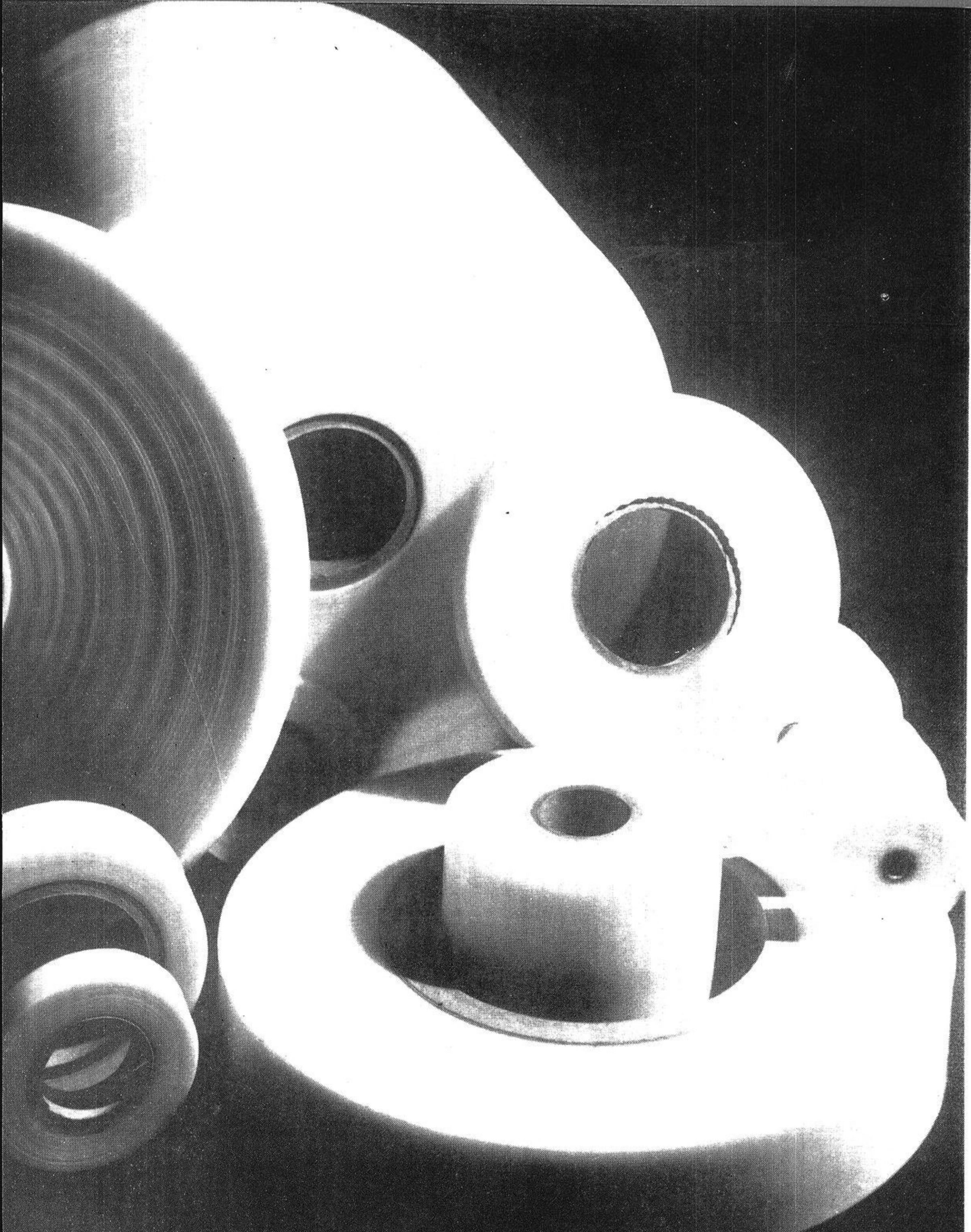
JANUARY
1957

The Wisconsin

25¢

engineer



HOT POLY

Page 24

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Volume 61 JANUARY, 1957 Number 4

WISCONSIN ENGINEER

The Student Engineer's Magazine

FOUNDED 1896

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Frontispiece

Here's one of two nine-foot gas recirculating fan wheels for use in the first commercial supercritical steam generator at the American Gas & Electric Service plant, Philo, Ohio.

Cover

These rolls of Irrathene irradiated polyethylene tape represent the first commercial product of General Electric's research in electron irradiation—the science of bombarding materials with high-velocity electrons to produce chemical changes.*

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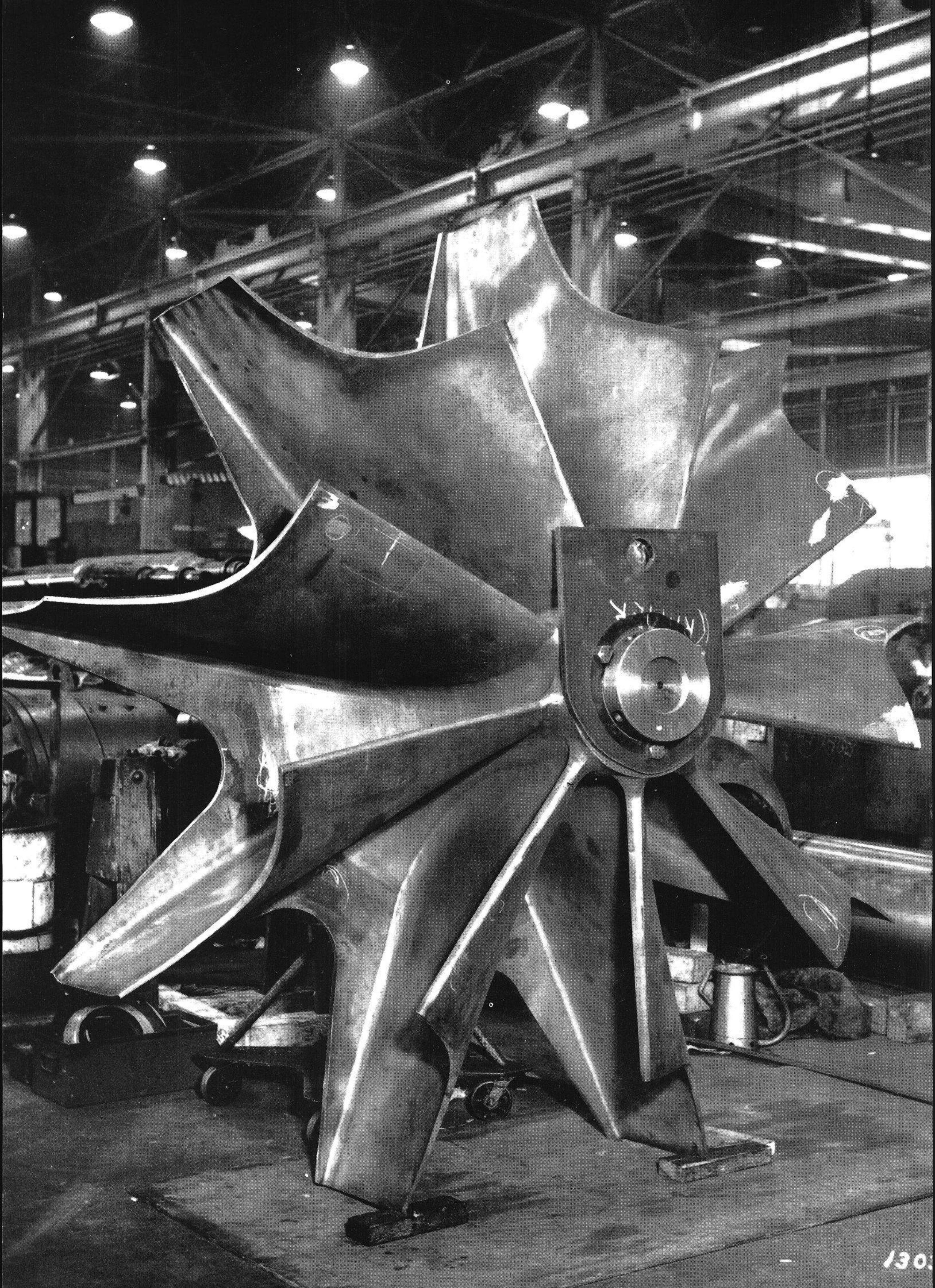


Rambling WITH THE EDITOR

Are We Fooling Ourselves?

Many cartoons have been drawn and many jokes have been written about the high starting salaries for engineers. Sure the starting salaries are high. Graduate engineers are drawing on the whole much more than they are worth, but industry is making an investment in the future. What happens to these salaries after graduation?

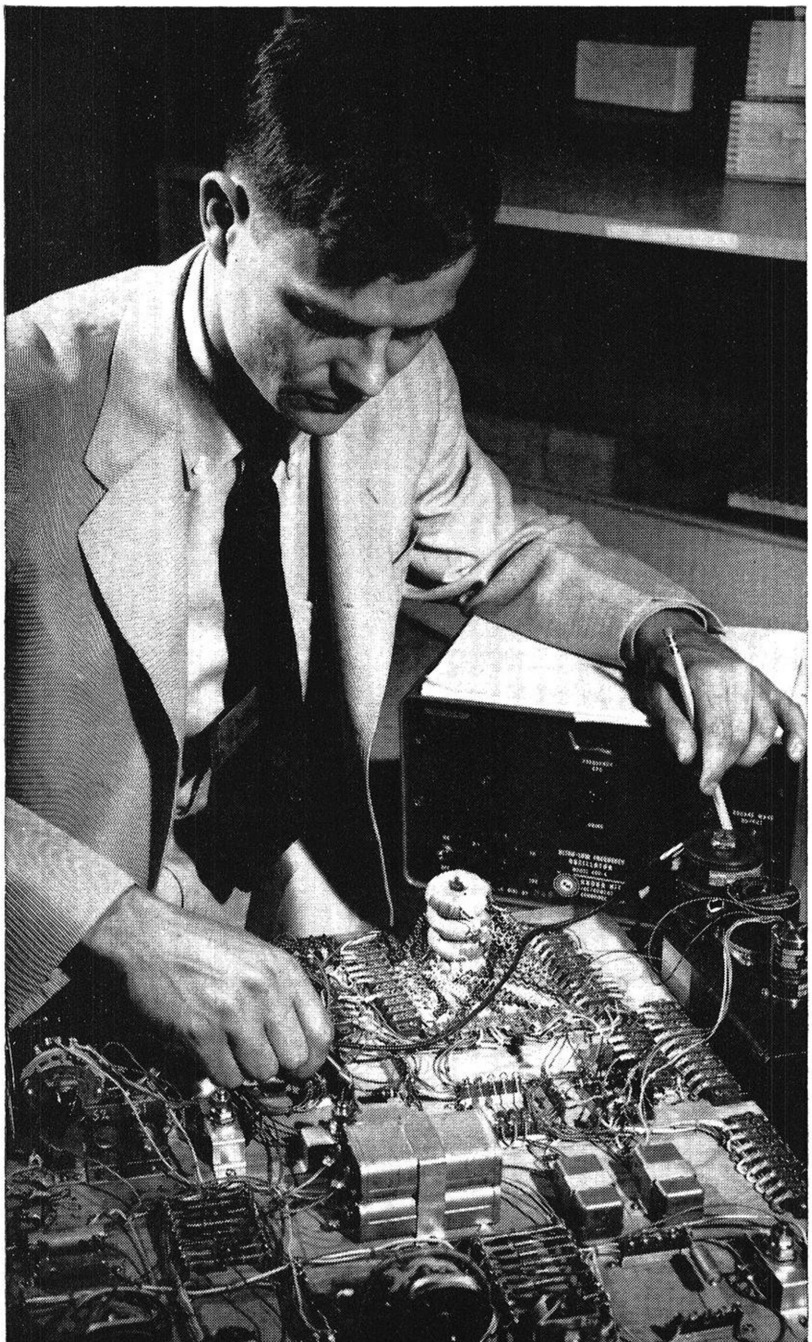
According to an article in U. S. News & World Report, the average engineer's starting salary will be 12% higher than the average salesman's in 1957 at $433. By 1967 the same salesman will be making twice as much money and 12% more than today's graduating engineer who will be earning $740. Even the average accountant's salary will be higher than the engineer's in ten years time. One fallacy in this comparison is that many of the highest paid salesmen will have switched from engineering to sales.

The fact remains that engineers are not making more money in the long run and should belittle their friends on the hill salary-wise because eventually they may have the upper hand. Whether this equality is good or bad is not for us to say but before we start bragging let us evaluate our true position.

R. F. S.

How keen is your

IMAGINEERING?



This young Sperry engineer is developing a component in a new control system to be used on intercontinental multi-jet bombers. Can your imagination tell you what it is?

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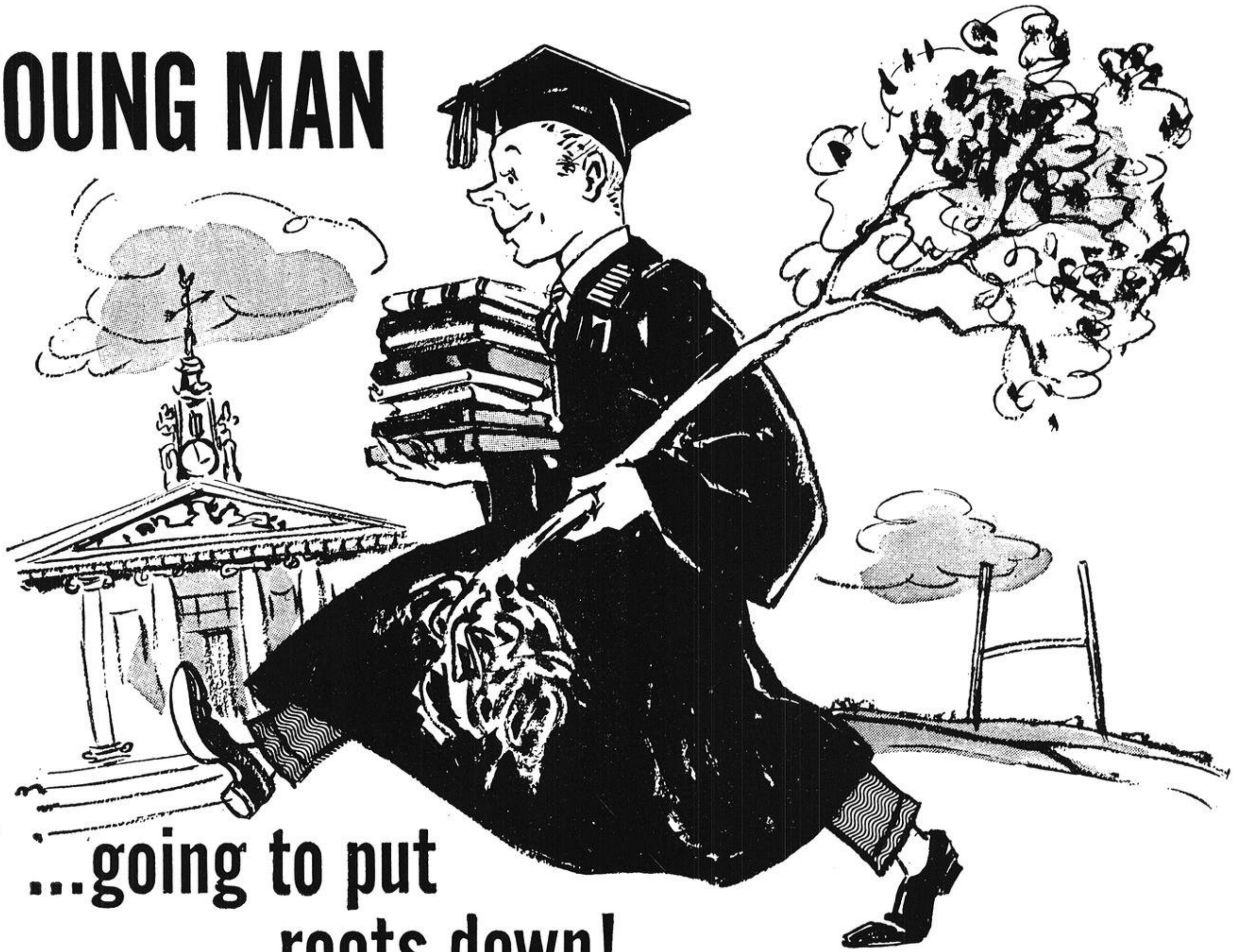

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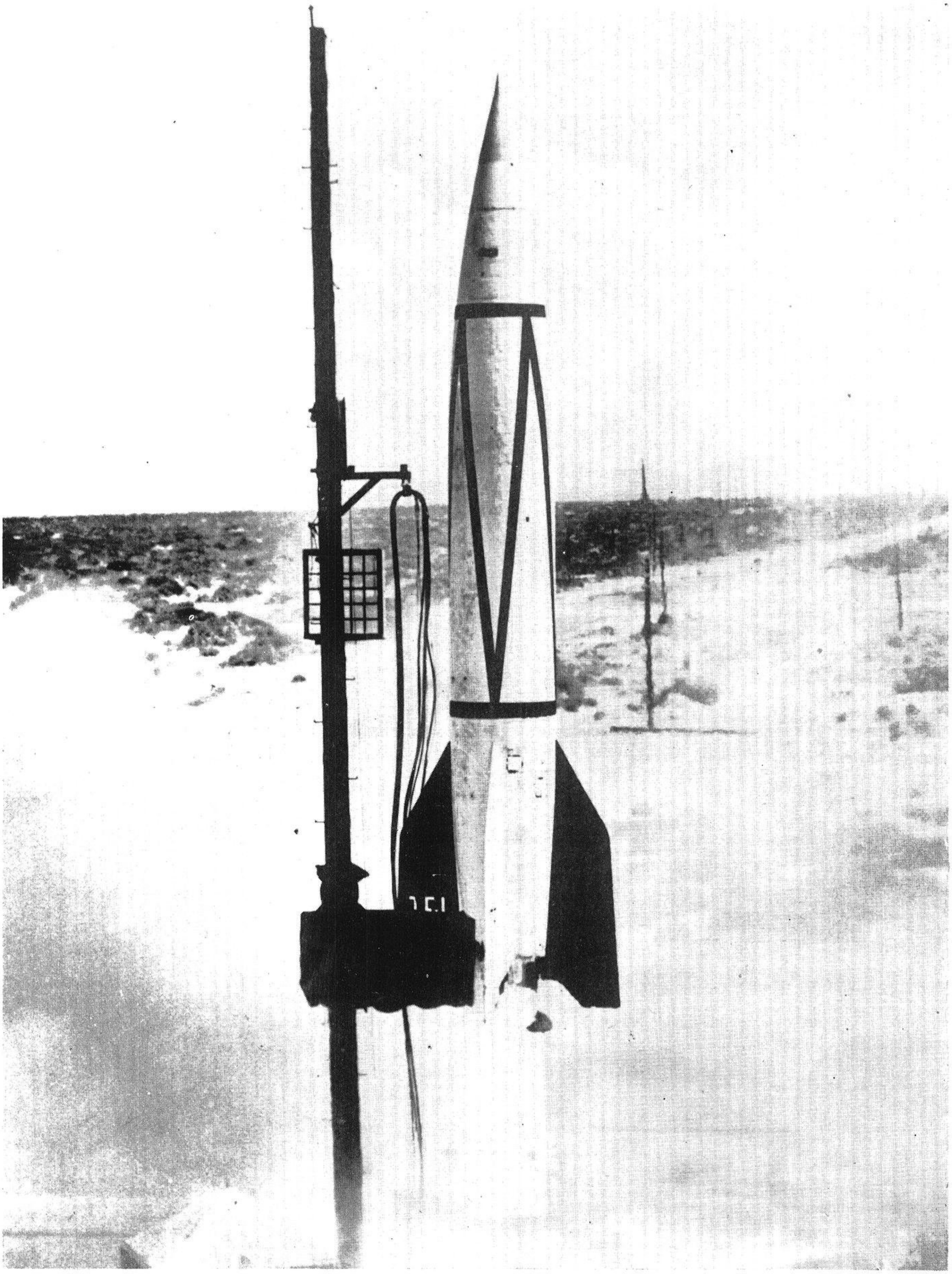


—Courtesy General Electric

The critical moment during any rocket launching, which occurs immediately after the takeoff. During this period, the vehicle gradually increases the ratio of its thrust over its weight.

ROCKETS AWAY

In this article the author discusses one of the main problems that faces rocket engineers, that of developing a satisfactory rocket propellant. He begins by reviewing the principles of rocketry and then passes on to various power sources that are being considered for both the rockets of today and those in the projected future

by Jerome B. Webster che'58

During recent years, interest in rocketry has greatly increased due to speculation in the development of earth satellites, rocket missiles and space travel itself. While the latter seems far in the future, many advances have been made in related rocket fields. With the new larger, long distance rockets that are being developed (of which the German V–2 was the first practical one) many new problems arise.

Not the least of these problems is the search for a satisfactory rocket propellant. A rocket fuel differs from an ordinary fuel in that because a rocket is designed to travel through the vacuum of outer space, it must carry its own oxidant. Other fuels are oxidized by the oxygen from the air through which they travel. It can be seen, then, that the rocket must lift only the fuel it uses, but also the oxidant for the fuel.

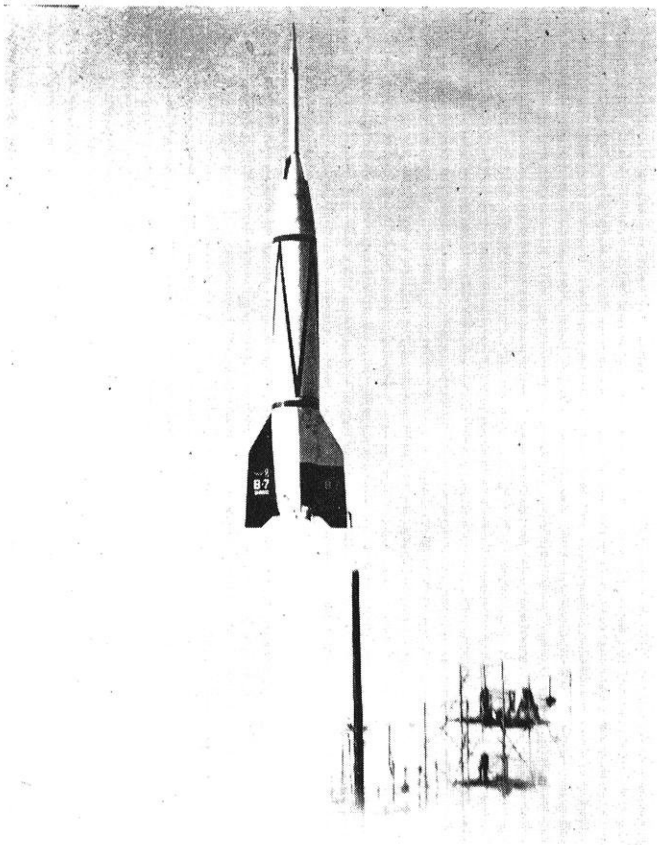
In the use of liquid fuels the oxidant and fuel may be present in two ways. They may be combined in a monopropellant and carried in a single tank or the fuel and oxidant may be carried separately as a bi-propellant. At present, the bi-propellant type is the most common.

The rocket engine, much like other engines, derives its power, or thrust, from a chemical reaction, usually oxidation, which produces a large amount of gas at a high temperature. In the case of a bi-propellant, the fuel and oxidizer are injected into a combustion chamber which is fitted with an escape nozzle through which the hot gaseous products escape after combustion.

These combustion products build up a large pressure gradient between the inside of the chamber and the outer nozzle end. The jet velocity resulting from this pressure gradient is used to calcaulate the thrust of a rocket. However, while the thrust of the engine is a function of the jet velocity, the rocket power is not derived from this jet as in a conventional jet engine.

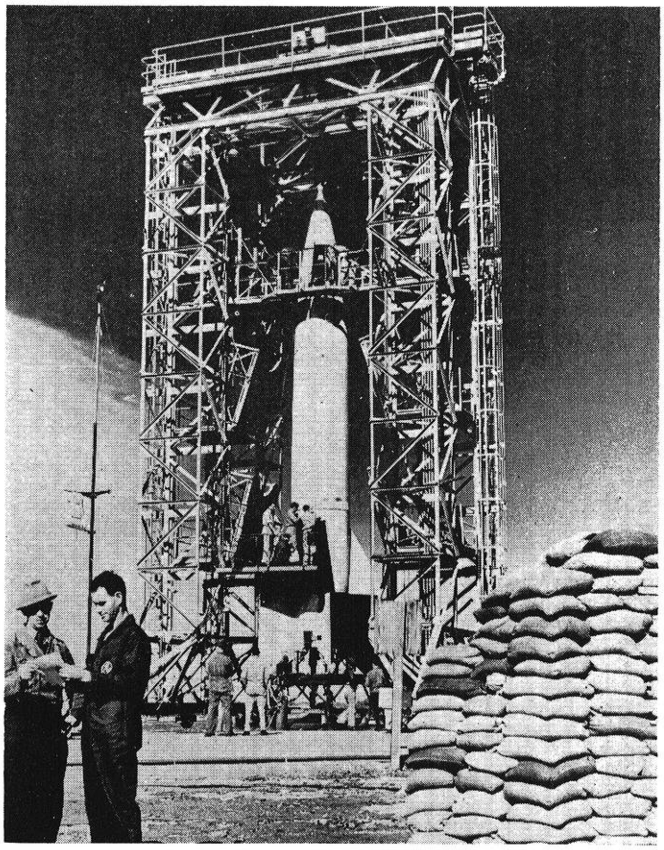
The power source of a rocket is the hot, high pressure gases inside the combination chamber. These gases, on combustion, have a tremendous amount of thermal energy. (The amount of energy varies directly as the temperature of the gases.) This energy imparts great speed to the molecules of the gas. The highly energized molecules then bombard the walls of the chamber and are reflected elastically.

This process of the conversion of thermal energy to mechanical energy gives the rocket engine its thrust.



—Courtesy General Electric

Army Ordnance's two-stage Bumper rocket zooms skyward from the long-range Proving Ground at Cocoa, Florida, on the first leg of its flight.



—Courtesy General Electric

Here a crew of technicians are shown preparing a V-2 test vehicle for firing.

It has been shown, however, that only about 10% of this thermal energy is converted to usable mechanical energy.

It is necessary then, that a fuel have chemical properties that insure the formation of a large amount of gas on combustion. It is desirable also to select a propellant that will form products at a high temperature so that the thermal kinetic energy they possess will be at a maximum.

Since the flow rate of the jet is a function of the temperature of the combustion products (varying directly), it is apparent that a high jet velocity would mean a high temperature of the combustion products and, in turn, high thermal energy of the gases. Therefore, it would be desirable to have the greatest rate of flow in the jet per smallest required combustion chamber. (The size of the combustion chamber must not be neglected because its size affects the overall weight the fuel must lift).

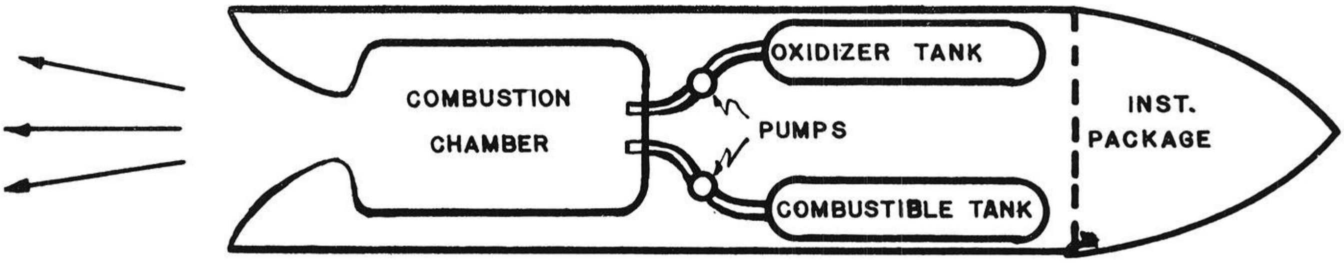
Experiments have shown that the chamber size per unit mass flow rate of the jet varies little, less than 25%, regardless of the fuel combinations used. This is unexpected because laboratory combustion of different chemical compounds has shown great variations in the heats of combustion. The reason, then, for this small variation of chamber size must be due, not to chemical but to physical properties common to all the propellants used, that is, the evaporation and mixing of the fuel and oxidizer after injection and prior to combustion. This proves to be the case.

An analysis of the gases in the combination chamber of an operating rocket motor has shown that cool, unmixed fuel and oxidant, and small droplets of the unevaporated propellant were found near the injection end of the chamber while near the nozzle end the products of combustion were near their theoretical flame temperature. It follows that if the combustion chamber could be reduced to contain only the hot gases, there would be a greater jet velocity per required chamber size, therefore increasing the efficiency of the engine.

To partially overcome this obstacle, the fuel and oxidizer have been vaporized prior to injection. This reduces the time in the chamber required for the bi-propellant to release its energy, making a smaller chamber possible. From this fact it can be seen that a propellant with low viscosity would be desirable in order to promote ease of vaporization.

With the limitation of flame temperature partially overcome by preinjection vaporization, it might be assumed that the selection of a fuel with the highest *theoretical* flame temperature would be justified. However, another limitation now becomes apparent. It has been found that the primary combustion products dissociate at high temperatures into unstable or less energetic forms. (This temperature in a carbon, hydrogen, nitrogen, oxygen system is near 2500 degrees Kelvin.)

This is an undesirable characteristic because the



SCHEMATIC OF TYPICAL ROCKET FUEL-COMBUSTION SYSTEM

energy absorbed in these dissociations in unavailable for the conversion to the mechanical energy which provides the thrust of the rocket engine.

Because this problem arises as a result of the properties of the products rather than the reactants, the solution cannot be found in the selection of a different combination of propellants from the same system. For instance, in the carbon, hydrogen, nitrogen, oxygen system the products of combustion would be the same, causing the same dissociations no matter which combination is selected.

A partial solution which helps only slightly is the selection of reactants with negative heats of reaction. This would increase the amount of heat released on combustion. However, a large increase in the heat released gives only a slight increase in actual flame temperature (again due to product dissociation).

Throughout the foregoing discussion it must be remembered that, while it is very desirable to have the actual flame temperature at a maximum, it is absolutely necessary that the engine itself is able to contain this high heat. That is, the structural strength of the engine must not be unduly sacrificed. Another factor that should be considered with respect to the structure of the engine is the corrosive property of the fuel selected. Naturally, highly corrosive propellants are undesirable.

Although chemical properties are important it should now be apparent that physical properties play a large and perhaps more important part in the selection of a propellant.

The most efficient combination of fuel and oxidant is one which will produce the greatest amount of gas volume per unit mass of propellant. High density then, is of extreme importance. A high density propellant would occupy less space per unit mass, and therefore require a smaller tank for storage in the rocket. This, in turn, would reduce the overall weight that the fuel must lift. High density is especially important in the choice of an oxidizer because the oxidant charge is usually greater than the fuel charge.

The freezing point should also be considered in the selection of a propellant. Although it is conceivable that the fuel and oxidant could be kept from freezing by heating of some kind, it is more desirable to lower the freezing temperature by the use of an additive which will not alter the propellants' favorable characteristics to a great extent. Such an additive should have a low molecular weight, a high content of available oxygen, high density, high boiling point, low corrosivity and a low content of combustible atoms.

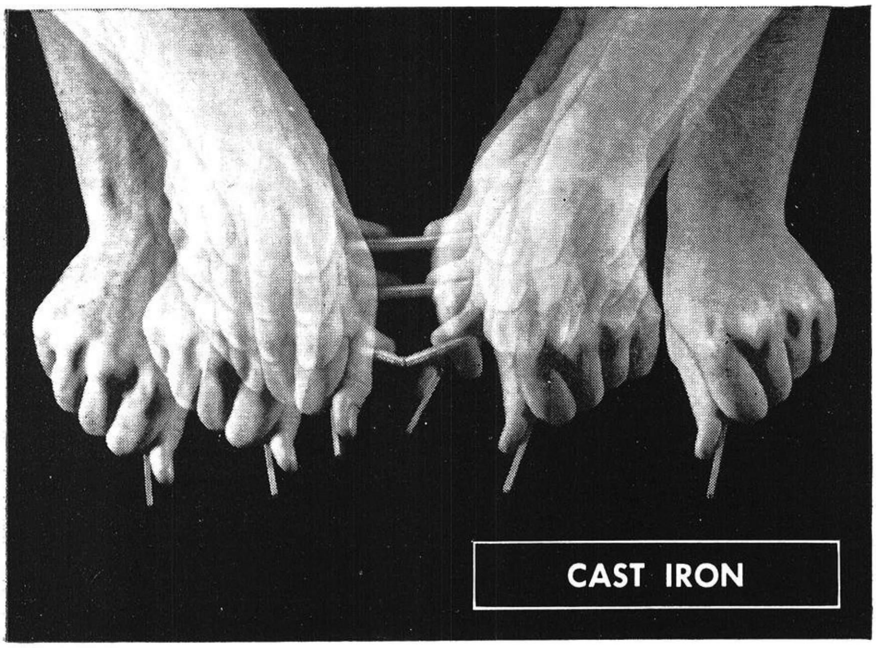
In addition to previously stated properties the oxidant must, of course, have a high content of available oxygen. Liquid oxygen, which at present is the most common oxidizer, certainly satisfies this requirement. However, the density of liquid oxygen is not as high as desired. This fact, among others, has given rise to the use of other oxidizers.

Another important requirement of the oxidant is that it be easily handled and stored without decomposing or loosing its strength. Here again liquid oxygen is deficient. The use of oxides of nitrogen has become important because the bond of oxygen to nitrogen, while loose enough to furnish sufficient available oxygen, is stable enough for satisfactory storage and handling at normal temperatures.

Spontaneous fuels, that is, fuels which ignite on contact with the oxidant, have been found for all practical oxidizers. This is indeed a highly desirable characteristic for a fuel. The advantages are that the combustion chamber can be smaller and lighter, and the injection simpler. The disadvantage of these fuels is that their high cost makes them impractical to use as the only fuel in a rocket.

The properties of these hypergolic fuels, as they are called, can still be utilizer, however. The ignition of a

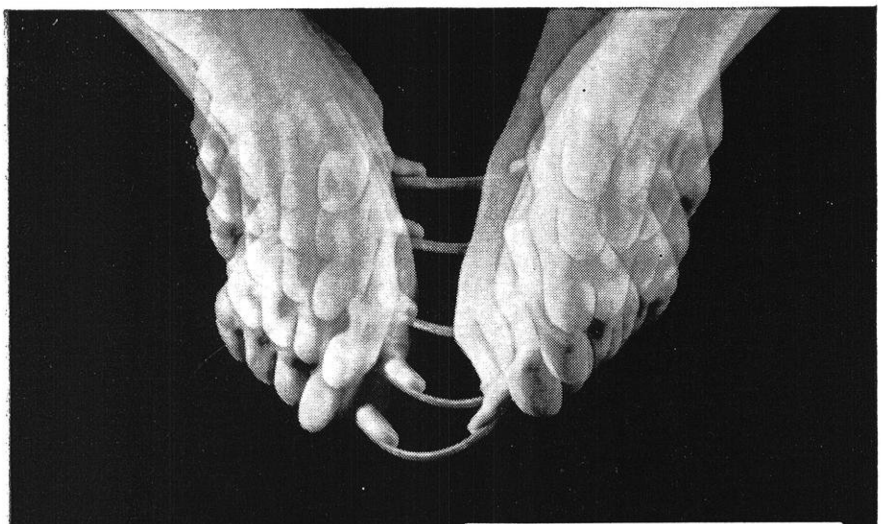
(Continued on page 68)



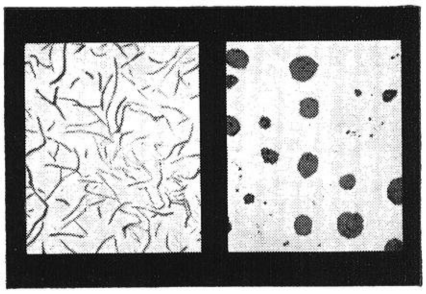
Repetitive flash photography makes it plain how ordinary (flake graphite) cast iron, when stressed, will break off short without bending.

Slow-Motion Proof

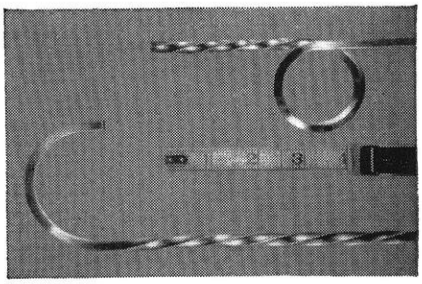
that Inco-developed Ductile Cast Iron has exceptional ductility—can be bent like mild steel



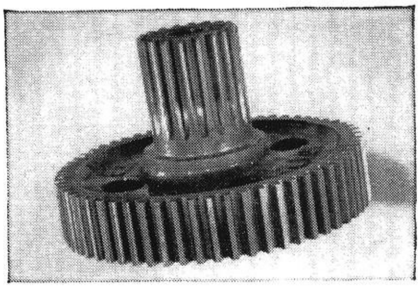
Under the watchful eye of the strobe camera, Ductile Cast Iron bends and bends. No break!



WHY Ductile Cast Iron is different: In conventional cast iron (left) the graphite is in flake form, making for brittleness. In Ductile Cast Iron (right) it's formed into tiny spheres — this makes for toughness, plus greater strength. (Magnified 100 times.)



HOW Ductile Cast Iron can be twisted and bent without breaking is shown above.



TODAY, Ductile Cast Iron is a material of many varied uses. Everything from pinking shears to plowshares—washing machine gears to jet plane parts! And industry is rapidly expanding its uses of this economical cast material.

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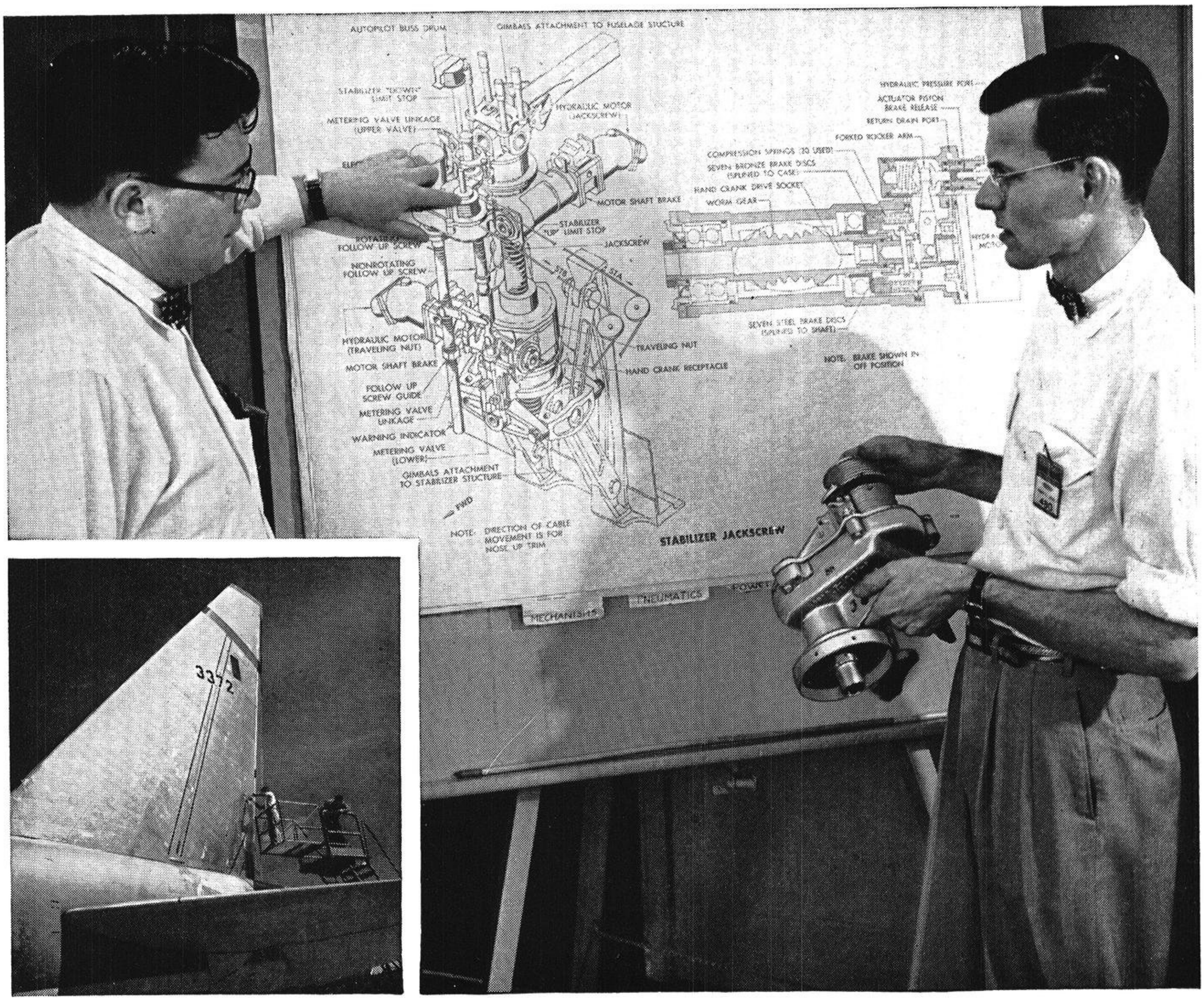

B-52 jack screw—a typical Boeing design challenge

On Boeing B-52 bombers, the horizontal tail surface has more area than the wing of a standard twin-engine airliner. Yet it can be moved in flight, up or down, to trim the aircraft.

The device that performs this function is a jack screw, which, though it weighs only 255 pounds, can exert a force of approximately 225 *tons!*

Many kinds of engineering skills went into designing and developing a jack screw so precise that it automatically compensates for stretch and compression under load. Civil, electrical, mechanical and aeronautical engineers, and mathematicians and physicists — all find challenging work on Boeing design projects for the B-52 global jet bomber, and for the 707 jet tanker-transport, the BOMARC IM-99 pilotless interceptor, and aircraft of the future.

Because of Boeing's steady expansion, there is continuing need for additional engineers. There are more than twice as many engineers with the company now as at the peak of World War II. Because Boeing is an "engineers' company," and promotes from within, these men find unusual opportunities for advancement.

Design engineers at Boeing work with other topnotch engineers in close-knit project teams. They obtain broad experience with outstanding men in many fields, and have full scope for creative expression, professional growth and individual recognition. And they find satisfaction in the high engineering integrity that is a Boeing byword.

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ELECTRICAL CALCULATORS AND THEIR APPLICATIONS

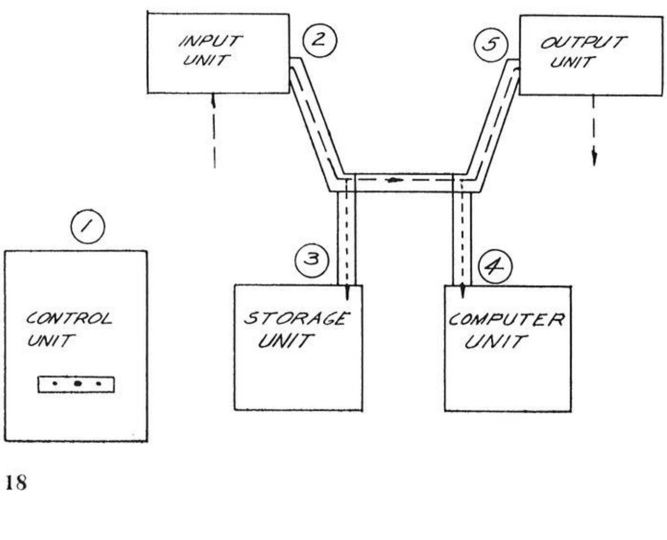
Computers—those machines that "think" aren't really Magic; here's an introduction

by John Quigley che'57

This article is written to explore the field of electrical calculators and their applicability to engineering problems. Before moving into the problem requirements for the use of calculators, let's look at basic calculator construction and design.

Basically, there are two types of calculators. The most used is the analog calculator and the most accurate is the digital. The general workings of both are similar, the difference being that the single analog works with measurable physical quantities directly, such as current while the digital works with any number of parallel analog type circuits.

For this reason the analog calculator gives answers only as accurate as the milliammeter used to measure its output current, while the digital calculator could have thirty parallel circuits giving thirty significant figures.



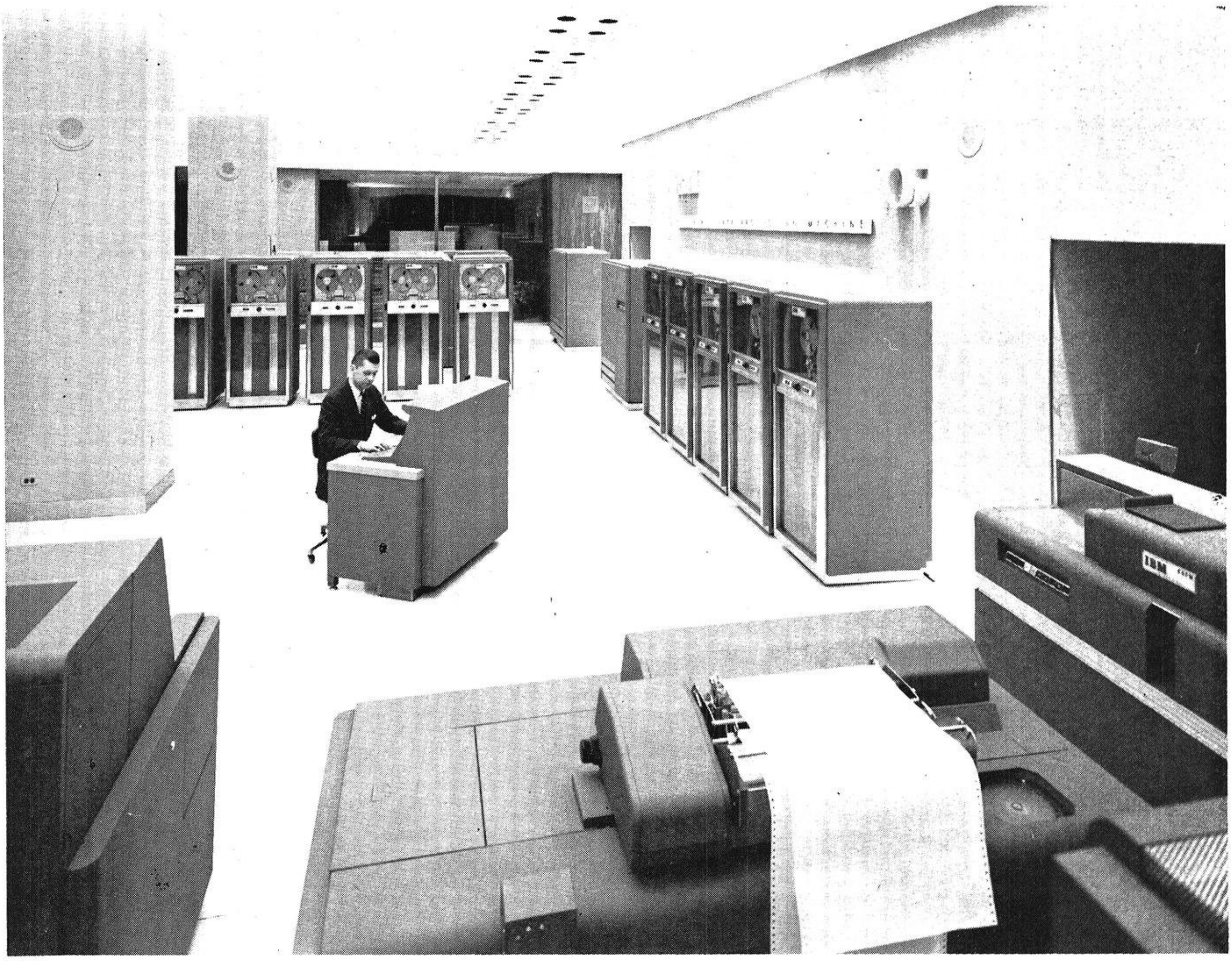
The components essential to all electrical calculators are the following: a control unit, an input unit, a storage unit, a computer unit, and lastly, an output device. The functions of each of these will be described here.

First, the control unit, once activated, sets up and regulates the sequence of all operations for the other units of the calculator. From the controller emanate the signals which cause the registers to charge or discharge, the ratio disks to rotate, and the circuit breakers to open or close.

Instructions can be fed into the controller unit to repeat any operation any number of times. Similarly, through the controller the brain can be made to exercise a certain amount of discretion. Limits may be fed in such that the machine will repeat a sequence of operations and automatically choose new values for the variables each time. This operation could continue until a desired answer is obtained.

At all times, the controller audits the operation of all components to assure their proper functioning. Should any phase malfunction, the controller will cause all operations to cease and will designate to the operator where the failure is.

Second, the input unit translates the data fed in on punch cards and magnetic or pneumatic tapes into electrical and mechanical signals which the computer



The IBM 705 Electronic Data Processing Machine combines the ability to calculate at unbelievably high speeds with a vast electronic storage bin or "memory" on magnetic tape and drum units; it can make "logical" decisions based upon predetermined or calculated conditions.

can manipulate. If, for instance, punch cards are used, a conventional method of translating is for a pneumatic card reading device to actuate circuit breakers. The electrical signals produced are then relayed into the storage and computer units for manipulation.

Third, the storage unit retains on magnetic tapes, banks of charged vacuum tubes, electro-magnets called registers, and/or punch cards all signals fed into it from the input unit until the computer can utilize them. Similarly, during sequence of operation changes in the computer unit, the storage unit will retain partial answers which must be re-fed into the computer at a later time.

Fourth, the computer unit is where all actual manipulations of quantities take place. It is in the computer unit that the summations of currents and mechanical torques are performed in proper sequence to produce answers. The means by which these operations take place require to explain them circuit diagrams which are beyond the scope of this article. Suffice it to say that all operations involve the orderly transmittance of mechanical torques through calibrated disks and the orderly flow of currents through rectifier guarded circuits. No Magic!

Last, the output unit translates the computer's currents and torques into interpretable symbols. Examples of the forms of output are as follows: panels of lights, magnetic or pneumatic tapes, punch cards, electric typewriters, measureable electric currents, and digital dials.

With this as an introduction to calculators, it is necessary now to examine the form in which a problem must be expressed to facilitate the use of a calculator. Since all systems are analogous, the simplest will be considered here. This system consists of a binary numbering system.

In a binary numbering system there are only two numbers, zero and one. The following table will best illustrate the manner in which a binary system can express the conventional digit system.

binary	0	1	10	11	100	101	110	111	1000
decimal	0	1	2	3	4	5	6	7	8

After the data and instructions have been translated into the binary system, the numerals could be punched into a paper tape, a hole representing the number one and a blank space representing a zero. The input unit could convert this information into energized circuits and open circuits.

The problem presented here is to select suitable analogous values. If, for example, it is required to solve a problem dealing with angles, certain angles would have to be associated with certain numbers as follows:

0: Turn through 0°, or no right angles.
1: Turn through 90°, or one right angle.
10: Turn through 180°, or two right angles.
11: Turn through 270°, or three right angles.

From this the calculator could then handle addition and subtraction to produce an answer as follows:

addition c=a+b

a \ b	0	1	10	11
0	0	1	10	11
1	1	10	11	0
10	10	11	0	1
11	11	0	1	10

Subtraction C=-A

a	c
0	0
11	1
10	10
1	111

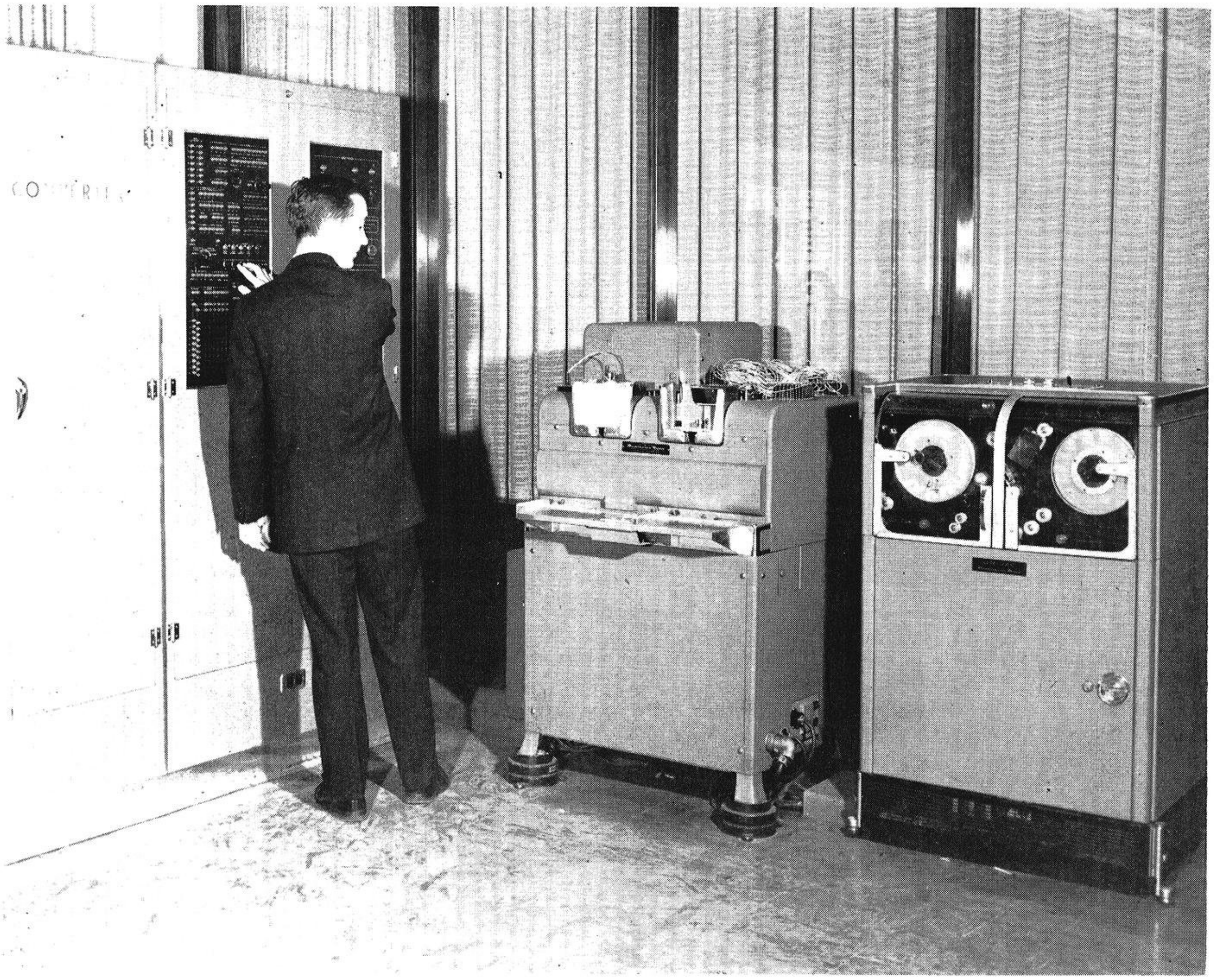
When the first table gives "one plus three equals zero", it means that the rotation through four right angles produces no net change, and, similarly, the second table gives "two equals negative two", meaning that rotation through two right angles in either direction produces the same net result.

From this example, the importance of representing known quantities in terms of symbols which the computer can manipulate, and the importance of choosing the symbols in such a manner that the answers produced by the calculator can be interpreted and used is illustrated.

With properly chosen symbols, the operations a calculator can perform are:

1. Retain information supplied to it.
2. Apply instructions when needed.
3. Add, subtract, multiply, divide, and round off.
4. Look up numbers in its memory.
5. Look at results and make choice, provided for criteria and alternatives on which the choice is to be made are given it.
6. Do long chains of operations in sequence.
7. Write out an answer.
8. Check the answer.
9. Know when one problem is finished and turn to another.
10. Work unattended.

(Continued on page 66)



This Tape-to-card Converter of the Remington Rand Univac System converts information on Magnetic Tape to Punched Cards at the rate of 75–120 cards a minute—automatically.

"Van" Wolford wants to know:

How often does Du Pont transfer technical men?

Fred V. Wolford receives his B.S. in Chemical Engineering from the University of Texas in January 1957. "Van" is a member of the Southwestern Rocket Society, Canterbury Club, and local Vice-President of A. I. Ch. E. Like all students, he's interested in finding out about the best opportunities offered in his profession.

Ed Berg answers:

Edward H. Berg received his B.S. Ch. E. from Cornell in 1944 and served as an Engineering Officer on destroyer duty until 1946. Since coming with Du Pont, he has worked at New Jersey plants as a Field Supervisor in Du Pont's Engineering Service Division. Ed was recently transferred to Du Pont's Design Division to further round out his professional development.

WE'VE just completed a study on that subject, Van, so I can speak with some authority.

Using technical graduates who came with Du Pont in 1949 as a base, we found these men averaged 1.7 transfers of location in 7 years. We frequently shift men from one assignment to another at the same location, to broaden them professionally. But it's interesting to note that 38% of those surveyed had not changed their location of employment at all.

Changes of work location depend a little on the type of work a man enters. For instance, there are likely to be more transfers in production and sales, fewer in research.

But one thing is certain. Du Pont transfers are always purposeful. The majority are a natural result of Du Pont's continued growth and expansion. And they invariably represent opportunity for further professional development.

Additional employment information is given in "Chemical Engineers at Du Pont." This booklet describes in detail the work and responsibilities of chemical engineers who work at Du Pont. Write for your free copy to the Du Pont Company, 2507C Nemours Bldg., Wilmington 98, Del.

DU PONT

REG. U. S. PAT. OFF

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

Watch "Du Pont Theater" on Television

HOT POLY

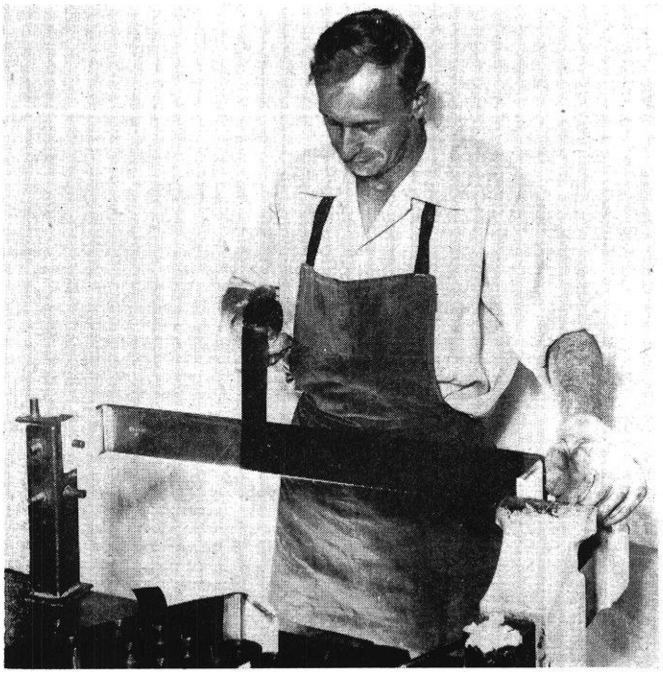
Irradiated polyethylene shows properties that are not like the unirradiated polyethylene. The cheapest source of radiation is the waste products of the government atomic plants

by George Jaeger che'57

Irradiated polyethylene shows properties that are not like the unirradiated polyethylene. The cheapest source of radiation is the waste products from the government atomic plants. Irradiation chemistry is being studied in many fields to find an outlet for these waste products. Two processes are being studied for the irradiation of polyethylene. First, studies are being conducted on irradiating the polyethylene products. Second, irradiation of ethylene to form the polymer is being studied.

Polyethylene promises to become even more useful in the form of the irradiated polyethylene. This form of polyethylene will not melt at as low a temperature as the unirradiated polyethylene. It is also more elastic, more resistant to elongation, more unreactive to chemicals and has better dielectric properties. In general the properties of irradiated polyethylene are similar to those of a polymer of ethylene of a higher molecular weight. Bottles of irradiated polyethylene are not soluble in most reagents, have an elasticity to withstand dropping and will permit sterilization at high temperatures. Irradiated polyethylene insulation has very good dielectric properties, resists chemical attack and has good resistance to abrasion. The list of irradiated polyethylene was made during World War II. England was cut off from her supply of insulating materials and was forced to develop polyethylene for use in radar sets as insulation. Polyethylene has excellent dielectric properties and is resistant to chemical attack. However, its use is limited by the *abrupt melting point* of about 115 degrees. Polyethylene has been developed as containers because of its unreactivity, and lack of taste and odor. It is also used for tubing, gaskets, beading, sheets, containers, and toys.

Irradiated polyethylene is the product of radiation chemistry. This form of chemistry is still in the experimental stage and has yet to be proven in industry. Many products that are manufactured today can be made by radiation chemistry. Some of these processes show advantages over the present method. For the most part the radiation processes are still too expensive to merit industrial usage. The cost of a radiation plant is calculated to be slightly more than a comparable heavy industrial plant and less than a comparable small machine plant. Before cost there should be the consideration of the radiation source. The cheapest source would



Irradiated polyethylene tape is hand-wrapped on bus bar for metal-clad switchgear. The tape forms a tight, uniform insulation, free of voids or bunching, while the number of wraps per voltage level is reduced about 50 per cent.

This machine "wraps" 600 complete laps of insulating tape per minute on a generator coil. Irradiated polyethylene tape is wrapped around bends and knuckles of the three-turn coil, then heat-bonded to provide a tight seal against moisture, dust, and dirt.

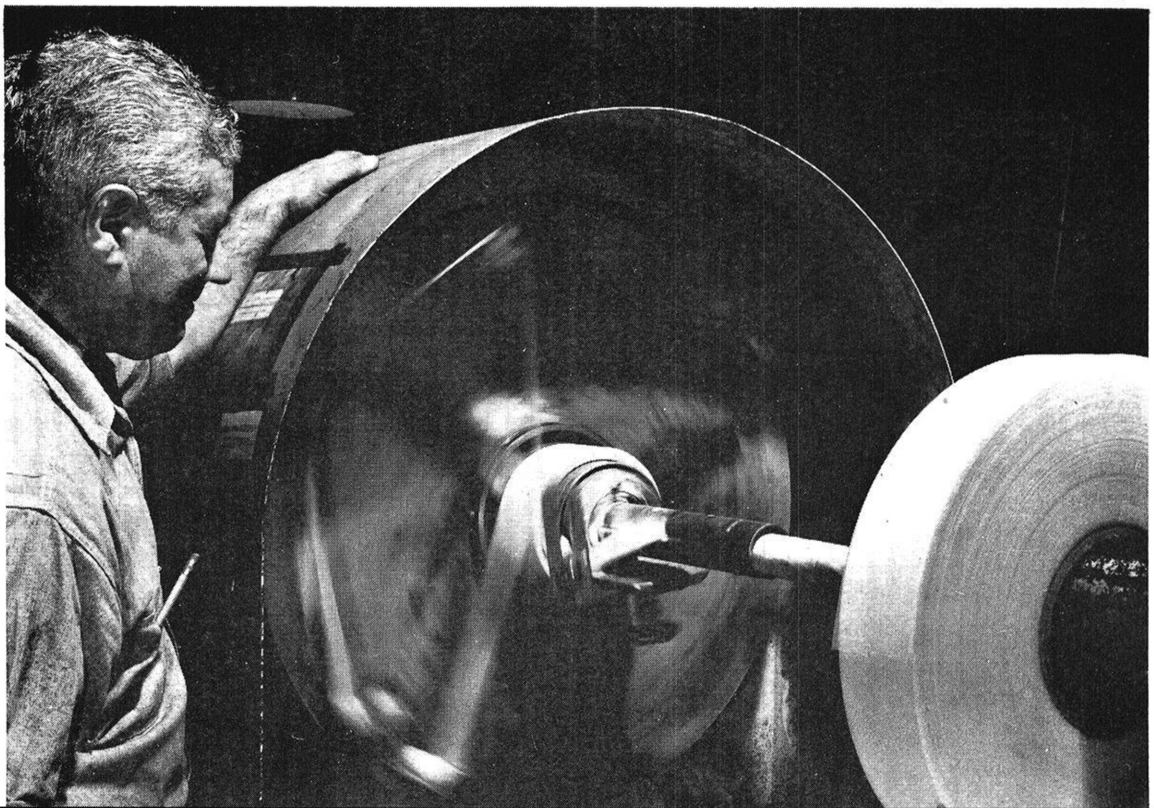
be government waste products, but these are not intense enough for many reactions. This presents the problem of condensing the waste products.

Radiation chemistry is here to stay. The United States Government is faced with the problem of disposing of radioactive waste products from its war plants. The cost of destroying one million curies of this waste is $12,500. The stockpiling of waste products has lead to the granting of research contracts. These contracts are for the invention of industrial uses of the government's excess waste products. Research is being carried out in various fields: polymerization, oxidation, reduction, decomposition and synthesis. There is also some work being done in the field of food sterilization and packaging. The approximate mean of the waste products is the isotope Cobalt.[60]

Research in irradiated polyethylene is being carried out in two fields. The first is the irradiation of the

Whirling at high speed, taping head of planetary cabler wraps irradiated polyethylene tape around Telecable (R) at Whitney Blake Company. Worker checks taping tension for cable containing 404 single telephone wire.

—All Photos Courtesy General Electric Co.



polyethylene product. The second field of investigation is the irradiation of the ethylene gas to produce the polymer.

John W. Ryan of the General Electric Company at Schenectedy, New York, E. J. Lawton and his associates of the same company and Malcolm Dole with his colleagues at Northwestern University have made some studies in the irradiation of polyethylene products. Extruded or calendered polyethylene might be passed thru a reaction chamber and irradiated to the cross-linked polymer.

J. W. Ryan irradiated polyethylene in sealed aluminum containers for six months with 10 to the 11th power photons per square centemeter per second. The physical properties of this irradiated polymer were improved and the chemical properties were changed in that the product was even more unreactive than before irradiation. The effect of the irradiation is the cross-bonding of the ethylene polymer chains. This cross-bonding gives the product its new properties. Higher melting point and better elastic qualities are a result.

Experiments of this type have shown that a few seconds' exposure to radiation will cross link the polymer to the extent that it's softening point exceeds 121 degrees Centagrade. It can be seen that irradiated polyethylene can be used in tubing and containers for pharmaceutical purposes because it can be steralized and is resistant to chemical reaction.

This ribbon-like irradiated polyethylene tape is used to wrap coils for sintered-plate batteries, nickel-cadmium type. Hand-wrapped around the battery cores, irradiated polyethylene tape forms a stable chemical-resistant insulation between core and cylinder.

Technician assembles cores for sintered-plate batteries, nickel-cadmium type, used in photographic equipment, complicated electrical systems, and for triggering missiles. The cores are wrapped with irradiated polyethylene tape, inserted in cylinders, filled with electrolyte, and sealed.

Irradiation of ethylene is being studied by Randalph H. Bretton at Yale University, A. Charlesby at the Atomic Energy Research Establishment, Harwell, England, and E. J. Lewis and his associates at the University of Michigan. Irradiation of a gaseous material, such as ethylene, could be carried out as a continuous process. The gas is pumped into the reactor and the liquid polymer is withdrawn. Developments along lines like these are part of the problem that these men are looking into.

R. H. Bretton is carrying out his research with a reactor using Co^{60}. This Co^{60} has a half life of 5.2 years. The gamma-radiation source was fabricated at Brookhaven National Laboratory. It consists of a Cobalt tube, which is about 13 inches long and has an internal diameter of about 2 inches. The Cobalt tube is permanently encased in a lead pig, which is enclosed in a stainless steel shell. An access hole is provided in the top of the pig through which samples may be inserted. The pig itself is mounted on a concrete base and additional shielding is provided by a concrete wall 5 feet high and 8 inches thick which encloses the pig and base.

For reactions that are to be carried out at nearly atmospheric pressure and room temperature, a pyrex glass batch reactor is used to introduce the sample into the radiation chamber. The glass reactor is connected to a manometer with a capillary tube. The reactor can be evacuated and charged thru this tube. The mano-

(Continued on page 64)


NATIONAL ENGINEERS' WEEK
FEBRUARY 17-23, 1957
ENGINEERING... America's Great Resource

"A new era is beginning...

"As I review the progress in aeronautics within so short a span, and marvel at the complex aircraft of today, I call it an achievement little short of miraculous.

"Today, electronically-guided planes take off and land without human touch. Lethal sky missiles seek and destroy invisible targets with uncanny precision. And still other fantastic achievements in both man-controlled and pilotless flight are now in the offing.

"When men go to the moon and planets, electronically-controlled skycraft will take them there. Aviation maps will be studded with stars as well as with cities. New developments in aeronautics will go on and on. Success opportunities and careers will continue to develop for ambitious young men in this exciting field where a new era is beginning."*

LEE De FOREST

Appropriately qualified to speak for aeronautics and other fields in which his own scientific achievements play an important part, Dr. Lee de Forest gives helpful counsel to young graduates headed for successful, rewarding careers.

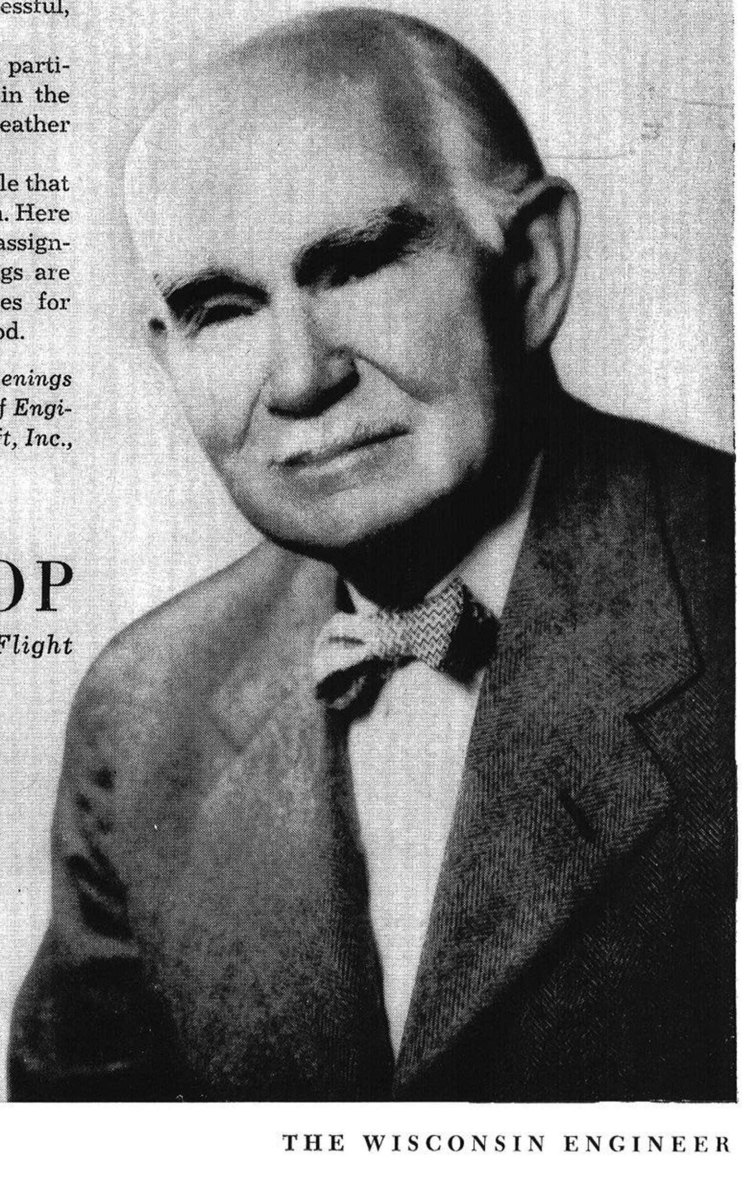
His expression, "a new era is beginning," has particular significance at Northrop, world leader in the design, development and production of all-weather and pilotless aircraft.

At Northrop, permanent positions are available that offer full play for individual talent and ambition. Here the graduate engineer will find interesting assignments for which he is best fitted. Surroundings are attractive, co-workers congenial, opportunities for advancement unceasing, the compensation good.

For detailed information regarding specific openings in your field of specialization, write Manager of Engineering Industrial Relations, Northrop Aircraft, Inc., 1001 East Broadway, Hawthorne, California.

NORTHROP

Pioneers in All Weather and Pilotless Flight



**A statement by Dr. Lee de Forest, pioneer in radio.*

SCIENCE HIGH-

by Ted Witzel e'57

X-RAY MICROSCOPE

A powerful new tool for research into hitherto unexplored fields of metals, foods, chemicals and criminology. Under development for more than 4 years, the x-ray microscope promises to reveal hidden facts concerning such vital facts as corrosion in metals, the effect of foreign materials in metals, the soundness of electroplated coatings, and the effects of various processes on the behavior and structure of metals.

Secret of the x-ray microscope lies in the extremely tiny size of the focal spot, which is bombarded by electrons and thus caused to give off x-rays. This target is only 40 millionths of an inch in diameter. X-Rays emanating from such a small spot fan out in all directions and hence magnify any object which they pass through. The x-ray microscope achieves magnifications up to 1,500 times, and at the same time discloses the inner structure of the object being examined.

While not as powerful in its magnifying power as the electron microscope, the x-ray microscope has an advantage in that it does not require mounting the specimen in a vacuum and other special preparation techniques.

It has an advantage over the optical microscope in depth of focus which permits three-dimensional examination of the specimen. No special sectioning is required to prepare the specimen.

Its inherent advantage over both is that it penetrates to the interior of the object and reveals structures otherwise not visible.

The x-ray microscope may be used either for direct viewing or for recording the image on film. A Polaroid camera may be attached to produce an immediate record on film.

Basically, this is how the x-ray microscope works: A narrow beam of electrons emerges from an electron "gun". This beam is cut down to desired size by a condenser lens, and then passes through an objective lens. The tiny beam then bombards the target made of a sheet of tungsten which is thick enough to stop the electrons but thin enough to permit the generated x-rays to pass through.

The remainder of the instrument is a simple shadow projection microscope. That is, a specimen placed near the x-ray source casts an enlarged image on a fluorescent screen, where it can be viewed by the eye, or on a photographic film where the image is recorded.

REVOLUTIONARY NEW TYPE OF PRINTED CIRCUIT PANEL IS MOULDED AND ELIMINATES PIERCING DIES

A revolutionary new type of printed circuit panel, moulded of a variety of resins that are superior in electrical and physical characteristics, will eliminate the use of expensive piercing dies and punch presses. The panel, which sells for two-thirds the cost of an average etched panel, has been developed by Die Form Circuits, Inc.

The panel is custom made to any design or size. Its design characteristics provide indestructible attachment of components by automatic soldering. Adhesion of circuitry ap-

A group of engineers inspect the new G.E. Electron Microscope, including 2nd from left, S. E. Summers of the Milwaukee X-ray Plant.

The new G.E. X-ray Microscope, adapted for direct-viewing.

LIGHTS

proaches molecular attraction without the use of adhesives. No wet flux application is required prior to soldering, thereby eliminating the necessity of cleaning after assembly.

Relatively large hour glass shaped holes allow automatic insertion entirely free of jamming prevalent in paper laminate caused by misalignment of holes, due to shrinkage after heating prior to piercing. The conductors and hole linings are entirely of copper with electroplated solder applied to the entire circuitry to prevent copper oxidation which also facilitates soldering.

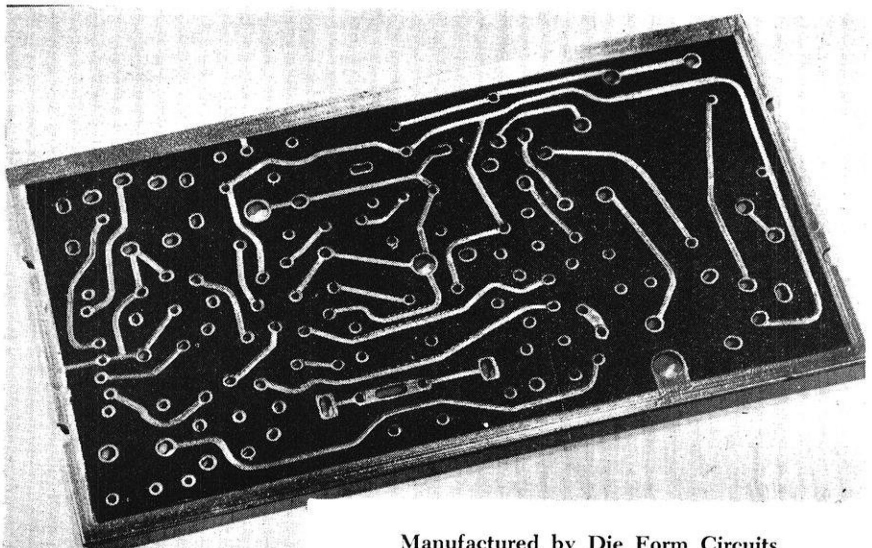
Rosin flux is baked onto the panel, applied to points to be soldered, thus eliminating the use of wet flux and the additional operation of washing off the residue after soldering. The hour glass shaped copper lined holes of the panel after soldering are completely filled by a solder nugget securely imbedding component terminals. Accordingly, no component terminals need be crimped either for holding or of affect soldering.

The elimination of crimping will allow manual insertion of parts by operators at the assembly machine and therefore permit complete assembly in any combination of manual and automatic insertion.

Circuitry configuration and holes are moulded into the panel, thus depressed below the outer surface secure from physical damage and free from circuit shorts due to component enclosures resting on the panel surface.

Die Form uses an electrical grade phenol resin whose minimum characteristics of power factor, dialetric constant and water absorption are far superior to the most expensive grades of paper laminate.

This unique method of fabricating a printed circuit provides a completely cured panel that will not soften under the high temperatures necessary in soldering to assure complete alloying to the circuitry. The panel will be approved for continuous operating temperatures in a finished instrument of 150 degrees Centigrade, 45 degrees above Underwriter approval for paper laminate.



Manufactured by Die Form Circuits.

Physical stability of the completely cured panel prevents lifting of circuitry as presently experienced in paper laminates due to vapor pressure induced by volatiles and unpolymerized resins of the laminates.

Low moisture absorption and homogeneous texture of the surface prevent retention of acid salts, whereas etching or plating of paper laminate risks absorption in plies of wood fiber exposed on all edges and holes. Material in sheet form only is usable in current printed circuit panels. However, any resin that can be transfer moulded may be used in the panel.

NEW RCA ELECTRONIC MEMORY UNIT CAN HANDLE MILLIONS OF ITEMS AT SPLIT-SECOND SPEEDS

A new memory device that will enable electronic computers to store more than a million bits of information in a space little larger than a shoe box and to recall any or all of the items in a few millionths of a second was announced here today at the David Sarnoff Research Center of the Radio Corporation of America.

The new memory, consisting basically of thin, printed plates of special magnetic material perforated with small holes, was developed by a research group under the direction of Dr. Jan A. Rajchman, who also developed the high-speed magnetic core memory system used in many present-day computers.

"A key point in the operation of all electronic computers is the information storage system in which various elements of a computing problem are stored electronically and recalled instantly as they are needed," said Dr. Wolff. "The development by Dr. Rajchman of the magnetic core system several years ago brought substantial gains in speed and efficiency by providing for the first time a means for storing thousands of bits of information and recalling them instantly in any desired order, combination, or quantity.

"The new apertured plate now carries this development several steps further, providing a means for handling millions rather than thosuands of bits of information, and at the same time offering far greater compactness and operating simplicity than could be achieved with the earlier system. Moreover, the new device lends itself to extremely simple molding production techniques, in contrast to the relatively complex process of threading thousands of tiny cores onto a wire matrix to produce the magnetic core device.

"This development should permit the design and construction of larger and more versatile electronic computers and data processing systems, and it will at the same time provide a compact and economical type of memory for relatively small computing equipment."

Information is stored in magnetic form—Explaining the new device, Dr. Rajchman pointed out that its operating principles, like those of the magnetic core system, are based on the fact that computer language consists only of "0" and "1," used in various combinations to represent any words, numbers or symbols.

"Since any desired information can be formulated in terms of 0 and 1, it is possible to employ a storage or memory system in which each of the memory elements can be switched electrically to represent one or the other of these two values," Dr. Rajchman explained.

"The new aperture plate memory stores this information in the form of magnetic fields. One of the two values is represented by a flow of magnetism, or magnetic flux, in one direction around a hole in the plate, while the other value is represented by a magnetic flux in the opposite direction."

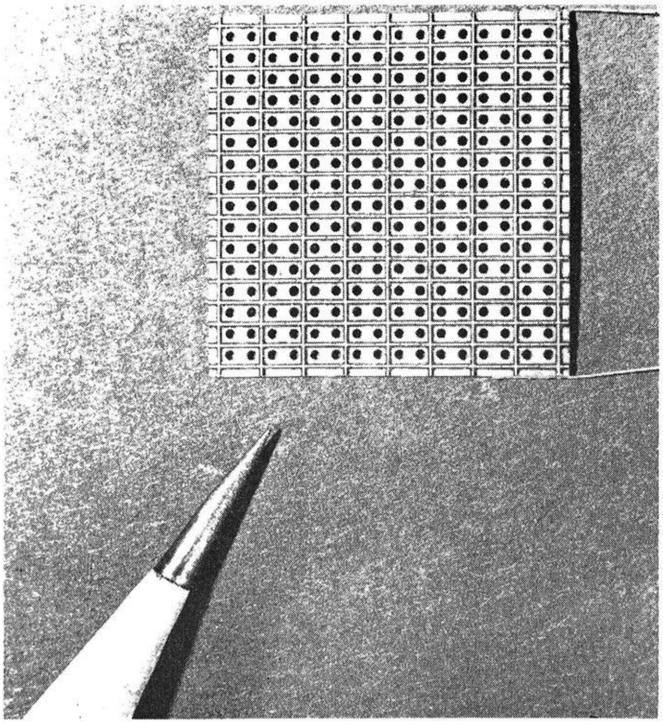
According to Dr. Rajchman, the small plates used in the new system are made of a special ferromagnetic material, a ceramic-like substance that can be molded in any desired size or shape, and hardened by heating. The experimental units produced are less than an inch square and contain 256 holes, permitting the storage of 256 bits of information in each plate.

Dr. Rajchman pointed out that production of the presently-used magnetic core memory system involved a complex assembly operation, since it was necessary to thread wires in two directions through tiny ferromagnetic cores, and then to link all of the cores in a system with two more windings. The row and column windings in the core system served to address each individual core, while the other windings provided the means for storing and reading out information.

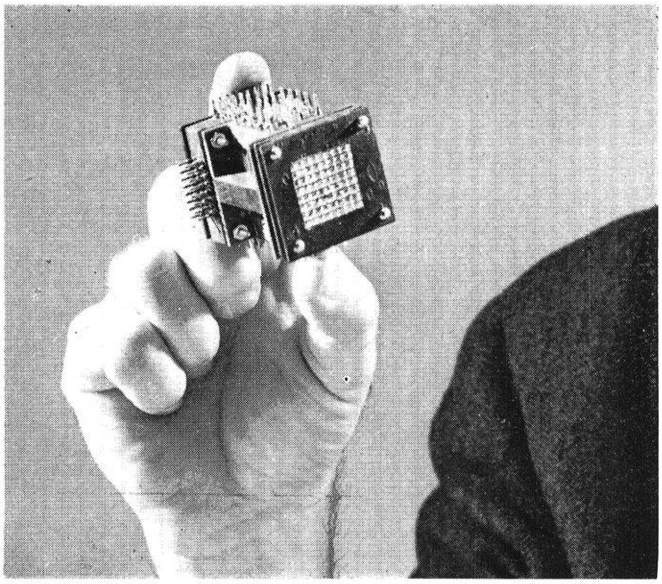
"With the new plate system," said Dr. Rajchman, "the plates themselves are insulators and the holes can be joined by conductors using the highly efficient printed circuit technique in place of the complex storage and readout windings of the previous core ssytem.

"The development of these aperture plates has now reached a stage which opens possibilities of memories of very large capacities—millions of bits. Because this arrangement requires much less driv-

(Continued on page 70)



Apertured plate for the new RCA memory device.

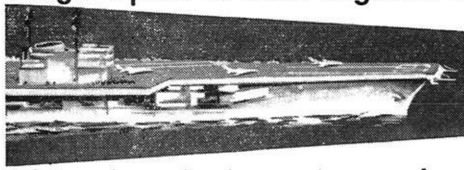


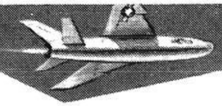
New memory device developed at the David Sarnoff Research Center of the Radio Corporation of America.

Keeping up with progress can be a full-time job, but *making* progress is the key to adventure. This is the province of the engineer, and today his

New Ideas

are sparking dramatic technical advancements. Chance Vought's respect for a new idea has attracted selective engineers for 39 years. Here, the young engineer needn't settle initially on modest goals, for lack of experience. His *ideas* can elevate him to positions of leadership. To draw technical opinions from all levels, Vought opens to each engineer a wide view of his own job and its relation to others. This broadening begins in the first weeks of





orientation. As it continues, the engineer's contributions become more valuable. Spectacular weapons like our Crusader fighter have been one result. Spectacular careers, another. If you'd like a chance to speak up and step up in a growing company, check your capacity for a Vought career. Send a resumé of your background to:

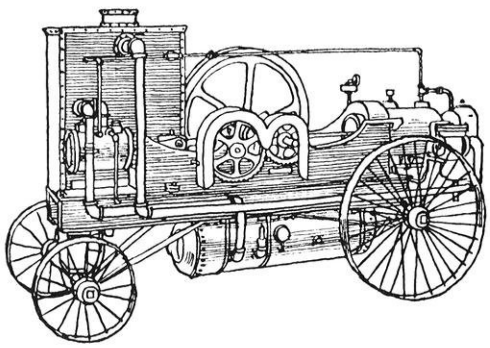
Mr. J. W. Larson, Asst. Chief Engineer, Engineering Personnel Dept. 11

CHANCE VOUGHT AIRCRAFT

INCORPORATED · DALLAS, TEXAS

55 YEARS AGO

this early portable compressor made air power history



THIS gasoline-powered portable air compressor, introduced by Ingersoll-Rand in 1902, may look crude and cumbersome by today's standards. But at the time it was a real innovation — one of the first practical compressors which could be easily moved about from job to job.

TODAY *it's the* GYRO-FLO

. . . another basic advance in compressor design by Ingersoll-Rand

THE GYRO-FLO is a rotary sliding-vane portable compressor with oil injection cooling, first introduced by Ingersoll-Rand in 1950. The success of this unit has been proven by the ever-growing trend to this type of design, and the increasing demand for rotary air power. Ingersoll-Rand now manufactures the most complete line of rotary portable compressors available.

If you'd rather help make industrial history than read about it, why not investigate the fine job opportunities available with Ingersoll-Rand — recognized leader in the machinery field. For further information contact your Placement Office or write Ingersoll-Rand.

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COMPRESSORS • BLOWERS • GAS & DIESEL ENGINES • PUMPS • VACUUM EQUIPMENT • AIR & ELECTRIC TOOLS • MINING & CONSTRUCTION EQUIPMENT

ENGINE EARS

by Dave Rex m'57

G. L. LARSON AWARD WINNER

University of Wisconsin student **Ronald L. Kausch** recently received from the Wisconsin Chapter, American Society of Heating and Air Conditioning Engineers the first G. L. Larson Award established in memory of the late Gustus L. Larson. The recipient of the award is a senior in mechanical engineering.

Professor Larson was president of the Society in 1936. He also was chairman of the Mechanical Engineering Department, University of Wisconsin. As a Society officer and an educator he was an inspiration to many of today's prominent leaders in the heating, ventilating and air conditioning profession.

Ronald L. Kausch.

In recognition of this exemplary influence the Wisconsin Chapter of the Society has established this memorial consisting of a fund for outstanding students of heating, ventilating and air conditioning.

On October 21 the Council of the Society voted final approval and recognition of the Wisconsin Chapter's Gustus L. Larson Award Committee making it, by this action, an official Society committee.

Junior and senior undergraduates are eligible for this award. To date a total of nearly $3,000.00 has been received by the committee from firms and 3 interested individuals. The committee plans to expand the fund by bringing the award to the attention of other companies and interested individuals.

Serving on the committee are Louis C. Plaehn, chairman; Paul D. Gayman, co-chairman; Burnett M. Kluge, secretary; Bert Fredericksen, F. W. Goldsmith, Frank J. Nunlist, Jr., and Irvin J. Rossiter.

FEF SCHOLARSHIP WINNERS

Foundry Educational Foundation (FEF) has announced the following scholarship winners:

Lewis A. Ake
James A. Behring, Met.E., 1957
John W. Bolstad
Thomas J. Bosworth
Richard E. Duchow, E.E., 1958
Richard M. Gregory, Met.E., 1957
John A. Hren, Met.E., 1957
Robert I. Kernland, Met.E., 1958
Ronald R. Schild
Donald Vanden Noven
Robert J. Walter
James J. Wert, Met.E., 1957
James R. Widmoyer

Scholarships are awarded on the basis of: (1) interest in the foundry industry, (2) scholastic capabilities, (3) desirable character and personality traits, and (4) the need for financial assistance.

ENGINEERING INSTITUTES

Students Are Invited to Attend These Institute Meetings

Objectives—The Engineering Institute program at the University of Wisconsin is an adult education activity planned for persons currently employed in industry. Concentrated courses of up-to-the-minute engineering information are offered to technical personnel to help them keep abreast of their fields. Industrial Plant Maintenance, Drafting Organization, Materials Handling, Tool Engineering, Heat Treating, Inspection Methods, and Plastic Processing are but a few of the timely subjects offered.

Sponsors—The Institutes are sponsored by the College of Engineering and the University Extension Division, with the cooperation of industry, professional and technical societies, and trade associations. The programs are given on the University of Wisconsin campus in Madison and last from two to three days.

Who teaches them—Because of the immediate practical aspects of the programs, most of the speakers are chosen from industrial organizations. Specialists from research laboratories, consulting firms, and the faculty of the University of Wisconsin and other educational institutions are selected when the subject matter is appropriate.

How information is given—Material is presented by informal talks, panel discussion, films, slides and demonstrations. Many of the talks are mimeographed and distributed to those in attendance.

Who attends—An average of thirty-three Institutes are given per year, with an average total attendance of 1400 persons. This total attendance represents approximately 560 different companies, 206 communities, plus Washington, D. C., and Canada. A typical conference group includes executives, chief engineers, plant maintenance men, research engineers, product engineers, sales engineers, technicians, draftsmen, and others.

For more information—If you would like a copy of our current announcements, or if we can give you any additional information about the Institute program, write to Engineering Institutes, University Extension Division, The University of Wisconsin, Madison 6, Wisconsin.

NOBEL PHYSICS PRIZE TO ALUM BARDEEN

A Wisconsin alumnus, Dr. John Bardeen, is one of three Americans to receive a 1956 Nobel prize in physics for development of the transistor.

Dr. Bardeen and two colleagues, Dr. William Shockley and Dr. Walter H. Brattain, received the awards Monday in Stockholm, Sweden.

Dr. Bardeen received his B.S. and M.S. degrees in electrical engineering from the university in 1928 and 1929. He received his Ph.D. from Princeton in 1936. Dr. Bardeen is the son of Charles R. Bardeen, former dean of the School of Medicine here.

—Courtesy the Capital Times

Dr. John Bardeen

He developed the transistor, the miracle midget electronics tube, while he was a physicist for the Bell Telephone company at Murray Hill, New Jersey from 1945 to 1948.

FELLOWSHIPS

The Daniel and Florence Guggenheim Foundation announced today that 18 to 20 Fellowships for graduate study in the fields of jet propulsion and flight structures will be awarded in 1957 by the Daniel and Florence Guggenheim Jet Propulsion Centers at Princeton University and California Institute of Technology and the Institute of Flight Structures at Columbia University.

Carrying stipends of $1200 to $2000 each, plus tuition, these Fellowships will enable promising young men to pursue advanced work at these institutions. The Fellowships were originated to attract the most capable young men with degrees in the physical sciences to work in the field of jet propulsion and flight structures.

The Jet Propulsion Centers were established at Princeton and California Institute of Technology in 1948 by the Daniel and Florence Guggenheim Foundation to provide special facilities for graduate study and research in the fields of jet and rocket technology. The Institute of Flight Structures was set up at Columbia University in 1954 as a center for advanced education and research in flight structures, a field which has not maintained pace with the rapid advances being made in power plant development for transsonic and supersonic aircraft. All three of the establishments were designed to speed graduate training and research in the peacetime applications of jet power and jet-propelled craft.

Application forms are available from the Presidents and Deans of all engineering and technical colleges; Presidents, Plant Managers and Personnel Directors of all companies, laboratories and engineering organizations known to be engaged in rocket, jet propulsion or flight structures work; commanding officers of Armed Forces units and establishments engaged in rocket and jet propulsion development and testing; Secretaries of principal technical societies; and from the Daniel and Florence Guggenheim Foundation, 120 Broadway, New York City, as well as the jet Propulsion Centers at Princeton University and California Institute of Technology and the Institute of Flight Structures at Columbia University.

JOB OPPORTUNITIES

The Kansas City Regional Office of the Civil Aeronautics Administration has announced it is recruiting 200–300 additional air traffic controllers, civil electronic engineers, and specialists in connection with the increased air navigation control program approved by Congress.

The positions, which are under civil service, are located in Michigan, Wisconsin, Illinois, Indiana, Missouri, Minnesota, Iowa, Kansas, Nebraska, North Dakota, and South Dakota. Beginning salaries range from $3,670 to $7,035 per year. Individuals with experience as a pilot, air traffic controller, aeronautical communications, electronic engineer, or specialist are

(Continued on page 46)

PUTTING SALT ON BACTERIAL TAILS

by Clinton Ayers che'58

In childhood days, many of us had the idea that if we could only put some salt on a bird's tail, we could catch it. For birds it doesn't work. For bacteria, it does!

This news comes from a firm manufacturing chemical air conditioning units. The firm had been getting reports that its chemical dehumidifiers were reducing bacteria, mold, and pollen counts in conditioned air.

This was of significance because if it were true, the units could be used in laboratories, plants making products, both moisture and microorganism sensitive, and in large public or commercial buildings. The system would do in one step what it takes conventional setups two.

The type of unit used, called "Kathabar", passes incoming air through a solution of lithium chloride in water. This solution, as it cools, can absorb moisture from the air. After absorbing moisture, the solution can be heated to drive off the excess moisture, cooled, and recirculated. The entire cycle is automatic and continuous. The potency of the solution apparently comes from its bactericidal power.

Tests were made by the Research Foundation of the University of Toledo. Three methods of collecting were employed. They were: the funnel impinger, the Electrostatic Air sampler, and the all glass impinger method. In the funnel impinger method, air is drawn through a 45 degree funnel onto a surface coated with nutrient solution. The Electrostatic Air Sampler collected air through a funnel, and passed it through a tube to air sampling ducts. The all glass impinger drew air through five banks of sample tubes 6 to 10 mm in diameter. The device used a 16.5" of Hg vacuum.

For comparison purposes, an open petri dish layout was used in some of the rooms of the buildings in which the tests were being made. This method is analogous to counting the flies in a room by catching them on a strip of fly-paper!

Tests were run in two hotels in Toledo. One had Kathabar, the other had conventional refrigeration-air conditioning. The Kathabar unit handled 4150 cfm of fresh air, and 5600 cfm of regenerated air. The conventional unit handled 1735 cfm of fresh air, and 2685 cfm of regenerated air.

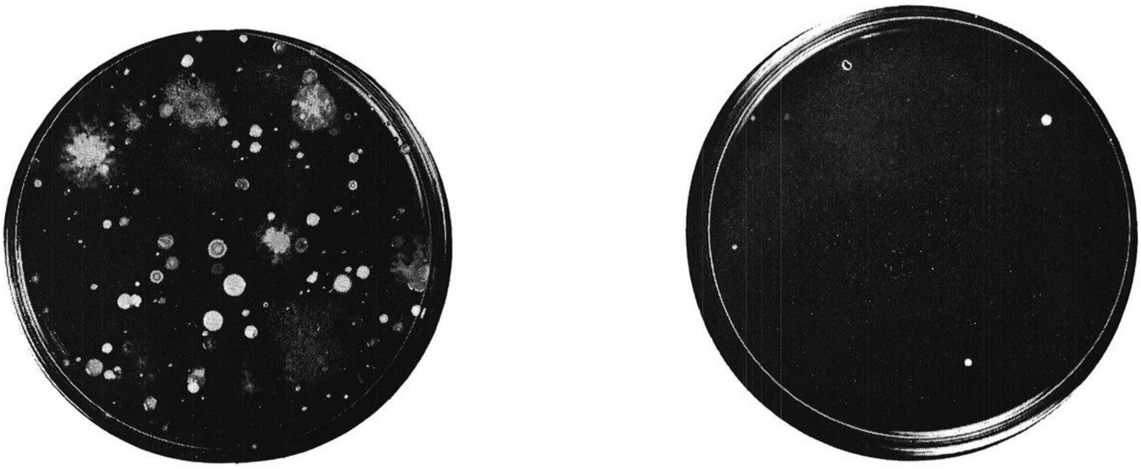
Tests were conducted in the following manner for the Kathabar device: Four stations were set up, number one where the room air entered for recirculation, number two where fresh air was entered, number three between the Kathabar unit proper and the fan, and number four just downstream from the fan. After a series of tests, it was decided to use only the all glass impinger and the electrostatic air sampler.

Samples were of units of ten cubic feet, and were incubated at room-temperature or a little above for 48 to 96 hours, at the end of which time the number of colonies were counted. The results are shown in the table below:

	Station 2	Station 3
No. of Samples	34	34
Average no. of Colonies	525	9.7

A further check was made on recirculated air and the mixture of fresh and recirculated air to see how well microorganisms were removed from air returned to the room. The results were:

	Station 1	Station 2	Station 3	Station 4
No. of Samples	21	21	21	21
Average no. of Colonies	223	220	1	119



Open petri dish examinations show visible proof of the effect of Kathabar on the formation of bacteria colonies. The Kathabar test is on the right.

Kathabar removed 98% of the microorganisms from fresh air, and half of the colonies present in room air.

These tests were on total microorganisms. Further checks were made for pathogenic (disease-carrying) microorganisms. The results were:

	Station 1	Station 4	Station 2	Station 3
No. of Samples	21	21	21	21
Average no. of Colonies	22	12	10	1 per 10 or 11 samples

Kathabar was very effective in removing pathogenic organisms.

The tests in the second hotel were made while the refrigerator was on, and also at intervals of about twenty minutes for an hour and a half after the refrigeration had been turned off, while the fan was running. Swab samples were taken from the coils themselves. The results were:

	Fresh Air	Return Air	Air to Coils	Air from Coils
No. of Samples	22	22	22	22
Average no. of Colonies	809	800	817	885

The refrigerator coils added to the number of organisms present.

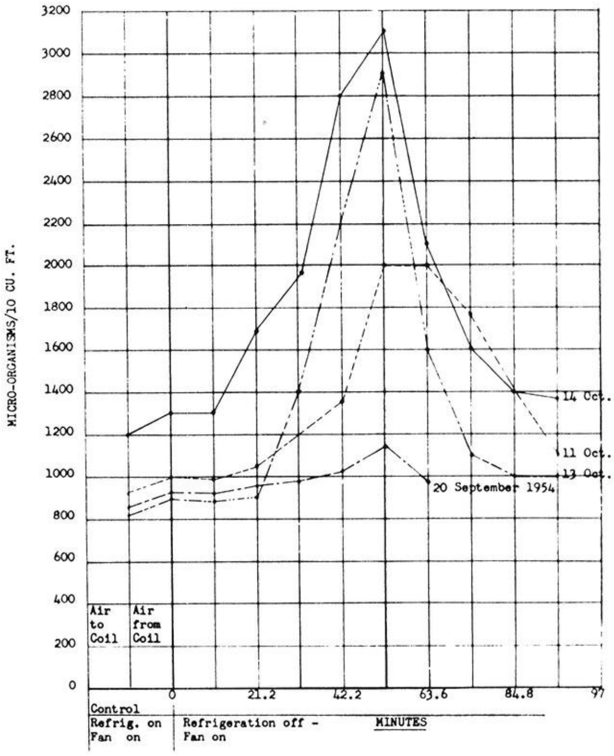
The swab samples showed over 10,000 colonies per square inch. As the coils warmed up, they released increasing numbers of microorganisms with a peak being reached about one hour after the refrigeration was turned off.

The Kathabar equipment as presently designed will remove about 98% of the organisms present. Its efficiency could be increased by adding a second bath and a more easily sterilized fan. Where 100% removal is needed, an air incinerator is needed.

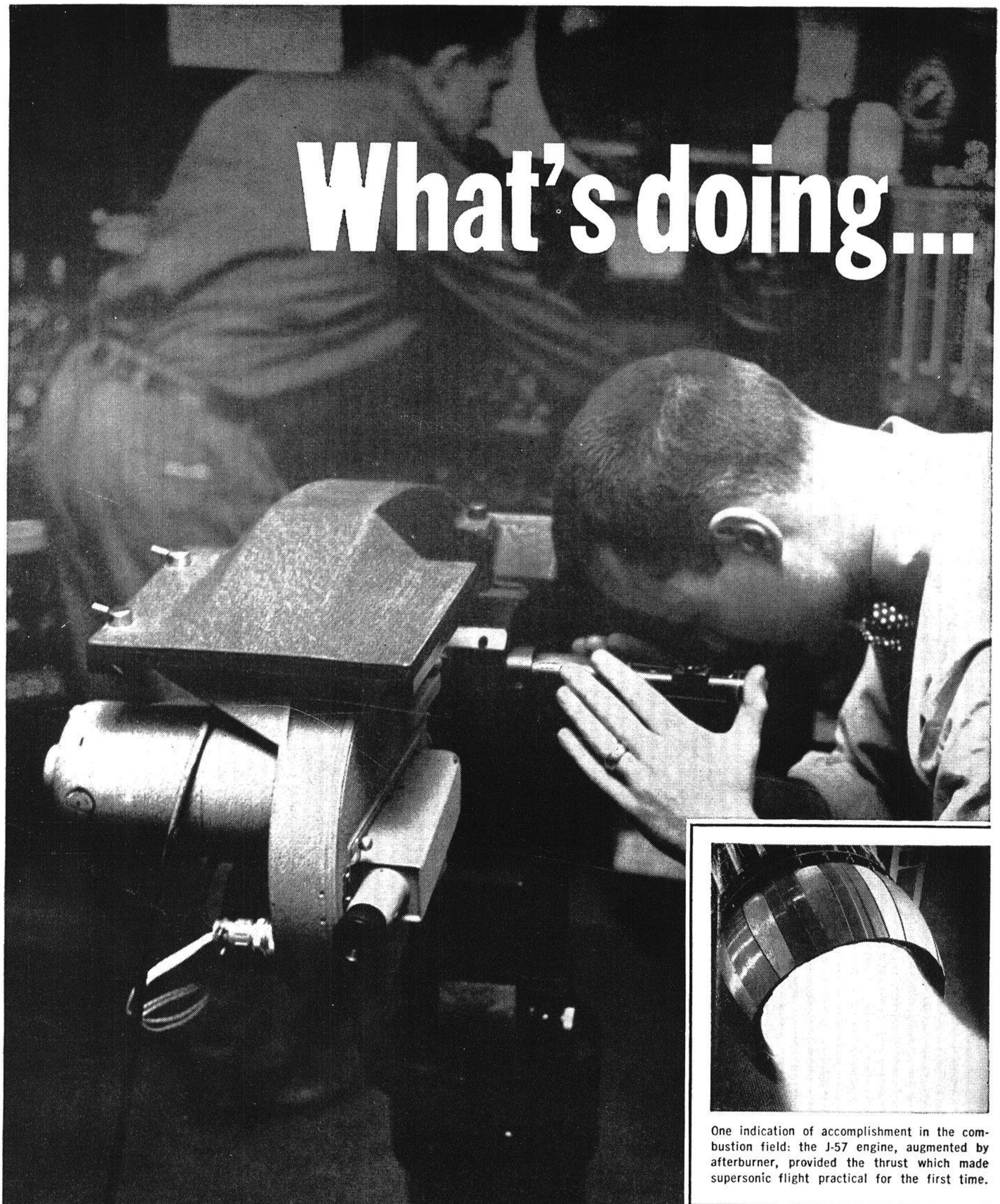
Three prime advantages of Kathabar are: first, it is completely automatic, requiring only a minimum amount of maintenance; second, it is not necessary to decontaminate the system because the organisms are contained in the solution, which is bacteriacidal; third, the machinery also controls humidity.

By carefully controlling the cooling of the solution during its regeneration the amount of moisture it will take up, and therefore the humidity, can be more carefully controlled than with conventional units.

Workers using glass filter media have reported 99% removal of microorganisms. If performances of this order were required, one of these filters could be set up behind the Kathabar fans. The filter would be acting only on a small percentage of the entering bacteria so it could be used for longer times before it had to be changed or cleaned. It would also make the sterilizing of the fan less critical. THE END



The effect of Kathabar shown graphically.



One indication of accomplishment in the combustion field: the J-57 engine, augmented by afterburner, provided the thrust which made supersonic flight practical for the first time.

This special periscope gives Pratt & Whitney Aircraft engineer a close-up view of combustion process actually taking place within the afterburner of an advanced jet engine on test. What the engineer observes is simultaneously recorded by a high-speed motion picture camera.

W. S. P. E.

WISCONSIN SOCIETY OF PROFESSIONAL ENGINEERS

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NATIONAL REPRESENTATIVE
HAROLD TRESTOR

ENGINEERS' CREED

As a professional engineer, I dedicate my professional knowledge and skill to the advancement and betterment of human welfare.

I PLEDGE

To give the utmost of performance, to participate in none but honest enterprise, to live and work according to the laws of and the highest standards of professional conduct. To place service before profit, the honor and standing of the profession before personal advantage, and the public welfare above all other considerations. In humility and with need for Divine Guidance, I make this pledge.

WISCONSIN STATE EMPLOYMENT SERVICE

About a year ago the Wisconsin State Employment Service announced the organization of a Professional Placement Division. As a member of the engineering profession, you may be interested in their progress report.

Employers and applicants alike have given support to the program. The volume of activities illustrates the extent to which the service is being used. Since the inauguration of the program, many professional workers have been placed in jobs with salaries of $4000 to $12,000 per year.

In addition to engineers, placements were made in the following occupations: accountants, lawyers, mathematicians, physicists, personnel managers, chemists, sociologists, economists and psychologists. The service has a nation wide affiliation. One out of every four persons registering with the division is successfully placed in employment.

Further information may be obtained by contacting the Wisconsin State Employment Service, 105 South Blair St., Madison 3, Wis.

WSPE MEMBERS IN MILITARY SERVICE

Members of the society who are drafted into military service may have their dues waived each year by requesting such in writing.

NATIONAL ENGINEERS' WEEK

February 17–23, 1957

The Week of George Washington's Birthday is being spotlighted over the nation because our first United States president was one of America's first engineers, and certainly one of the most distinguished.

Special programs, on radio, TV, newspapers, civic clubs, technical clubs, schools will be held throughout the nation during that week.

Engineers Select Theme for National Week. "Engineering—America's Great Resource" has been chosen as the theme for the 1957 National Engineers Week. It was chosen because of the "increasing recognition of the fact that our real resources are not underground but rather walking around about 6 feet above ground in the minds and attitudes of our people." A current situation is the use of atomic energy: "It is not the atom that will revolutionize the power industry, but the engineering skills that are applied to the harnessing of atomic processes."

The Engineer. Engineers make up one of America's largest professions, and engineers are becoming ever more important to our national survival as we move into the age of nuclear power and automation. Today engineering skills are among our most precious resources. They are the foundation stones on which much of our future prosperity will be built. Advances in engineering directly influences such varied fields as public health, agriculture, traffic and industrial safety and medicine. The labor saving devices in our homes are the fruits of engineering knowledge. And our home radio and television sets are things which would have appeared miraculous only a few generations ago. Engineers took the basic discoveries in electronics, made in the last century, and developed them into practical means for wireless communication. The same thing is happening right now in the field of nuclear energy. The atom is being put to work to generate power for our homes and industries, one

(Continued on page 44)

Meet the President

JAMES W. JOHNSON
President, Western Chapter

James W. Johnson, President of the Western Chapter of W. S. P. E. was born in Osseo, Wisconsin on August 18, 1900. After his graduation from Eau Claire State College in 1932, he taught high school mathematics and science for two years. Mr. Johnson then attended the University of Wisconsin in 1925 and 1926. In 1926 he became employed by the La Crosse district of the Wisconsin State Highway Commission where he is now serving as District Five Federal Aid Secondary Engineer. He was married to Laura Jane Fox on December 16, 1923. They have one son and two daughters, all of whom are married. Mr. Johnson is a member of the First Congregational Church of La Crosse, also the F. and A. Masons and the Scottish Rite Bodies.

Mr. Johnson is a charter member of the Western Chapter of W. S. P. E. He served as Director from 1949 to 1951 and Chairman of the Membership Committee from 1952 to 1955.

W.S.P.E.

(Continued from page 42)

more example of America's engineering resources in action.

Objectives of National Engineers' Week. National Engineers' Week is an effort to acquaint the public with facts about the engineering profession and the role it plays in our national welfare.

A profession cannot fully carry out its fundamental obligation of public service if the public is not aware of the many ways in which the profession can be of service to it. It is, therefore, one of the duties of a profession to keep the public informed as to what the profession does and how it affects everyday life.

The struggle for the survival of the free world is largely a technological struggle in which the professional engineer plays a vital and indispensable role. Continuance of our way of life is dependent upon maintaining our position of technical supremacy, which demands the highest quality of technical ability. To maintain America's present leadership, it is essential that we attract the most talented, the most creative minds of our young men and women to engineering and scientific pursuits.

It has been truly said that the finest youth are attracted to that profession to which their country attaches most prestige. In totalitarian countries, a few men can decree which profession shall have such prestige. Behind the "iron curtain," strong incentives are offered to young men and women to follow engineering and scientific careers. In a free country like ours, we must attain the same result by selling the idea that the building up of the prestige of the engineering profession is the patriotic duty of every member of our profession. This can be done most effectively by a continuous program of public information.

SOUTHWEST CHAPTER

The largest attendance as yet recorded for a regular meeting of this chapter (110 members and guests) saw slides of India and heard Dr. Gerald Pickett tell of his trip to that country. Dr. Pickett had recently returned from Bangalor University where he was a guest professor. The slides gave an insight into life in India as well as showing some recent engineering works.

Present at this meeting were 14 new members attending for the first time. In line with current policy of the Chapter each of these men was presented with an NSPE pin.

The following program was announced for the next few meetings:

January 15. National Representative Harold C. Trester will speak on "The Purpose of Functional Groups Within The Framework of the WSPE". Mr. Trester is an Engineer with the C. R. Meyer & Sons Co., General Contractors, Oshkosh.

February 21. Engineers Week Meeting. Tom Jordan has been appointed Chairman of the Engineers Week Committee.

March (date not yet set). Joint meeting with the Rockford Chapter of Illinois SPE, and ASME. To include trip through Beloit Iron Works and dinner at Beloit Country Club.

Henry J. Hunt was presented with a pin commemorating his 50 years of service with the firm of Mead and Hunt, Inc., at the annual Christmas dinner held December 9th at the Madison Club.

FOX RIVER VALLEY CHAPTER

A joint supper meeting of the Green Bay Engineers' Club and the Fox River Valley Chapter of the Wisconsin Society of Professional Engineers was held on Thursday, December 6th, at the Hi-Rock Club.

Principal speaker was Mr. Edgar L. McFerron, P.E., vice-president and general manager of G&L and Hypro Division, Giddings and Lewis Machine Tool Co., Fond du Lac. His address was on "Tape Control and Automation in Machine Tools", in which he illustrated some of the ways by which modern precision-production machines are guided and operated by data punched or magnetically recorded on tape reels and translated into machine motions by relays and electronic devices. Mr. McFerron also presented a short film, "Skin-Milling Machine", showing how automation precisely controls the formation of machined aircraft parts. The speaker was introduced by Mr. Walter B. Wigton, chief engineer of this division of Giddings and Lewis.

Presiding jointly over the meeting was Marvin Peterson, president of Green Bay Engineers' Club, and John K. Primm, of Manitowoc, president of Fox River Valley Chapter, WSPE. Organization secretaries are Milton Henderson, GBEC, and James Zimmerman (Appleton), FRV–WSPE.

The GBEC meets monthly in the Green Bay area. The Fox River Valley Chapter's next meeting will be February 21, 1957, at the American Legion Club in Oshkosh, as part of the observance of National Engineers' Week (Feb. 17–23).

WESTERN CHAPTER

Fall meetings of the Western chapter were well attended and excellent programs presented.

John Kramer, chief chemist at the La Crosse Rubber Mills, outlined the history of that plant and described the proceses involved in the manufacture of rubber footwear at the October meeting.

The group was shown a movie on the assembly of rubber footwear, and Kramer displayed models of insulated sporting boots, tennis shoes, women's and men's casuals, overshoes and playshoes.

At the November meeting, M. Sgt. Fred Schaefer of the Air Corps, stationed at Dubuque, Iowa, reviewed the work of the Ground Observer Corps and its function in national defense.

Three radar networks guard the United States against attack from the north; the Distant Early Warning Line (DEW Line) just under

(Continued on page 54)

Engine Ears

(Continued from page 37)

urged to write the Civil Aeronautics Administration, Kansas City, Missouri, for details.

Applications are being accepted for the positions of Electronic Scientist, Electronic Engineer, and Physicist for duty at the U. S. Navy Underwater Sound Laboratory, New London, Connecticut, and the U. S. Air Force Cambridge Research Center, Bedford, Massachusetts, the United States Civil Service Commission announces. The beginning salaries range from $4,480 to $10,320 a year.

To qualify, applicants must have had appropriate education and/or experience. Further information may be obtained at many post offices throughout the country, from the U. S. Civil Service Commission, Washington 25, D. C., or from the establishments where the positions are located.

Applications will be accepted until further notice and should be mailed to the Board of U. S. Civil Service Examiners at either the U. S. Navy Underwater Sound Laboratory, Fort Trumbull, New London, Connecticut, or to the U. S. Air Force Cambridge Research Center, L. G. Hanscom Field, Bedford, Massachusetts.

The United States Civil Service Commission has announced examinations for Highway Engineer and Highway Engineer Trainee positions, $3,415 and $4,480 a year; Student Trainee (Engineering), $3,175 a year; and Student Trainee (Civil Engineering), $3,415 a year. The Highway Engineer positions are in the Bureau of Public Roads throughout the United States, and the Student Trainee positions are principally with the Bureau of Reclamation in the western States and in Alaska.

Engineering students who would like to combine their college study with on-the-job training in a Federal establishment may be interested in applying for one of these examinations. The Highway Engineering examination is also open to persons who have completed their college study and to those who have had appropriate technical experience.

Full information regarding the requirements and how to apply may be obtained at many post offices throughout the country, or from the U. S. Civil Service Commission, Washington 25, D. C. Applications will be accepted until further notice but interested students are urged to apply as soon as possible.

SOCIETIES

POLYGON

DAVE REX

James E. Christenson, CiE 4, was awarded the Outstanding Award, given by Polygon to the outstanding senior in the College of Engineering. Jim is president of three organizations on campus and a member of Tau Beta Pi; these are only a few of Jim's many achievements.

Jim Christenson.

The following were elected at the last Polygon meeting to serve a term of office: **Ken Stall,** president; **Hymen Jonas,** vice-president; **John Nyhus,** treasurer; **Pete Reichelsdorfer,** corresponding secretary; **Dick Kramer,** recording secretary.

INSIDE S.A.E.

DONALD BECKER

Engineers—are you enrolled in the Society of Automotive Engineers here on campus? If not you've been missing an opportunity to pick up a little more knowledge in your field that you won't find in books. Here's your chance to get together with the men who are in the same courses that you are, to get to know each other a little better, and to talk over engineering ideas, both new and old. You'll find a speaker from industry with an interesting talk on the agenda of every meeting. Afterwards, there is plenty of time for informal discussion over refreshments.

The first meeting of the year was opened by president Bob Wilda in the Loft of the Memorial Union at 8 o'clock on October 25. It was decided to remove the Lincoln chassis from the lounge of the Mechanical Engineering building and replace it with the Fararri you've probably all noticed by now.

The guest speaker was Mr. James Smith of the Aluminum Company of America who talked on the future possibilities of aluminum in the automobile engine. He brought with him a number of samples and a good set of slides. Refreshments were served at 9:40 when the meeting was adjourned.

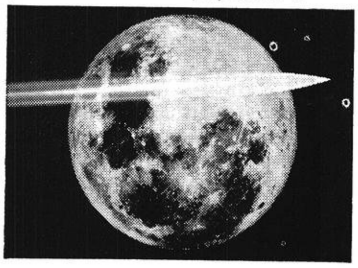
The November meeting was held in the Union also. Carl Jaeck and Will Ebel, the Polygon representatives, gave a report on the financial results of the 1956 Engineering Exposition. Included in the re-

(Continued on page 54)

Graduates in engineering, physics, applied math., allied sciences:

You can do much better than a "standard" career today!

Careers, like cars, come in various models. And nowadays such things as security, adequate compensation, vacations-with-pay are not "extras" any more—they're just "standard equipment"!

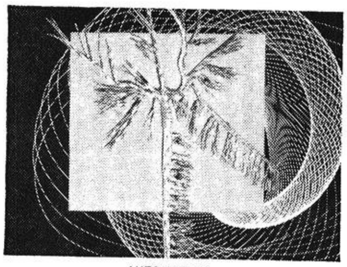


MISSILE DEVELOPMENT

As an individual, **you** decide whether you want white wall tires or maybe a sportscar. You should do no less in choosing where you want to work. At North American, fringe benefits are second-to-none; but you can get much more than that. Such extras as creative work, advanced technology, latest facilities to implement your work—these all add up to rewards an ordinary job cannot give. You'll work with men of high professional standing. Your personal contribution will earn quick recognition.

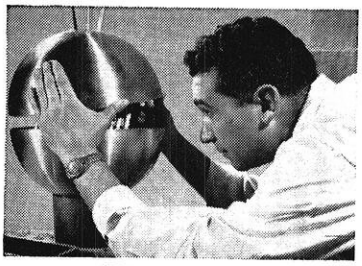
It will be worth your while personally, as well as financially, to find out about the **extras** that go with a position in any of these four pioneering fields.

MISSILE DEVELOPMENT ENGINEERING
The SM-64 Navaho Intercontinental Missile is only one of the projects here. You can well imagine the exacting standards of the work, the quality of the facilities, the caliber of the men. Here you will deal with speeds well up into multiple Mach numbers, encountering phenomena that were only being guessed at a few years ago.



AUTONETICS

AUTONETICS DIVISION—Automatic Controls Man Has Never Built Before.

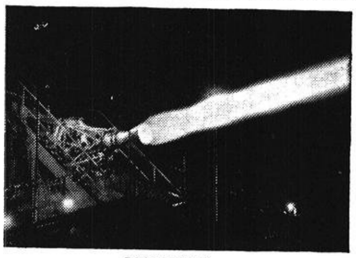


ATOMICS INTERNATIONAL

The techniques of Electro-mechanical Engineering reach their ultimate efficiency in their application to missile guidance systems, fire and flight control systems, computers and recorders. You will explore, study, test, develop and produce apparatus that can extend or supersede the human nervous system.

ROCKETDYNE DIVISION—Builders of Power for Outer Space.

If you like challenging work, the large liquid-propellant rocket engine is your field. This Division operates the biggest rocket engine **workshop** in the **Free World:** the Rocketdyne Field Test Laboratory in the Santa Susana Mountains. The engineers and scientists say they meet more different phases of work in a week here than in a year of "conventional" practice.



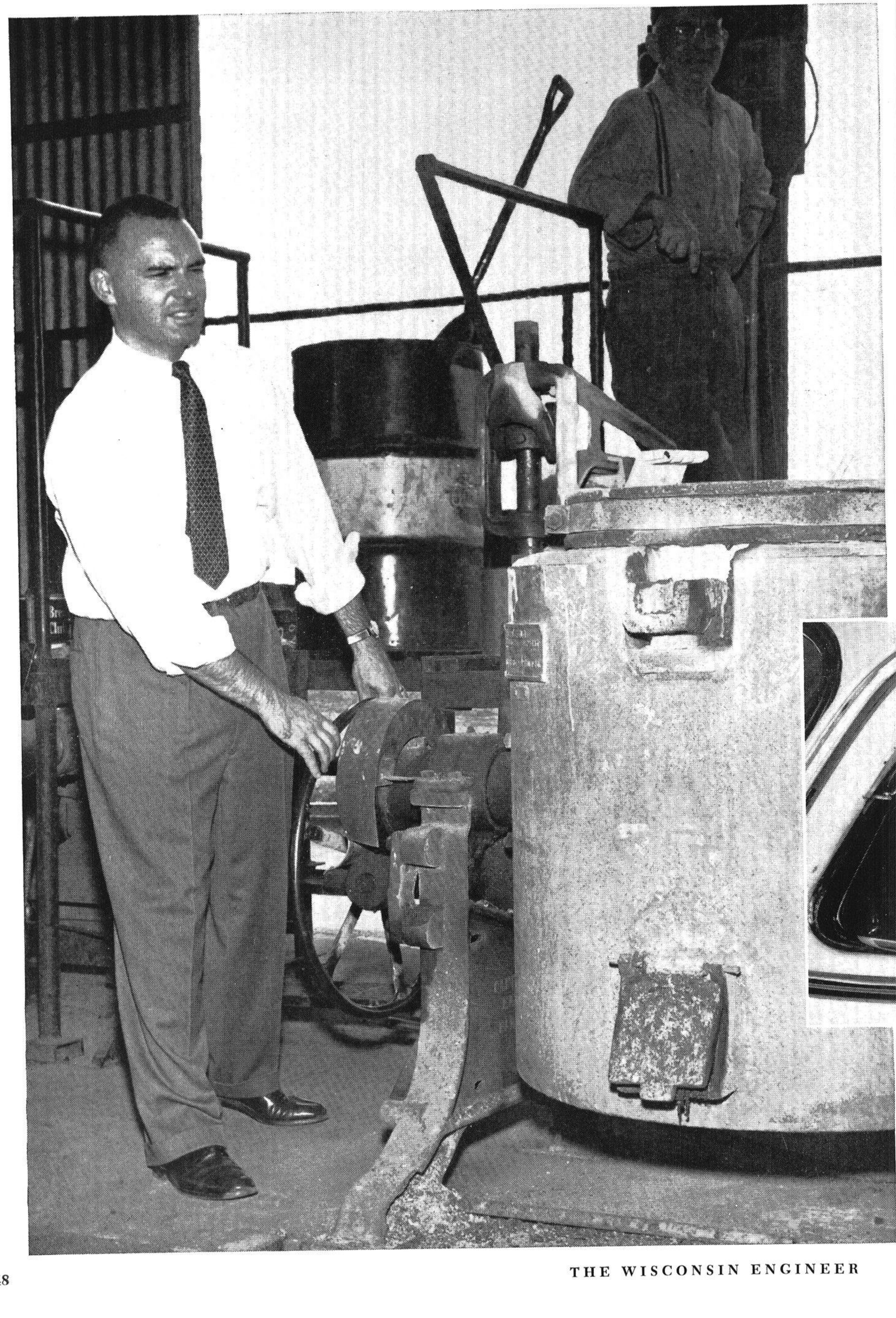
ROCKETDYNE

ATOMICS INTERNATIONAL—Pioneers in the Creative Use of the Atom.

At this Division you will see a new industrial era taking shape, and play your part in putting the peaceful atom to work for mankind. Nuclear Reactors of various kinds, for both power and research applications, are designed and delivered to order by Atomics International. With many "firsts" to their credit, these dedicated men continue to spearhead the progress in this exacting field.

For more information write: College Relations Representative Mr. J. J. Kimbark, Dept. 991-20 Col., North American Aviation, Inc., Downey, Calif.

NORTH AMERICAN AVIATION, INC.

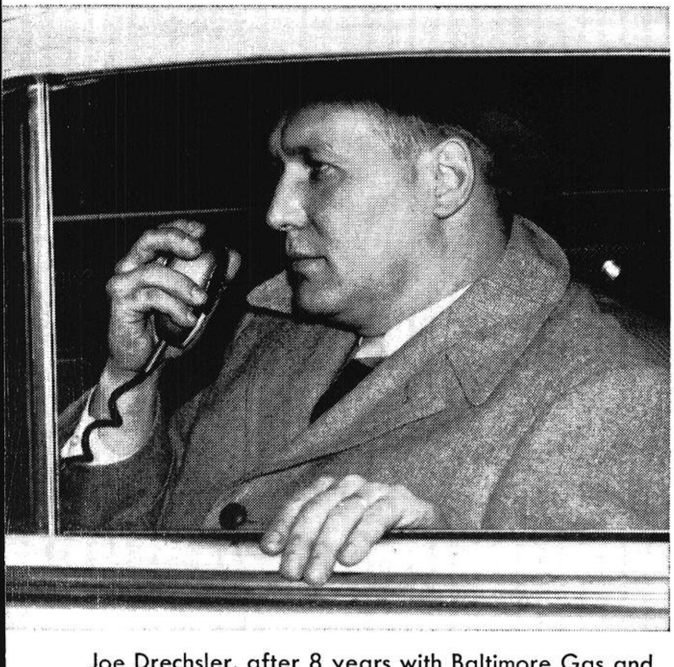


More graduate engineers moving up in the GAS industry ... the nation's sixth largest

The Gas industry—the sixth largest in the nation—has a total investment of over $15 billion. Last year the industry set a new all-time record in number of customers, volume of gas sold, and dollar revenue. In fact, Gas contributed 25% of the total energy needs of the nation as compared with 11.3% in 1940. The Gas industry is a major force in the growth development and economic health of this country.

There are many opportunities for you in the Gas industry. The industry needs engineers, and does not overhire. You won't be regimented. There's always room for advancement. With utility companies and with manufacturers of Gas equipment, there's a future for you as an engineer. Call your nearest Gas Utility. They'll be glad to talk with you about your opportunity in the Gas industry. *American Gas Association.*

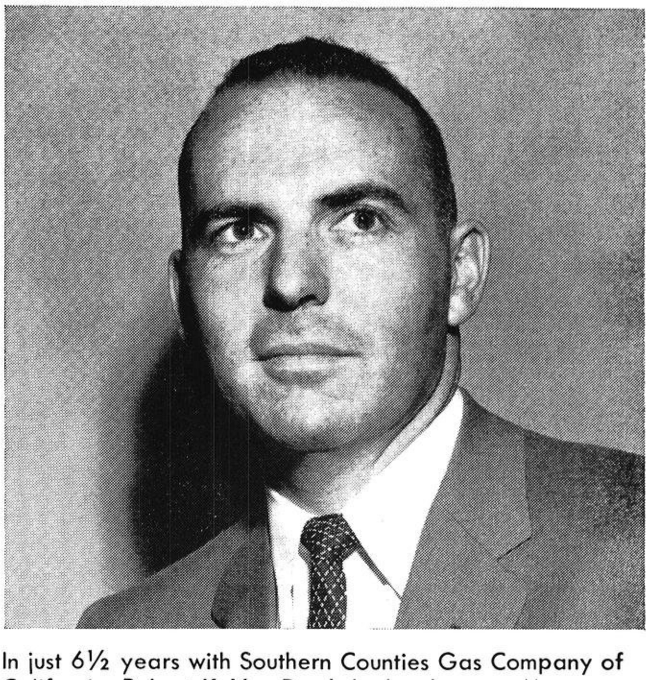
JOSEPH J. DRECHSLER
B.S. in Mechanical Engineering, 1948, Johns Hopkins University



Joe Drechsler, after 8 years with Baltimore Gas and Electric Company, is now Assistant Superintendent in a department with over 450 employees

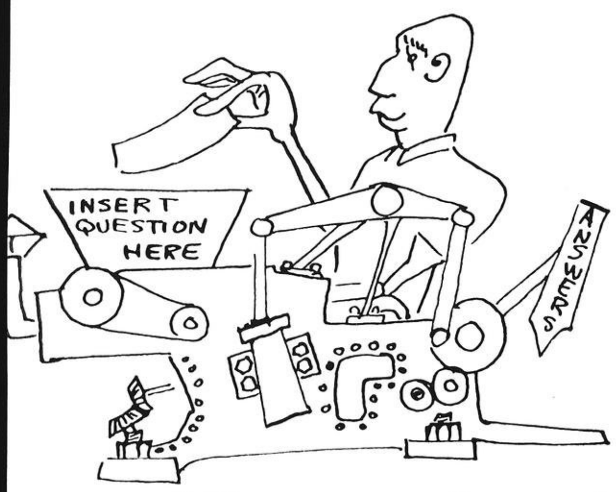
After completing the company's Student Engineering Training Program, Joe spent one year in the Gas and Steam Testing Laboratory. He was then promoted through various levels of engineering and supervisory assignments, to his present job of Assistant Superintendent on April 1, 1956. This department has over 450 employees and is responsible for the installation and servicing of industrial, commercial and domestic gas appliances on customers' property, and the installation and servicing of gas and steam metering and pressure recording equipment.

ROBERT K. VON DER LOHE
B.E. in Industrial Engineering, 1948, University of Southern California



In just 6½ years with Southern Counties Gas Company of California, Robert K. Von Der Lohe has become Manager of Commercial and Industrial Sales

After two years with a construction engineering firm, Bob Von Der Lohe joined the gas company and began his steady climb to his current position. Starting as an assistant technician in 1950, Bob has moved up through the jobs of industrial sales engineer and staff representative-industrial sales, to his present post as Manager, Commercial and Industrial Sales. Bob does more than "sell" industries and commercial operations on the use of gas. He also supervises a staff which advises restaurant and hotel owners on ways to improve their gas operations and over-all productive efficiency.



FINAGLE FACTORS

Multiply	*By*	*To Get*
miles per hour per sec	1.467	feet per sec per sec
miles per hour per sec	1.6093	km per hour per sec
miles per hour per sec	0.4470	M per sec per sec
miles per minute	2682	centimeters per sec
miles per minute	88	feet per second
miles per minute	1.6093	kilometers per min
miles per minute	60	miles per hour
milligrams	10^{-3}	grams
millihenries	10^{6}	abhenries
millihenries	10^{-3}	henries
millihenries	$1/9x10^{-11}$	stathenries
milliliters	10^{-3}	liters
millimeters	0.1	centimeters
millimeters	0.03937	inches
millimeters	39.37	mils
mils	0.002540	centimeters
mils	10^{-3}	inches
miner's inches	1.5	cubic feet per min
minutes (angle)	$2.909x10^{-4}$	radian
minutes (angle)	60	seconds (angle)
months	30.42	days
months	730	hours
months	43.800	minutes
months	$2.628x10^{6}$	seconds
myriagrams	10	kilograms
myriameters	10	kilometers
myriawatts	10	kilowatts
Ohms	10^{9}	abohms
Ohms	10^{-3}	megohms
Ohms	10^{6}	microhms
Ohms	$1/9x10^{-11}$	statohms
ohms per mil foot	166.2	abohms per cm cube
ohms per mil foot	0.1662	microhms per cm cube
ohms per mil foot	0.06524	microhms per in. cube
ounces	8	drams
ounces	437.5	grains
ounces	28.35	grams
ounces	0.0625	pounds
ounces (fluid)	1.805	cubic inches
ounces (fluid)	0.02957	liters
ounces (troy)	480	grains (troy)
ounces (troy)	31.10	grams
ounces (troy)	20	pennyweights (troy)
ounces (troy)	0.08333	pounds (troy)
ounces per square inch	0.0625	pounds per sq inch
Pennyweights (troy)	24	grains (troy)
Pennyweights (troy)	1.555	grams
Pennyweights (troy)	0.05	ounces (troy)
perches (masonry)	24.75	cubic feet
pints (dry)	33.60	cubic inches
pints (liquid)	28.87	cubic inches
poundals	13,826	dynes
poundals	14.10	grams
poundals	0.03108	pounds
pounds	444,823	dynes
pounds	7000	grains
pounds	453.6	grams
pounds	16	ounces
pounds	32.17	poundals
pounds (troy)	0.8229	pounds (av)
pounds per cubic foot	$1.356x10^{7}$	centimeter-dynes
pound-feet	13,825	centimeter-grams
pound-feet	0.1383	meter-kilograms
pound-feet	421.3	kg-cm squared
pounds-feet squared	144	pounds-in. squared
pounds-feet squared	2.926	kg-cm squared
pounds-inches squared	$6.945x10^{-3}$	pounds-feet squared
pounds-inches squared	0.01602	cubic feet
pounds of water	27.68	cubic inches
pounds of water	0.1198	gallons
pounds of water	$2.660x10^{-4}$	cubic feet per sec
pounds of water per min ..	0.01602	grams per cubic cm
pounds per cubic foot	16 02	kg per cubic meter
pounds per cubic foot	$5.787x10^{-4}$	pounds per cubic inch
pounds per cubic foot	$5.456x10^{-9}$	pounds per mil foot
pounds per cubic inch	27.68	grams per cubic cm
pounds per cubic inch	$2.768x10^{4}$	kg per cubic meter
pounds per cubic inch	1728	pounds per cubic foot
pounds per cubic inch	$9.425x10^{-6}$	pounds per mil foot
pounds per foot	1.488	kg per meter
pounds per inch	178.6	gram per cm
pounds per mil foot	$2.306x10^{6}$	grams per cubic cm
pounds per square foot	0.01602	feet of water
pounds per square foot	4.882	kg per square meter

Multiply	*By*	*To Get*
pounds per square foot	$6.944x10^{-3}$	pounds per sq inch
pounds per square inch	0.06804	atmospheres
pounds per square inch	2.307	feet of water
pounds per square inch	2.036	inches of mercury
pounds per square inch	703.1	kg per square meter
pounds per square inch	144	pounds per sq foot
Quadrants (angle)	90	degrees
Quadrants (angle)	5400	minutes
Quadrants (angle)	1.571	radians
quarts (dry)	67.20	cubic inches
quarts (liq)	57.75	cubic inches
quintals	100	pounds
quires	25	sheets
Radians	57.30	degrees
Radians	3438	minutes
Radians	0.637	quadrants
radians per second	57.30	degrees per second
radians per second	0.1592	revolutions per second
radians per second	9.549	revolutions per min
radians per sec per sec	573.0	revs per min per min
radians per sec per sec	9.549	revs per min per sec
radians per sec per sec	0.1592	revs per sec per sec
reams	500	sheets
revolutions	360	degrees
revolutions	4	quadrants
revolutions	6.283	radians
revolutions per minute	6	degrees per second
revolutions per minute	0.1047	radians per second
revolutions per minute	0.01667	revolutions per sec
revs per min per min	$1.745x10^{-3}$	rads per sec per sec
revs per min per min	0.01667	revs per min per sec
revs per min per min	$2.778x10^{-4}$	revs per sec per sec
revolutions per second	360	degrees per second
revolutions per second	6.283	radians per second
revolutions per second	60	revs per min
revs per sec per sec	6.283	rads per sec per sec
revs per sec per sec	3600	revs per min per min
revs per sec per sec	60	revs per min per sec
rods	16.5	feet
Seconds (angle)	$4.848x10^{-6}$	radians
spheres (solid angle)	12.57	steradians
spherical right angles	0.25	hemispheres
spherical right angles	0.125	spheres
spherical right angles	1.571	steradians
square centimeters	$1.973x10^{5}$	circular mils
square centimeters	$1.076x10^{-3}$	square feet
square centimeters	0.1550	square inches
square centimeters	10^{-4}	square meters
square centimeters	100	square millimeters
sq cm (cm sqd)	0.02402	sq inches (inches sqd)
square feet	$2.296x10^{-5}$	acres
square feet	929.0	square centimeters
square feet	144	square inches
square feet	0.09290	square meters
square feet	$3.587x10^{-8}$	square miles
square feet	.1296	square varas
square feet	1/9	square yards
sq feet (feed sqd)	$2.074x10^{4}$	sq inches (inches sqd)
square inches	$1.273x10^{6}$	circular mils
square inches	6.452	square centimeters
square inches	$6.944x10^{-3}$	square feet
square inches	10^{6}	square mils
square inches	645.2	square millimeters
sq inches (inches sqd)	41.62	sq cm (cm sqd)
sq inches (inches sqd)	$4.823x10^{-5}$	sq ft (feet sqd)
square kilometers	247.1	acres
square kilometers	$10.76x10^{6}$	square feet
square kilometers	10^{6}	square meters
square kilometers	0.3861	square miles
square kilometers	$1.196x10^{6}$	square yards
square meters	$2.471x10^{-4}$	acres
square meters	10.764	square feet
square meters	$3.861x10^{-7}$	square miles
square meters	1.196	square yards
square miles	640	acres
square miles	$27.88x10^{6}$	square feet
square miles	2.590	square kilometers
square miles	3,613,040.45	square varas
square miles	$3.098x10^{6}$	square yards
square millimeters	$1.973x10^{3}$	circular mils
square millimeters	0.01	square centimeters
square millimeters	$1.550x10^{-3}$	square inches

IMPORTANT ON-CAMPUS INTERVIEWS FOR POSITIONS AT

NORTH AMERICAN'S COLUMBUS DIVISION

North American Aviation, foremost in the design and production of military aircraft, has an established engineering team at its Columbus Division with prime responsibility for complete design and development of Navy aircraft.

The New FJ-4—Navy's latest and fastest FURY JET—is the most recent achievement at Columbus. Other, even more advanced designs are now being developed from initial concept to actual flight...creating top opportunities for virtually all types of graduate engineers.

Contact your Placement Office for an appointment with North American representatives.

Or write: Engineering Personnel Office, Dept. COL, North American Aviation, Columbus 16, Ohio.

NORTH AMERICAN AVIATION, INC.
COLUMBUS DIVISION

NORTH AMERICAN HAS BUILT MORE AIRPLANES THAN ANY OTHER COMPANY IN THE WORLD

New careers for engineers, now that

Color TV is here!

RCA's pioneering in this exciting medium means unlimited opportunities for you in every phase from laboratory to TV studio

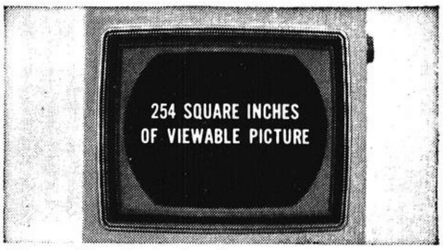
Now, more than ever, new engineering skills and techniques are needed in the television industry — to keep abreast of the tremendous strides being made in Color TV. RCA — world leader in electronics — invites young engineers to investigate these challenging opportunities. Only with RCA will you find a scientific climate particularly suited to the needs of young engineers. Your knowledge and imagination will be given full rein. Rewards are many.

Your talents are needed in research — in TV receiver design — in network operations — even "backstage" at TV studios. The experience and knowledge you gain can take you anywhere!

WHERE TO, MR. ENGINEER?

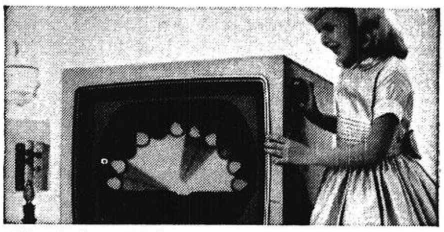
RCA offers careers in TV and allied fields — in research, development, design and manufacturing—for engineers with Bachelor or advanced degrees in E.E., M.E. or Physics. Join the RCA family. For full information write to: Mr. Robert Haklisch, Manager, College Relations, Radio Corporation of America, Camden 2, New Jersey.

Like 2 sets in 1—get Color and black-and-white shows, too! It's RCA Victor Compatible Color TV. See the great Color shows in "Living Color"—regular shows in crisp, clear black-and-white. With Big Color, you see *everything*.

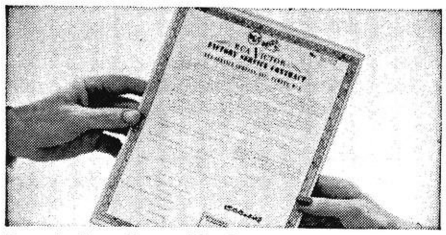


Big-as-life 21-inch picture tube — overall diameter. Actually 254 square inches of viewable picture area. And every inch a masterpiece of "Living Color." Here are the most natural tones you've ever seen—on a big-as-life screen!

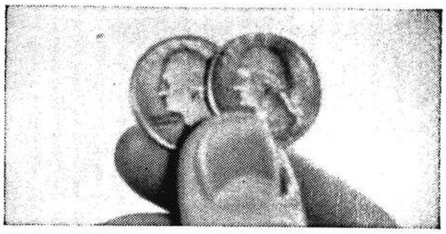
Color every night — right now! Something for everyone! You'll have "two on the aisle" for the best shows ever—drama, comedies, Spectaculars, children's shows, local telecasts. For now 216 TV stations are equipped to telecast Color.



Big Color TV is so easy to tune, even a child can do it! Turn two color knobs and there's your Big Color picture! It's easy, quick, accurate. It's a new thrill when the picture pops onto the screen in glowing "Living Color."

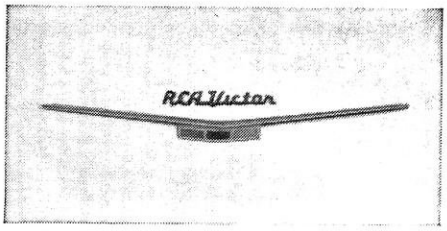


Practical and trouble-free! Service at new low cost! Big Color is *dependable* Color. And RCA Victor Factory Service is available in most areas (but only to RCA Victor owners). $39.95 covers installation and service for ninety days.



Color TV is a common-sense investment—costs only a few cents a day. It's sure to become the standard in home entertainment for years to come—yet you can enjoy Color every night *right now!* And you can buy on easy budget terms.

Now starts at $495 — no more than once paid for black-and-white. This is the lowest price for Big Color TV in RCA Victor history! There are 10 stunning Big Color sets to choose from—table, consolette, lowboys, and consoles, too.



Make sure the Color TV you buy carries this symbol of quality. Because RCA pioneered and developed Compatible Color television, RCA Victor Big Color TV—like RCA Victor black-and-white—is First Choice in TV.

RADIO CORPORATION OF AMERICA
ELECTRONICS FOR LIVING

W.S.P.E.

(Continued from page 44)

the Arctic Circle, a second line in Canada and the Pine Tree Line at the Canadian border. Since these 3 networks prevent a surprise attack, the Ground Observor Corps is now on a standby basis only.

V. L. Fiedler, District Engineer for the State Highway Commission, District 5, gave a talk November 28th before the Lions Club of Tomah, entitled "The Effects of the 1956 Federal Aid Act upon Wisconsin and Local Communities."

Fiedler discussed the history of the Act and the impact that the construction of the Interstate System of Interstate and Defense Highways would have upon the economy of the State and local communities, greatly enhancing Wisconsin's position as a leading recreational state.

Donald A. Juza, employee of the State Highway Commission of Wisconsin, has recently returned from Ottawa, Illinois, where the A.A.S.H.O. Road Test is located.

Juza was one of the six engineers loaned by the states of Ohio, Wisconsin, Iowa, Missouri, Kansas and Oklahoma to aid in engineering the construction of this project.

Purposes of the project are to develop facts and criteria which can be used in design and construction of pavements and bridges, evaluate load carrying capabilities of existing highways and obtain information which can be used as the basis of adequate and equitable legislation regarding allowable loadings on highways.

MILWAUKEE CHAPTER

Ernest Szekely, retired president and general manager of the Bayley Blower Co. died November 29, 1956 at his home, 6026 West Washington Blvd., Wauwatosa.

He was a member of the Wisconsin Society of Professional Engineers, Milwaukee Chapter of the American Society of Mechanical Engineers, Pi Tau Sigma, Tau Beta Pi, and a past president of the Engineers' Society of Milwaukee.

Engine Ears

(Continued from page 46)

port were the purpose and works of Polygon.

The guest speaker was Mr. Daniel Lamb, assisted by Mr. Aristotle Paris, both from the Evinrude Division of Outboard Marine. They represented the research division of Evinrude, and spoke on: "The 2-stroke cycle engine and it's application to outboard use". They covered the origin of the outboard motor and it's improvements to todays engine. A 7.5 horsepower motor and a complete set of slides served to illustrate the high points of their talk. Refreshments were served and an informal discussion with the speakers followed.

Keep your eyes peeled for meeting announcements which are posted on the bulletin boards of the engineering buildings. Don't miss out any longer on your chance to learn and have fun with S.A.E.

AIME

JOHN NYHUS

The Mining and Metallurgy Club held its annual Christmas banquet on December 12 at the Town Club. The banquet was a huge success; there was an excellent turnout and an inspiring speaker.

Guest speaker was Mr. Agostini of Grede Foundries in Milwaukee who spoke on what graduating engineers should consider before joining a company. Progressive advancement and enjoyment of the type of work were factors he thought would lead toward a successful career with a company.

Recently several carloads of students and faculty members made a trip to Chicago to attend the annual Student Night held by the Chicago Section of A.I.M.E. Previous to the evening meeting, the group was the guest of Gray Steel Works at Gary, Indiana. The Gray Works, a division of United States Steel Corporation, entertained the group to luncheon and then took them on a guided tour of their operations. The evening meeting of A.I.M.E. held in downtown Chicago consisted of a wonderful dinner and a talk on Atomic Energy by Mr. Whittenberger, chairman of student A.I.M.E. chapters.

INITIATION BANQUET— ETA KAPPA NU

GERALD J. CARLSON

The Fall initiation banquet for Eta Kappa Nu, Honorary Electrical Engineering fraternity, was held Thursday evening, December 6 at the Wing Inn. Eighteen newly elected members of the organization together with the actives and faculty members present enjoyed the dinner menu topped by a delicious main course of fillet mignon.

The main speaker for the evening was Prof. Erwin H. Ackerknecht. Dr. Ackerknecht, who is presently a professor at the University, has recently accepted a position as the director of the Medical History Institute of the University of Zurich at Zurich, Switzerland. His talk entitled, "Medicine and Science in 19th Century Europe" was interestingly given and enjoyed by all.

Following is the list of men who were initiated into Eta Kappa Nu at the Fall initiation:

Charles L. Blodgett, John Chantiles, Jack G. Chin, Deryl F. Davidson, Patrick M. Gannon, Marvin Gish, Russell E. Jacobson, Thomas P. Leland, Charles E. Maurer, James Murphy, Robert A. Nichols, Stephen J. Pech, Gene Reed, Kenneth E. Schaefer, James E. Schilling, Thomas S. Stafford, Wayne L. Stiede and Earl R. Strandt.

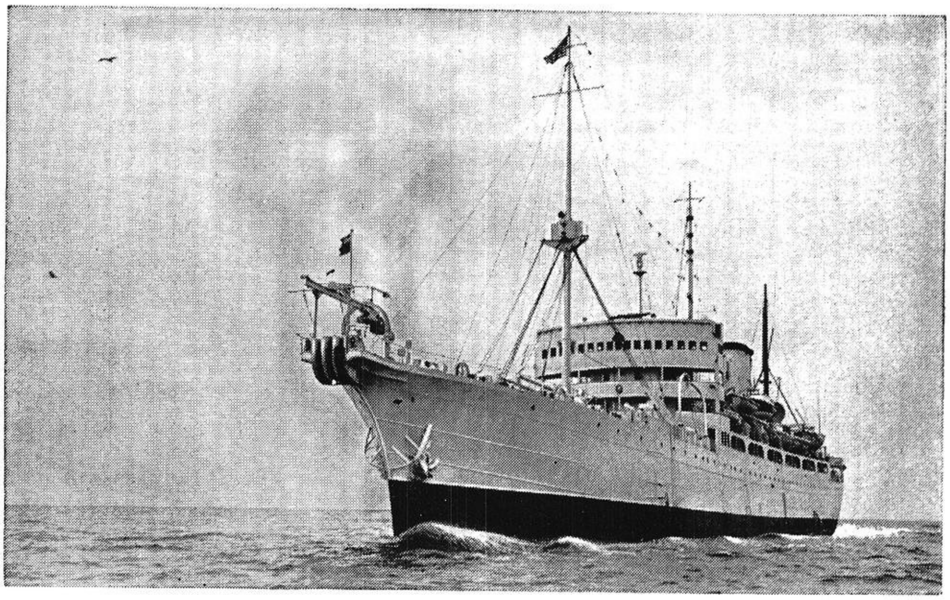
Congratulations, and Welcome!

ALUMNI

Appointment of **Charles T. Link, Jr.**, as chief engineer for the Wayne Manufacturing Co., Pomona, Calif., was announced.

Gil M. Wayne, executive vice president, said Link will be re-

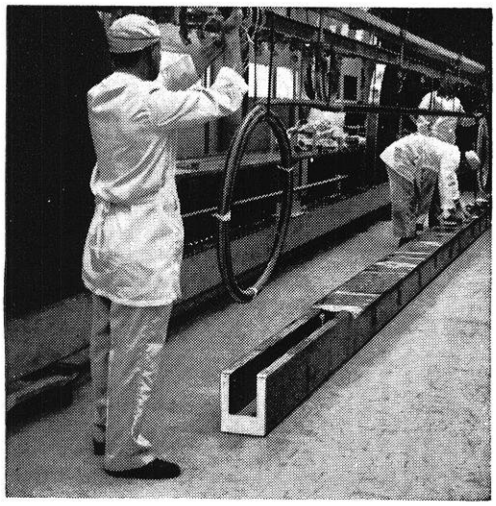
(Continued on page 75)



Great Britain's H.M.T.S. *Monarch*, world's largest cable-laying ship. A.T.&T. joined with the British Post Office and Canadian Overseas Telecommunications Corporation in the historic venture.

Victory at 2400 fathoms

Background of the first transatlantic telephone cables



Each room in Western Electric's clinically clean repeater plant was kept under positive air pressure at all times so that dust-laden air could not leak in.

Teamwork characterized the Bell System's role in the success of a tremendous undertaking: laying the first transatlantic telephone cables.

One challenge given engineers and scientists at Bell Telephone Laboratories was that of designing equalizing networks and amplifiers to be placed in the cables every 40 miles to compensate for the huge attenuation losses. Electron tubes of unrivaled endurance were developed, capable of operating for up to twenty years.

Western Electric, manufacturing and supply unit of the Bell System, assembled the repeaters in a special plant under clinical conditions. A mere speck of dust could fatally upset the sensitive amplifiers.

The delicate and demanding job of laying the cables was supervised by engineers from Long Lines Department of A. T. & T. New cable-laying equipment was designed, and exacting procedures were devised so that the cable could be laid smoothly and safely on an ocean floor in places more than two miles deep.

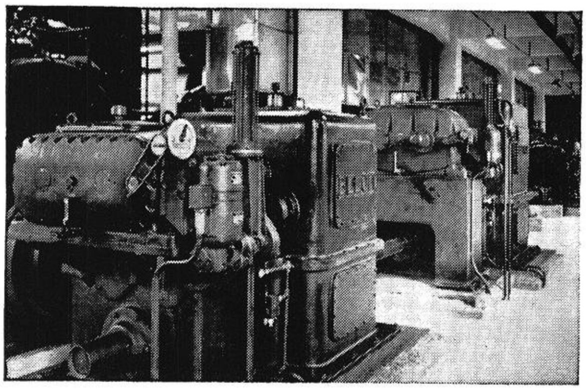
Teamwork helps Bell System engineers and scientists to anticipate and provide for America's growing communications needs, no matter what the magnitude of the job to be done.

Able, imaginative young engineers and scientists will find absorbing careers with the Bell Telephone Companies, Bell Telephone Laboratories, Western Electric and Sandia Corporation. Your placement officer can give you more information about career opportunities in the Bell System.

Bell Telephone System

Another page for **YOUR BEARING NOTEBOOK**

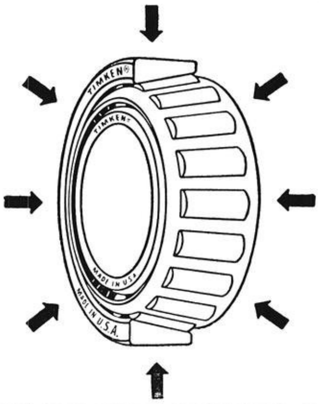
How to keep paper machine speeds and tensions under control



To give better control of roll speeds and sheet tensions in a paper machine, engineers developed a new differential drive system that uses a single line shaft to power individual paper machine rolls. This called for rigid shaft mountings and extremely accurate gear mesh. So the engineers specified Timken® tapered roller bearings for the drive units. Timken bearings hold shafts and gears in rigid alignment. Gear mesh is smoother, more accurate. Shaft wear is eliminated, gear wear reduced.

How TIMKEN® bearings hold gear shafts rigid

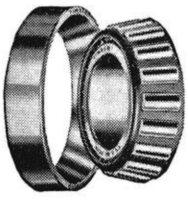
The full line contact between rollers and races of Timken bearings gives shafts rigid support over a wide area. Shaft deflection is minimized. And the tapered design of Timken bearings permits them to be set up with the most desirable amount of end play or preload that gives the best performance.



Want to learn more about bearings or job opportunities?

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

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



NOT JUST A BALL ○ NOT JUST A ROLLER ⊂⊃ THE TIMKEN TAPERED ROLLER ⊂⊃ BEARING TAKES RADIAL AND THRUST LOADS OR ANY COMBINATION

HONEYWELL MEN ADVANCE RAPIDLY!

The ability to accept and discharge responsibility, and to plan and execute programs mean advancement. Men who get things done, get better jobs.

Such is the case at Honeywell. Ability, drive and the spirit of team play—combined with education and experience—determine where and how fast you progress. And our growth means we are always eager to find men with capacity for greater responsibility.

Who measures this? Your immediate supervisor does. He will speed your progress by seeking your ideas and opinions, by stimulating your interest and enthusiasm and by giving you additional responsibilities as you are ready to accept them.

Then, twice a year he will review your accomplishments with you and determine your salary increases. A program like this is assurance that contributions are rewarded by compensation and advancement.

There are other factors that accelerate advancement.

Engineers predominate among our vice-presidents, divisional executives and departmental managers. So, attitudes and opinions of our scientists and engineers are understood and supported by management.

Honeywell is composed of small units working as a team. These units multiply opportunities for early managerial experience and lay the foundation for more important management assignments in future years.

HONEYWELL OFFERS MANY EXTRA BENEFITS!

The importance of benefits in career planning cannot be underestimated. Honeywell's program ranks as one of the most liberal in industry. There's free group life insurance . . . free accident and sickness insurance . . . free hospital insurance. You will find a liberal policy on paid vacations and holidays and modern pension and retirement program paying lifetime benefits.

HONEYWELL PLANTS ARE LOCATED ALL ACROSS THE COUNTRY AND ABROAD!

If you have a geographical preference either in the U. S. or abroad, consider Honeywell's many engineering and production locations. You'll find challenging opportunities for a variety of engineering specialties with Honeywell in Beltsville, Md.; Boston; Chicago; Denver; Freeport and Warren, Ill.; Independence, Iowa; Los Angeles; Minneapolis; Philadelphia; St. Petersburg, Florida; Wabash, Ind.; and Toronto, Ontario.

Abroad, Honeywell factories are located in Amiens, France; Amsterdam, Netherlands; Frankfurt, Germany; Newhouse, Scotland and Tokyo, Japan.

If you prefer sales and application engineering you'll find 127 sales and service offices in principal cities across the nation and Canada, and 45 countries abroad.

HONEYWELL'S MAIN FIELDS AND LOCATIONS ARE:

Heating and Air Conditioning Controls: Engineering and manufacturing plants in Minneapolis, Chicago, Wabash and Los Angeles.

Industrial Instruments and Controls: Research, engineering and manufacturing plants in Philadelphia and Beltsville, Md.

Aeronautical Controls: Research, engineering and manufacturing plants in Minneapolis, St. Petersburg and Los Angeles.

Precision Switches: Engineering and manufacturing in Freeport and Warren, Illinois, and Independence, Iowa; research facilities in Denver.

Ordnance and Missiles: Engineering and manufacturing in Minneapolis, Monrovia, Calif., and Seattle, Wash.

Servo Components and Controls: Engineering and manufacturing plants in Boston.

Oscillographic and Photographic Equipment: Research, engineering and manufacturing facilities in Denver.

Transistors: Research, engineering and manufacturing plants in Boston.

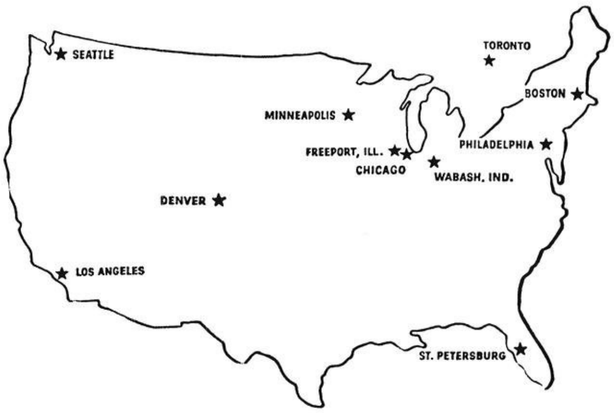
Research: In addition to research and engineering activities carried on by various divisions, Honeywell also maintains a Research Center in the Minneapolis suburb of Hopkins. Prime concern of the Center is basic projects of interest to the entire organization.

Whichever Honeywell division or location you choose, you'll be assured of special training to help you grow in your job. This training includes regular on-the-job instruction, formal classes at the company and tuition-aid courses at nearby institutions.

HOW TO LEARN MORE ABOUT HONEYWELL!

A Honeywell representative can answer your questions and give you additional information about opportunities at Honeywell. Please consult your college placement office for the date of his next visit to your campus.

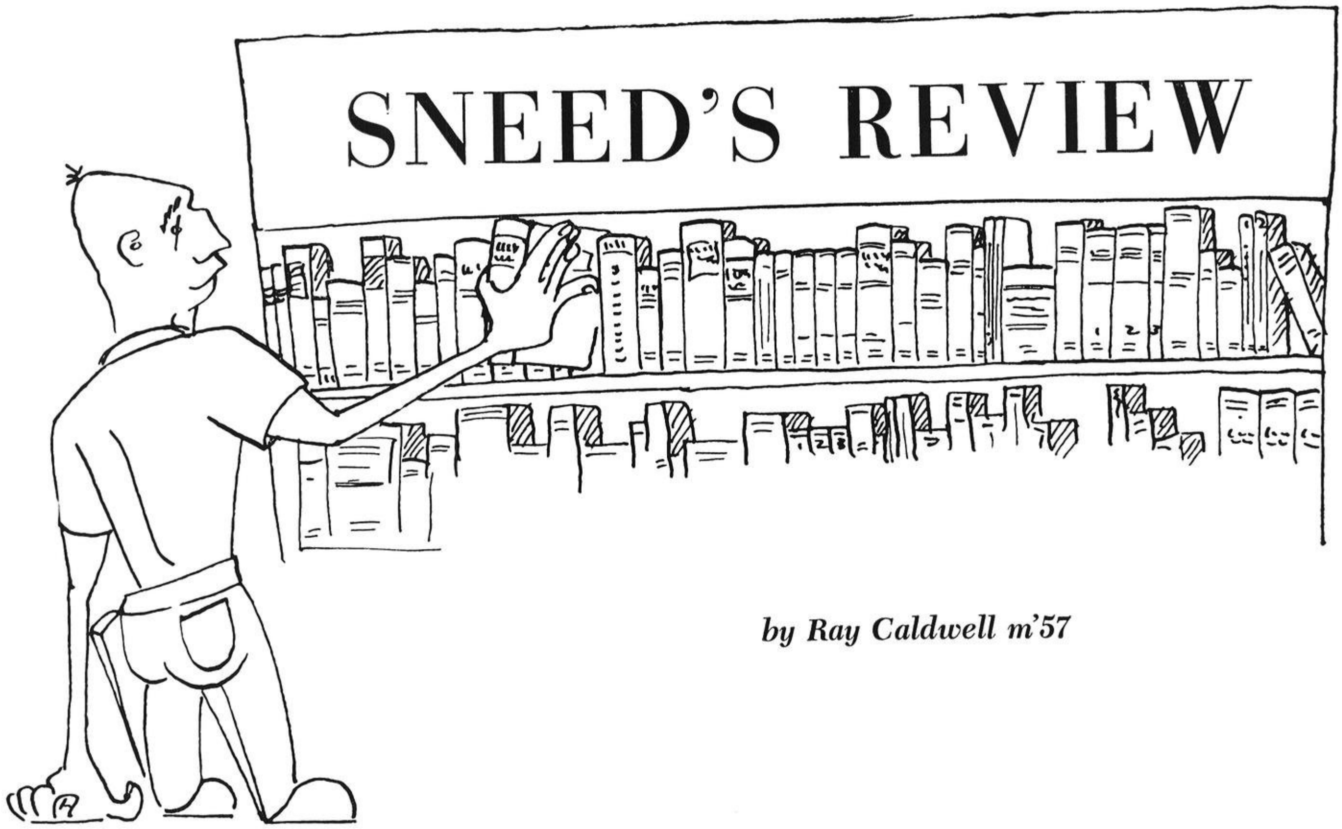
Meanwhile, you will want to read a booklet titled "Your Curve of Opportunity in Automatic Controls." Write H. T. Eckstrom, Personnel Administrator, Dept. CM, Minneapolis-Honeywell Regulator Company, 2753 Fourth Avenue, South, Minneapolis 8, Minnesota.



★Indicates location of Engineering-Research facilities

Sales Offices in 127 Cities in the U.S. and Canada

MINNEAPOLIS
Honeywell
First in Controls H HONEYWELL



by Ray Caldwell m'57

NUMERICAL ANALYSIS

Edited by John H. Curtiss

Excellent background material for those interested in computer technology.

This book, edited by John A. Curtiss of the American Mathematical Society, is of real value to applied mathematicians, computer-programming people, computer designers, and certain physicists and engineers. It contains all but two of the papers which were presented at the meeting of the Sixth Symposium in Applied Mathematics held at Santa Monica City College, co-sponsored by the American Mathematical Society and the National Bureau of Standards. The subject of the Sixth Symposium was numerical analysis.

SELECTED ASTM ENGINEERING MATERIALS STANDARDS

A good supplement for use in college curricula with practical approaches stressed.

This compilation has been prepared for use by college engineering students and teaching staffs. By supplying representative illustrations of nationally accepted standard specifications and the standard test methods which support them, the student can be made familiar with the existence, availability, nature, and origin of the specifications for the materials which all engineers must use. Specific standards were selected on the basis of a poll among engineering educators. They are intended to include not only the standards most closely linked to the work of the course but also standards that illustrate the varied nature and approach to problems of standardization.

Introductory and supplementary material to provide background and breadth of grasp has been included. The condensation of the 1907 ASTM Presidential inaugural address by Charles B. Dudley points up the need for standards and illustrates the variety both of the tangible and psychological problems that relate to their use. The modern engineer should also have some appreciation of the legal aspects of standardization and that, too, is given limited attention.

Although the compilation is intended to be closely correlated with the formal course work in materials and materials testing, it is not in any sense a textbook; it is a supplement rather than a replacement.

A MANUAL OF ENGINEERING GEOMETRY AND GRAPHICS

By Hollie W. Shupe and Paul E. Machovina

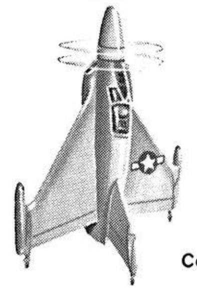
Analytic graphics presented in a comprehensible, practical manner.

Hollie W. Shupe, Professor of Engineering Drawing and Paul E. Machovina, Associate Professor of Engineering Drawing—both at The Ohio State University, realizing the recent trend toward including more "analytic" graphics in drawing courses, in addition to the material needed in engineering geometry, are providing further information for a more general coverage of graphic solutions.

The theory of orthographic projection is presented in connection with engineering geometry and employs reference planes placed in convenient positions. Folding lines and plane traces are not used.

(Continued on page 62)

Convair R3Y-1 and R3Y-2



Convair XFY-1

Lockheed C-130

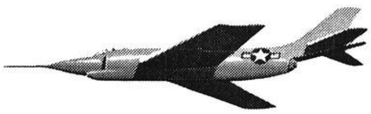
Northrop F-89D

Convair YC-131C

They're ALL ALLISON-POWERED

And, Allison Engineering will continue to play a leading role in future development of greater **AIRCRAFT POWER**

Martin TM-61 (missile)

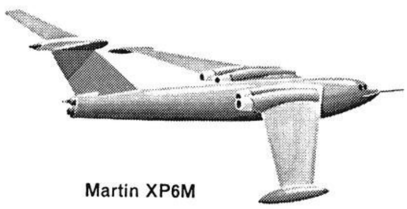


McDonald F3H-2N

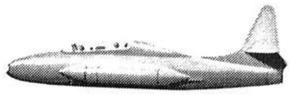
Chance Vought Regulus (missile)

Douglas RB-66 & B-66

Allison Turbo-Liner



Martin XP6M



Lockheed T2V-1

ALLISON ENGINES have accumulated an impressive record of flight time in many different types of turbo-jet and turbo-prop aircraft. Included in the wide variety of aircraft are single and multi-engine planes—both land based and water based—as well as expendable missiles.

TODAY, with this valuable accumulation of engineering experience—coupled with our vastly expanded engineering research and development facilities—we look to the future. And, what a future it promises to be in this era of supersonic speeds . . . nuclear energy application, and—well, the sky is the limit.

Opportunities at Allison are equally unlimited for engineering graduates, ambitious young men who recognize the advantages of being identified with an established leader in the design, development and production of high performance aircraft engines.

• • •

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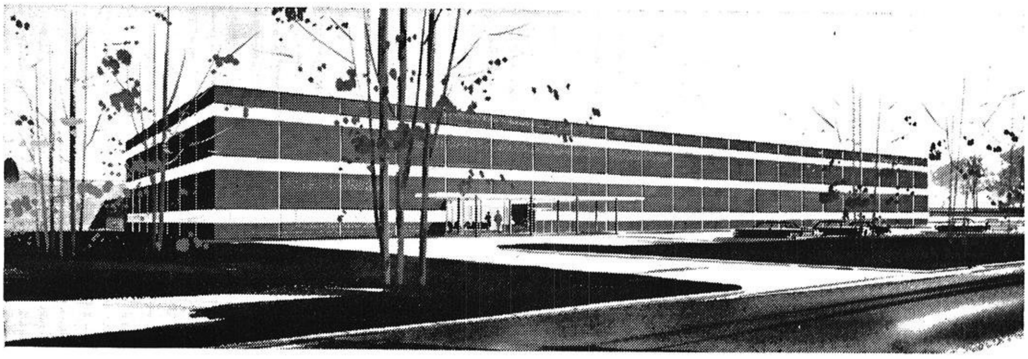


Sneed's Review

(Continued from page 60)

Wherever applicable, drawings showing problem solutions are separated into stages to illustrate the step-by-step procedure, and to avoid complexity.

The material covered includes: the fundamentals or orthographic projections and their use in the solution of the geometric problems of line and surface relationships, and vectors; functional scales and their applications in conversion and sliding scales, alignment charts, curve fitting, and graphic calculus.

PHYSICS AND MATHEMATICS

By R. A. Charpie, J. Horowitz, D. J. Hughes, and D. Littler

This is the first volume of an outstanding new series—"Progress in Nuclear Energy".

This volume presents a summary of results, and methods for their analysis, pertaining to the properties of the fissionable nuclei. The latter part of the volume includes material on Reactor Physics, and involves the techniques used in planning experiments with reactors. The results and methods presented will be of greater value to workers in reactor design.

There is data dealing with the thermal cross-sections of the fissionable nuclei, resonance energy levels of these nuclei. The experimental techniques used to obtain "Elastic and Non-elastic Cross-sections", and reactor physics.

FUNDAMENTALS OF VIBRATION ANALYSIS

By Nils O. Myklestad

A compact, clear, logically organized book for thorough understanding.

In this book, N. O. Myklestad, Head of Stress, Vibration, and Gear Group, Air Research Manufacturing Company of Arizona, gives the reader a thorough understanding of the subject of vibrations from a basic point of view rather than by presenting routine methods of analysis.

Since only the classical method of analysis is used, every effort is made to develop the material in such a way that a clear picture of the phenomena involved is brought out while numerical and routine methods of analysis are reduced to a minimum. After the fundamentals have been mastered in this way, the reader will be able to go on to study the numerous special tools that have been developed for the purpose of obtaining solutions to more complicated problems. Many examples and problems are introduced to develope the readers understanding of the subject and to demonstrate the applicability of the methods of analysis used. Also, a new proof of the orthogonality condition, introduction of the concept of damped modes of free vibration, and new treatments of vibration, instruments and balancing are included.

Fourth Edition of MECHANICAL VIBRATIONS

By J. P. Den Hartog

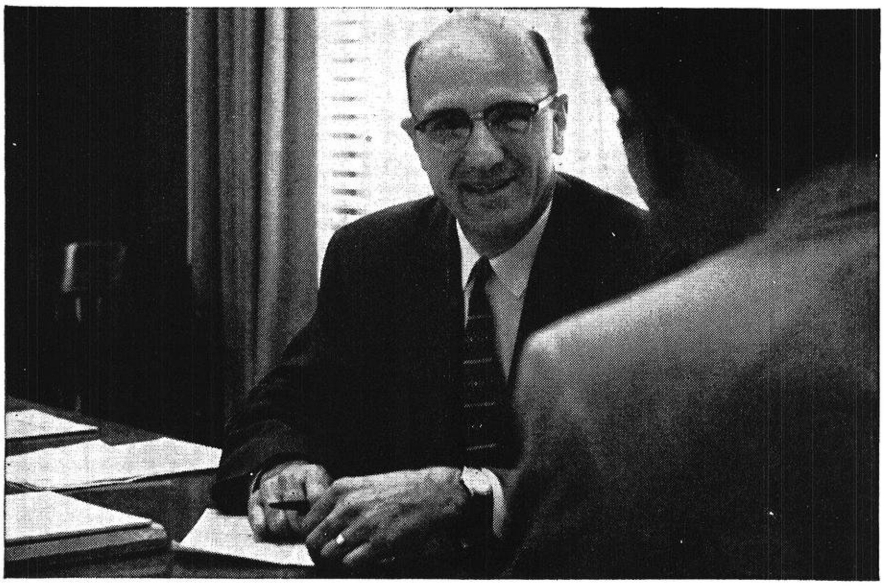
The fourth edition is expanded and improved, clearly and simply explained.

J. P. Den Hartog, Professor and Head of the Department of Mechanical Engineering at Massachusetts Institute of Technology, deals with vibration phenomena in a thoroughly technical manner, emphasizing the many applications to the practical vibration problems encountered by the practicing engineer. Complete explanations and proofs are given without mathematics higher than simple differentiations and integrations.

Fourth edition changes and additions include; 1) New material has been added on Karman vortices and on nonlinear vibrations, with examples of cases that have appeared in practice since 1947, 2) The number of problems has been increased substantially, and 3) Changes have been made in every chapter to bring the subject up to date; in order to keep the size of the volume within bounds these changes consisted of deletions as well as additions.

THE END

CAREERS WITH BECHTEL



KARL BAUSCH, *Chief Electrical Engineer, Power Division of the Bechtel Corporation.*

ELECTRICAL ENGINEERING

One of a series of interviews in which Bechtel Corporation executives discuss career opportunities for college men.

QUESTION: *Mr. Bausch, in considering a position with Bechtel, or any other firm, isn't it true that what most college men want to know first of all is "What will I be doing?"*

BAUSCH: That's true, and it isn't an easy question to answer. So much depends on individual preferences and abilities and the way a man develops. On joining us, he would be asked if he'd like to work on the drafting board doing layout work. As an alternate, he might prefer a starting assignment involving helping out on calculations, requisitioning materials, writing specifications, etc.

QUESTION: *In other words you try to give the new man some freedom of choice?*

BAUSCH: As far as possible. We know that the beginning period is a difficult one. It takes some time for him to get his feet on the ground and we try to "expose" him to many different activities. In that way he gets needed experience and familiarity that help him decide the work for which he feels best qualified. It also gives us the opportunity to evaluate his potential.

QUESTION: *Assuming a man shows the necessary ability and begins to produce, how does he branch out?*

BAUSCH: Generally, in either of two ways. He may work on the electrical portion of power plants, designing circuits, control and relaying systems, unit protection, etc. The other way is on the physical layout of power plants—that is, location of equipment, conduit and raceway systems, etc. In either case he would be put in charge of one section of the project.

QUESTION: *And his next advance would be...?*

BAUSCH: Assuming he progresses satisfactorily, he would ultimately move into a lead job as a group supervisor in charge of the design of the electrical system of the complete plant.

QUESTION: *Could you give an estimate of the time involved in the various steps?*

BAUSCH: That's impossible. We have no hard and fast schedule. In general, we have found that it takes a man about a year to get his feet on the ground and become a real producer. From that point on, it's up to him.

QUESTION: *In other words, he can advance in keeping with his individual ability?*

BAUSCH: That's right. Of course, there are many other factors involved, including the vitally important one of the great advancements being made in every phase of the electrical industry. These create new jobs and new types of jobs involving new skills. And for every opportunity existing today, it is safe to predict there will be at least two tomorrow.

Bechtel Corporation (and its Bechtel foreign subsidiaries) designs, engineers and constructs petroleum refineries, petrochemical and chemical plants; thermal, hydro and nuclear electric generating plants; pipelines for oil and natural gas transmission. Its large and diversified engineering organization offers opportunities for careers in many branches and specialties of engineering —Mechanical...Electrical...Structural ...Chemical...Hydraulic.

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Address: John F. O'Connell, Vice President, Industrial Relations 220 Bush Street, San Francisco 4, Calif.

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A technician gives roll of irradiated polyethylene preliminary check for uniformity. Starting out as conventional polyethylene, the irradiated tape is bombarded with high-velocity electrons to make it flexible and resistant to chemicals, moisture, heat and stress.

Hot Poly

(Continued from page 26)

meter attached to the tube seals the system and registers the charges in pressure. It is assumed that the drop in pressure is proportional to the rate of polymerization. The field intensity with this reactor was about 83,800 roentgen per hour. A roentgen is defined as that amount of gamma or X radiation that produces a total of 1.61 times 10 to the 12th power ion pairs per gram of dry air at standard conditions of temperature and pressure.

A second reaction chamber was prepared for high pressure and temperature work. This reactor was machined from stainless steel in order to eliminate welds which might be weak points. The reactor was a tube with an enlarged top. A plug fits into the tube to limit the area of the tube to the region surrounded by the Co^{60}. This plug is seated on a brass washer in the enlarged top of the tube and held there with cap screws. The unit was tested hydraulically to a pressure of 3000 pounds per square inch gauge pressure. Themocouples and heating elements make it possible to observe the temperature and control it. The unit is placed in the reaction chamber of the Co^{60} and connected to a 300 pound per square inch gauge by a small tube. The tube is filled with a thin wire to limit the volume of gas it contained and minimize the error.

Experiments with these reactors lead to the conclusions that the reaction goes faster with increase in temperature or pressure up to 125 degrees Fahrenheit. After 125 degrees the reaction no longer continues at a fixed rate. Increasing the surface of the gas does not increase the rate of reaction. Air, which is a catalyst in the manufacture of polyethylene, is an inhibiting factor in the polymerization of polyethylene by irradiation. There is also an indication that the irradiated polythylene may have an adverse effect on the polymerization of the remaining ethylene. This is an indication that a continuous process may be the best method for the irradiation of ethylene.

Radiation chemistry is still in the experimental stage. Irradiated polyethylene is one of the promising products of this branch of chemistry. The mass production of irradiated polyethylene will come from experimentation like this.

THE END

Electrical Calculators

(Continued from page 20)

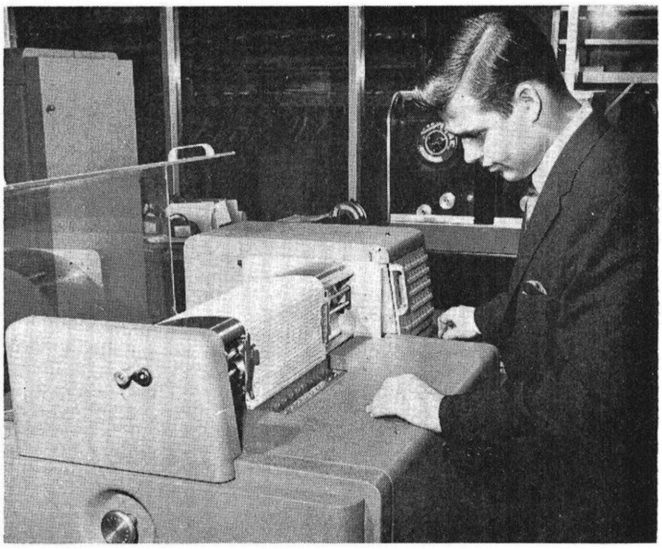
The best way to illustrate the type of problem for which calculators are useful and the methods involved in using a calculator on a problem is with an example. This problem was presented to the research staff of a paper company that was building a branch plant in Canada.

The water supply in the area of the new plant was unsually fouled with sludge and organisms. The pulp to be used was of a relatively low grade and after cooking contained an unusually high percentage of small, dark colored chips called shives. Further, the paper to be produced was to be used on high speed presses for which a very high degree of uniformity is required.

It was important to choose the *correct filter screens* the first time because of the high cost of construction in that area. It also was important to make the choice quickly because the plant had to be in operation before the fall freeze ended the construction operations.

Several conventional screens and screening processes were given tests at the site on a pilot plant scale. From these tests, sample hand sheets were prepared and sent to the research center. The only method known to check the efficiency of the various screens and screening processes was to visually count the number of shives and dirt specks in each hand sheet.

This visual counting was tried in two ways: either the hand sheets were placed on a glass table with a light under it and the shives counted, or a metal plate with holes drilled in it was placed over the hand sheet. The shives visible through the holes were counted and multiplied by a factor to relate the visible area through the holes to the total area of the hand sheet. Both methods proved useless due to the time factor.



The High Speed Printer of the Remington Rand Univac System for handling large volume output. It is capable of printing 600 lines a minute.

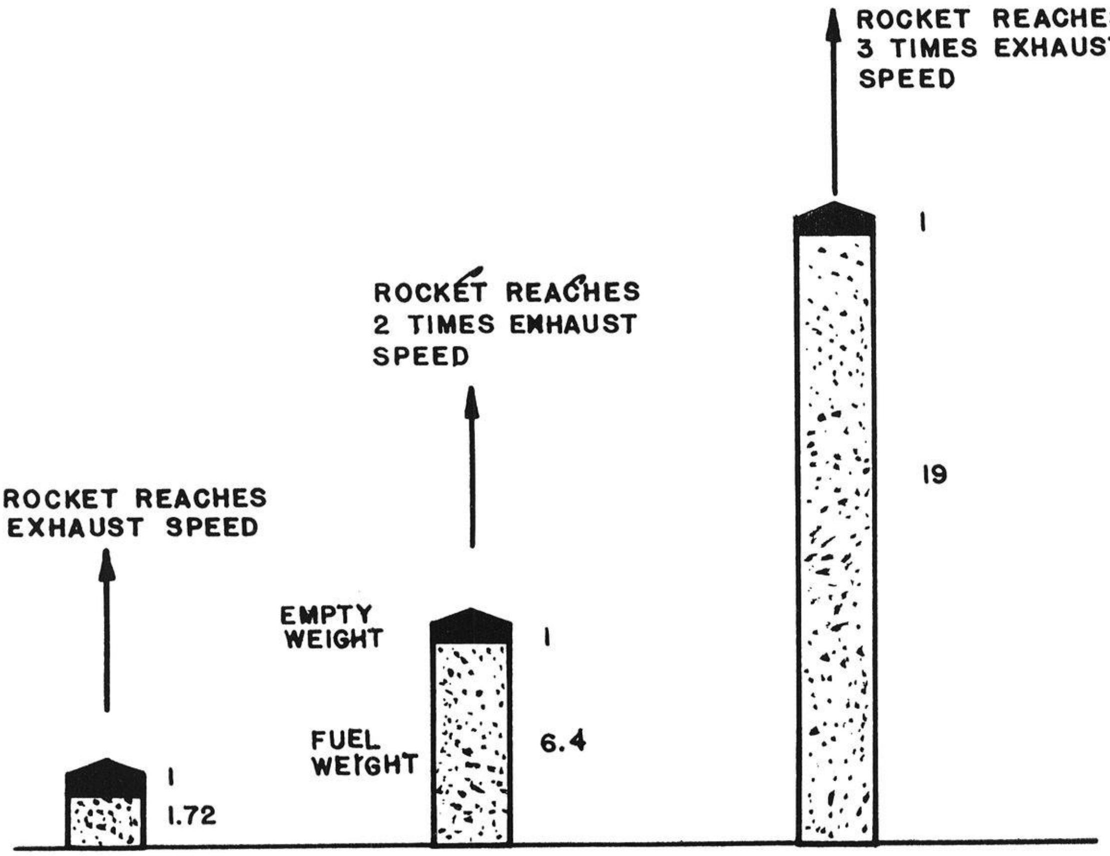
A device which measures the degree to which a sheet of paper is opaque in terms of an electrical current was tried. A mathematical expression, involving the magnitude of these currents, which correlated the number and size of the shives in the hand sheet to the area under a curve was then derived. The complexity of the expression made plotting the curves very difficult and slow.

It was at this point that a calculator was brought into use. Once the expressions had been broken down into simple summations and the sequence set up in the computer, the corresponding areas for several thousand hand sheets were evaluated in a matter of hours.

In conclusion, the following limitations of calculators should be emphasized. No calculator now in existence can:

1. Do intuitive thinking.
2. Make bright guesses and leap to conclusions.
3. Determine all its own instructions.
4. Perceive complex situations outside itself and interpret them.

However, if a problem involves repetitious computations of a sufficiently large number to justify the time required to set up a calculator, and the characteristic properties of the derived answer can be expressed in a suitable manner for the controller unit, then a calculator is the answer. The economy of a calculator in such a case is very great. Calculators are available that can perform 5000 additions per minute. Hence, years of paper work may become only hours with a calculator. THE END



MASS-FUEL RATIO EFFECT

Rocket Fuels

(Continued from page 15)

rocket motor may be accomplished by the injection of a small quantity of the spontaneous fuel first, then following it with a more conventional, less expensive fuel.

It should be noted that oxidation, while being the most common, certainly is not the only reaction possible in a rocket engine. Fluorination has shown promise and is in strong competition with oxidation. Also, simple decomposition of endothermic compounds may be utilized. For instance, hydrogen peroxide decomposes to liberate a considerable amount of heat along with a good supply of oxygen. This desirable property has brought hydrogen peroxide to the foreground as a propellant.

Another possible source of energy has come to light due to observation of an experiment at the rocket testing grounds in Nevada. It was observed that molecular oxygen from a rocket in the upper atmosphere was dissociated to atomic oxygen by the ultra violet rays of the sun. The energy of the atomic oxygen was released as a spot of light in the upper atmosphere.

If this energy could be harnessed for propulsion, it would indeed be a boon to rocket researchers. Perhaps this phenomenon could be used in conjunction with hydrogen peroxide which could furnish the oxygen to be acted upon by the ultra violet rays from the sun.

The field of propellants for large rockets has been dominated until now by the chemical bi-propellants. This should not imply that it is the only course, or even the best one, open to rocketeers.

Another type of fuel, as mentioned previously, is the monopropellant. This is a propellant that carries the oxidant as an integral part of the fuel itself. The advantages of a monopropellant would be in some weight reductions. This is because just one storage tank, one fuel pump and feed line would be required. However, this type of fuel has an outstanding draw back. The explosion hazard in handling is very great and until this hazard is greatly reduced, application of the liquid monopropellant on a large scale seems impractical.

While being relatively new to the field of large rockets (V–2 size and above) solid propellants have shown great promise. They are superior to liquid fuels in many respects. For example, solid fuels are more dense, have better storage and handling characteristics, and are less corrosive than many liquid propellants.

However, solid fuels have not been able to compete with liquid fuels. One reason for this is that it has been impossible to feed the solid fuel into a small combustion chamber. Therefore, the storage tank must be used as the combustion chamber. This, at first, appears to be desirable in that the weight of the combustion chamber

(Continued on page 75)


IT'S ENOUGH TO MAKE YOUR
BLOOD BOIL
The jet speedway, that outer envelope of air 10 to 15 miles above the earth, could be a chamber of death to today's pilots because of the lack of air density. If the pilot were not protected by ingenious accessories to provide an artificial climate, his blood would bubble like fizz water. Advanced, space-conquering equipment such as these air conditioning units are now being produced by Hamilton Standard for America's most modern aircraft. It is a dynamic, exhilarating engineering environment where the accent is on tomorrow.
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exist for engineers in the fields of design, test, liaison, development, vibration, analysis, with Hamilton Standard. It's a GREAT place to work. Write to Ted C. Fisher, Administrative Engineer.
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Science Highlights

(Continued from page 32)

ing power than previous systems, it promises also to reduce and simplify the associated electronic circuits. Furthermore, it makes possible very compact memories of relatively small capacity."

In illustration, Dr. Rajchman displayed a compact memory plate unit consisting of ten plate assemblies and a novel switch also made from the plates. This developmental unit, measuring only 2 cubic inches, has a storage capacity of 2560 bits of information.

"Three years ago, it was predicted that micro-second memories with capacities reckoned in millions of bits would be available at a relatively low cost in a distant future," Dr. Rajchman said. "We believe that the ferromagnetic aperture plate is now ready to usher in this era. But the demand for larger and faster memories is incessant, and we may look forward to the development of still newer techniques in the future, making possible the storage and instant selective readout of billions of bits."

GOLD WINDSHIELDS

Atoms of pure gold are being used experimentally in Dearborn, Mich., to insulate automobile windshields and window glass against summer heat rays.

Ford research engineers say that when glass samples are coated with a gold film 30,000 times thinner than a human hair, they filter out the sun's heat-producing rays but allow cooler beams of light to pass.

Light insulating experiments also are being conducted with silver, aluminum, zinc, copper, vanadium, tantalum, titanium and uranium, as well as with minerals having unusual optical properties.

Ford researchers place gold foil and a sample of glass plate in a bell jar and then pump vacuum in the jar comparable to that in a common radio tube.

Then they melt gold electrically inside the bell jar. The gold "evaporates" in the vacuum and sprays atoms in all directions at speeds above 5,000 miles an hour. This puts a gold coating on the glass plate.

While the atomic bombardment coats the glass, a light meter continuously measures the amount of light passing through the glass. The meter halts the depositing process before the coating becomes heavy enough to affect the transparency of the glass plate.

Engineers say the coating process is halted when the deposit of gold atoms is one thousand times thinner than a machinist's micrometer can measure.

NEW TYPE SIGNS FOR KANSAS TURNPIKE

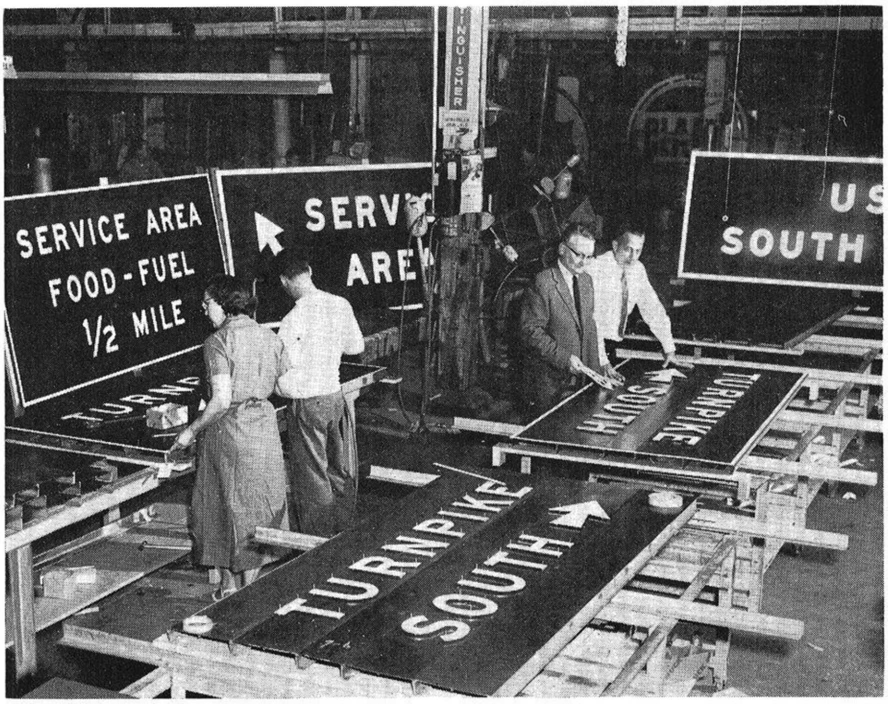
Porcelainized aluminum extrusions and raised reflective lettering have been combined for the first time to double the life expectancy of highway signs on the new Kansas Turnpike.

Ordinary highway signs must be refinished or replaced every five to eight years. The Kansas Turnpike signs, installed by Federal Sign and Signal Corporation, are expected to last for as long as 15 years without recoating. The Turnpike sign program involves $400,000 worth of highway signs and markers.

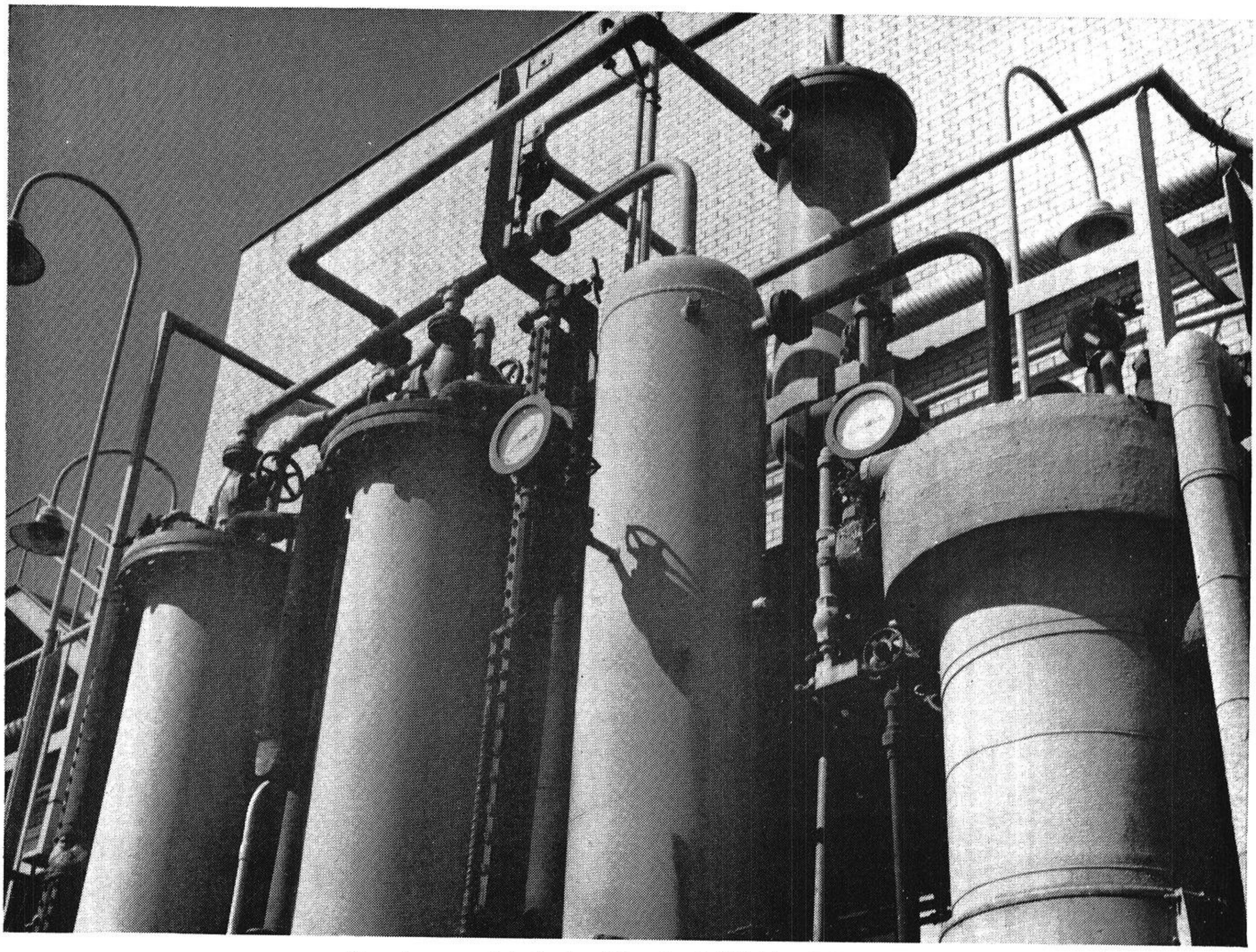
The process of porcelainizing extruded aluminum has been perfected only during the past year. The process is delicate because enameling ovens must be heated to approximately 25 degrees of aluminum's melting point to achieve the required result. Steel, which commonly forms a base for enameling, is more than 100 degrees from its melting point when in the bake ovens.

Approximately 1,500 of the dark green porcelain signs will guide motorists along the 236-mile Kansas Turnpike, which will form a major link in the proposed Maine to California turnpike system. The Kansas Turnpike extends from Kansas City, south through Topeka and Wichita, to the Oklahoma border.

A safety innovation used on the Turnpike will be 30,000 delineators —the small "cat's eyes" on posts which mark shoulders of the roadway—placed in four continuous lines the length of the Turnpike. The delineators will be amber-colored at interchanges and service areas, and of clear crystal elsewhere. **THE END**



Signs of the times. Two new processes, used for the first time on highway markers for the Kansas Turnpike, are inspected in the Federal Sign and Signal Corporation plant in Chicago.



One of many pilot plants at Standard's Whiting Laboratories. Scientists and engineers frequently take new processes from the "bench-scale" all the way to final field application.

Like to try on this man's shoes?

DONALD PLAUTZ belongs to the group of engineers at Standard Oil's Whiting, Indiana, Research and Engineering Laboratories who are fitted by training and talent for a process engineering career. His fraternal affiliations include Phi Eta Sigma, Tau Beta Pi, Phi Lambda Upsilon and Theta Tau.

B.S. (University of Wisconsin); M.S. (Ohio State); Ph. D. (University of Illinois), all in chemical engineering, Dr. Plautz has utilized this training in carrying out varied responsibilities on development of the Ultraforming process. He has operated pilot plants, correlated data, prepared process manuals, and assisted in the initial operation of new Ultraforming units.

Ultraforming is an intricate refining process which Standard invented, patented and makes available to other refiners, as licensees, to provide increased yields of high octane gasoline.

Perhaps you're not ready to try on this man's shoes yet, but Standard Oil offers outstanding career opportunities to college men in almost all fields of science and engineering.

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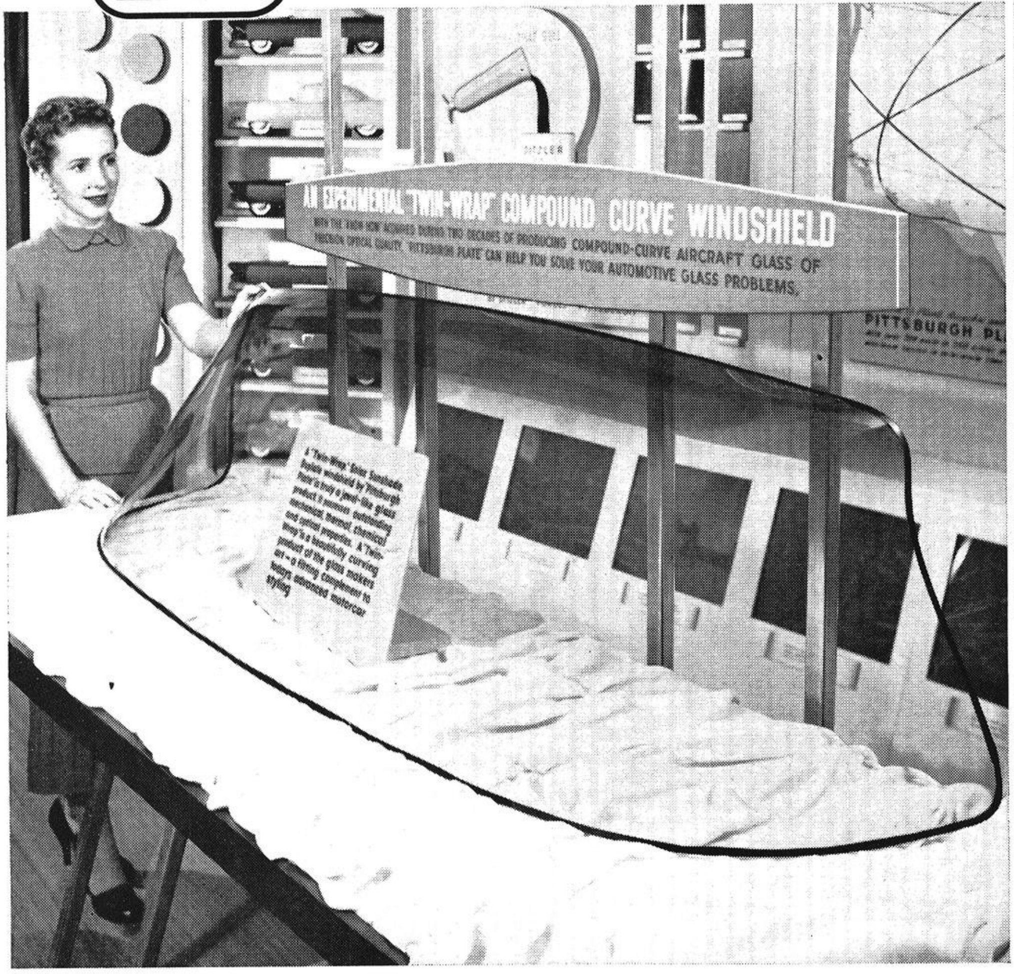
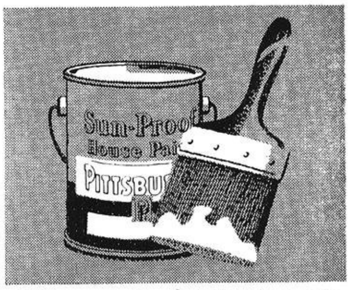
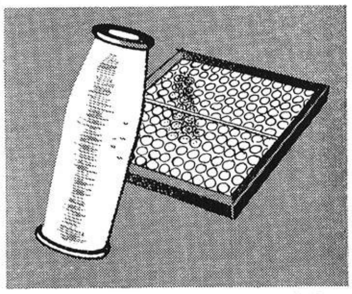


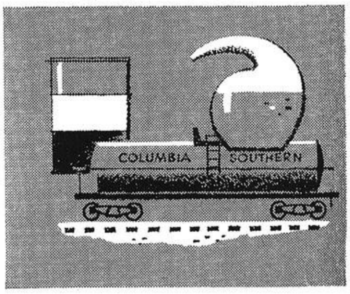
PPG produces volume items such as wrap-around windshields, other automotive glass, Herculite® doors, and processes radar screens, atomic glass, aerial camera lenses, and the like.



PPG has nineteen plants whose sole production is paints and brushes.



PPG's fiber glass is being used for constantly expanding applications.



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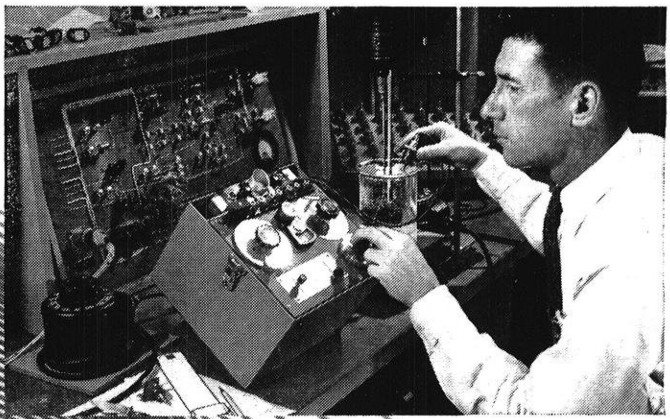

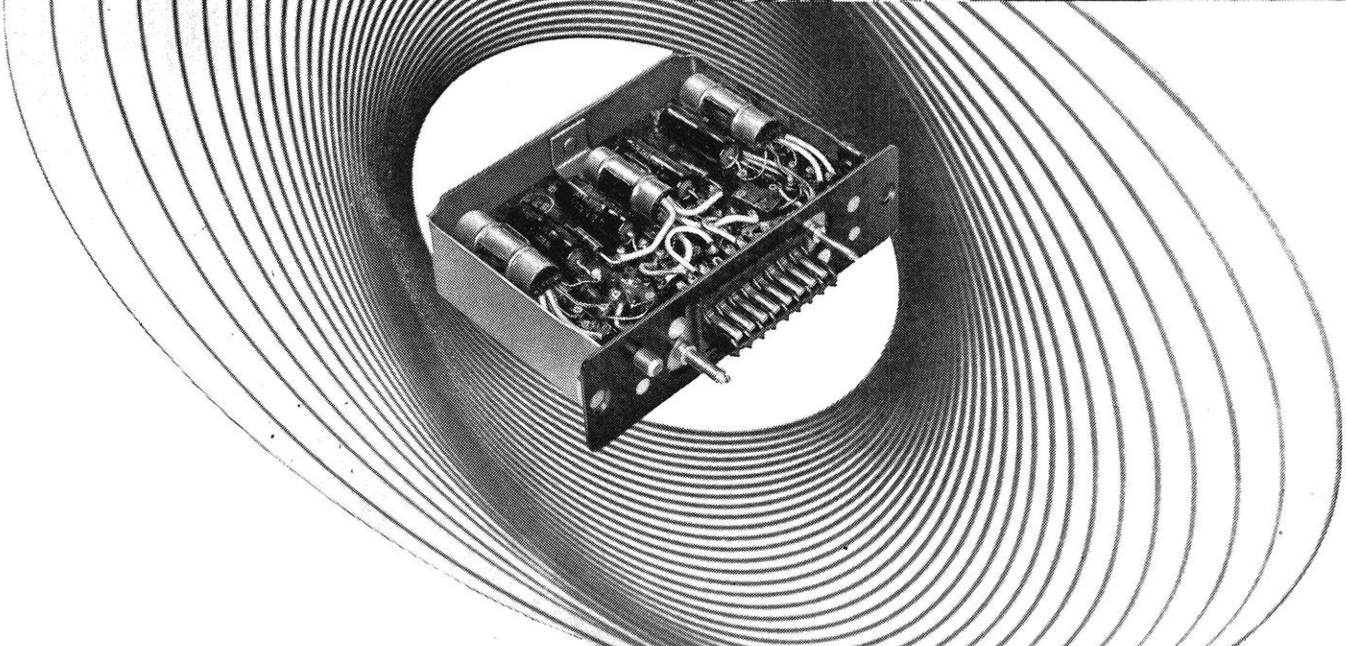

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So You Think You're SMART!

by Sneedly, bs'61

Welcome back from Christmas vacation. Sneedly hopes you had a very enjoyable time over the holidays. Also Sneedly hopes that you found time to work out the answers to last months problems and perhaps send them to Sneedly here at *The Wisconsin Engineer.* In case you didn't, here they are:

The escalator problem can be approached in several ways. Let's assume you did it by considering the escalator's projection on the lower floor (the x-projection) and assumed that the treads were each a unit length long. The situation results in a moving belt, horizontal, with a length equal to the number of steps. We now have a simplified $d=rt$ problem.

Let b=rate of belt in units/sec
m=Norm's rate in units/sec
w=Barney's rate in units/sec
d=length in units

The time necessary for Norm's transit was $d/(b+m)$ units, and Norm walked 28 units. We can therefore say that

$$\frac{bd}{(b+m)} + 28 = d,$$

and for Barney, that $bd/(b+w)+21=d$. Also $m=2w$. Although the three equations have four unknowns, you found to be 42 units anyway, and that, you further concluded, meant that the escalator has 42 steps instantly visible.

Our adventurous treasure-seeker located his treasure because it did not matter where the gallows was located. The spot where the treasure was buried lies equidistant from the two trees mentioned and one-half of the distance to the left of the point where the equidistant line and the line connecting the trees intersect.

* * *

For you fellows who like probabilities, here's a little problem. Figure out the probability that a stick, being broken into three chance pieces, may be arranged in the form of a triangle. Realize that if a 12″ stick is broken into two pieces 2″ long and an 8″ piece, no triangle can be made.

* * *

The other evening Sneedly and a group of fellow engineers went slumming and stopped at a place called Ratscaller. The place was teeming with frail, long-haired little men who Engineer Gene Poison immediately identified as hill students. Over in one corner of the room a little fellow with greenish skin was snickering merrily while the others in the group were cheering him on in their squeaky, high-pitched voices. Finally, after several toasts of carbonated orange had been drunk, the hero protested that he must leave now before he caught a chill. He just put on his overshoes when Engineer Jack Lieferson walked up, puffing contentedly on the stub of a pipe held firmly in his granite-like teeth. The fumes from the pipe were too much for the hill students' hero and the fellow collapsed on the floor, still clutching his black umbrella in his withered, scaly hands. On the floor beside him lay a piece of paper entitled, "2=1". It read as follows:

$$1-3=4-6$$
$$1-3+9/4=4-6+9/4$$
$$(1-3/2)2=(2-3/2)2$$
$$1-3/2=2-3/2$$
$$1=2$$

Engineer Richard Robertson immediately saw the error in this "proof". Can you?

Engine Ears

(Continued from page 54)

sponsible for engineering and design of the firm's entire line of power sweepers and electric vehicles.

Link formerly was in charge of research and development for an Illinois street sweeper manufacturer.

Prior to his eight years with that firm, he was a member of the engineering department of Racine Hydraulics and Equipment Co., Racine, Wis.

CURRENT ENGINEERING INSTITUTES

CONSTRUCTION CONTRACTING

January 9, 10, 11

Construction contract contingencies, special contracts with units of government, Wisconsin's statutes relating to public works, kinds of insurance necessary and desirable for contractors, the economic justification of safety programs, how to organize and run a successful safety program, methods of developing properly trained personnel, and cost keeping and estimating will be some of the subjects considered at this institute. The program will be planned for general contractors.

Fee: $25. Leonard F. Hillis, Institute Coordinator.

ELECTRIC METERS

January 15, 16

This institute is arranged for persons responsible for the testing, calibration, maintenance, and installation of electric meters of various types. Concurrent sessions will be held for basic and advance students during part of the institute. Subjects to be covered include: review of mathematics and basic electricity, report of the use of a mobile testing laboratory, single and polyphase meter applications, and other measuring instruments. The Meter and Customer Service Committee of the Wisconsin Utilities Association is assisting the staff in arranging the program.

Fee: $25. Ralph D. Smith, Institute Coordinator.

THE END

Rocket Fuels

(Continued from page 68)

would be eliminated. But because these solid fuels burn well only under high pressure, the storage tank, which must be large enough to contain the initial fuel charge, must be heavy in construction. This adds to the weight of the rocket.

Atomic energy, because it represents energy in the most concentrated form, would seem to be the answer to a great many problems that arise in the serach for a satisfactory rocket fuel, but the utilization of this tremendous energy for a high thrust rocket is very difficult.

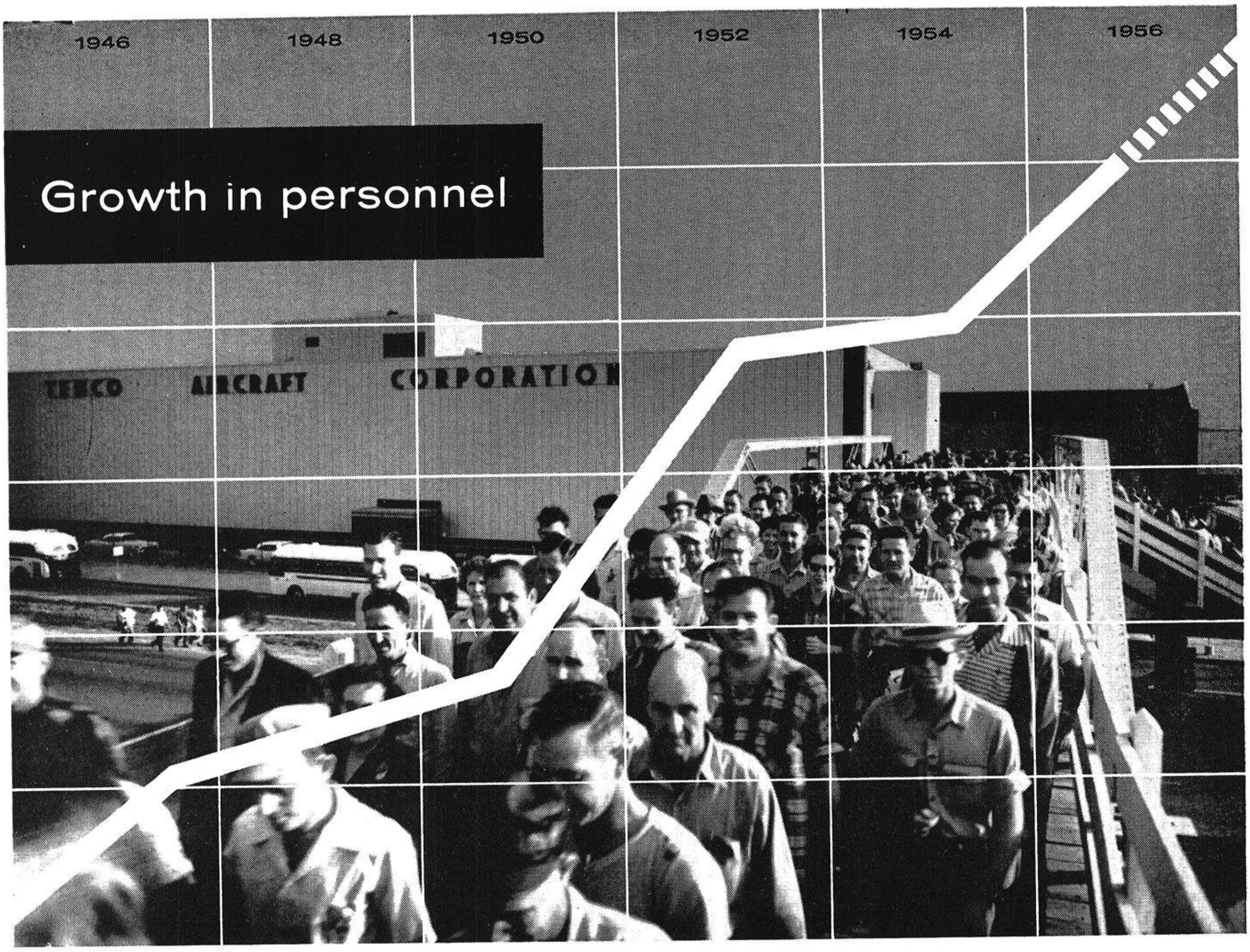
In a fission reaction, particles are released at great speed in all directions. It must be remembered that the rocket would derive its thrust from the reflection of these particles. However, particles emitted by a fission reaction penetrate the walls of the containing vessel and the reflection is so small that no appreciable thrust can be obtained.

Another power source from atomic energy would seem to be the possibility of transferring heat from an atomic pile to a workable fluid. This presents still another problem. In order to compensate for the added weight of the pile, exceptionally high temperatures must be sustained. (in excess of 20,000 degrees Kelvin). There are no cooling methods of materials known to contain such high heat.

Even though much of the research in this field is not published due to security reasons, it has been hinted that the use of atomic fuel is not impossible.

The selection of a satisfactory fuel from the many possibilities now at hand presents many problems. There is no combination of chemicals that has all the desired characteristics. Much research has gone into this study and much more is proposed. This new field is indeed a challenge to the fertile mind.

THE END



Growth — in personnel, for example, tells the Temco success story.

In 1945, Temco had 259 employees. Today, Temco has over 10,000 employees — at three integrated Texas plants — at work on contracts covering fourteen of the country's key military aircraft. Constant expansion in every department has equipped Temco to meet the increasing needs of the aircraft industry—to push ahead the company's own developments in electronics and in aircraft and weapon systems.

Temco's sturdy growth — in skills, facilities and experience — opens up outstanding opportunities for a complete range of engineering talents. If you are looking for a rewarding career in aviation, you will find it at Temco.

ENGINEERS

Openings in all phases of aircraft design and development. Write to Joe Russell, Engineering Personnel, Room 10-A, Temco Aircraft Corporation, Dallas, Texas.

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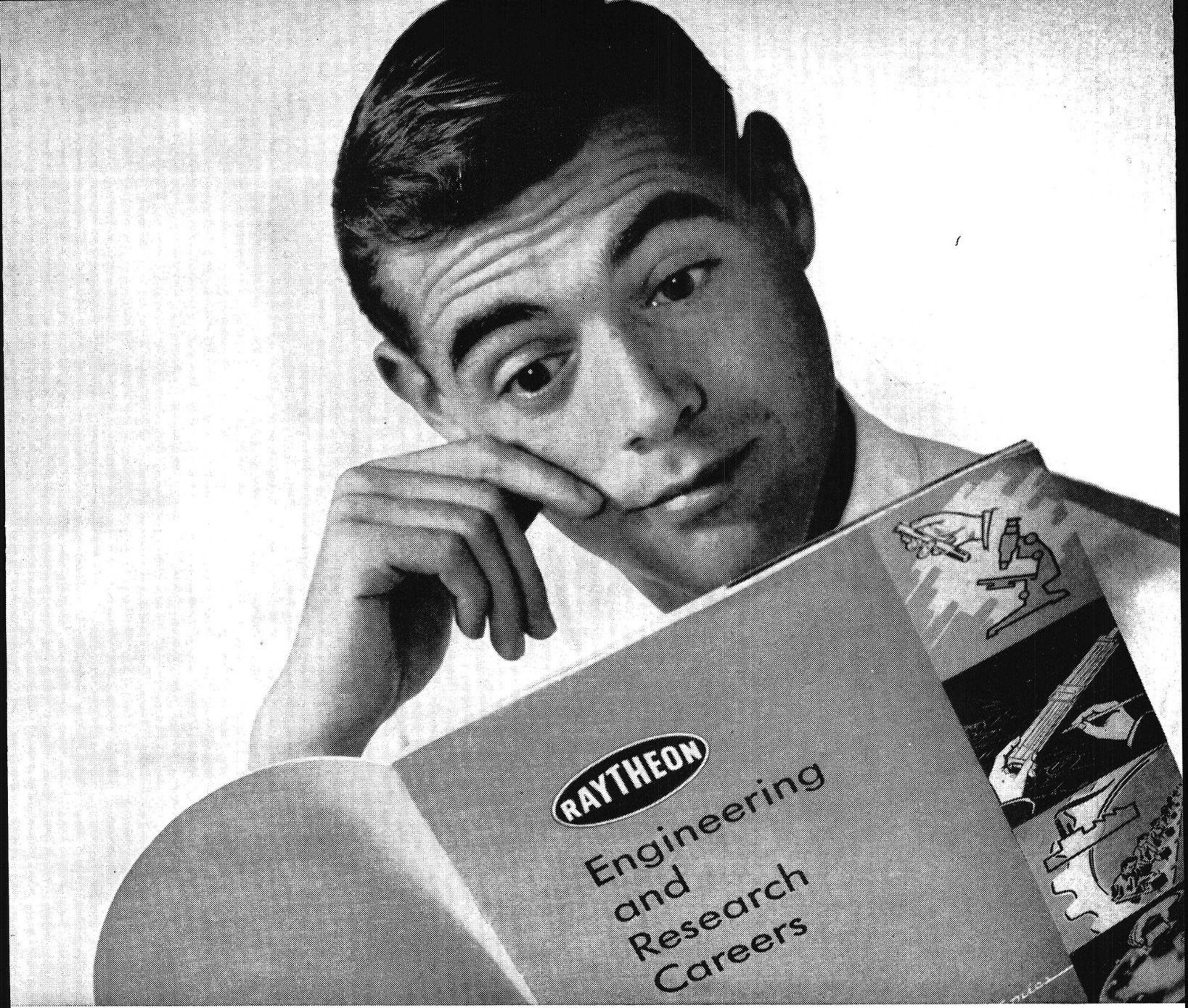

RAYTHEON
Engineering
and
Research
Careers

STA  TIC

THE ENGINEER

Who is the man designs our pumps with judgment, skill, and care?
Who is the man that builds them and keeps them in repair?
Who has to shut them down because the valve seats disappear?
The bearing-wearing, gearing-tearing Mechanical Engineer.
Who makes his juice for half a cent and wants to charge a dime?
Who, when we've signed the contract, can't deliver half the time?
Who thinks a loss of twenty-six percent is nothing queer?
The volt-inducing, load-reducing Electrical Engineer.
Who is it that takes a transit out to find a sewer to tap?
Who then with care extreme locates the junction on the map?
Who is it that goes to dig it up and finds it nowhere near?
The mud-bespattered, torn and tattered Civil Engineer.
Who thinks without his products we would all be in the lurch?
Who has a heathen idol which he designates Research?
Who tints the creeks, perfumes the air, and makes the landscape drear?
The odor evolving, grass-dissolving Chemical Engineer.
Who is the man who'll draw a plan for everything you desire?
From a trans-Atlantic liner to a hairpin made of wire?
With "ifs" and "ands", and "howe'ers", and "but's", to make his meaning clear,
The work-disdaining, fee-retaining Consulting Engineer.
Who builds a road for fifty years that disappears in two?
Then changes his identity so no one's left to sue?
Who covers all the traveled roads with filthy, oily smear?
The bump-providing, rough-on riding Highway Engineer.
Who takes the pleasure out of life and makes existence hell?
Who'll fire a real good-looking one because she cannot spell?
Who'll substitute a dictaphone for a coral-tinted ear?
The penny-chasing, dollar-wasting Efficiency Engineer.
Who is the man that digs up our lawns and streets with cheek
Who is the man that strings pipe through field and swamp and creek
Who'll discuss combustion efficiency with lack of fear
The odor injecting, leak detecting Gas Engineer.

—Submitted by—R. W. Kunkel, U.W.E.E. '51; Thomas J. Lambeck, U.W. M. '33; Antone G. Prasil, U.W. Che. 46, all of the Gas Engineering Dept. of the Wisconsin Public Service Corporation.

* * *

If it takes 10 hours for a woodpecker with a rubber bill to chop $65 worth of shingles from an oak tree, how long does it take a grasshopper with a wooden leg to kick the juice out of a dill pickle?

* * *

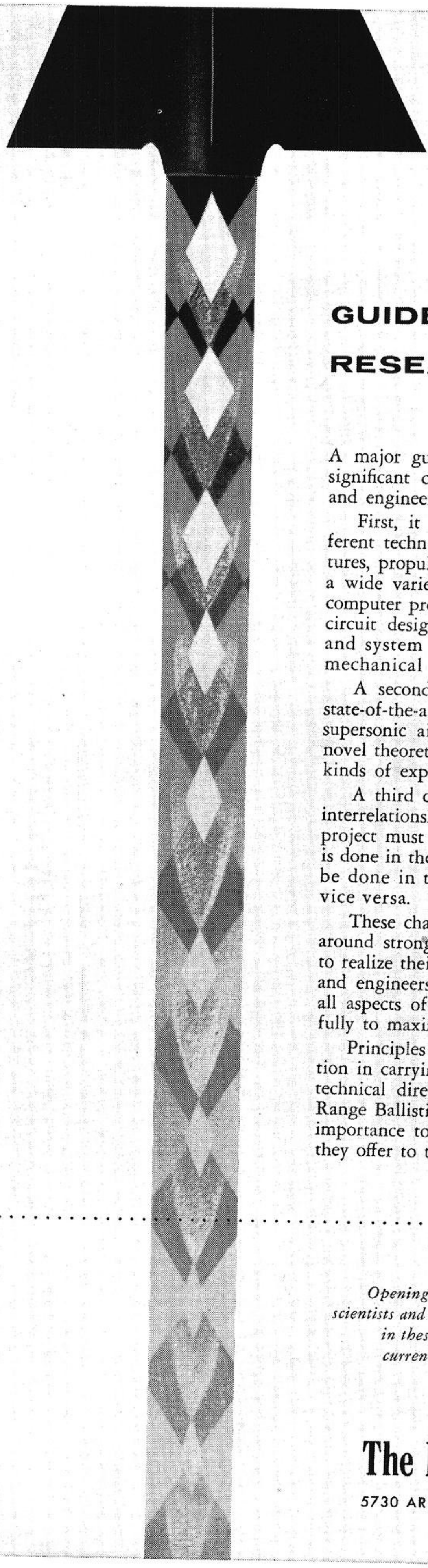
The little boy's watch had stopped ticking and he tried to find the trouble. Finally he took the back off it and went into the works. He found a dead little bug. "No wonder it doesn't work," he said, "the engineer's dead!' '

* * *

A group invented an atom bomb so powerful that it would destroy the world. They just couldn't resist trying it just once. When the smoke had cleared away, the only thing left alive on the face of the earth were two monkeys somewhere in Tibet. The male monkey leered at his companion and said, "Well, shall we start the whole thing over again?"

* * *

There is only one engineer who ever got rich. He recently died in Arkansas and left a fortune of $50,000 which he amassed through unceasing toil, superhuman perseverance, remarkable ingenuity, and the death of an uncle who left him $49,000.



GUIDED MISSILE RESEARCH and DEVELOPMENT

A major guided missile research and development program has several significant characteristics that are of particular interest to the scientist and engineer.

First, it requires concurrent development work in a number of different technical areas such as guidance and control, aerodynamics, structures, propulsion and warhead. Each of these large areas in turn contains a wide variety of specialized technical activities. As an example, digital computer projects in the guidance and control area involve logical design, circuit design, programming, data conversion and handling, component and system reliability, input-output design, and environmental and mechanical design.

A second characteristic is frequently the requirement for important state-of-the-art advances in several of the technical areas. For instance, the supersonic airframe needed for a new missile may necessitate not only novel theoretical calculations, but also the design and performance of new kinds of experiments.

A third characteristic of missile development work is that such close interrelationships exist among the various technical areas that the entire project must be treated as a single, indivisible entity. For example, what is done in the guidance portion of the system can affect directly what must be done in the propulsion and airframe portions of the system, and vice versa.

These characteristics make it clear why such work must be organized around strong teams of scientists and engineers. Further, for such teams to realize their full potential, they must be headed by competent scientists and engineers to provide the proper technical management. And finally, all aspects of the organization and its procedures must be tailored carefully to maximize the effectiveness of the technical people.

Principles such as these have guided The Ramo-Wooldridge Corporation in carrying out its responsibility for overall systems engineering and technical direction for the Air Force Intercontinental and Intermediate Range Ballistic Missiles. These major programs are characterized by their importance to the national welfare and by the high degree of challenge they offer to the qualified engineer and scientist.

Openings exist for scientists and engineers in these fields of current activity:

- Guided Missile Research and Development
- Aerodynamics and Propulsion Systems
- Communications Systems
- Automation and Data Processing
- Digital Computers and Control Systems
- Airborne Electronic and Control Systems

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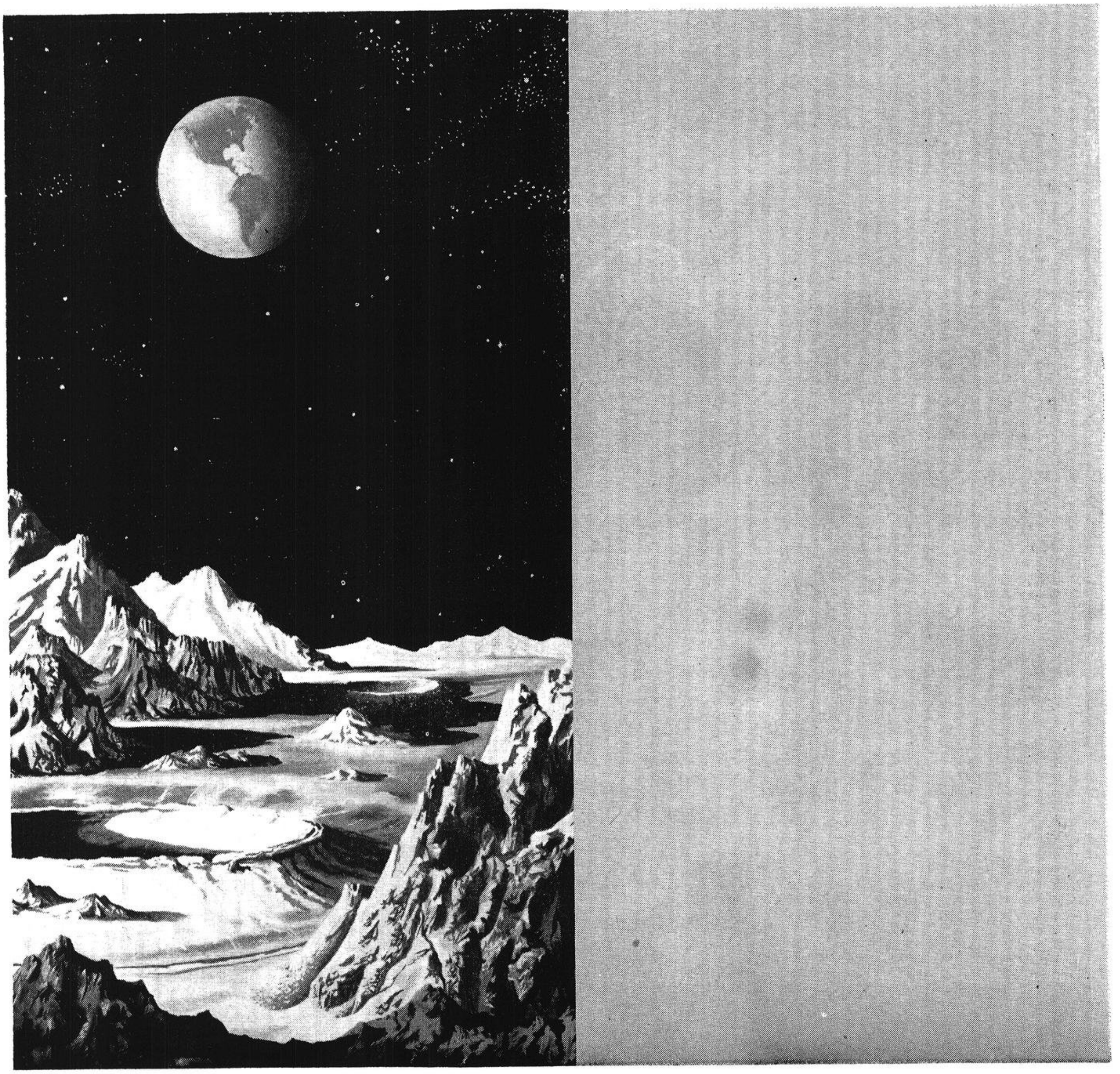

"THERE'S A BEAUTIFUL EARTH OUT TONIGHT"

These words will be spoken by a traveler from the planet Earth—and the speaker is alive today.

A whole new science of astronautics has come into being in the past decade. And today at Martin, thousands of engineering man-hours are daily being devoted to the development of guided missiles, rockets and flight systems of vital importance to the security of our country—and to the future of astronautics.... It's sooner than you think!

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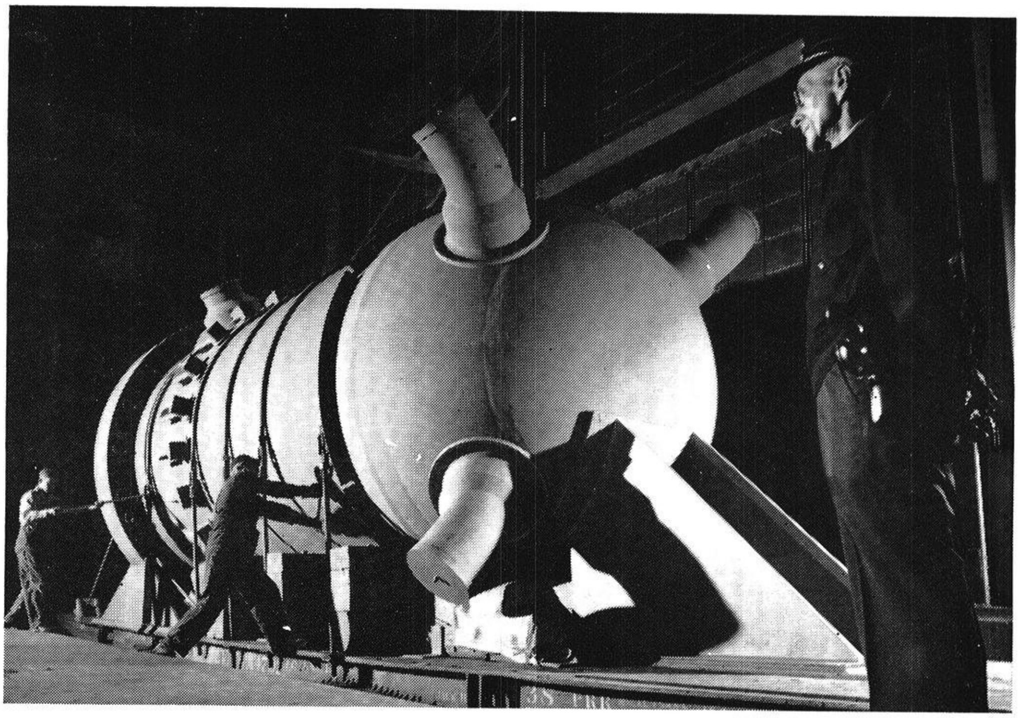
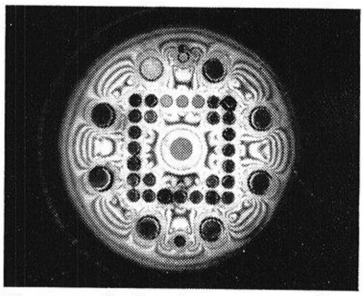
PHOTOGRAPHY AT WORK—No. 25 in a Kodak Series

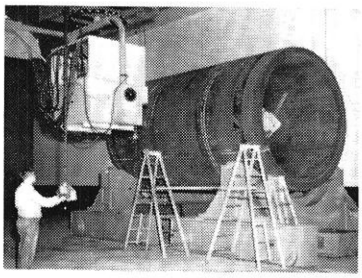


Nuclear reactor vessel for Shippingport, Pa. power plant designed by Westinghouse Electric Co. under contract with the A.E.C. for operation by Duquesne Light Company.

Where atoms turn into horsepower



Photograph showing patterns of stress concentration. It was taken of a plastic model of a reactor vessel loaded to simulate the strains a real reactor vessel would undergo.



Radiographs of the reactor vessel welds were made with a 15,000,000-volt betatron. Every bit of the special steel, every weld had to be proved sound and flawless.

Combustion Engineering designed and built this "couldn't-be-done" reactor vessel for America's first full-scale nuclear power station. And photography shared the job of testing metals, revealing stresses and proving soundness.

COUNTLESS unusual—even unique—problems faced Combustion Engineering in creating this nuclear reactor vessel. Nine feet in diameter with walls 8½ in. thick, it is 235 tons of steel that had to be flawless, seamed with welds that had to be perfect. And the inner, ultrasmooth surface was machined to dimension with tolerances that vie with those in modern aircraft engines.

As in all its construction, Combustion Engineering made use of photography all along the way. Photography saved time in the drafting rooms. It revealed where stresses and strains would be concentrated. It checked the molecular structure of the steel, showed its chemical make-up. And with gamma rays it probed for flaws in the metal, imperfections in the welds.

Any business, large or small, can use photography in many ways to save time and money. It can go to work in every department—design, research, production, personnel, sales, and accounting.

CAREERS WITH KODAK

With photography and photographic processes becoming increasingly important in the business and industry of tomorrow, there are new and challenging opportunities at Kodak in research, engineering, electronics, design and production.

If you are looking for such an interesting opportunity, write for information about careers with Kodak. Address: Business and Technical Personnel Dept., Eastman Kodak Company, Rochester 4, N. Y.

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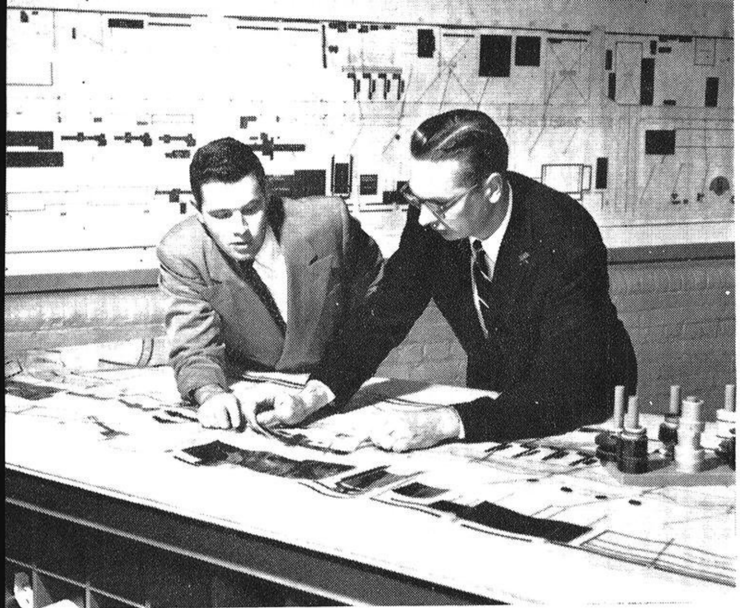


DESIGNING COMPLETE PLANT LAYOUT for a new manufacturing activity are Howard Jenkins, Maine '50, and Dick Rayve, Brooklyn Polytechnic '54. This manufacturing engineering problem involves operation planning, materials handling, and designing machine tools.

EXTENSIVE ENGINEERING INSIGHT and a firm knowledge of manufacturing problems guide Tom Robinson, Alabama Polytechnic Institute '54, in purchasing materials for operating departments. Tom, at left, discusses possible application of metal products with vendors.

AT GENERAL ELECTRIC . . .

Your engineering background fits you for expanding opportunities in manufacturing

Today's engineers are going to work in manufacturing—and rightly so. The products of our rapidly advancing technology—involving mechanical, electrical, hydraulic, chemical and electronic components—call for greater engineering skill in their production. With the advent of atomic devices there will be an even greater demand for engineering knowledge in the manufacturing function.

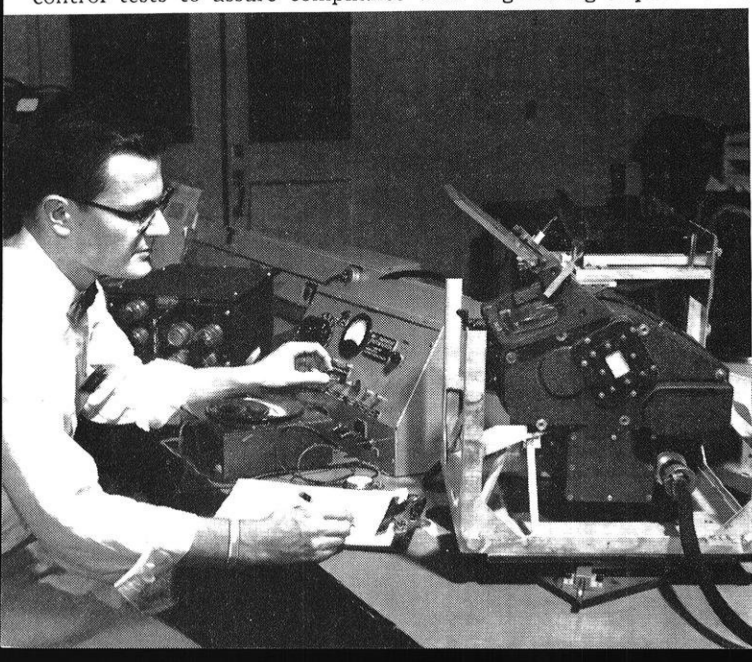
General Electric, long a leader in modern manufacturing methods, is currently planning expansions and improvements to double its production rate in the next ten years. To meet this intensified demand, the Company has instituted a Manufacturing Training Program to develop young men for the important jobs which will result from this manufacturing growth.

You can share in G.E.'s manufacturing progress. This is a field where manufacturing engineers will apply all their technical knowledge to provide solutions for industry's many problems. Mechanical, industrial, electrical, and chemical engineers will all find wide opportunities in the varied activities of modern G-E manufacturing. For complete information on careers in manufacturing, write to John E. Jones, Manufacturing Training Program, General Electric Company, Schenectady 5, New York. 957-1

Progress Is Our Most Important Product

GENERAL ELECTRIC

IN QUALITY CONTROL ENGINEERING Chuck Fehlau, Bates College '49, is responsible for devising test procedures and designing test equipment for this jet fighter gun-sighting system. Chuck also audits quality control tests to assure compliance with engineering requirements.



DESIGNING AUTOMATION EQUIPMENT for a new motor production line are these G-E manufacturing engineers. The high engineering content of operations in this manufacturing development laboratory requires the technical skill of outstanding young creative engineers.