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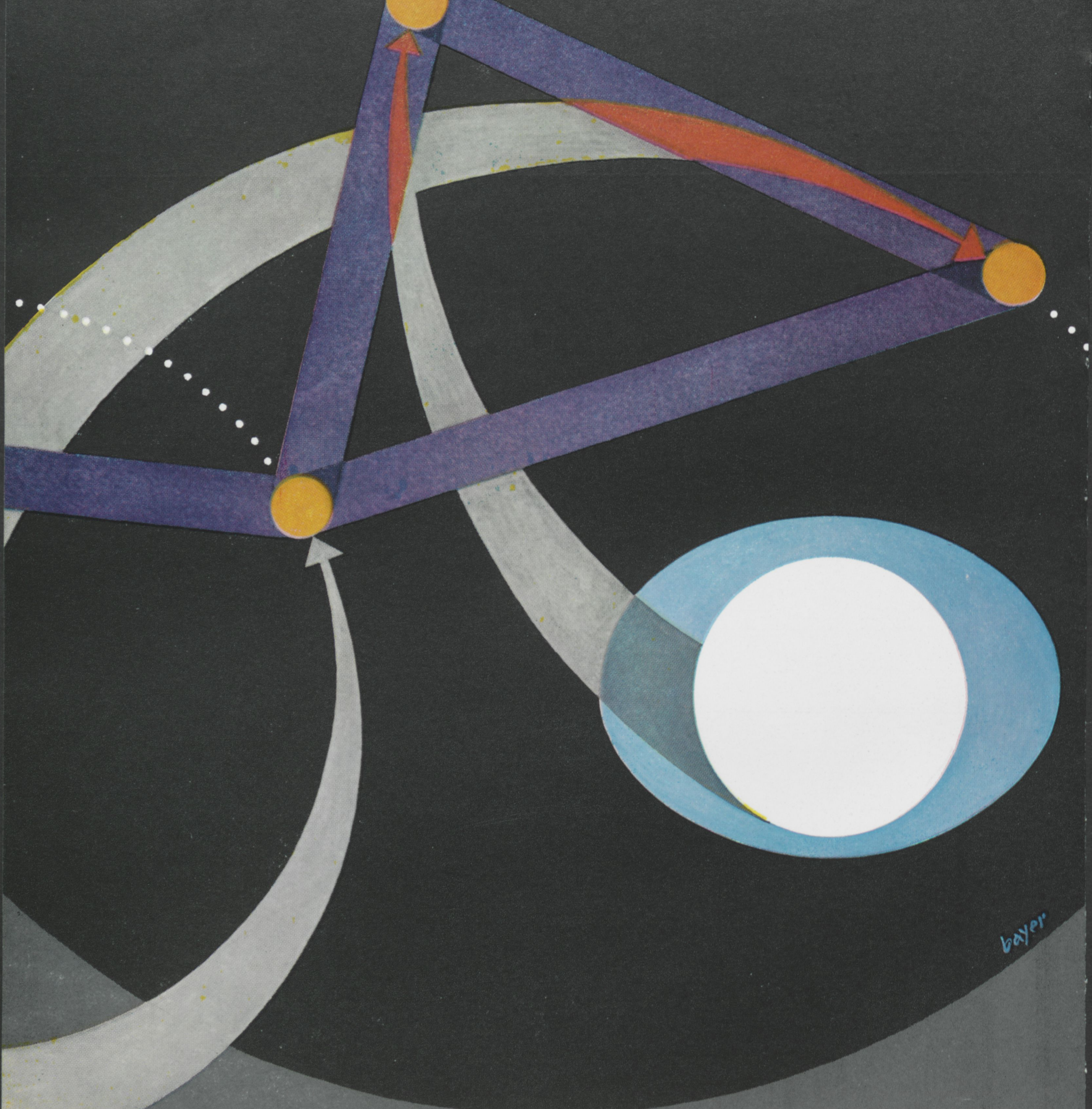
Rose Technic

April 1963

FIFTY CENTS

THE MENACE OF OYSTERISM
IONIC ROCKET PROPULSION
LETTER FROM ALUMNUS



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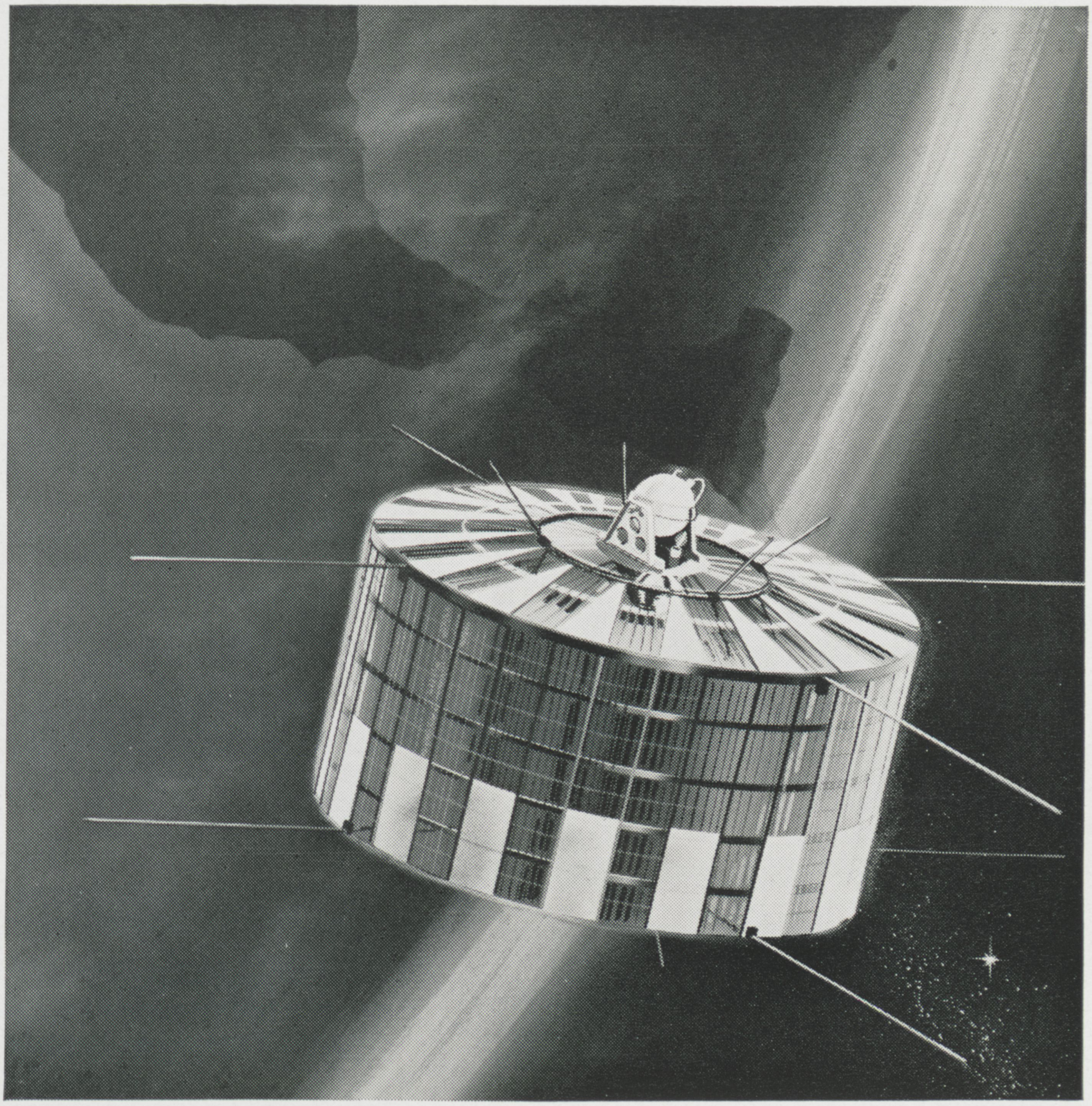

Illustration Courtesy The Martin Company

Atomic power for outer space

Monsanto . . . a world leader in chemicals, plastics and petroleum products . . . has also taken a giant step into the atomic space age. Now broadcasting signals from space is a *Transit* satellite transmitter, powered by an "atomic generator." This long-lived power source is fueled with plutonium 238 processed and encapsulated at Mound Laboratory, which Monsanto Research Corporation, a wholly owned subsidiary of Monsanto, operates for the Atomic Energy Commission.

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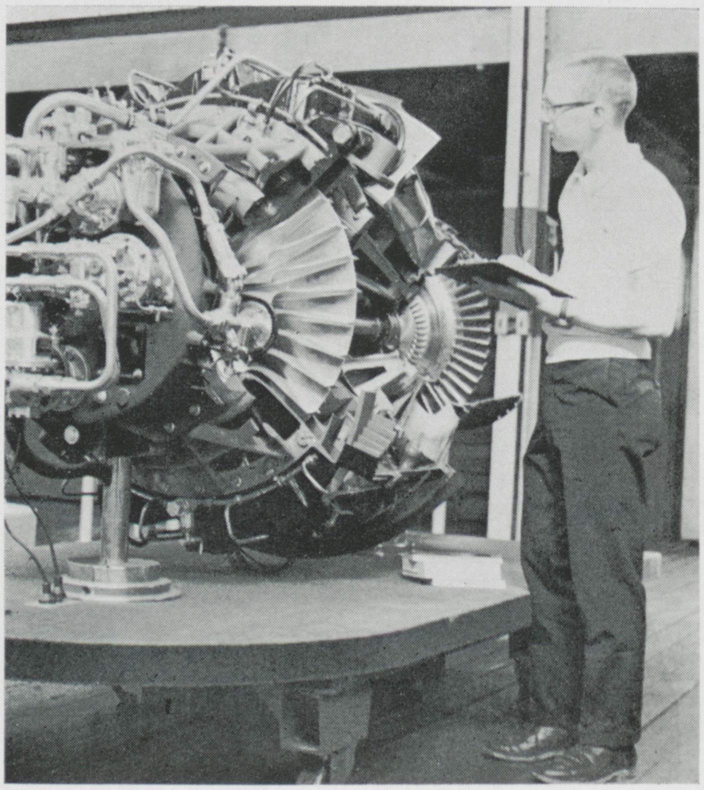

Cover Note

A gyroscope with no wheels, motors, gears, bearings, gimbals, rotors, springs or bushings? Yes, it has a heart of water, contained in a small glass sphere enclosed in electrical coils while align the water's nuclear particles like bar magnets. When the gyro's orientation is changed, these particles are disturbed. They emit a faint current, which signals the change. The advantages over mechanical gyros: Drift due to friction-zero. It will never wear out.

This cover made possible through the courtesy of Republic Aviation Corporation, Farmingdale, Long Island, New York.

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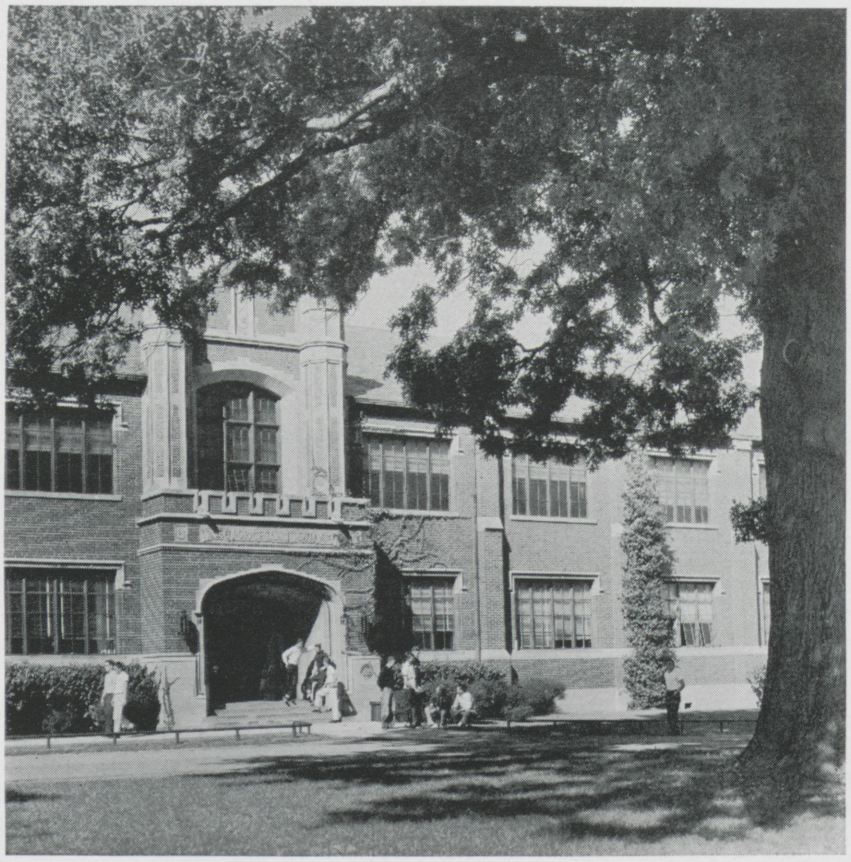

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The Individual at Rose

For the past three years while attending Rose, I have observed with interest the position of the individual. These observations indicate a lack of respect for the autonomous individual.

When one is asked to define an individual, the usual reply is either a statement of the rugged individual characterized by the early Americans or the modern version of an eccentric, freakish, or odd-ball type person. The person who possesses the quality of independence of mind is seldom mentioned as being an individual.

A modern characteristic of the American people is that of seeking comfort and security through membership in a particular segment of society (group conditioning). Examples of these groups include the government and related groups, classroom groups here at school, work groups in industry, social groups, and a vast array of organizations which perform social and professional services. These groups often resent anyone who thinks independently of the approved group conditioned thought. Mediocrity becomes the normal state of mind, any uncommon man who excels becomes some sort of freak. Conformity to the group conditioned thought type of environment in which one finds himself becomes the goal.

It is unfortunate that this state of affairs exists today. All new ideas and improvements originate in the nonconforming and critical mind possessed by the individual — never in the group conditioned thought found in the group. It is therefore advantageous to utilize, to the greatest extent, the values of individuals.

Man is infinitely diverse in his talents and interest. The higher the cultural level obtained, the greater this diversity. The individual who possesses independence of mind will find that an adjustment to a group conditioned thought belongs to primitive ages.

In the March 1963 *Rose Technic,* President Logan discussed the Rose environment in "The President Comments." In his article he states: "The college [Rose] must develop an educational community designed for the express purpose of facilitating the broadest kind of education — intellectual, social, cultural and physical." There was no mention that this "express purpose" must be to place their emphasis on the development of the individual's innate capacities and to develop him into an independent self-determining American citizen. It is not possible to have a broad education if this development is overlooked.

Another factor affecting the individual at Rose is one of an increasing population. As the school becomes more and more populous, the tendency for each person to become an individual, as he must when men are few in number, decreases rapidly unless steps are taken to correct the trend.

In our expansion program, we must cultivate an environment in which the autonomous individual can prosper. We must accept the idea that man as man, individual man, is the "measure of all things."

M. D. T.

Holding the line . . . for a richer harvest

Boll weevil, codling moth, leaf rollers, thrips and beetles . . . these are only a few of the thousands of insects that chew up millions of dollars worth of farm crops each year. Fortunately, however, they are no match for a new Union Carbide product called SEVIN insecticide. In the United States and many other countries, the use of SEVIN has already saved such staple crops as cotton, corn, fruits and vegetables from destruction by ravaging insects. ▶ You can now get SEVIN insecticide for your own garden as part of the complete line of handy EVEREADY garden products that help you grow healthy vegetables and flowers. SEVIN comes from years of research in Union Carbide laboratories and at an experimental farm in North Carolina where scientists prove out their latest agricultural chemicals. ▶ This is only one area in which chemicals from Union Carbide help improve everyday living. The people of Union Carbide are constantly at work searching for better products that will meet the needs of the future.

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the menace of oysterism

This article was submitted by Mr. Goodwin as a Tau Beta Pi pledge essay in the fall of 1962.

The article was chosen as the winning essay of the fall pledge class here at Rose.

By Max Goodwin
Sr. Physics

A young man is advised to stay out of politics because it is a "rough game." An engineering student looks for fringe benefits before opportunity for advancement in a company. A poll shows socialized medicine gaining in public favor. A psychology professor points out that one way to reduce frustration is to adjust goals downward. In each of these instances we can see symptoms of a phenomenon which we might call "oysterism."

"Oysterism" is used here to describe a way of life which is widespread in our society today. It is characterized by preoccupation with security, a tendency to always "play it safe," acceptance of undesirable situations instead of making efforts to change them, and a general attitude of withdrawal inside a comfortable oyster-like shell for protection, rather than welcoming the challenges and risks that come with living boldly.

Oysterism is certainly not new; it has always been present to some extent in our society. What is new, perhaps, is the elevation of oysterism to a position of respectability. Whereas we once took as our hero the frontiersman with his qualities of boldness, resourcefulness, and individuality, we now seem to have replaced that hero with a middle class organization man who specializes in gracious living, compatibility, and sophistication. Moreover, we have been bombarded with advice from amateur psychologists and beatnik philosophers to the effect that it is foolish for man to try to change his environment, and that he should, instead, adjust his goals and standards until they conform with his environment. These quacks point out that man often suffers from frustration, anxiety, and tension and that we should strive to eliminate these conditions. Thus, since frustration results from failure to obtain one's goals, we should lower our goals until they are readily attainable. Likewise, we are advised to avoid situations which are likely to produce tension or anxiety in order to maintain peace of mind.

I submit that such advice is pure hogwash, that it is not a guide to successful living, and that it is actually a threat to our society. Certainly it is possible to reduce frustration, anxiety, and tension, and to some extent this is necessary and desirable; but to make this the primary goal is to forfeit the chance for really satisfactory living.

The men who have made lasting contributions to our society have not spent their efforts in reducing their frustrations and tensions. If Lincoln had been concerned with protecting himself from unpleasant emotions he would never have entered politics, or if he had he would certainly have quit after his first election defeat. Edison, had he listened to the oysterists, would have gone back to whale oil after the first few failures of his electric lamp. George Gershwin, his music blasted by critics, would have diverted his efforts to another field. If all the American pioneers had embraced oysterism as their philosophy there would be no America today.

Let me put it another way. We are all familiar with the late Grantland Rice's poem about the game of life:

> For when that one Great Scorer comes to write against your name,
> He marks—not that you won or lost—but how you played the game.

Perhaps, if the trend toward oysterism continues, the mark beside our names will not say how we played the game, but that we chose to sit on the sidelines and watch, and did not play at all.

The great men in our history have played the game hard, regardless of the odds. They have played to win, not to avoid injury. They have viewed the frustration of defeat as a springboard for fighting back, not as a signal to quit. They have accepted tension as a stimulus, not as a dreaded affliction. In short, they have lived aggressively, not defensively as the oysterists would have us do.

(*Continued on Page* 28)

IONIC ROCKET PROPULSION

By Gerald Zinngrabe
Jr. M.E.

The rocket of the present time is powered by the chemical propulsion engine. However, this type of engine is unable to meet the power required for use in the future. This power will be supplied by rocket engines energized only by electricity.

The rocket is a reaction propulsion engine, characterized by the expulsion of mass at some exhaust velocity, c. This reaction, the expulsion of mass, produces a thrust, F. The thrust, or "force of lift" on the rocket is given by:

$$F = \frac{mc}{t} + (P_c - P_o)A_c$$

where $\frac{m}{t}$ is the mass rate of flow, p_e is the exit pressure, and p_o is the pressure of the outside atmosphere. The exit pressure acts through the exit area A_e. The pressure term in the equation accounts for only a small part of the thrust, so it can be disregarded. The equation reduces to:

$$F = \frac{mc}{t}$$

The thrust is a measure of the performance of the engine.

Another parameter used extensively in rating engine performance is the specific impulse, I_{sp}, which is the impulse delivered per unit weight of the propellant.

$$I_{SP} = \frac{Ft}{m g_o} = \frac{c}{g_o} \text{ (sec)}$$

It can be seen from the expressions for thrust and specific impulse that the performance of a rocket engine can be magnified by increasing the exhaust velocity.

The chemical rocket engine of today depends upon the kind of propellant used. This dependency is expressed as:

$$c = K\sqrt{\frac{T_c}{m}}$$

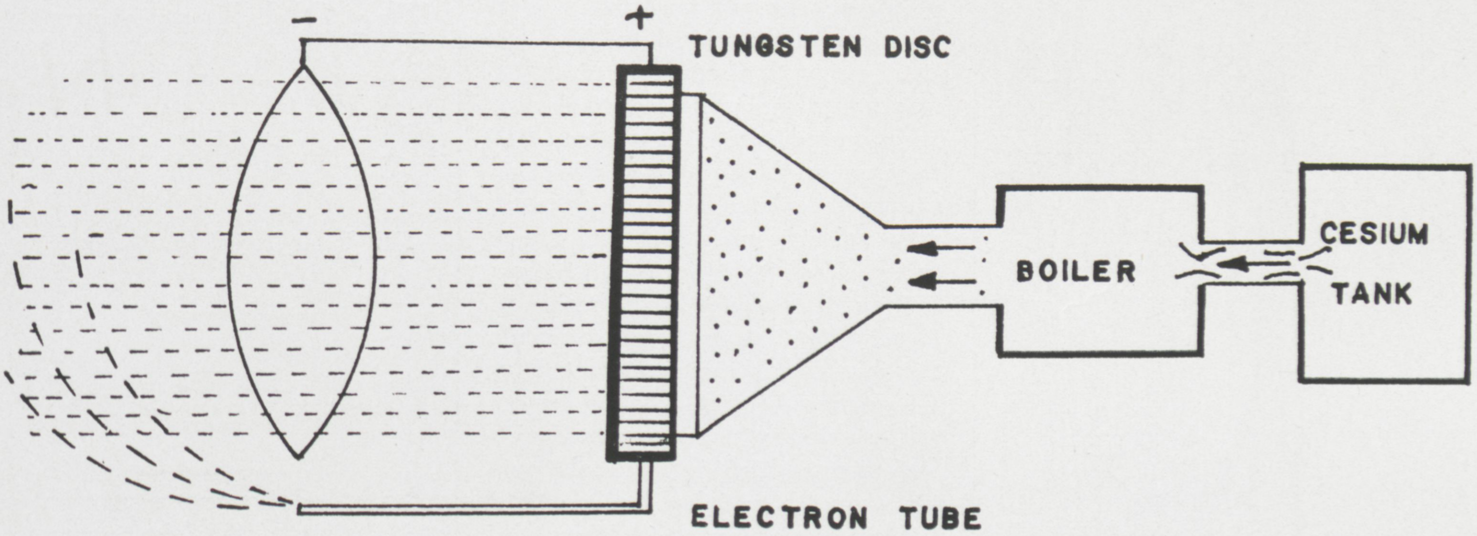
The exhaust gas velocity is directly proportional to the combustion temperature, T_c, and inversely proportional to the molecular weight of the exhaust gases. Laboratory tests show that raising the combustion temperature of the chemical propellants usually increases the molecular weight of the exhaust gases. The opposite is also true. Chemical rocket engines may be improved up to twenty per cent in the future, but a much greater improvement will be needed for interplanetary travel.

One improvement is the nuclear engine. In this engine, hydrogen (lowest molecular weight of the elements) is heated in a nuclear reactor and expelled. This engine also has a limit on its performance due to the fact that the temperature to which the reactor can be heated is restricted.

The newest and most promising idea is the concept of the ion rocket engine. The basic principle of this engine is quite simple and quite sound. All that is needed for a good engine is a high velocity of exhaust mass. Charged particles can be accelerated to tremendous speeds by attractive and repulsive forces. This speed is bounded by the speed of light, a fantastic improvement over the much slower exhaust gases of the chemical rocket engine.

The kinetic energy for any particle is:

$$K.E. = \frac{1}{2} mc^2$$



Remembering that work is defined as the energy per unit time, the work performed will then be:

$$W = \frac{1}{2}\frac{mc^2}{t} = \frac{1}{2}\frac{Wc^2}{gt}\ \frac{\text{ft-lb}}{\text{sec}}$$

But one horsepower (HP) is equal to 550 ft-lb_f/sec. Therefore,

$$550\ H.P. = \frac{Wc^2}{2tg}$$

$$c = \sqrt{\frac{HP}{w}}$$

The above equation gives the exhaust velocity of a group of particles. The weight rate of flow is given by w. The thrust is known to be Mc, where M is the mass rate of flow. Thus the thrust caused by a group of particles is given by the formula:

$$F = 5.85\sqrt{w(HP)}$$

The specific impulse is known to be c/g. Therefore, the specific impulse of a group of particles is given by the formula:

$$I_{sp} = 5.85\sqrt{\frac{HP}{w}}$$

If an electrical propulsion system has a flow rate of 1000 lb_f/sec and a power of one million horsepower, the exhaust velocity is 188,000 feet per second. The thrust is 5850 lb_f. The specific impulse is 5850 lbf-sec/lbm. It is evident that the electrical ion propulsion system, consisting of a group of charged particles, can develop thrusts and specific impulses of an order great enough to propel a rocket ship.

Mathematically, then, the ion rocket engine is highly desirable. But how is the basic principle, the acceleration of a charged particle by attractive and repulsive forces, going to be applied? An electric field will supply the necessary forces on the charged particles. The question now is, where can a source of ions be found? There are numerous possible ion sources, but the one that has received the most attention is the cesium system.

Extensive tests and experiments have established that when a hot tungsten surface anode is exposed to a low vapor pressure of cesium, the alkali may be completely ionized by the potential of the field. Of course, there are only certain conditions in which this ionization might occur. There is a vapor pressure above which the alkali will be emitted from the tungsten as atoms. There is also a critical tungsten temperature for every arrival rate of alkali atoms. Above this temperature ionization of the alkali will readily take place, but below it the evaporation will occur as atoms.

Figure one is a schematic diagram of an ion rocket engine. Cesium is stored in the tank at the left. It is melted at 81.5° F, and fed in to the boiler, where it is boiled at 1238° F into the gaseous state. This gaseous cesium is passed through holes in the tungsten disc. With the correct temperature and pressure conditions present, the cesium atoms in the vapor tend to ionize. This means that the atom splits into a positive particle, which is used for propulsion, and a negative particle, an electron.

The electrons must be disposed of since they tend to recombine with the positive particles to form atoms. This operation is the function of the electron tube which feeds the electrons into space. Now the ions (the positive particles) are in an electric field caused by an extremely high potential. Since the ions are positive, they are repelled by the positive terminal and attracted by the negatively charged accelerating ring. The ions are attracted to the ring. By the time they reach the ring, the ions are moving with such velocity, and have such great momentum, that they pass right through it. The ions are then exhausted into space at great velocity, producing tremendous thrust. The ejected ions then recombine with the ejected electrons to form cesium atoms. This prevents the ions from being reattracted by the accelerating ring.

The energy requirements for a fast, manned flight into the solar system cannot be satisfied by the chemical propulsion systems. These deliver maximum specific impulses between 379 lbf-sec/lbm and 420 lbf-sec/lbm. The nuclear propulsion system is a slight improvement producing maximum impulses between 800 lbf-sec/lbm and 1200 lbf-sec/lbm. Specific impulses as high as 3,000 lbf-sec/lbm have already been created by ion propulsion engines. Impulses of this magnitude more than fulfill the necessary conditions for interplanetary travel.

There are still some problems involved in the development of the ionic propulsion engine. The main one is the development of a low mass, power generating station. The one million horsepower generator described in the illustration would weigh close to ten million pounds. The 5850 pound thrust could not even begin to lift a rocket of this size. However, once the rocket is in space, where the force of gravity would be sufficiently diminished, the ion propulsion engine will drive the rocket quite satisfactorily.

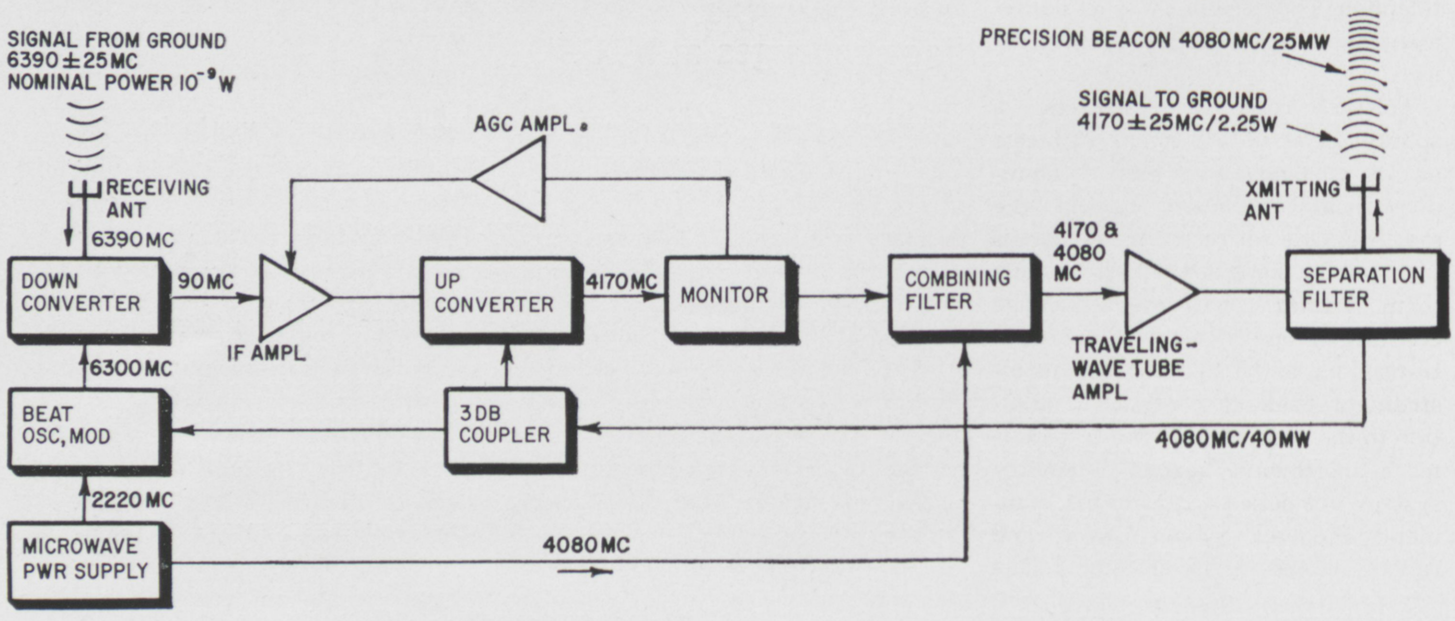
As the reader will have undoubtedly deduced from this article, the electrostatic ionic propulsion engine, although relatively young, is basically sound in theory. There still remains much work in the complete development of the engine, but once it is perfected, it will replace the less powerful chemical engine. This is the engine of the future.

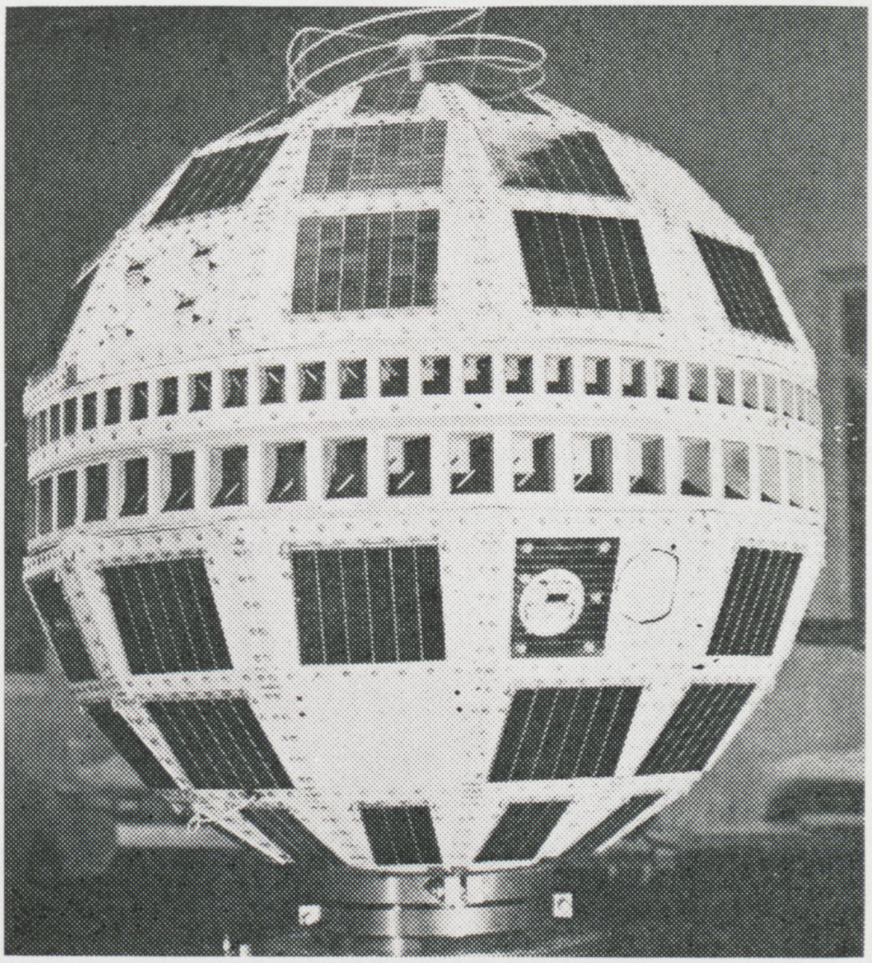
TELSTAR

By John Howlett
Freshman

On July 10th, 1962, man's dream of intercontinental communications via satellites was fulfilled. On that date a huge "Delta" rocket soared aloft with the Telstar communications satellite in its nose cone. Telstar was sponsored by the American Telephone and Telegraph Company and was designed and built by Bell Telephones Laboratories. AT&T paid the National Aeronautics and Space Administration approximately $3-million dollars for the rocket, launching facilities, and initial tracking of the satellite.

Telstar was an initial success and made many new advances in the field of satellite communications. It was quite an advance over the "Echo" satellite in that instead of merely reflecting radio signals, Telstar receives a signal, amplifies it, and then retransmits it almost 10 billion times as strong as it was received. On July 23rd, the first live TV program from the United States to Europe was broadcast via Telstar. This program was a joint effort of the three U.S. television networks. A few hours later, Eurovision broadcast a program in the opposite direction. In September, the first live color telecast from Europe was broadcast when Telstar retransmitted a special medical information program for the Twelfth International Congress of Dermatology in Washington, D.C. During the telecast a panel of doctors on each side of the Atlantic talked to each other over the Atlantic telephone cable. This program was broadcast through the color television facilities of Smith, Kline and French Laboratories, Philadelphia, and its British subsidiary, Smith, Kline and French Laboratories Limited. Telstar was also used to synchronize the master clock of the U.S. Naval Observatory with the master clock of the British Royal Greenwich Observatory. The clocks were synchronized to within ten-millionths of a second on August 25th and two days later were syn-





chronized even more accurately to one-millionth of a second.

Telstar has been termed a "microwave tower in the sky." The range of microwave transmissions has been seriously affected by the line of sight factor. Microwaves can be transmitted between two points only if the receiving and transmitting towers are in the same line of sight. With Telstar, high above the earth, intercontinental range could be achieved. It can handle TV, FM, facsimile, or any other broad-band microwave signals that can be transmitted on the ground. At present, Telstar can handle either one TV channel, 600 simultaneous one-way telephone conversations, or an equivalent band width of the other services.

Telstar roughly resembles a sphere. In actuality, it has 72 facets on its surface. Two sets of omnidirectional antennas encircle the satellite. One set receives the signals from earth, the other set retransmits them. Telstar's instrument package consists of one electron tube, 1,064 transistors, and 1,464 diodes. This instrument package contains in addition to the receiver and the transmitter, a microwave beacon, telemetry system, vhf beacon transmitter, command receiver, power plant, and radiation experiment equipment. The solar power plant consists of 3600 solar cells mounted on 60 of the facets on the outer surface of the satellite.

Telstar receives on 6390-mc. This signal is mixed with a 6300-mc. from a crystal oscillator which produces an i.f. of 90-mc. The lower frequency can be effectively handled by the transistor circuits. The i.f. signal is amplified about 1,000,000 times by fourteen germanium diffused-base transistors. The signal is prevented from being retransmitted at more than 2¼ watts by an automatic gain control. The amplified signal is then mixed with a 4080-mc. signal to produce the 4170-mc. signal that the satellite transmits. Final amplification is achieved with a foot-long traveling-wave tube which amplifies the signal an additional 5,000 times. This traveling wave tube serves a double purpose. Along with the 4170-mc. communication frequency, it transmits a one/two-hundredth watt signal on 4080-mc. for the tracking signal to home on.

Since Telstar is an experimental model, it carries many devices for checking conditions of the space environment such as the number of free protons and electrons, radiation effects, and sunlight readings. It checks a total of 115 conditions. Every one of these conditions is sent back to earth once in every minute. A 136-mc., ¼ watt transmitter does the task of getting these readings to earth. Transmitting continuously with 200 mw., it acts as a secondary tracking beacon. Since it transmits continuously, the telemetry pulses (PCM) frequency modulate (FM) a 3-kc. subcarrier which amplitude modulates (AM) the 136-mc. carrier. This combined signal is called a PCM-FM-AM transmission. This signal is transmitted via a helical antenna. After two years this transmitter is to automatically turn itself off in order to give other satellites a chance to use its frequency.

Two remote control systems are used to turn the telemetry equipment on and off. These two systems each consist of a 220-mc. receiver and a decoder. This shut-off is provided in order to conserve power when the satellite is not in radio contact with its Andover ground station.

As was mentioned earlier, power is provided to the satellite by means of 3600 solar cells. These are used to charge a 19 cell nickel-cadmium storage battery. Initially, power output was to be about 15 watts. This was expected to drop somewhat in time even though the solar cells are protected by a thin layer of synthetic sapphire. If all the equipment in Telstar is on at the same time, it would draw 34 watts which would eventually discharge the battery. This is why the equipment is run in a cycle and turned off when it is not being used.

All of the electronic equipment is protected by foamed plastic and suspended by Nylon cords in order to protect it from vibration and shock.

Telstar sends its information to and is controlled by a ground station in Andover, Maine. There are two foreign stations and another domestic one in Holmdel, N.J., but the Andover station is the principal one. The main component of the ground station is the huge horn antenna. It weighs 340 tons, is 177 feet long, and has an area at its mouth of 3600 square feet. This huge antenna is protected from the weather by an inflated radome. In addition to this main antenna, there are two tracking antennas. One of them, a quad-helix, picks up Telstar's 136-mc. tracking beacon and initially tracks it as it comes over the horizon. When this antenna is locked in good, Telstar is signaled to turn on its communication equipment and the 4080-mc tracking signal is picked up by an 8-foot dish antenna. Final accuracy in tracking the signal is done by the horn itself. This triple system provides a very accurate tracking of the satellite. The weak signal picked up by the horn antenna is amplified by a special ruby maser. The horn antenna is also used as the ground transmitting antenna. Power is delivered to the antenna by a special high-power traveling-wave tube. Power level of this transmitter can be adjusted between .2 watts and 2000 watts depending upon the satellites proximity to the earth. This powerful transmission and an incoming signal are kept from interfering with each other by means of a suitable diplexing system. Telstar is controlled and its data collected by a complex system of transmitting and receiving equipment, and electronic computers.

Although Telstar enjoyed wide initial success, it soon developed some serious difficulties. About three months after being launched, a minor difficulty was encountered in the command circuitry. This was an intermittant malfunction and did not interfere with the satellite's communications systems. On November 23rd one of the command receivers failed completely. There was speculation that the failure could have been produced by intensified high level radiation which might have damaged the receiver's semiconductors. This intensified radiation in the Van Allen radiation belt was due to the U.S. high altitude nuclear test on July 9th. It was decided to leave the telemetry transmitter on permanently when this failure was first noticed after 1,242 orbits. This was accomplished by special coded signals sent out by Bell Telephone Laboratories' engineers on January 3rd. Telstar again failed to obey its commands in late February. It is believed that Telstar misinterpreted a command and disconnected its storage batteries.

Even though it has had a few difficulties, Telstar has been a great step forward in communications. On February 14th another communications satellite (SYNCOM) was launched. Contact with it was later lost but other launches are now being planned. In the future, with a system of satellites like Telstar, we will be able to turn on our TVs and watch programs originating in all parts of the world. Telephone and other intercontinental communications media will be greatly improved by these satellites which could handle many more conversations than the equivalent number of Atlantic cables. Telstar has indeed launched a new era in intercontinental communications.

RADAR TRANSPONDERS

By Dennis Moore
Jr. Math

In January, 1962, Motorola was awarded a $3.3 million contract to develop and build the new Goddard Range and Range Rate Tracking System. This system will have greater tracking accuracy than the present Minitrack system. Motorola will develop, deliver, and install three complete air-transportable ground tracking stations, along with three flight transponders and necessary electronics.

A key element in this system is the transponder. Liscum Diven, head of Motorola's Transponder Section, was in charge of the development of the transponders for this project.

Radar transponders have many uses and many forms. One of the more simple types consists of an r-f receiver which receives a pulse signal from a radar, amplifies it, and regenerates it to trigger an r-f transmitter which sends an acknowledgement to the radar receiver on either the same or a slightly different frequency.

The basic use for transponders is in range safety. The transponder tracks the missile's position at all times to ensure destruction of the missile should it deviate from the intended course. It also provides very accurate trajectory data. Radar transponders are able to provide range and angle data with greater accuracy and at a much greater range than a skin track alone. Having accuracy comparable to that of other long-range tracking systems, a radar transponder may be employed with an alternate system, one as a back-up to the other in case of trouble. Radar transponders play a very important part in instrumentation of guided missiles at the various United States missile test ranges.

Formerly the primary band tracking radar was the S-band (2700-3000 mc.) SCR-584. This is now being replaced with the AN/FPS-16, a high-precision C-band (5400-5900 mc.) monopulse radar. Using this new band, radar has a tracking accuracy of ±0.1 mil in azimuth and ±5 yards in range. Newer versions having even greater accuracy are being developed.

When used in the old skin-track method, the accuracy of a new radar tracking system is diminished. This is caused by the targets being larger than the radar's inherent measuring ability. By using a well-designed transponder, all measurements may be made at one specific point on the missile—the transponder antenna.

To achieve maximum accuracy the radar must receive signals very large in comparison to the noise. Even for so-called "smooth track," which requires accuracy less than maximum, the signal-to-noise ratio must be at least 10 db for the AN/FPS-16. Since a transponder regenerates a signal at a constant level, it provides a more constant signal from a target than does a skin return. The signal received at the radar from the transponder is stronger than that from skin return; for the signal from the transponder varies as the inverse of the square of the range while that from the skin return varies as the inverse of the fourth power.

A high quality transponder, as all electronic equipment, must be of minimum size and weight and must consume a minimum of power. Let it be emphasized that, to achieve these ends, performance and reliability should not be sacrificed; for a small package that only causes trouble is of value to no one.

Also of particular interest in a transponder is its sensitivity. Sensitivity is that signal level at which the transponder will reply to at least 99 percent of the interrogations, with gain control set for only occasional random firing on noise. Random triggering of a great amount should be avoided as it is an unstable condition. To achieve the defined sensitivity, a signal-to-noise ratio of approximately 15 db is necessary. Sensitivity must be sufficient to respond to the radar transmitter at the maximum range desired. If greater sensitivity can be obtained without undue increases in size, weight, and cost, a margin of safety may be provided. The power supply should provide the radar accuracy desired at the maximum range. Since power is expensive in size, weight, and cost, the safety margin should be sufficient, but not excessive.

For accurate tracking, receiver stability must be excellent. This stability is achieved usually by providing sufficient bandwidth. Since bandwidth is part of a requirement for minimum sensitivity between two specific frequency limits, the transponder designer can trade off receiver stability and bandwidth and possibly improve the sensitivity or lower the cost. The radar receiver AFC is not as effective under low signal conditions, therefore frequency stability of the transmitter is of great importance under marginal tracking conditions. The effects on transmitter frequency of antenna VSWR, which vary in magnitude and phase, may cause troublesome frequency shifts between bench adjustment and missile operation. Other undesirable in-flight variations are atmospheric ion or electron density variations.

Another feature to be considered in developing a transponder is the type of coding to be used. The type of coding required is determined by the radar capability. The ranges have been using a variety of encoders for their radars and the use of coding varies. At ranges where false triggering would occur if coding were not used, multiple interrogations are used. Although reply coding is not commonly used with the older instrumentation transponders, it is often used with multiple transponders for identification.

As in all electronic circuits there is the unavoidable minimum time delay through the transponder circuitry. In addition to this, to separate on the radar display the skin return and the beacon return, one or more fixed time delays are added. This delay adjustment is necessary to solve a ground-clutter problem which may be associated with a particular launch pad—radar site situation. So that the radar can be used with maximum effect, the delay stability should be comparable to the radar range accuracy. The input signal level is one of the factors affecting delay stability. The transponder delay is usually considered to be the interval between points on the forward edges of the interrogation and reply pulses having 50 percent of the maximum amplitude. When the input pulse achieves an r-f level just below the threshhold of the sensitivity level, the reply pulse is triggered. Because the leading edge of the interrogation signal is not constant, the transponder delay is influenced by the signal level. The magnitude of this effect depends on the shape of the pulse from the particular interrogator and therefore varies.

Another factor to be considered in the development of a radar transponder is the recovery time. This is the time interval required after a transponder has replied once before it can reply again. The change in sensitivity to successive interrogations should be unnoticeable and the decrease in power output of successive replies should be negligible. These parameters are most important when multiple radars are used. For example, in the Atlantic Missile Range stretching from Cape Canaveral to Ascension Island, a chain of several radars is used taking turns tracking the missile along the range. From this chain of radars a transponder may receive successive interrogations that vary widely in time separation and in signal level. Fast Recovery is necessary to reduce the data loss during any period which the radars overlap. One of the most important recovery problems is "lock on." If some types of modulators are triggered before full recovery, they will fail to recover at all. The high power switch device "locks" in the "on" state. This can either greatly extend the recovery time, place a heavy load on the reserve power supply, or damage the transponder. A good transponder would be able to receive an interrogation signal during the recovery period without unduly degrading the normal recovery time.

These considerations are of no value unless the transponder can meet these requirements in the stringent environment of missile and space vehicles. Since the transponder is used in a system in which, compared to the cost of the transponder, failure is extremely expensive, reliability must be designed into the equipment and quality control must assure that it remains there.

Standards of compatibility between radar and transponder were established by representatives of the various missile ranges. The specific requirements are determined by the particular transponder specifications and represent a compromise among performance, size, weight, cost, and reliability. Atlantic Missile Range pioneered the specifying of high-performance long-range instrumentation transponders. Shortly after the installation of the prototype models of the AN/FPS-16 early in 1958, Air Force Missile Test Center specified the requirements for use with this radar. These requirements have been changed periodically to keep up with the other improvements.

An example of a satisfactory transponder is the AN/DPN-66. It has a power output of 500 watts and receiver sensitivity of —70dbm. Several fixed reply delays are available for selection. The transponder is completely transistorized except for its local oscillator and magnetron. It weighs 10.8 pounds and its volume is 200 cubic inches. Another transponder has a power output of 400 watts and —65 dbf sensitivity. It weighs only 3.5 pounds and its volume is less than 40 cubic inches. These compact transponders are suitable for small missiles in which space is at a premium, and where the small radar cross-section makes a transponder necessary.

The trend is toward smaller transponders with less power output. Solid-state components will be used more and the use of microminiaturization techniques will reduce the amount of video and i-f circuitry.

With the rapid advance of technology, transponders are being used more and more and at longer and longer ranges.

FUEL CELLS

By
Steve Chitwood
Freshman

For years scientists and engineers have been searching for new and better methods of transforming chemical energy into useful mechanical energy that could be put into widespread use throughout the mechanical world. In recent years intensive study has gone into the development of the fuel cell. A step toward the long-sought goal of a practical fuel cell that will operate on inexpensive fuels such as natural gas has been demonstrated by scientists at the General Electric Research Laboratory.

Fuel cells are devices that convert chemical energy directly into electrical energy without the use of moving parts. Most earlier fuel cells developed by American scientists and engineers have operated on hydrogen, a fuel substantially higher in cost than the common hydrocarbons (natural gas, propane, coal, and gasoline). Cost factors are therefore likely to limit hydrogen fuel cells to special applications such as power sources for spacecraft and portable military communication systems.

General Electric's new cell operates at high temperatures and incorporates novel features for "self-starting" and for maintaining itself at approximately 2,000 degrees F. without the use of externally applied heat. The new cell is the result of work carried out at the Metallurgy and Ceramics Research Department of the Research Laboratory.

Although a great deal of research and development remains to be done, a fuel cell that runs on inexpensive hydrocarbon fuel offers the hope that power generators of this type may some day be used for industrial applications, vehicles, and even bulk energy production.

The novel cell has a solid electrolyte made of zirconia, a refractory oxide. Several of the cells have been stacked together in the form of a "fuel battery." It is estimated that the maximum efficiency of fuel batteries of this type would be in the neighborhood of 30%, using natural gas as the fuel. Greater efficiency may be possible with other hydrocarbons. By comparison, the typical internal-combustion automobile engine is about 20% efficient, large central-station power plants achieve about 40%, and hydrogen fuel cells operate in the range of 50-80% efficiency.

In a fuel cell, as in a conventional battery, electrons move from one electrode to the other, then pass outside through a circuit in which they do useful work as an electric current. Unlike a conventional battery, however, the fuel cell draws it energy from natural gas that is piped in, instead of consuming its own electrodes.

In the new cell, the natural gas breaks down into carbon and hydrogen. Carbon builds up inside the cell to form one electrode. Oxygen is obtained from air which is introduced into the other electrode (molten silver), and oxide ions migrate through the zirconia electrolyte to the carbon electrode. The oxygen yields its electrons to the carbon and combines with part of the carbon to form carbon monoxide gas. The electrons are conducted out of the cell as an electric current. To supply heat for the self-sustaining feature of the cell, the left-over carbon monoxide and hydrogen gases are burned within the cell assembly.

Laboratory versions of non-self-sustaining cells have operated at current densities of up to 150 amperes per square foot at 0.7 volt. Similar cells on life test at lower current densities have been operated for as long as 3,000 hours without deterioration.

Among the advantages of the new cell is the fact that it does not require significant quantities of expensive catalytic electrode material. General Electric scientists also point out that the solid electrolyte has great structural and chemical stability.

Allis Chalmers Corporation has achieved success in using a collection of fuel cells to power a farm tractor, and many other companies are showing fast progress. Who knows, maybe in the near future we will be driving automobiles that are powered by fuel cells.

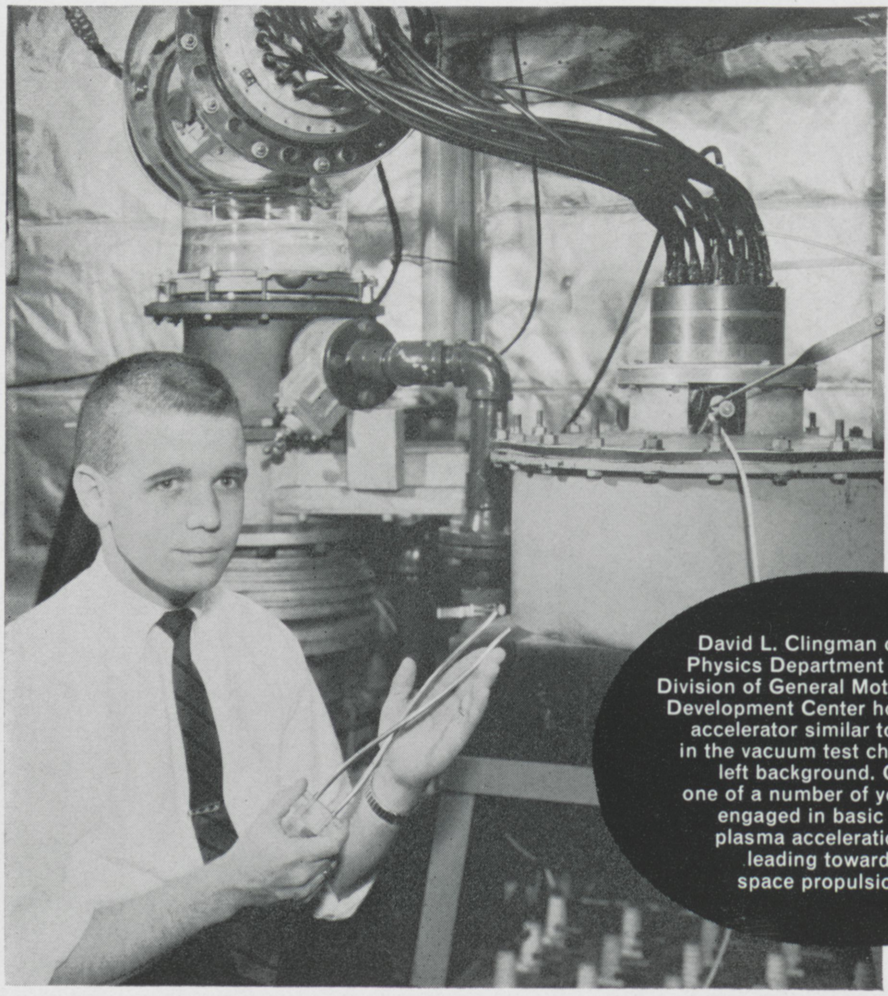
miss technic for april

This month's Miss Technic is Miss Kathie Burke who is a senior at ISC where she is majoring in art.

Miss Burke is a member of the Chi Omega Sorority and treasurer for the Kappa Pi Art Honorary Fraternity.

She was Miss Indiana and Miss Indiana State College in 1961.

During the past two decades Miss Burke has grown to a height of 5′8″ and attained a mass of 128 pounds. Her perimeter at three randomly chosen locations are 38-25-38.



David L. Clingman of the Plasma Physics Department at the Allison Division of General Motors Research and Development Center holds a helical rail accelerator similar to one installed in the vacuum test chamber in upper left background. Clingman is one of a number of young scientists engaged in basic research in plasma acceleration programs leading toward primary space propulsion systems.

● **ENERGY CONVERSION IS OUR BUSINESS**—Admittedly, a broad and far-reaching theme, but then, so are the scientific investigations now underway at Allison Division of General Motors.

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Allison—long a leader in advanced types of aircraft engines—now is extending capabilities of turboprops to meet urgent, new military needs generated by current limited warfare requirements. There's emphasis on new engines for V/STOL applications, incorporating BLC (Boundary Layer Control), and programs to maximize fuel economy and range through high temperature regenerative cycles.

In the nuclear energy conversion area, Allison is prime contractor for development of MCR (Military Compact Reactor)—a highly mobile, completely self-contained nuclear fission power system—to provide electric power in remote areas.

First and second stage rocket engine cases designed and produced by Allison for Minuteman have achieved a 100 per cent reliability record. Allison's steadily growing competence in the field is reflected in the forward strides made in titanium and glass filament-wound ICBM cases. Also, in the missile field, Allison has developed a highly efficient regenerative liquid metal cell that may point the way to a powerful yet compact electrical system for space-age applications.

That's a small sample of the broad diversification of our activity today.

Perhaps there's a challenging opportunity for you in the creative environment at Allison. Talk to our representative when he visits your campus. Let him tell you first-hand what it's like at Allison where

"Energy Conversion Is Our Business."

Rocket Propulsion Systems

By Allyn Haase
Freshman

Since the very beginning of modern rocketry, liquid fuels have been the prime source of power. In fact, before the early 1940's many prominent rocket experts thought of solid fuel rockets as a plaything, good for one thing only—fireworks.

Most of the early experimental rockets built by most of the early experimenters employed liquid fuel. They seemed to think of solid fuels as being inadequate for the job to be done. In fact the liquid fuel rocket was the only one available in any form until the late 1940's. Notably the V-2 rocket developed by the Germans in World War II is an example.

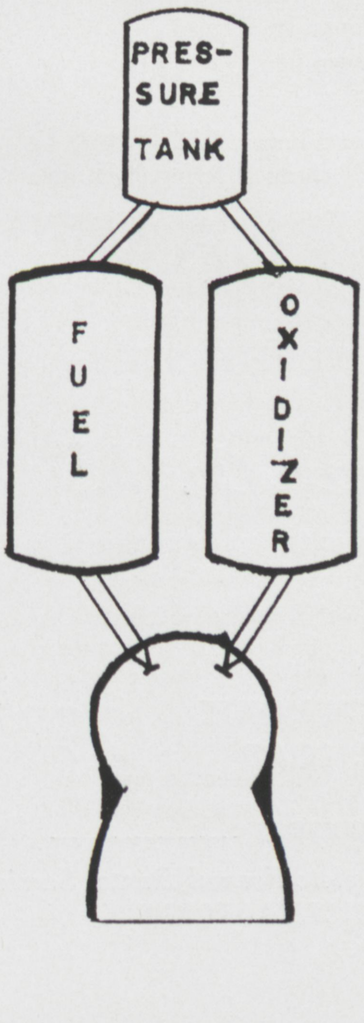
In the last decade, however, the trend has been to solid fuel rockets instead of liquid fueled ones. As an example of this the Minuteman solid fuel ICBM is rapidly replacing the older Atlas and Titan ICBM's employing liquid propellants. All of the smaller tactical rockets used by the United States Army are solid fuel.

There are points in favor of both types of fuel system. Each has its own good points and critical shortcomings which make neither of them perfect.

There are several important advantages of liquid propellants:

One is the ability to control the rocket from the ground or from an internal control system. This may be done by mounting the rocket motor on gymbals, by stopping and starting the rocket motor at the proper interval, or by taking auxiliary motors off of the main fuel supply. A type of auxiliary nozzle is used to control the pitch and yaw of the Mercury capsule. These incorporate a hydrogen peroxide type of rocket motor. Another advantage of the liquid fuel rocket is that it can be moved about and stored with no danger of explosion. This is true only because it is not fueled until a few hours before use.

There are a number of disadvantages connected with liquid fuel rockets. There is so much plumbing and intricate flow control works that it is easy for something to go wrong. This fact is most readily noted in the delays and postponements of several important space shots. This is usually no more than a loose connection or a stuck valve. This is the main disadvantage.



The nature of the fuels themselves provides another disadvantage. Most fuels and oxidizers are highly corrosive. This creates tremendous problems in handling and storage. This also makes the fueling of the rocket extremely critical. This may be seen in the number of explosions around the V-2 rocket, after being fueled with 80-90 percent hydrogen peroxide. The extreme cold of liquid oxygen and hydrogen have been known to shrink the rocket's skin and cause it to fall from its holding devices.

Due to the intricate plumbing and poor properties of the fuels, it is necessary to check the entire rocket before it is launched. This process starts about two or three days before the rocket is launched and continues until lift-off.

A solid fuel rocket, however, can be placed in a condition to go in a few short minutes. This is due to the fact that it is fueled beforehand and has no complicated plumbing or intricate mechanisms. The rocket can be launched at any time and at any place with little trouble. For this reason, the solid fuel Minuteman ICBM is replacing the liquid fuel ICBM's in our missile silos.

Another advantage is the fact that there is not as much dead weight as in the liquid fuel rocket. Thus the solid fuel rocket is more efficient, more economical, and more compact.

But the solid fuel rocket cannot be controlled too easily and, once started, cannot be stopped. It is very difficult to guide a rocket of this type. This problem is in the process of being solved.

Another problem is the fuel itself. As it is in a solid form, it must be shaped. The shaping is very tedious since many of the fuels are highly explosive. There are also many problems in the storing and checking of the fuel grain (charge). This must be done to make sure that the fuel grain does not develop any undesirable flaws. However, new fuels and methods are making the whole process faster and easier.

By looking at the two diagrams, one gets a general idea of what liquid and solid fuel systems basically look like. Both systems have been greatly simplified to show only the basic parts.

Recent tests have shown that a multistage rocket with one or more liquid stages and one or more solid stages gives the best results.

From the previous paragraphs and the drawings, one may conclude that the "best" rocket would be a solid fuel with the added qualities of a liquid fuel rocket. In the years to come a rocket of this type, or a liquid fuel rocket with the simplicity of solid fuel will evolve. This rocket will supplant all existing methods, unless some of the more exotic, non-chemical propulsion systems emerge beforehand.

In conclusion, eventually the solid fuel rocket will have completely replaced the liquid fuel rocket in all phases of rocketry. This is due to only one basic reason: the simplicity of this type of rocket.

The Rose Technic - 1917

The Scraps

edited by Steve James

The annual Sophomore-Freshman pink tea encounters are now recorded in the annals, with honors about fifty-fifty. The first engagement of the rival forces occurred just six hours after school had been opened. Both classes had been favorably impressed by the green lawn at Wiley, so there were two class meetings at that institution that were not on the day's schedule. The Sophs chose an earlier hour, so they had a young multitude on hand when the Frosh were just beginning to collect. Then, with a dash of bravery that will always be a credit to the Class of '20, they proceeded to "pick off" — in the words of the poet — the unsuspecting Freshmen, one by one. It was a grand burst of daring, undoubtedly of the same sort that wins iron crosses, the Legion of Honor, Carnegie Medals, and so on. Though these maneuvers continued but a short time, they served a purpose — '21 was unable to assemble, and when the clash did come, the Soph numbers defeated the Frosh nerve.

On the next evening at seven o'clock, '21 swarmed to Seventh Street and Third Avenue, and, in spite of the threatening weather and the Soph "bear stories," eighty-five percent of the class showed up. Scrap Cap Gale was injured on the eve before, and although unable to fight, he told the yearlings how it's done in the best circles. At exactly 7:45 the procession started.

At the south end of the football field stood a tall, gloomy looking telephone pole that had long since received an honorable discharge. This pole, by the way, has had some history — and a ringside seat at all the scraps in the days of scraps that were. From its top in the glare of four huge lights floated the challenge in the cool night breeze. Huddled about its base were the hosts of the evening—defendants of the amateur lock and chain title—fifty strong, listening to the last words of Cap Gray. Scores of proud little brothers, anxious sisters, nervous mothers and curious dads lined the enclosure.

Such was the scene when '21, led by acting Captain Steffen, came rushing and roaring into the slaughter. The fight was all that could be expected. The classes were about equal in numbers and the scrap resolved itself into so many individual encounters. As is always the case, the fence gave way and the spectators crowded into "the squard circle" with the gladiators.

"Twenty, Help! He's killin' me!"

"Chain here, Twenty!"

"Lay still or I keel you!"

"Aw, I say, don't shove my face in this mud!"

"I'll git you for that, Freshman!"

"Getoffamyneck, will you!"

"Stand back here, please! Give 'em air!"

"Where's Gil? Couple knocked cold in the gym —"

"I don't care; I think this whole affair is perfectly outrageous. The police should interfere—"

"Not so tight, they're cuttin' me now!"

"Better have a little of this. You'll be glad of it later on!"

— and so on. This we heard above the snapping of locks, the clicking of chains and thunderous thuds as masses of legs and arms would hit the cold ground.

It took just one hour and a half of this gentle form of debating 'til it was decided that '20 was the master. Soon two trucks arrived on the scene, and the luckless Frosh were given a ride into the wilds of the surrounding country, where they were left chained, to entertain our wild animals.

The pipe rushes were equally good. The Frosh grabbed the verdict when the count showed that they had eighteen hands to sixteen of the Soph's, on Hath's 3-B. The counters are not enjoying great popularity among the losers, though.

It is true that several spectators remarked that such events are outrageous and barbarous, and that no possible good comes from them. In defense we are forced to say that to call a man "yellow" is about the worst thing we could say about him. And there is no doubt but what class scraps are the best "yellowcides" ever put on the market. Draw your own conclusions. And then, too, "ain't it a grand an' glorious feelin' " when your dear one finds out about it, and she just looks and says "Oh-h, George!"

How long've you been out of school?

Since '52. Purdue. Then two years in the Navy and a year for my Masters at Caltech.

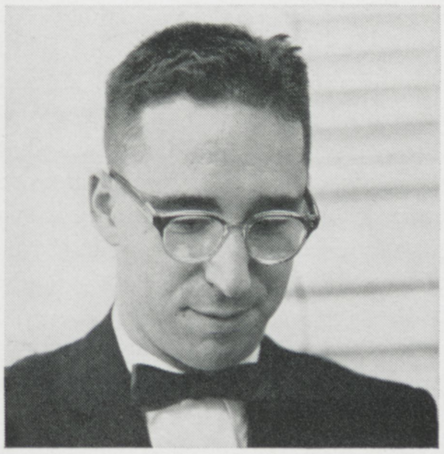
I came to Jet Propulsion Laboratory right after that. '55. I like it very much. It's a nice atmosphere for engineers to work in. There's a lot of work, a lot of hard work. But interesting.

And because we're operated by Caltech, we can work closely with some of the top scientific minds in the country. I think that makes a difference. We have a lot of freedom within our individual disciplines, too.

I'm an Engineering Group Supervisor. Our group is among those responsible for communications with spacecraft designed by JPL to go to the moon and planets.

Among other things, we want to find out what the moon is made of, and if there's life on other planets. Contributing to space exploration is a challenging vocation.

We've excellent facilities here. One of the largest technical libraries, for example. There are at least two support people for every scientist and engineer at JPL. And they're all great to work with.



I bought a home close by. Only 20 minutes from coffee cup to coffee cup. My wife likes that. The kids like where we are, too. We like hiking and there are excellent trails minutes from our house.

You've just been chatting with Dick Mathison, JPL engineer. He likes his work. He likes where he works. Would you like to share in the challenging and important work he does? Maybe you can...why not write to JPL and see.

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letter from an alumnus

go sign for Rose

This month, THE ROSE TECHNIC interviews Mr. Robert L. Royer of the class of 1949.

Mr. Royer was a member of Theta Xi, Tau Beta Pi, Blue Key, several activity organizations, and the track team during his stay at Rose. He graduated with high honors in Electrical Engineering and was awarded the Hemingway Medal.

With the exception of two years in the armed forces, Mr. Royer has been with the Louisville Gas and Electric Company where he has held a number of positions. He is presently Assistant Vice President - Operation.

When we wrote to Mr. Royer, we asked him the following four questions:

1. Would you be willing to give the "go sign" to a young fellow planning to walk the same path as you, concerning Rose and engineering?
2. Have you enjoyed the life of an engineer in the past few years?
3. Would you care to comment generally on some of your basic philosophy?
4. What emphasis would you place on good grades in college?

The following, then, is the letter we received from Mr. Royer as he answers our questions, while at the same time giving us plenty of food for thought.

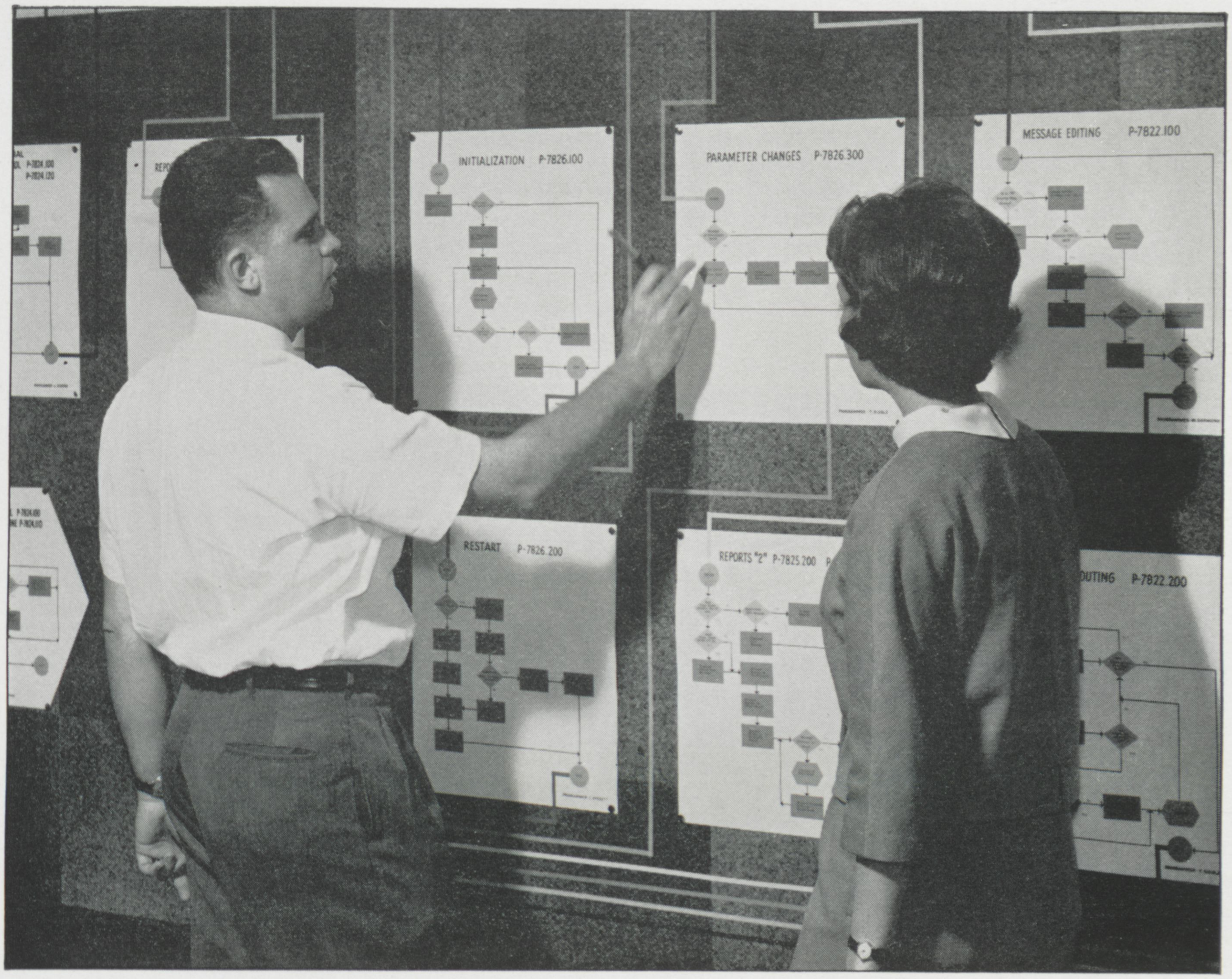
"While I must admit that I am perhaps somewhat prejudiced when it comes to discussing Rose, I am quite certain that I could with a clear conscience counsel an interested young man to follow the road to engineering by treading the path through Rose. To become an engineer is to develop a way of thinking, a method of applying one's talents to the solution of a problem in a logical manner. Any institution can *teach* him the mechanics by which they are applied. To develop an engineer, however, is not merely to *teach* him but rather to *train* him, to train him to apply himself by his abilities to a heretofore untried or unsolved problem and to exercise reasonable judgment in his attempt to solve it. Training implies a personal communication between the instructor and the student and the very fact that the philosophy of instruction at Rose is built upon such a relationship is justification for recommending it as one of the finer engineering colleges in the country.

Certainly during a man's lifetime he should endeavor to make a finite contribution to the society of which he is a part. A portion of this contribution will be made through his vocational pursuits and a portion will arise from within his personal life aside from work. For a man to perform with maximum effectiveness in his job, he must be as free as practical from personal problems; however, to gain such freedom is in part to be able to have a personal life which is not complicated by incompatible problems which he brings home from work. That is to say, a man owes it to himself and his family to be so satisfied with his work and enjoy it to such an extent that when he comes home in the evening he can reflect this satisfaction in his attitude toward his loved ones.

This sounds simple enough until one looks closely at the contradiction. So often the ultimate objective of the two purposes are not aligned to assist each other, thus each must be so chosen and directed as to complement the other. For this reason I feel that it is imperative that an engineer seek out above all a type of assignment which will give him the maximum satisfaction in its pursuit and solution. Though in many instances it may not be the most rewarding by monetary measures, I feel it will result in the most rewarding in overall accomplishment.

Thus to answer your question directly, yes, I have enjoyed my life as an engineer in the past few years, for had I not, I would have felt com-

(*Continued on Page* 28)



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LETTER FROM AN ALUMNUS

(*Continued from Page* 26)

pelled to redirect my efforts.

Grades, not intending to minimize their importance, are but one measure of a student. Just because a boy stands 6'6" is not proof that he weighs over 200 pounds nor does it necessarily mean that he has the ability to be a fine basketball player. On the other hand it generally would indicate that he will weigh more than a shorter boy of similar frame and that if he is agile and coordinated he stands a better chance of being developed into a first string player than the boy who lacks his height by a head.

So, I feel, it is with grades. Grades are the apparent measure of how well the student has mastered the fundamentals of his formal education. While knowledge of a student's grades alone will not guarantee that he will be either a success or a failure, all other things being equal, he will probably be a more capable individual than his less learned counterpart. Similarly if the student also has good common sense, practical ability, and a knack for getting along well with people, his scholastic accomplishment will couple together with these traits to indicate that the chances that he can be developed into a valuable employee are excellent.

As the industry of tomorrow becomes more technical in nature, its operation will require direction from people who have the ability to comprehend the more technical language and to reason effectively. For this reason, if for no other, it would appear to me that the engineering student of today is charged with the responsibility of giving an extra measure of effort to sharpen the tools of his trade, his mind. As grades are one measure of this effort, he has little choice but to dig hard into the vast wealth of knowledge available to him.

I will make one final comment which I would assume should fall in the broad general category of personal philosophies.

The new graduate of an engineering curriculum should take a moment to study the meaning of the sheepskin he has just acquired. Although at first glance he may assume that it pronounces him an engineer, if he looks more closely he will note that it only acknowledges that he has successfully completed a course in engineering. That is to say, he has been given the tools of his trade much as a carpenter is given a hammer and a saw. He now has the responsibility of learning the practical side of using them. It is during the balance of his career that he will learn to be an engineer.

So often the young graduate fails to recognize the significance of this attitude and until he does he is unwilling to seek or accept help from his associates and fellow employees. To become proficient we must continue our education beyond the ivy-covered walls, but it comes to a standstill until we acknowledge that we have a lot left to learn and openly seek someone else's assistance. If you never let on how much you know, you'll be surprised at how much you will learn."

THE MENACE OF OYSTERISM

(*Continued from Page* 7)

In an article about movie actor John Wayne, Dean Jennings tells of a clash between Wayne and Professor Herman Finer of the University of Chicago during a television panel discussion of Wayne's movie, *The Alamo*:

"We were talking about the picture and the definition of a hero," Wayne says, "and this professor started right out twisting words around in my mouth, and he tried to say that all the good traditions were just legends. And he said that he was afraid to let his wife and daughter go out on the streets of Chicago, and if he didn't know that he had the Social Security thing, he wouldn't know what he'd do."

Wayne restrained himself while the show was on the air, but when the mikes were dead, he let Professor Finer have it.

"You miserable little so and so," he said, clenching his club-like fists, "the people who developed Chicago didn't know whether they were going to be alive the next day, or whether their kids would be chopped up by Indians, or whether they could raise enough food and develop this place for you. And now you're whining, sitting in your easy chair over at that university and teaching kids this philosophy."

The moderator commented later, "Duke feels very strongly about some things."

It is good that he does. So should we.

library notes

By Carson Bennett

"If we can produce enough properly guided men we won't need guided missiles. . . . I am not willing to accept a mechanical solution to a human problem."
—Marine commandant General David M. Shoup

Spring is here and so our thoughts are changing pace — toward sports, car racing, and as we often hear where a young man's fancy turns this time of year, . . . that is, of course, to term papers and reports, we want you to know that we have books to help you with any one problem or all.

If you are interested in baseball, tennis or bridge, come in and go through our sport and recreation books. One of the new books we have on racing is 500 MILES TO GO: THE STORY OF THE INDIANAPOLIS SPEEDWAY, by Al Bloemaker. We have THE RACE, photography by Bob Verlin and text by Angelo Angelopolous. We also have Floyd Clymer's, INDIANAPOLIS 500 MILE RACE YEARBOOK for many years. So if you can't go to the race, or even if you can, stop in the library and enjoy the books about it.

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Trelease, Sam F. — How to write scientific and technical papers.

Turabian, Kate L. — A manual for writers of term papers, theses and dissertations.

CONCISE DICTIONARY OF AMERICAN HISTORY, edited by Thomas C. Cochran, is an abridgement in one volume of the famous Dictionary of American History originally edited in five volumes. Here in one volume, on our reference shelf, are the answers to questions worth asking about our past, from the first landfall of the explorers to the election of President John F. Kennedy. This publication will help you know how the United States of America came to be what it is today.

SPACE AGE ASTRONOMY, edited by Armin J. Deutsch and Wolfgang B. Klemperer. This book was compiled to record the transactions of a three day Space Age Astronomy Symposium. The contributions of the Symposium participants, a most authoritative and articulate group, are reproduced here with the intervention of only minor editorial changes. Both engineers and scientists contributed.

REINCARNATION: AN EAST WEST ANTHOLOGY, compiled and edited by Joseph Head and S. L. Cranston. This anthology deals with a subject which many philosophers have called the central issue of our time — the question of man's immortality; and deserves to be read from cover to cover. In no sense dogmatic, the ideas presented are stimulating, challenging and inspiring.

OUR SYNTHETIC ENVIRONMENT, by Lewis Herber. Along with the wonderful scientific advances achieved by our civilization have come surprising and unheralded dangers, many of them only vaguely known to most of us. Some of these dangers are as dramatically immediate as fallout and radiation; an equal number have been too technical heretofore to be easily understood by the public or have been concealed by those with an ax to grind.

In clear language, Mr. Herber deals with a host of brand-new hazards in a synthetic world and brings into one dramatic book a rare summary of what scientists know about these dangers. These include the hazards to man and wildlife created by agricultural chemicals; the use of chemical additives to food and food processing; the sometimes irresponsible use of antibiotics and other ccrative drugs which may not have been sufficiently tested and even the dangers arising from automobile exhausts.

MY FATHER, MARCONI, by Degna Marconi. This richly detailed biography of a fascinating man — Guglielmo Marconi, the "father of the wireless," is written with lively affection and understanding by his eldest daughter.

He was the man who really changed the whole history of communication. Completely captured by contemporary discoveries in electricity, Marconi was dedicated to the private little world of his attic laboratory, where he spent many months running tests. His Irish and Italian father thought it was childish tinkering. He was just twenty years old when he assembled his first wireless that carried signals several hundred meters. From her position as a daughter of the famous scientist, she carefully blends the excitement and glamour of Marconi's fame as an internationally renowned inventor with the passion and loneliness of his personal life.

SCIENCE AND RELIGION, edited by John Clover Monsma. As science has broken through into new areas, what have its discoveries done to the innermost beliefs and persuasions of outstanding men of religion? Have their beliefs and persuasions been affected in any way? Twenty-three outstanding men of religion — Protestants, Catholics and Jews — give a joint answer to those who declare their disbelief in God on the grounds scientific progress has made ancient religious teachings untenable. Here we learn how modern science has shown its effects on our religious leaders of today.

DAM GEOLOGY, by R. C. S. Walters. Along with the technical part of this excellent book we are shown the influences of dams and reservoirs. Notes are included on causes of dam disasters.

Just a few definitions that we feel might interest you are:

A meeting — A mass mulling of masterminds.

A conference — A place where conversation is substituted for the dreariness of labor and the loneliness of thought.

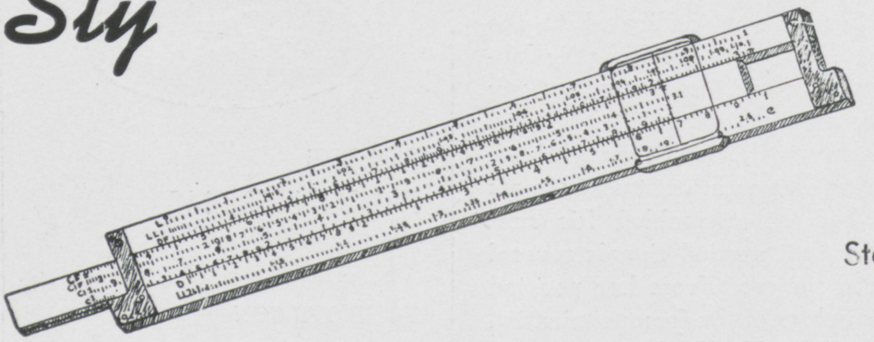
To Negotiate — To seek a meeting of the minds without a knocking together of heads.

Reorientation — Getting used to working again.

A Clarification — Filling in the background with so many details that the foreground goes underground.

Note and initial — Let's spread the responsibility for this.

Sly Droolings



Stolen by Gerrand Mellinger, Jr. E.E.

They had been sitting on the swing in the moonlight alone. No word broke the stillness for half an hour.
Then -

"Suppose you had money," she said, "what would you do?"

He threw out his chest in all the glory of young manhood and proclaimed, "I'd travel."

He felt her young, warm hand slip into his. When he looked up she was gone . . . In his hand was a nickel.

* * *

"Mother, will college boys go to Heaven?"

"Yes, dear, but they won't like it."

* * *

Angry wife: "One of the ducks you were out shooting yesterday called and left her number."

* * *

The scene is a train compartment in Rumania. The characters: A Russian officer, a Rumanian, an old lady, and an attractive girl.

The train enters a tunnel. The passengers hear first a kiss, then a vigorous slap.

The old lady thinks: "What a good girls she is, such good manners, such fine character!"

The girl thinks: "Isn't it odd that the Russian tried to kiss the old lady and not me?"

The Russian thinks: "That Rumanian is a smart fellow: he steals a kiss and I get slapped."

The Rumanian thinks: "Am I a smart fellow! I kiss the back of my hand, hit a Russian officer, and get away with it.

* * *

They moved apart as Frank lit their cigarettes; then she snuggled close to him again.

"Darling," she cooed, "how many others were there before me?"

After a few minutes of silence, she said, with a slight pout: "Well, I'm still waiting."

"Well," he replied, puffing thoughtfully, "I'm still counting."

* * *

A fellow and a girl charged around a corner and bumped smack into each other. They stepped back, apologized and started up again, but they both dodged in the same direction and bumped once more. Again they started up, bumped, and apologized. This time the fellow stopped, raised his hat and gallantly remarked, "Just once more, honey, then I really have to go."

* * *

A sweet old lady, always eager to help the needy, spied a particularly sad-looking old man standing on a street corner. She walked over to him, pressed a dollar into his hand and said "Chin up." The next day, on the same corner, the sad old man shuffled up to the lady and slipped ten dollars into her hand. "Nice picking," he said in a low voice. "He paid nine to one."

* * *

Judge: "Officer, what makes you think this M.E. is intoxicated?"

Officer: "Well, Judge, I didn't bother him when he staggered down the street, or when he fell flat on his face, but when he put a nickel in the mailbox, looked up at the tower clock and said, 'My God, I've lost 14 pounds,' I brought him in."

* * *

Sarge: "I suppose when you get out of the army you'll be waiting for me to die so that you can spit on my grave."

Rookie: "No, sir. After I shed this uniform, I never want to stand in line again."

* * *

A Boston spinster was shocked at the language used by workmen repairing telephone wires near her home, so she wrote to the telephone company. The manager immediately asked the foreman on the job to make a report and here's what the foreman said:

"Spike Williams and me were on this job. I was up on the pole and accidentally let the hot lead fall on Spike - and it went down his neck. Then Spike looked up at me and said: 'Really, Harry, you must be more careful."

* * *

Two duck hunters were sitting behind their blind, one drinking from a thermos of coffee, the other from a jug of whiskey. After some hours of this they spotted a lone duck winging through the sky. Taking quick aim, the coffee drinker rose, let fire, and missed. The whiskey drinker rose, let fire and brought the duck down. His companion, properly amazed, complimented him on the shot. He replied, "Aw, it's nothing, I usually get five or six out of a flock like that."