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Rose Technic Staff
Rose-Hulman Institute of Technology

Rose Technic

December, 1961

Season's Greetings

In This Issue

PRINCIPLES OF ULTRASONICS
ROLLER ROADS
EPOXY RESINS

A second sun: made in U.S.A.

The sun produces energy through nuclear fusion—a gigantic hydrogen explosion that has been going on for more than 500 million years. We may duplicate it. Scientists at Princeton University are experimenting with a *Stellerator* to attain controlled nuclear fusion that will produce endless energy from the hydrogen in sea water. The Stellerator is supported by 17 USS Quality Forgings that could be made from only one material—a new, non-magnetic Stainless Steel called Tenelon, developed by United States Steel.

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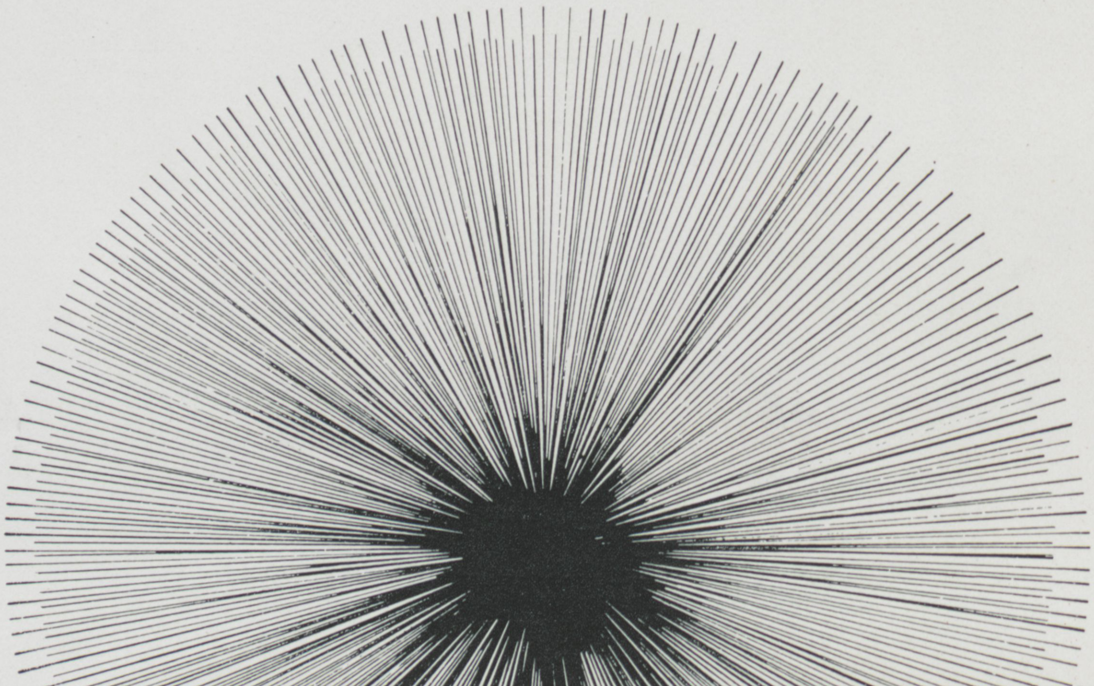

United States Steel USS

Good reasons why I chose American Oil

by Don Anderson

"Here you're treated as an individual. The Company respects and recognizes individual achievement. The work is challenging and affords the chance to use your own ingenuity."

That's Don Anderson talking, 31-year-old mechanical engineer engaged in testing lubricants at American Oil Company. Don spent six years in the military service prior to earning his Bachelor of Science degree at the University of Illinois. Don, the father of two children, explains, "The routes to the top are many and varied. There's plenty of opportunity for advancement—and that's the best kind of job security I can think of."

The fact that American Oil attracts talented college graduates like Don Anderson may have special meaning to you as you plan your career. Don is one of many young scientists and engineers at American Oil who are growing professionally in a wide range of research projects. There are challenging opportunities in many areas. Chemists, chemical engineers, mechanical engineers, physicists, mathematicians and metallurgists can find interesting and important work in their own fields.

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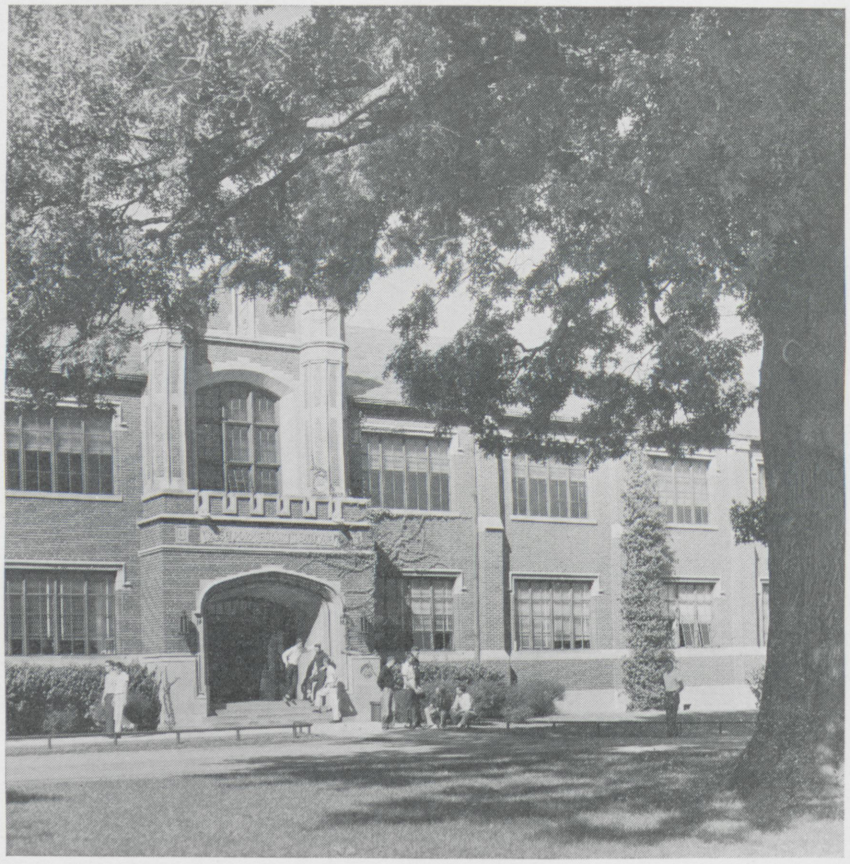


Ending the Meeting Moratorium

This semester, because of increased enrollment, Rose has abandoned the eight-period day with a lunch hour between fourth and fifth periods. The new schedule utilizes instead a nine-period day, from 7:50 A.M. to 4:00 P.M., with each student supposedly having a free period fifth or sixth hour in which to eat lunch.

The advantage of the new schedule is improved lunch service in the student center. The lunch line has been shortened (if only by a minute amount), and a combination of more tables and fewer people has made it a little easier to find a seat. Service in the cafeteria has probably also improved, though apparently long lunch lines have never been a pressing problem there.

Unfortunately, the new schedule has created a larger problem than it has solved. The losers under the new plan are the students who belong to student organizations, which includes a large percentage of Rose men. Under the former schedule, short meetings could be held during lunch hour, and longer meetings could be called for fourth hour Tuesday or Thursday, stretching as far into lunch hour as necessary. There is now no time during the week, except possibly after short convocations on Wednesday afternoon, when all students are free to attend meetings.

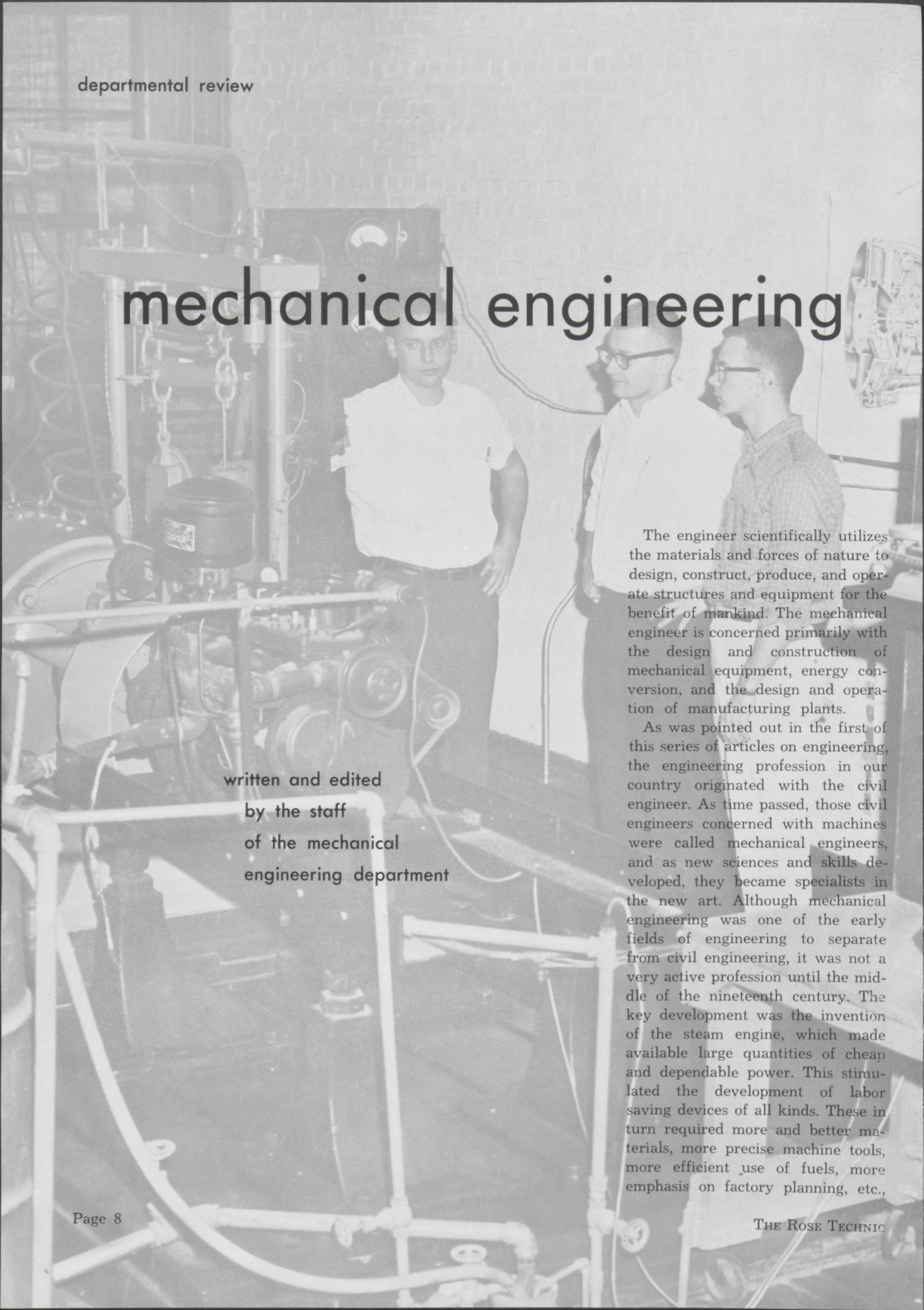
The result is near chaos. Student Council members are late to supper. Blue Key meets, bleary-eyed, at 7:00 A.M. Editors cha e after staff members to give them messages because of the impossibility of getting their staffs together during the day. Fraternities wonder when practices for the inter-fraternity sing can be held next semester. Committees search in vain for time during the day to meet only a few short minutes.

The difficulty of arranging meetings before 7:50 A.M. or after 4:00 P.M. is enough to cause the most capable organization president to throw up his hands in despair. Commuting students hate to stay at school two or three hours after they finish their classes. No one wants to wait around for a twenty-minute meeting, and if it's much longer than that, it means a late supper. As for pre-school meetings, 7:50 classes are bad enough, without an even earlier meeting.

It is hoped that calling this problem to the attention of faculty and administration will result in a schedule improvement next semester. Surely it would be possible to schedule two or three periods a week near the middle of the day when all students would be free. For instance, the split lunch periods could be continued, with all students being given a free period sixth hour on Tuesdays and Thursdays. This would allow three more hours per week for scheduling classes than under the single lunch hour schedule, but in addition would allow at least a partial return to the convenient noontime meetings. The lunch line would be no longer during the free periods than at any other time, since the students would still be free to eat lunch during fifth hour.

If this, or some other plan which would permit noontime meetings next semester is approved, organizations will function more efficiently, their presidents will lose hair more slowly, fraternities will sing better, committees will get more done, and editors will be forced to reduce their infinite list of gripes by one.

M. E. G.



mechanical engineering

written and edited
by the staff
of the mechanical
engineering department

The engineer scientifically utilizes the materials and forces of nature to design, construct, produce, and operate structures and equipment for the benefit of mankind. The mechanical engineer is concerned primarily with the design and construction of mechanical equipment, energy conversion, and the design and operation of manufacturing plants.

As was pointed out in the first of this series of articles on engineering, the engineering profession in our country originated with the civil engineer. As time passed, those civil engineers concerned with machines were called mechanical engineers, and as new sciences and skills developed, they became specialists in the new art. Although mechanical engineering was one of the early fields of engineering to separate from civil engineering, it was not a very active profession until the middle of the nineteenth century. The key development was the invention of the steam engine, which made available large quantities of cheap and dependable power. This stimulated the development of labor saving devices of all kinds. These in turn required more and better materials, more precise machine tools, more efficient use of fuels, more emphasis on factory planning, etc.,

and thus mechanical engineering was established.

The mechanical engineer, in today's rapidly expanding technology, occupies a position of increasing importance and of mounting complexity. To be useful to society, practically all basic scientific and engineering achievements must be reduced finally to mechanical form. Almost all fabricated products and the industrial equipment needed to produce them are of concern to the mechanical engineer.

The mechanical engineer is often required to act as a supervisor or overseer; guiding and monitoring the contributions of engineering and the various sciences. He must, therefore, possess a wide range of knowledge and understanding in all fields, to properly put together the individual parts into the over-all scheme. As never before, he must be able to communicate with the basic physicist, the scientist, and with the engineer in other branches of engineering. To do this he must keep up with all the advances that are being made in engineering and science.

The mechanical engineer spends a great deal of time perfecting designs based on physical principles, materials and techniques which did not exist a few years ago. The final designed products are manufactured with production techniques and processes of increasing sophistication.

Since the mechanical engineer is often working in uncharted fields, he must develop a creativity of a level far exceeding that of past generations of engineers. The importance of his role, the necessity of coordinating varying activities, the ever-increasing breadth of his field—all of these demand of the mechanical engineer an ability to envision, to create, and to develop products which will best serve our rapidly expanding technology. With this demand for creativity, the mechanical engineer through inspiration and organization of thought must train himself early to think logically and creatively.

In the undergraduate training of mechanical engineers during the past years, emphasis has been placed on three general areas of activity. These areas are: design and construction of mechanical equipment, energy conversion and the design and operation of manufacturing plants.

To illustrate the scope of the work of a mechanical engineer let us look into the problems involved in the design, construction and maintenof a rocket.

The mechanical engineer interested in the rocket power plant would seek ways to use less fuel and at the same time increase the "payload" of the rocket. He would work on methods of improving the heat transfer and reliability of the rocket engine.

Another mechanical engineer, who is perhaps classified as a designer, would apply his knowledge to increasing the reliability of the whole rocket by working to reduce such things as vibration and by striving to increase its structural strength. He would keep in mind the importance of increasing the rocket's speed, cutting down its weight and making it easy to keep in operational order.

An additional phase of mechanical engineering would be concerned with the coordination of the activities of other engineering fields in designing the devices which would control the rocket once it was in flight.

Many of the problems in designing and manufacturing of all kinds of engines and rockets are so complex that the services of specialists are required. A mechanical engineer trained as a specialist in a particular field of rocket design such as nozzle design devotes all his time to the study of nozzle performance and design characteristics and brings this knowledge into use in all questions relating to nozzles.

Rocket development engineers think up new ideas and improvements, test them and put them into use.

Rockets have mechanical difficulties and need repairs and servicing; therefore maintenance is very important. The mechanical engineer might supervise these maintenance activities in order to reduce costs and increase the dependability of the rocket. Or, if employed by the rocket manufacturer, it may be the mechanical engineer's duty to teach other employees what they need to

(*Continued on page* 24)

"DEPARTMENTAL REVIEW" is a series of articles written by members of the faculty at Rose. Each month a different department will describe for you the nature of their curriculum, some history of their profession, and what a student in their department might expect after graduation.

Because satisfaction during years of undergraduate study is so highly dependent on the proper choice of a curriculum, this series is designed to differentiate between the various fields of study at Rose and help the present and prospective student make his choice. Therefore it would be wise to consider the facts presented by these authors before making your selection of an undergraduate field of study.

the moral aspects of the atom bomb

This is the second part of a two part article. Last month Jack Hobbs told of events and decisions leading to the bombing of Hiroshima. This month—should the bomb be used?

written by:
Jack Hobbs
Junior Chemistry

The biggest question concerning the use of the atomic bomb is yet to be answered. Was the United States justified in dropping the bomb; thus killing thousands of people and plunging the world into new fears in the future? It was the United States, a humanitarian, democratic, peace-seeking nation which unleashed a new fear in the minds of the people the world over—including Americans. The American policy makers failed to realize that war is conducted by certain restrictions and methods and that in the Nuclear Age man must distinguish between military action and sheer massacre of populations, between the defense of human life and the destruction of human life.

"Willie" Higinbotham, an electronics specialist who worked on the bomb, had this to say of its use:

I am not a bit proud of the

job we have done . . . the only reason for doing it was to beat the rest of the world to a draw . . . perhaps this is so devastating that man will be forced to be peaceful. The alternative to peace is now unthinkable. But unfortunately there will always be some who don't think. . . .

This is the same feeling of many of the scientists who did not know for what they were working. Many had no idea that this new force was going to be used to kill people.

Perhaps the most talked about result of the atomic invasion of Japan is what will happen in the future if two nations, equipped with nuclear weapons, engage in total war. Will there be complete destruction of the human race, or will the bombs not be used? If they are used will there be limitations to the conduct of such a war?

In order to answer these questions we must first understand the connection between nuclear policy and the military and the Christian idea of war. Atomic warfare can be expressed in one word, which is common to both the theologian and the militarist. This word is murder. No matter in what ways man commits murder, killing will never become morally right. Since war involves the killing of men, it calls for the survival of the stronger or more clever. However, war can be justified under certain conditions, these being its necessity, its use as a solution to restoring peace, and the manner in which it is conducted.

Therefore, the theologian advocates war because it is a means of upholding one's spiritual idea of war, the Christian idea of war did not rule out the idea that the use of force is not subject to moral limitations. The theologian or moralist draws a line between war fought for one's rights and the war which has as its purpose adventure, destruction, or glory.

At present our security is based upon deterence, the use of military force. It is a consequence which arises when the forces of lethal power take opposite sides on an issue of international importance. Each power is deterred from striking the other for fear that he himself will be attacked. This policy of retaliation, when viewed by the Christian and his moral concept of war, appears to be barbarous. Thus our atomic energy program was pushed into a strategy of immoral retaliation. The bombs were used to obliterate the enemy's cities. The United States has become trapped in the middle of a scientific race, and technology itself, instead of strategic and moral reason, has played the most influential part in forming our weapons program and defense policies.

The main military policy of the United States should be the maintenance of a capacity to ward off aggression. The use of force is necessary, and our enemy will refrain from using force if we convince him it will mean his own ruin. We need a nuclear policy which realizes the military principle of usefulness and the moral principle of justice.

In order to make this policy become a reality, we must strive to push our differences with other nations into areas of economical and social importance instead of spheres of violence and hatred. We must show the rest of the world what could happen if an all out nuclear war were started. We must strive to change the idea of militaristic use of nuclear power into one of bettering the world by the application of the new force to improving society, not destroying it.

Thomas E. Murray says of nuclear strategy:

> Each passing phase of the world crisis makes it clear that what is required on the part of our nation is not merely a greater economic and technological effort, but an ever deepening moral insight which must underlie practical political wisdom. During the coming years, what America does or fails to do on the subtle plane of moral and political values will vitally affect the destiny of all men, all nations.

We must carefully plan our policies for the future, for it is our children who will be the most affected by our triumphs or failures. They will have to live with the consequences of the present, for as technology advances, new and bigger thermo-nuclear weapons will be developed.

Disarmament is one proposal for the survival of the nations of the world in the coming Nuclear Age. At present there are talks of disarmament, but can and will a nation throw out such a vast source of power when she knows that other nations also possess this power? Does she feel safe in assuming that these other nations will disarm? In order to assure that disarmament would work there would have to be a check system established. However, is it possible for one nation to permit a group of inspectors to tour around the country looking for violations of this disarmament? This doesn't seem to be the solution. You just don't throw away such a force which will someday open the door to space, but you can direct the use of such force toward the betterment of mankind.

Atomic energy has been used very effectively during peacetime. It has aided in the check of cancer and other diseases. Ships, rockets, and even airplanes can be propelled by atomic energy. It has even more potential in that a small amount of fissionable material can light a city for a week. Nuclear energy can be of service, and it is imperative that its peaceful uses be given a better look in the future.

The only way to avert an all out nuclear war is to stress the importance of nuclear energy in peaceful areas and, at the same time, to push our problems with other nations into social and economic areas instead of on a scale of physical violence.

Doctor James B. Conant suggested that the United States turn her back on atomic energy. He proposed that we solve our atomic energy problems by destroying all bombs and keeping the uranium in the earth. Doing this would place

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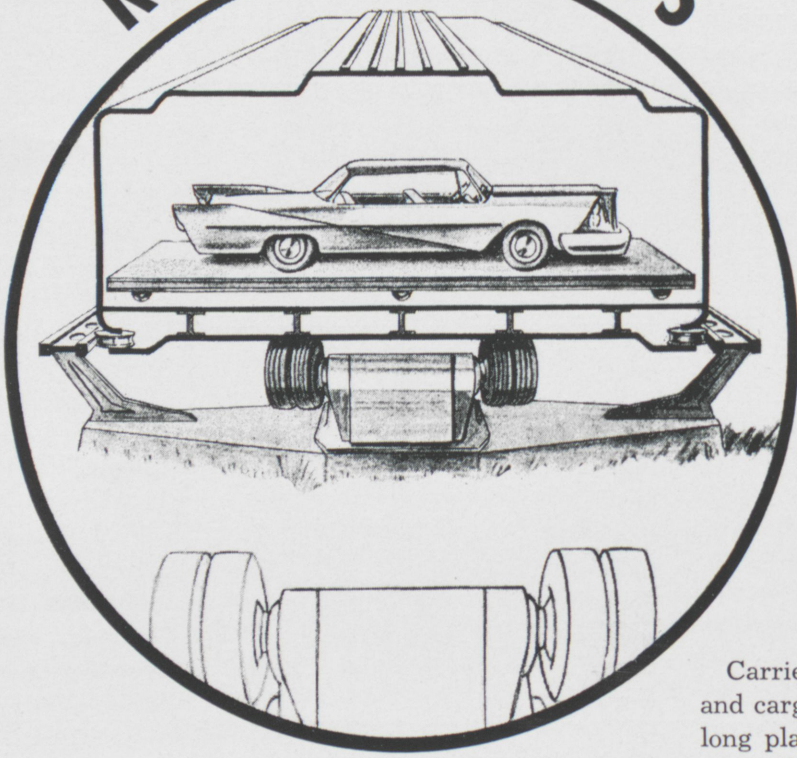
ROLLER ROADS



written by
Dave Rice
Sophomore
Mechanical

The only answer for handling today's unprecedented traffic is the construction of more toll and limited-access highways. Unfortunately, new highways will only offset the congestion that would accrue if these facilities were not built.

A group of engineers recently devised a system of transportation which would be suitable for both long-distance and short-distance travel at speeds of 120-150 miles per hour. This type of "highway" must provide adequate capacity with safety, and adequate reliability. Basically, the system is as follows:

Carriers for automobiles, people and cargo are in the form of sleds or long platforms, devoid of all apparatus whose failure might cause possible traffic shutdown or detention.

These carriers are propelled on a continuous system of individually powered rollers, receiving electric energy from neighboring interconnected electric utility systems. This "Roller-Road" will provide the highway surface, accelerate the carriers, keep them moving once accelerated, and provide braking power at the proper locations.

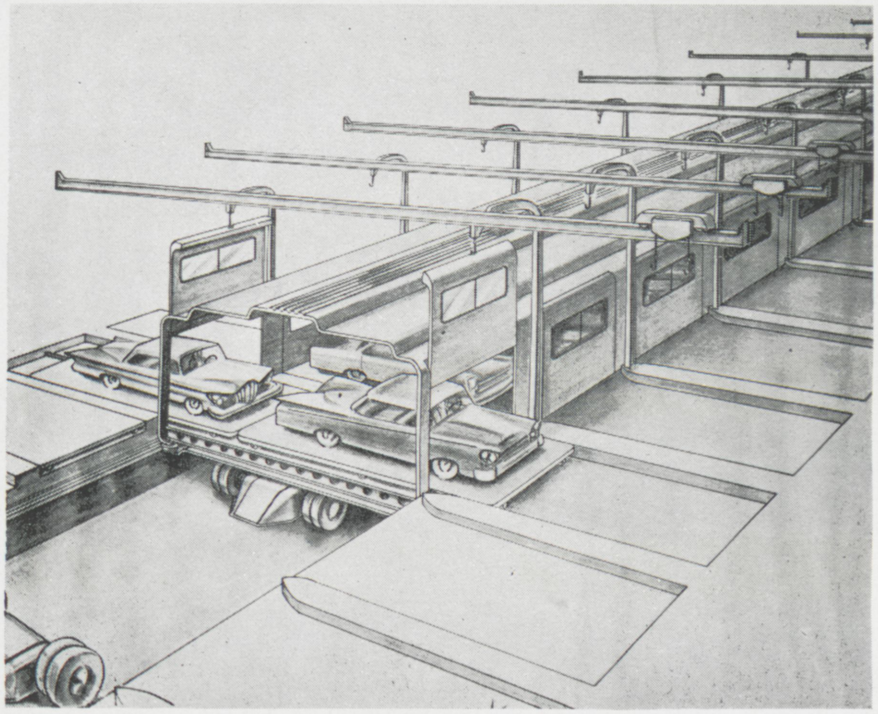
The carriers are stopped at fixed stations where automobiles are loaded automatically by mechanical means to secure uniform carrier loading in the minimum of time.

Several features of the proposed "Roller-Road" are worth emphasizing: (1) It can handle conventional toll road traffic at twice the speed; (2) its capacity can be in-

creased with little expense by increasing the number of carriers connected together as an operating unit; (3) it has the possible flexibility of any two-track rail system because sidings, turnouts, etc., can be installed wherever needed; (4) the same principles can be used to produce either a long-distance route or a rapid transit system for large urban-communities.

Each carrier in the proposed system is to be about 110 feet long, 20 feet wide, and 7 feet high. A carrier of this size could handle 10 automobiles and also contain a lounge, with rest room facilities.

Doors are provided on each side to load and unload automobiles. To avoid complicated door mechanisms the entrance and exit doors are automatically opened and closed by external means at the stations. Also, the automobiles are automatically loaded and unloaded by external means at these stations.



The carriers can be coupled to form strings of carriers of any length. Normally, the carriers probably would be operated in strings of three to ten units. Actually, the only limit to the number of carriers that could be coupled together would be the length of the loading facilities at stations.

The carriers would be both supported and propelled by a series of rubber-tired rollers while a guide rail is provided to steer the carriers along the rollers. The rollers also must be capable of both starting and stopping the carriers in an emergency any place along the route. The reliability of this system should be exceptionally high since a failure of any roller will not impair operation.

The maximum roller spacing is fixed by the length of the carriers, since it is essential for stability that a minimum of three rollers should support a single carrier unit at all times.

The drive package for each roller consists of a three-phase induction motor, a torque converter, a brake and a reduction gear. The torque converter will permit the rollers to start the carriers at any place without unduly increasing the driving motor capacity.

The motors and brakes on each set of rollers in the accelerating or braking zones adjacent to each station can be increased in capacity or the roller spacing can be reduced. To better tailor the rollers to these conditions, the gear ratio between the power package and the axle would be changed on the different rollers in steps from the beginning to the end of the accelerating and decelerating zones.

A "Roller-Road" system of this kind will require a computer for its control and to program its operation. Basically, this control must perform the following functions:

1. Dispatch strings of carriers at the proper intervals throughout the highway.
2. Provide protection against rear-end collisions, should any string of carriers be stopped.
3. Control the automatic loading and unloading at the stations.

No problems can be foreseen in the control of this highway system that cannot be solved.

Due to the large installed horsepower required for the Road, this concept would be applicable only for transportation systems designed to handle very dense traffic. The peak rating of the motors will be about 50,000 hp per route mile of highway. This would appear to be an exorbitant figure, but upon further analysis, it can be justified.

It is estimated that the motors would be operating at a peak load only about 3 per cent of the time. Therefore, the motors can be designed on a maximum torque basis rather than on a continuous-current basis. They could be severely overloaded for short intervals, and therefore could be much smaller physically than normally required for a given horsepower rating.

The "Roller-Road" concept contains the essential ingredients of a good rapid transit computing system as well as those needed for major transcontinental trade routes.

High acceleration rates, which are necessary to attain fast schedules where stops are frequent, would appear to be limited only by passenger comfort.

Although there are many technical problems to be solved in finalizing this new concept, none appear incapable of solution. Both the electrical and mechanical features of this proposed concept should be within the know-how of our present technology.

principles of ultrasonics

by Ken Miller
Junior Math.

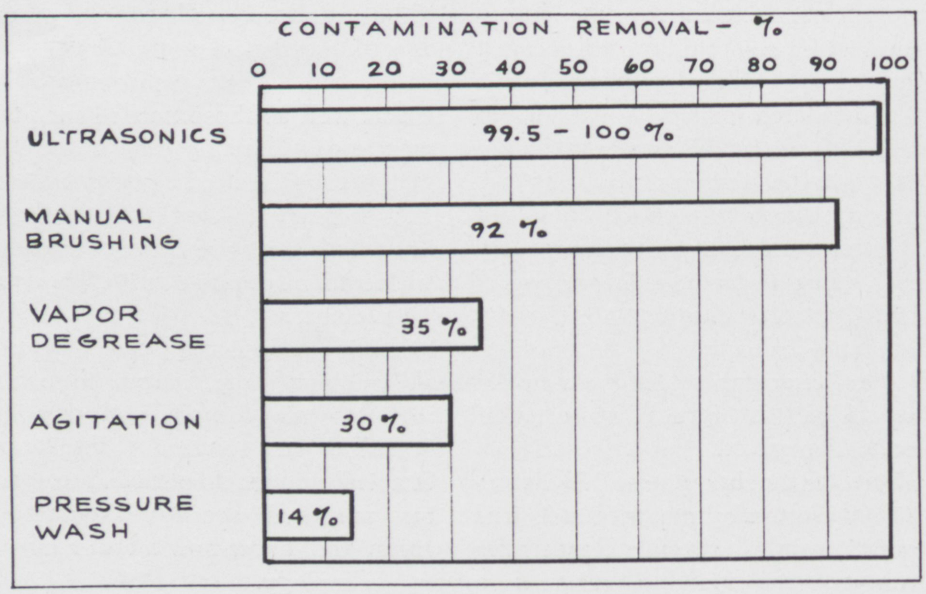
Somewhere in Metropolis, U.S.A., a homemaker immerses a dinner plate into a sink full of clear water. After a few seconds she removes it, rinses it in an adjoining, identical looking tub and finally places it in a dish rack to dry. No, she is not an incompetent housekeeper; the dish is antiseptically clean.

In the same city, a dietitian tastes a thick, charcoal-broiled steak. Although the meat is chuck, usually relegated to stew, he cuts it with a butter knife and exclaims that it is as good as choice tenderloin.

A neurosurgeon in Metropolis' medical research center maneuvers a monstrous electronic machine into place above a victim of Parkinson's Disease. Soon afterward, all trembling disappears, never to return.

These seemingly unrelated incidents do have something in common; all make use of ultrasonics, the science of "silent sound." Such examples form just a sampling of the many and diversified applications of ultrasonics.

As mentioned in a prelude to this article, the earliest application of ultrasonics was the Galton whistle. Ultrasonics merely remained a curiosity, however, until World War II, when the need for better submarine detection methods led to the development of sonar (sound navigation and ranging). Functioning much like radar, sonar consists of intermittent, high-frequency sound pulses radiated in all directions beneath the surface of the ocean. Upon striking a metallic object, the signal rebounds and is detected by sensitive listening equipment.



Comparison of cleaning methods on stainless parts with radioactive dirt. (T. J. Bulat, **Metal Progress**, 68 (1955), p. 94)

Not long afterward, the rise of the television industry made remote television tuning by ultrasonics a reality. Then, in the 1950's, ultrasonic research branched out into many fields and is now limitless in scope.

Generally speaking, the applications of ultrasonics today can be subdivided into the following basic categories:

1. Food Processing
2. Medical and Dental Treatment
3. Cleaning
4. Non-destructive Testing (NDT)
5. Miscellaneous

Specific examples of each fundamental application are to be considered, emphasizing the theory of operation and advantages over more conventional methods.

Food Processing

Within the next few years, ultrasonics may revolutionize the food industry and become a household word. Beef tenderizing with "silent sound" has already been tried and is advantageous over chemical tenderizers for two reasons. First, the meat is still firm after ultrasonic tenderizing, whereas chemical tenderizers break down the beef fibers, causing the meat to become soft. Second, ultrasonic tenderizing also makes the beef more edible by simultaneously killing bacteria. Even before the beef comes to market, it may well have encountered ultrasonic energy while still on the animal. A steer's entire life from the pasture to the table will be directed by ultrasonics. The steer will be checked for plumpness while in the field by an ultrasonic testing gauge. In the slaughterhouse, the carcass of the steer will be cut by ultrasonically vibrating knives and cleaned and tenderized by ultrasonic waves.

Shortly, coffee will be made more aromatic and flavorful because of ultrasonics. Green coffee beans will be pummeled full of tiny holes by powerful ultrasound, facilitating the removal during roasting of the oils that make coffee strong. A similar treatment of corn, rice and kidney beans will eliminate the need for soaking.

Cheese will ripen in one-half the time after ultrasonic treatment, yielding reduced storage costs. Salad dressing will not separate; peanut butter will remain creamy; and honey will not crystallize, no matter how long in storage. All this and more will be provided, in time, by the new wonder of ultrasonics.

Medical and Dental Treatment

One of the most significant contributions to the cause of mankind is ultrasonics research in medical therapy. At the present time, ultrasonic treatment heals wounds, cleans infected sinuses, relieves arthritic pains, soothes acute asthma and performs brain surgery. Ultrasonic therapy for amputees, whose stump pain made the use of artificial limbs an agony, now diminishes the discomfort so that the use of the limbs becomes bearable.

Most medical ultrasonic equipment generates energy at a frequency of one megacycle. Maximum benefit is realized by applying the transducer directly on the surface of the skin. However, areas too sensitive to permit direct application can be submerged in cavitating water, thus removing any pressure or contact to cause pain.

It is known that ultrasonic therapy relieves pain, but the exact mechanisms underlying this phenomenon are not understood. Nevertheless, progress continues in establishing the ideal frequencies, intensities and durations of treatment for various conditions.

Also sharing in the benefits of ultrasonic research is the field of dentistry. A new dental drill utilizing ultrasonic cutting is now in use and may force the traditional, complex, motor-driven unit into oblivion. Largely painless, the new, simpler ultrasonic unit cuts through the hardest teeth enamels effortlessly.

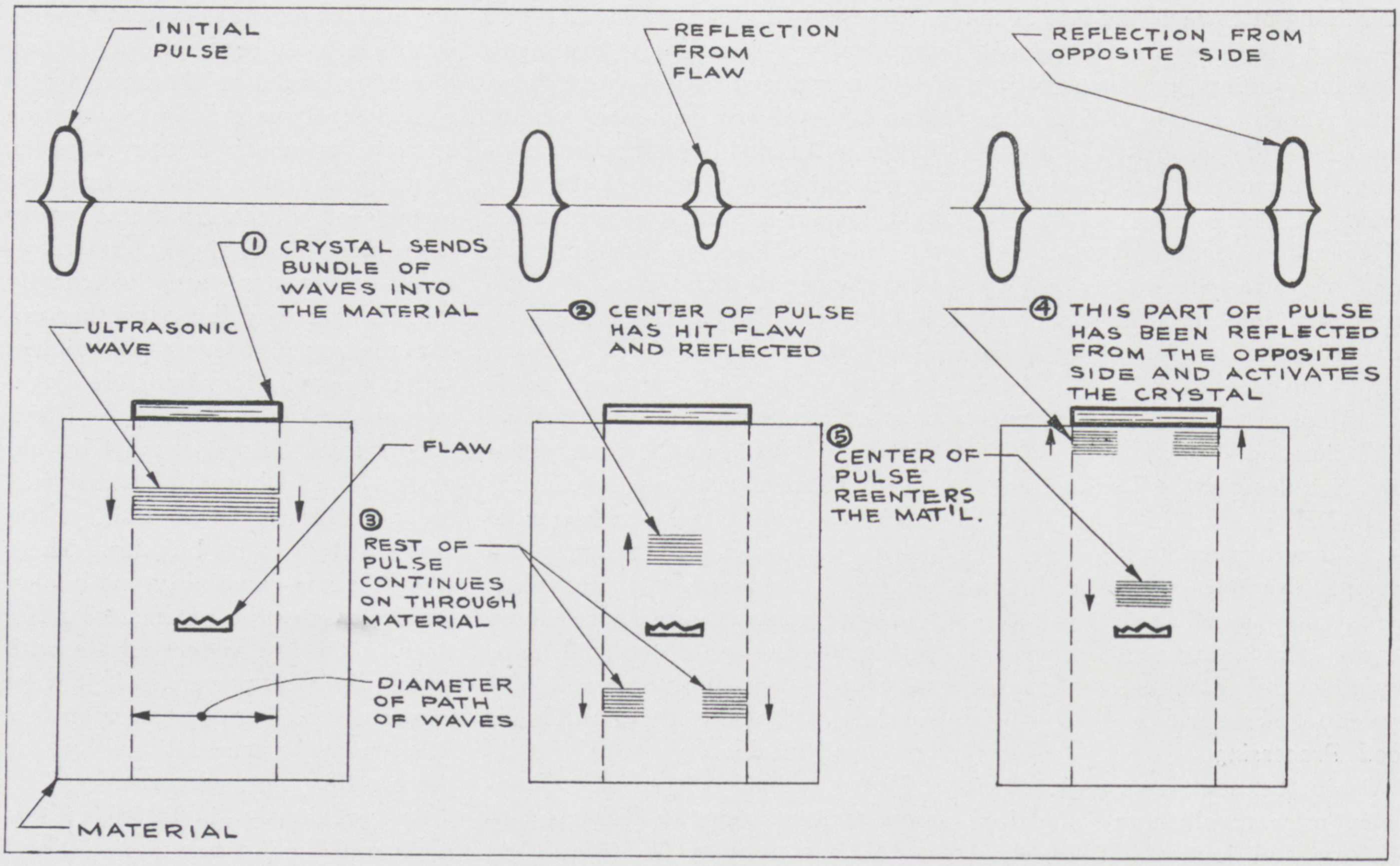
Cleaning

The basis of ultrasonic cleaning is an extremely forceful tool called cavitation, or ultrasonic boiling. An alternating current of 20,000 to 20,000,000 cycles per second is projected into a special piezoelectric transducer, which converts it to physical movements of expansion and contraction. A bank of such transducers is placed on the bottom of a container of water. The alternating current frequency is then adjusted to a submultiple of the natural frequency of vibration of the water molecules. Immediately, the molecules of water are alternately thrown apart and flung together under resonance, bearing the violent action of cavitation. Invisible, devastating shock waves from the transducers tear the water apart by implosion, i. e., a bursting inward, just the opposite of the explosive effect created by soap bubbles. These sounds above audibility, with one-hundred times the potency of a fire siren, make the water pulsate with almost limitless power, as if it were vigorously boiling over an open fire. What might be accomplished by harnessing this tremendous energy?

As previously indicated, ultrasonic cold boiling scours dishes and removes hardened egg yolk and lipstick in seconds. Experimental dishwashers employing ultrasonic principles have been designed to look like standard automatics, but the first models on the market probably will be open sink units. Some hospitals already use ultrasonic waves to clean hypodermic needles, as the small bubbles easily enter the minute crevices of the needles. Just imagine the revolution in cleaning watches and automobile carburetors due to ultrasonii energy. Orninarily time-consuming operations, the tasks would be simplified to a dip in an ultrasonic bath, a blast of dry air, a coat of fine oil, and reassembly.

One day clothes might be blasted by sound in a special closet; then the dirt will fall off and be swept away. Yet, this should not be necessary, since clothes will never become dirty. Ultrasonic precipitations in the home will coagulate all dust, and pollen into heavy particles that settle out of the air. Already in use in factories, such units need only be scaled down to size for the home. Similarly, huge ultrasonic precipitators may someday dispel dangerous fog from our highways and harbors.

(*Turn the page*)



Action of an ultrasonic pulse used in non-destructive testing (Benson Carlin, **Ultrasonics,** New York, 1960, 219)

An especially hopeful market for ultrasonic cleaning is the steel industry, where automated ultrasonic methods have speeded up metal-working processes and eliminated manual labor. In the mill, ultrasonics is useful in removing rolling oils from steel, in pickling the stock, and in rinsing to remove the residue from pickling. Processing time can be halved and production doubled by ultrasonic action in the pickling tank alone. Soils, grease, oxides and other contaminants found in crevasses and blind holes, inaccessible by ordinary methods, are no longer a problem with ultrasonic boiling.

In actual cases, ultrasonic cleaning methods have considerably lessened the chore of parking meter and gas meter maintenance. In one example, four meters can be serviced in one-sixth the time that it formerly required to clean one meter. No longer is it necessary to strip down the mechanism, other than removing the case. Once again, the merits of ultrasonic cleaning are manifest.

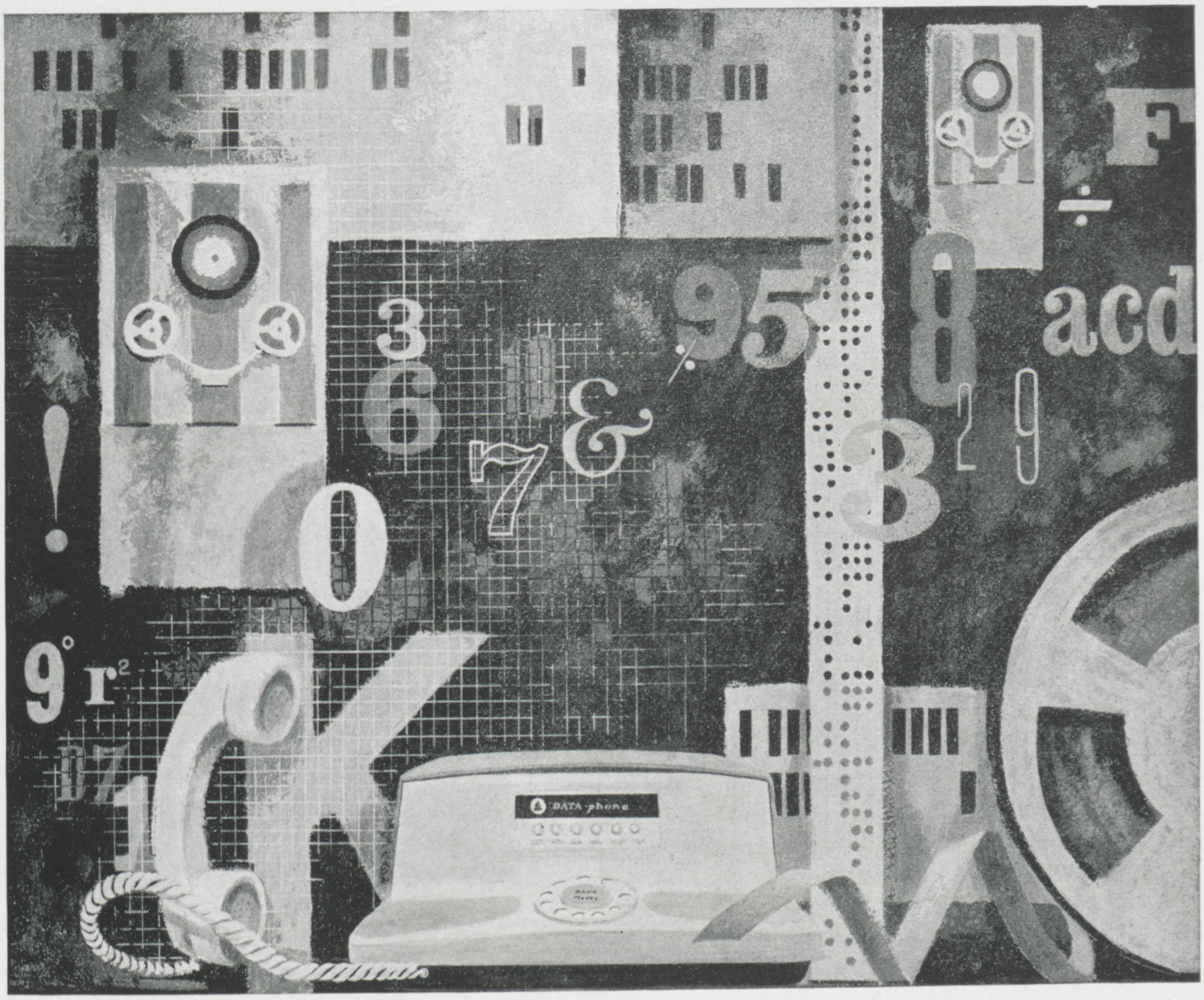
Non-destructive Testing

Ultrasonics has lately become a firmly entrenched technique for detecting irregularities of all types — hollows, crevasses, seams, weld imperfections, foreign matter, interfaces—in all kinds of metals. Although the passage of ultrasonic waves is merely the traveling of sound waves, there are three different methods of ultrasonic transmission. Only the pulse-echo method will be considered since the basic techniques of each are similar and differences are slight.

With the pulse-echo system, short ultrasonic pulses are transmitted from a transducer to the part being inspected. An echo is produced when a portion of the sound pulse is reflected from some surface. Then the echo is converted into an electrical impulse which appears as a "pip" on an oscilloscope screen. Reflections from the front and back surfaces appear as the first and last pips on the screen. Knowing the speed of sound and observing the time difference between pips on the screen, the thickness of the object can be calculated. Accuracies to within 0.1% can be achieved if the operator is skilled and if special recording equipment is used.

Continuing with the pulse-echo method, if the ultrasonic pulse hits a defect, a new pip will appear between the first and last pips. The flaw's location can be determined precisely if a calibrated ruler is attached to the oscilloscope screen. Besides location, the size and type of defect are estimated as well. The amplitude of the pip gives good indication of the approximate reflecting area; i. e., a crevasse or hollow will have a larger pip than a solid inclusion of the same area because the latter allows some signal to pass through. Test blocks, containing man-made imperfections (drilled holes) of about the same size and location as the reflected flaws in the part undergoing test, have their ultrasonic reflections compared with those from the natural flaws in the part. By this trial and error process, it is possible to evaluate fairly accurately the type of imperfection present in the part.

(*Continued on page* 33)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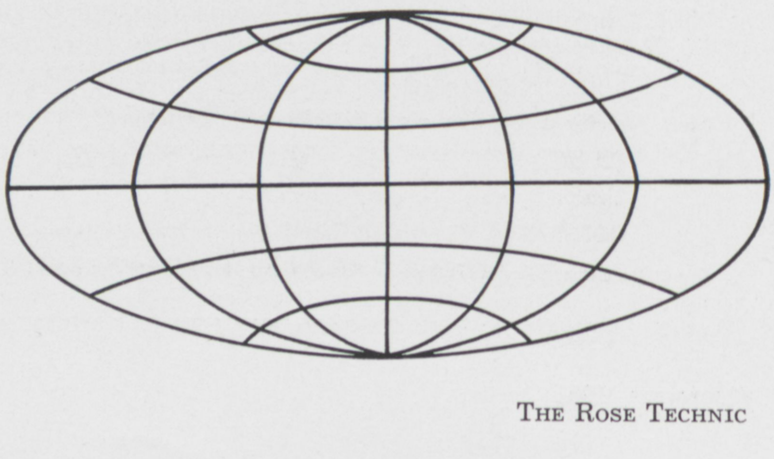

miss technic for december

The staff of the ROSE TECHNIC would like to cast its vote in favor of the addition of coeds to our campus. Miss Dixie Lee Kelly, whose picture appears on these pages, has proven without a doubt that women can be competent engineers.

Dixie is a sophomore transfer student at Indiana State from Vincennes University. Unfortunately she is not a Civil Engineering major; rather her interests lie in Elementary Education—what a waste of talent! Extracurricularly, she goes in for the twist, along with other conventional methods of dancing.

Miss Kelly is a 21 year old blonde with brown eyes. She stands 5′3″, weighs 110 pounds, and measures 34-22-34. Anyone looking for a lab partner?

greek briefs

SIGMA NU

With Thanksgiving turkeys fresh on our minds (and waistlines), and Christmas turkeys to look forward to soon, and with Aretta's cooking to fill in the eating time between the holidays, we are beginning to fear that we'll have to enlarge the rooms at 831 South Center to accommodate any given group of five men or more.

Along with the traditional tree and decorations that go along with the season, the old homestead has been endowed with a new ceiling for her active room. From now on exposed pipes and cracked plaster are a thing of the past, thanks to an energetic sophomore class, under the organization of Brother Joe Griffin. We hope that we can complete the job they started by paneling the walls by Christmas.

The latest word from Indianapolis (via carrier pigeon) tells us that this year's State Day will break the ice on a brand new policy. Alumni will take part in the planning of the occasion, and any alumni in the area will be invited to attend both dinner and dance on Saturday night. To accommodate the larger crowd expected we have procured the Indiana Roof, and the date is set at March 10th.

"Wedding Bells on June 20th" is the thought for the day (every day) for Brother Steve Charlton, who recently became engaged to Miss Sue McIver. Also planning a similar occasion in the near future are Brother Gary Reynolds and his fiance, Miss Sandy Higgins. Joining the ranks of Sigma Nu Pin Girls is Miss Judy Riggs, who is pinned to Brother Larry Bond. Also recently pinned are Brother Don Hurst and Miss Pam Quinn. Brother Ross Kuykendoll tells us that he is planning his marriage to Miss Jane Wilson sometime in February. Brother Dick Landenberger is the proud father of a baby girl, as of November 29th.

Brother Gib Robinson was elected Marshall for the remainder of the school year. Pledge training is one of our most important positions and we know that Gib will make us all proud in carrying out the duties associated with it.

Our V.M.I. Dance was a great success this year, having been held the Saturday before Thanksgiving. The decorations were attractive enough to transform the school auditorium, where the dance was held, into a ballroom. Co-operation with the ATO's once a year on a project such as this is something we all enjoy.

The fall semester is drawing to an end, and while grades aren't as high as previously predicted, spirit is at an all-time peak at Sigma Nu.

Joe Grumme

THETA XI

Howdy podners! Greetings from the cattle ranges of 6th and Park. I trust the Bison haven't trampled your soybean patches lately. We sure hate to see all you farmers go broke. After all, farm subsidies don't cover Bison damage; or do they?

Our cattle haven't been put out on the front range as of yet. The length of the grass on our 6th street range will testify that. I have just been informed by the foreman, that the herd will be turned out within

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Mechanical Engineering

(Continued from page 9)

know about repairing and maintaining rockets.

Someone may ask, why use the example of a rocket to illustrate the scope of the work of the mechanical engineer. Over the past decade, advances and changes in the sciences have brought about a significant expansion in the fields of mechanical engineering. The field of power now encompasses not only steam and internal combustion power sources, but gas turbines, rockets and nuclear engines and new forms of engines utilizing plasma and ion propulsion. Transportation has been expanded to include the jet airplane, rockets, missiles and space craft. Anyone of the above could have been used as an example to illustrate the scope of work of the mechanical engineer.

These advancements have created demands for increasingly sophisticated systems for heat and environmental control of man and his equipment. Permeating all the basic fields of mechanical engineering are specialized areas of technology such as instrumentation, machine computation, control and guidance, and systems engineering. With each advance in science, the province of the mechanical engineer will expand to encompass new and unprecedented areas of specialization.

The question may be asked, what are the engineering schools doing to ensure that the undergraduate mechanical engineer is being properly prepared for his profession? As was mentioned previously, the mechanical engineer is concerned primarily with the design and construction of all mechanical contrivances, including all types of prime-movers, vehicles, production machinery, and general engineering products. While it is believed that the types of work for a mechanical engineer will remain essentally the same in the future, the contents of the mechanical engineering curriculum have been undergoing and will continue to undergo strong changes. The changes are characterized by more emphasis on the science of the work and deemphasis on the associated arts. Today the mechanical enineer is basically trained in mathematics and the physical sciences and then receives additional training in the derivative sciences such as static dynamics, thermodynamics, heat transfer and electrical machinery and circuit design. In addition he also receives training in the application fields, in manufacturing processes and in creative design where he uses the knowledge obtained in the derivative science courses.

The mechanical engineering curriculum at Rose has been revised many times in the past. Fifty years ago students at Rose took courses in practice in wood, practice in wood and foundry and practice in metals. Today the mechanical engineering student can take courses in automatic controls, space technology and jet propulsion. Just as the curriculum has been revised in the past, it will be revised in the future as advances and changes in the sciences continue to expand the fields of mechanical engineering. Because of the broad spectrum of the mechanical engineering field, it is believed that the undergraduate engineer can hardly afford to direct his educational program toward narrow specialization. Instead, the emphasis must be on a solid grounding in the basics, leaving effective application to the engineer's continued development through industrial experience and advanced formal training. It is believed that the undergraduate engineering training in applications should emphasize the use of basic principles in engineering achievement rather than attempt to develop a practicing specialist.

These are times of changes and new developments in engineering. As was pointed out earlier in this article, the technological developments in the late part of the last century created the field of mechanical engineering and the growing technology of the past, present and the predictable future are adding continually to the vigor and strength to the field of mechanical engineering and to the whole area of the activities encompassed by mechanical engineering.

Some mechanical engineering technologies have faded, others have grown in importance and many new ones have and are continuing to appear. While we cannot predict what unusual technological advances will take place in the future we can with confidence and certainty predict what the mechanical engineer of the future will be doing. He will be doing as he has in the past, adopting and creating new ideas and putting them into use, and the areas the mechanical engineer will serve will still be broadly defined as power, design and manufacturing.

The undergraduate education the mechanical engineering student will receive at Rose Polytechnic Institute will in the future as in the past be designed to help a man step into the areas of work that have been described. The education will also provide strong support for the man who desires to continue his work towards a Master's Degree either at Rose Polytechnic Institute or elsewhere.

weather control

written by
Bob Light
Junior Physics

Bob discusses the possibility of push-button weather.

Through the ages, man has been a victim of his environment; his way of life influenced by the whims of nature. Always man has had to cope with devastating weather conditions, such as droughts, floods, or similar developments brought about by inclement weather. Recently accomplishments have been made towards controlling weather on a small scale. With the acquisition of more scientific knowledge, man hopes to modify weather on a large scale.

The dominating factor of climate and weather is the radiant energy from the sun and earth. The radiant energy from the sun consists of solar radiation absorbed by the atmosphere and earth after a small percentage is reflected by colloidal particles and clouds in the atmosphere and by the earth. Infrared radiation from the earth and atmosphere, mostly from water vapor and clouds, is emitted to space.

All of the earth does not receive the same amount of radiant energy because the equator is more directly in the path of radiation waves and is therefore hotter than the poles. With the various seasons the pole points in different directions thus still greater differences in the earth's heating. Also, the absorption of heat by the earth is not uniform. The earth's surface consists of light and dark areas, consequently greater reflection by the lighter areas.

Because the earth is heated unequally there is a warm belt of air (the equator) and two cold belts of air (the poles). The warm air is expanding and rising, whereas the cold air is contracting and sinking or settling. The lines of conflict between cold air and warm air cause air circulation over the surface of the earth. This flow is complicated by the fact that the earth is turning and that the equator is spinning much faster than the polar regions. These various flows from the equator and polar regions are not regular or of the same intensity thus causing numerous weather phenomena.

Local weather modification can be obtained through creation of artificial lakes, large scale reforestation, and suppression of evaporation. The most effective and promising method today is cloud modification.

Cloud seeding is the process by which artificial ice-forming nuclei are supplied to suitable cloud forms in great number so as to make up the deficit of such nuclei in nature. Natural ice-forming nuclei supplied

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progress in pakistan

by Mr. Zafarullah
Mathematics Department

Mr. Zafarullah discusses the governmental and educational reforms taking place in his native land . . . .

I desire to touch upon the recently introduced reforms of my present government and in this overall sphere I intend to explain our educational system as it is in the process of being reshaped and modified to bring it into conformity with our present needs.

Pakistan consists of two parts, West Pakistan and East Pakistan, separated by about one thousand miles of an alien territory. The population is predominantly Moslem. Though life is primitive, it is undergoing changes and being transformed along modern lines.

Pakistan came into being on August 14, 1947, as a result of the incessant struggle of Quaide-Azam Mohammedo Ali Vinnah who was rightly apprehensive of the future of Muslims in Combined India, and had therefore demanded the creation of Pakistan which was to be carved out of India and was to comprise those areas which were predominantly Muslim. It was through the ceaseless struggle of Mohammed Alid Vinnah against heavy opposition and his unflinching faith and devotion that won him and Muslims a country of their own, Pakistan. He is to us the builder of Pakistan.

After the death of Quaide-Azam, and his associate, Quaide-Millat, the country fell into chaos and confusion. No effective leadership was then forthcoming to fill the vacuum created by the deaths of the two great leaders. Harmful activities of selfish politicians began to corrode the national life. The country seemed to be dangerously drifting to a point of no return. Happily this drift was stopped and reversed by the present government led by Field Marshall Mohammed Ayub Khan who assumed leadership in October 1958 with the promise of correcting the wrongs done to the country. Since then his government has amply fulfilled the promise and this has won the confidence of the public so that it is now the most popular government we have had since the death of our great leader Quaide-Azam.

The most important reforms introduced by the present government relate to the redistribution of land. Serious maldistribution of the land had contributed greatly to the economic chaos and political instability that prevailed before the present government took over. Most of the land was concentrated in the hands of a few landlords, who had thus acquired great political and social influence with the result that existence of a government was at their mercy. It should then be understandable why no preceding government had attempted to rectify the serious defects prevalent in the land owner-

ship system. To achieve and maintain the political stability, it was therefore imperative that the growing influence of these landlords be smashed. The present government recognized this but was hesitant to take quick steps, for it was feared that it might do more harm than good. Consequently a commission was formed to study the whole problem and to suggest remedies to the serious maladies our agricultural system was afflicted with. Among the many recommendations it put forward, the most important one that promised to bring about radical changes in the economic, political and social life of the country as a whole, related to the restrictions on land ownership. No one was to own more than twenty squares of land. This step is likely to result in fuller and better utilization of the land resources in the country. This is so because most of the landholders owned unmanagably large tracts of land while the majority of the farmers owned small patches where improved methods of cultivation could not be adopted. By restricting the ownership, acquiring the surplus land and distributing it equitably among the almost landless peasantry, we hope to produce conditions favorable to the most effective and efficient utilization of our land resources. As a result of this the economic life of our country, which depends heavily on agriculture, is expected to be strengthened.

I now pass on to the other reforms, especially those relating to the educational system. An educational system, as you all know, cannot be static; it must be dynamic. It must be flexible. It must be adjustable to the changing needs of a modern society. With the attainment of freedom we needed patriotic citizens, builders, technicians, engineers, and skilled workers, to build the society into a strong prosperous one, while the educational system we inherited was designed to perpetuate our slavery. The need for bringing about radical changes in our educational system was thus quite obvious. Unfortunately the misrule of the country prior to the taking over of the present government, kept alive the ill-suited educational system. The present government attacked this problem with the same devotion, courage, and zeal that it exhibited in tackling other problems of the country. A profound and close study of our educational system and our educational requirements was, however, essential and must precede any effective step for modifying it. Consequently a commission, called the Commission on National Education was formed to study our educational system and in the light of the economic, social, and political conditions presently prevailing it was asked to suggest measures to make the educational system more responsive to the national needs. The commission's task was not an easy one. To search for and identify the basic defects in the haze and confusion that prevailed then was not an easy task indeed. But the commission, inspired by the patriotic leaders, tackled the problem with sincerity and patriotism. After a close study and exchange of views with teachers and students representing all aspects of our educational system, the commission came out with the very important recommendations which were adopted. The whole educational system is in the process of being modified in pursuance of the recommendations of the Commission on National Education. Curriculums at schools, colleges and universities have been diversified. Proper arrangements for the teaching of some essential arts have been made at school level. As a result of this, the student will have very wide selections to choose a subject most in line with his talents. This should result in proper and efficient utilization of manpower. Recognizing the importance of agriculture in our country, which remains and is likely to remain the profession of an *overwhelming* majority of persons in our country, an agricultural university in each wing has been established. Activities at these universities have been diversified, research facilities have been expanded and arrangements for post-graduate teaching have been made. Out of this university is expected to emerge a regular team of agricultural scientists and technicians equipped to solve the grave problems facing agriculture in our country.

Another aspect of our education that has been greatly and favorably influenced by the recommendations of the commission is the Engineering Education. It is hard to overstress the importance of the role that modern technology plays in the economic development of a country, especially a backward country like mine that needs a large number of engineers to develop industry in the country. In view of this an engineering university has also been established in each wing of the country. The functions of this university will be similar to those of agricultural universities.

In addition to these, other measures are also being taken to improve every aspect of the educational system and it is hoped that the new educational system will be more in line with the requirements of our society.

Besides this, the present government has endeavored to modify other aspects of the national life. Measures were taken to screen out corrupt officials in an attempt to stamp out corruption that was rampant then. As a result of this, public administration is much more efficient today.

There are various other problems that are claiming the serious attention of the government. Most of the steps taken so far have already yielded very useful results. Foreign exchange reserves have been strengthened. Construction activities have been intensified. Most of the industries are today working to the maximum capacity. Briefly speaking, constructive activities are going on in all aspects of the national life.

Finally I intend to dwell a little on the political reforms being introduced by the present government. In this connection I must say frankly that democracy as it is understood

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Weather Control

(*Continued from page* 25)

from the air mass is composed largely of small earth, dust, or sea salt particles. It has been shown by observation that there is a strong variation of nuclei content with temperature. In a sample of average air there seems to be about 10 nuclei per cu. m. effective at -15° C; 5 x 10^2 at -20° C, and 2 x 10^4 at -25° C. Concentrations of 10^5 per cu. m. are required for complete nucleation by artificial nuclei. Ordinarily, cloud tops at sub-freezing temperatures contain primarily super-cooled liquid droplets because their temperatures are insufficiently low and there is a dearth of natural effective nuclei.

Precipitation is largely initiated through the deposition of water vapor on natural ice-forming nuclei which are supplied by the same updrafts that supply the water for cloud generation. Ice crystals caused by the deposition of water vapor on the natural nuclei grow to snowflake size in the presense of supercooled water droplets because of their lower vapor pressure. As they descend the snowflakes collide with more supercooled cloud droplets which freeze upon them. On further descent, after melting, they collide and unite with cloud droplets, thus continuing their growth until they fall from the base of the cloud.[1]

In 1946 a scientific team composed of Vincent Schaefer and Irving Langmuir discovered a suitable substance that would serve effectively as an artificial nuclei was dry ice. Later Bernard Vonnegut joined the team and proposed using a substance for seeding clouds that would have the same crystalline structure as ice. Silver iodide showed to be the most suitable substance and is now the most commonly used artificial nucleant at present.[2]

Cloud seeding with dry-ice is usually performed by aircraft, whereas, cloud seeding by silver iodide can be performed by silver iodide smoke generators from either ground level or by aircraft. From a typical generator a finite's supply of smoke is sufficient to nucleate 1.2 cu. km. (0.29 cu. miles) of cloud at -15° C. It is of great importance that rapid dilution of the generator's smoke through a large volume of a cloud take place. There are no man-made means (other than the H-bomb) to achieve such rapid dispersal of the smoke. It is therefore necessary to depend on the natural diffusion processes of the atmospheric currents to produce the required reduction in concentration before the smoke reaches the proper temperature level for effective nucleation. It is therefore necessary that the smoke is carried aloft by the same updrafts which generate the liquid cloud droplets.[3]

The economic value resulting from cloud seeding has in most cases exceeded the cost. In the western mountain watersheds, seeding projects have increased precipitation by 10% to 15%. A 10% increase in snowpack and in consequent runoff may result in as much as an additional 100,000 acre ft. of water available for storage, from a watershed target area of 1500 sq. miles. The value of this water for hydroelectric power may range from $3 to $20 per acre-ft. In some areas cloud seeding has resulted in the increase of value of farm land.[4]

In order to change climate and weather on a large scale the reflectivity or albedo[5] of large portions of the earth's surface would have to be changed in order to influence the percentage of solar radiation absorbed. The only suitable places for consideration are the deserts and snow fields, since it would be unwise to blacken grassland which is so economically important.

It has been proposed that the deserts and polar ice caps could be blackened by laying down a thin layer of carbon dust. Light-colored deserts such as the Mojave and Death Valley have albedos of between 25 and 30 percent. A thin layer of carbon dust would reduce the albedo by one-half. This would increase the average energy absorbed by the earth's surface and the average temperature by 0.4° C. A thin layer of carbon dust over the Arctic ice pack would reduce the average albedo from 50 to 10 percent. This would result in a 50 percent increase of ice, salt or fresh, that is melted.[6]

The above proposal at this time appears to be highly impractical. It would take billions of tons of carbon and if a million Globemaster aircraft were used it would take each a 100 sorties to lay 1 billion tons of carbon. This would take considerable time during which wind erosion, melting frost, and snow deposits would tend to disperse and whiten the carbon layer.

A feasible plan proposed by H. Wexler for melting the Arctic ice pack includes the use of clean hydrogen bombs. Ten hydrogen bombs of 10 megatons each exploded in the Arctic Ocean would produce steam that would in turn gush into the atmosphere creating an ice fog. Such an ice cloud would require less than 10 years to melt the Arctic ice pack. But Wexler points out that the results could be more harmful than the previous aliment. The number of cyclones and snow storms would increase and thus increasing the size of now existing glaciers and cause new ones to form. Also, the amount of precipitation at various points of the globe would be altered. Only when man has increased his scientific knowledge of meteorology enabling him to make accurate predictions as to the results of such above proposals can he make serious steps towards weather control on a large scale.[7]

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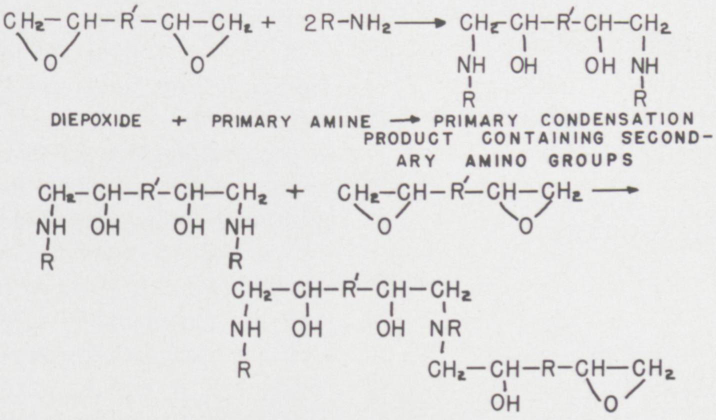
1. "Seeding of West Coast Winter Storms," by Robert D. Elliott, ASCE Irrigation and Drainage Division Vol. 86 IR1, p. 45, March, 1960.
2. "Serendipity and the Development of Experimental Meteorology," by Vincent J. Schaefer, ASCE Irrigation and Drainage Division Vol. 86 IR1, p. 8-9, March, 1960.
3. Elliott, *op. cit.*, p. 44.
4. *Ibid.*, p. 53.
5. Albedo is the ratio between the light reflected from a surface and the total light falling upon the surface.
6. "Modifying Weather on a Large Scale," by H. Wexler, Science Vol. 128, Oct., 31, 1958.
7. *Ibid.*, p. 1061.

epoxy resins

written by:
Lindley Ruddick
Soph. Chemistry



SECOND STAGE IN CROSS LINKING

The epoxy resins are those that contain an epoxide group. Commercial preparation of these resins began in about 1946. Their production has risen phenomenally until at present over thirty-five million pounds per year are made. Epoxies are produced by the reaction between epichlorohydrin and polyhydric compounds as phenols, glycols, and novolacs. Bisphenol A is also used which is a condensation produce of phenol and acetone. The family of products possible from these reactions vary from liquids at room temperature to high melting solids, all of which are linear polymers containing the epoxide grouping. These polymers may also contain hydroxyl groups in varying proportions with the epoxide group depending upon molecular weight. The lower molecular weight materials contain a predominance of epoxy groups while the higher members of the series contain larger amounts of hydroxyl radicals. The properties of these resins may also be altered by the addition of different organic radicals. For instance, esterification with acids from natural drying oils will give epoxy resins well suited to the formation of paints and varnishes.

These basic resins can be converted from the thermoplastic state by reaction with a curing agent. These include diamines, anhydrides, and primary amines. With the proper curing agents it is possible to cause cross linking of the lower molecular weight resins at ambient room temperatures. During this process heat is evolved. To obtain conversion of the higher difunctional homologues, it is necessary to heat them to moderate or high temperatures, depending upon the curing agent used. During the curing process the two resins modify each other's properties as do alloy metals. The combination, unlike either resin alone, has new properties and is thermosetting. Neither of the two ingredients can be recovered from the reaction mixture.

Above is shown the reaction for the curing of a diepoxide by a primary amine exhibiting cross linking.

It is clear from the above reaction sketch that a polyamide resin containing available primary and secondary amino groups is capable of reacting with epoxy resins and with compounds containing epoxy groups. By adjusting the ratio of amino containing polyamide resins and epoxy resins, a series of cured products of widely varying physical properties can be obtained.

An outstanding characteristic of the epoxy resins is their adhesiveness. This is related to their polar nature and their ability to wet both metallic and ceramic surfaces. Effcetive adhesives must also be flexible to a certain extent; this can be obtained by controlling the amount of curing agent to give sparse cross linking. Adhesives from epoxies can form quite strong metal to metal bonds, particularly aluminum to aluminum. In many respects these adhesivce bonds are superior to riviting. To promote ultimate properties, it is often advisable to chemically clean or etch the surfaces to be bonded.

Another outstanding property obtainable with the proper selection of variables are excellent electrical properties, a high degree of toughness, and good structural properties. Two unique properties of the cure are the fact that there are no volatile by-products of cure, and the shrinkage during cure is low. In the higher homologues there are hydroxyl radicals along the chain, and each polymer unit is terminated with epoxy groups. Upon polymerization of the epoxy and hydroxyl groups with tertiary amines or Lewis acid catalysts, only ether type linkages are produced. Accordingly excellent chemical resistance, as expected, is noted in these resins. Excellent chemical resistance, however, is also noted with the acid cured or esterified polymer systems and with the polyamine systems wherein the cross links are of the beta hydroxy amine type.

Casting applications take advantage of the property of an epoxy to convert from a pourable liquid to a useable solid, at ambient temperature or at elevated temperatures. The low shrinkage coupled with early high strength at room temperatures commends this class of materials to rapidly expanding markets, such as

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library notes

written by Carson Bennett and Winifred Kitaoka

Books are the legacies that a great genius leaves to mankind, which are delivered down from generation to generation, as presents to the posterity of those who are yet unborn.

Joseph Addison: *The Spectator,* No. 166.

FROM THE NEW BOOK SHELF

Life (Magazine)

Life Pictorial Atlas of the World

Rand McNally and Life Magazine have collaborated to create a new kind of atlas representing a total departure from the traditional.

In an age when men are seeing the earth from a satellite, it became important to attempt to show the earth in full three-dimensional reality. To achieve this, actual color photographs were taken of a specially constructed 6-foot diameter globe. These "global views" depict many new glimpses of our world as it really appears from a great distance. The atlas is organized so that you focus on a given region by means of these "global views" as a preview to actual maps and photographs of these areas.

Lukacs, John

A History of the Cold War

This book treats the history of the great struggle between Russia and America during the last fifteen years. It covers all events between the summits of Yalta in 1945 and Paris in 1960. Objectively and anallytically, Mr. Lukacs reviews these turbulent years — the agreements at the postwar conferences that split the world into divided camps — the problems of Germany, China, Korea, Hungary, Cuba, and other troublesome areas of the world — the men who have staged and controlled the events (Stalin, Roosevelt, Churchill, Tito, Dulles, Truman, Rhee, Macmillan, and Khrushchev, to mention a few) and their policies and ideologies which have affected the entire world.

American Heritage

Book of Indians

. . . a richly illustrated history that tells the wonder-filled story of the American Indians, in perspective from prehistoric times to the present. "American Indians defy any single description. They were and are far too individualistic. They shared no common customs. But collectively their history is our history, and should be part of our shared and remembered heritage."

This book follows the thread of history, century by century, for all Indians, as they affected each other, as they affected the white man—and as the white man, in turn affected the Indian. The text contains materials that will be fresh to the specialist, as well as the general reader.

Haines, William W.

The Winter War

"*The Winter War* is a historical novel, fiction grafted onto fact."

This exciting story follows the Indian fighting in the Montana Territory in the summer and winter of 1876. The Indian Chiefs Crazy Horse, Sitting Bull, and Lightning's Friend for the first time had formed a great federation of Sioux, Cheyenne and lesser tribes, and in four months they had dealt General Cook two humiliating defeats and massacred Custer. To revenge the failure of forty regiments, the Administration dispatched to Montana, General Nelson Miles and his 5th Regiment U. S. Infantry. It is their exploits and courage which give this book its vitality, and fills it with the drama of a long and hard fought campaign through the worst winter in Montana history.

Aiken, Conrad

The Collected Short Stories of Conrad Aiken.

This is a collection of all those stories Mr. Aiken wishes to preserve in permanent form. They represent his finest achievement. Some of the forty-one stories have been represented in many anthologies, but many have been unavailable for years.

The scope of these stories is as broad and familiar as daily life — and as mysterious. Mr. Aiken writes in the tradition of Henry James, Walter de la Mare, Katherine Mansfield, and Guy de Maupassant. Each of his stories testifies to the author's control of his medium — imagination and poetry are ever present.

Mitchell, William L.

Memoirs of World War I

An adventurous eye witness account of our first war in the air . . . by the "father" of American air power.

General "Billy" Mitchell was one of the most controversial figures in American military history. Flamboy-

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Atom Bomb

(*Continued from page* 11)

the control of nuclear energy in the hands of a nation whose policy is to rule the world. We would be in a less favorable position than if we did have sole control of atomic energy and faced at least a war in which we had a chance instead of total destruction.

Other proposals for the future use of nuclear power have been made. One of these was that a demonstration be given of the power of a multi-megaton bomb before representatives of the nations of the world. It was hoped that this demonstration would convince all nations that nuclear warfare can lead to the destruction of mankind. Another proposal consisted of a policy of selective retaliation against an enemy's key economic installations. It is hoped that such a proposal would keep war less total if it should begin.

E. W. Titterton outlines three things which must be done before the problems of the Nuclear Age can be solved. The first step is to realize the problem and then to give the people of the world an understanding of it. Secondly, time is needed to reorientate ourselves to the problem and find policies with which to end the problems. Lastly, it is necessary to find and follow all avenues to the settlement of international differences.

Albert Einstein, a scientist who played an important part in the development of the new force, outlined the primary moral considerations men must think about in the future.

> Science has brought forth this danger; but the real problem is in the heart and mind of men. We will not change the hearts of other men by mechanism but by changing our hearts and speaking bravely. . . .
>
> When we are clear in heart and mind—only then shall we find courage to surmount the fear which haunts the world.

It should be pointed out that the real significance of the two atom bomb blasts is that war must be removed from the earth in order that an all out atomic war doesn't start. The implications of the atom bomb blasts are so fantastic that one would have a hard time realizing what a nuclear war would be like. If man can avoid war he can look into the future without fear of annihilation and with the hope of improved living for all men, everywhere.

We have seen over a period of fifty years a world engrossed in new moral and political ideas. Within the last five decades man has just barely scratched the surface of the atom and its capabilities. In the future these capabilities will probably be beyond our imaginations, that is, if there is a future. The future is hard to predict, and we must base our ideas of what the future might be like on what has happened in the past—a past which is marked with immoral deeds. The future is up to man and his moral virtues—he has to live with himself in the future.

Ultrasonics

(*Continued from page* 16)

Where is ultrasonic non-destructive testing particularly useful? Certainly it is finding a home in raw materials and closely allied industries for detecting impurities by the method just described. Minute flaws often imperceptible to x-ray penetartion appear as extra echoes on the oscilloscope s c r e e n. Ultrasonic gauges determine the thickness of finished products, from bearings to satellite casings, and detect corrosion damage to tanks, boilers, and pipelines. In this operation, the frequency of the incident wave is adjusted so there is a 180° phase shift for the complete cycle from the front to the rear surfaces and back again. If a piece is inserted of the wrong size or the metal becomes corroded, it shows up as an improper phase shift. Automatic converters then activate a warning device or stop the machine until a correction can be made.

Ultrasonic depth gauges measure the level of liquid in a tank or the depth of the ocean floor. Ultrasonics provides an efficient method of quickly estimating the expanse of oncoming icebergs, an ever-present danger to ocean travelers. Likewise, ultrasonic detectors can locate schools of fish and submarines. One could continue listing possible uses of ultrasonic non-destructive testing and measuring. At least these few examples give a rough idea of what is being done with this newly born wonder of ultrasonics.

Certainly, not all applications of ultrasonics have been covered in this brief presentation. Ultrasonic metal fabrication and machining processes (drilling, welding, grinding, cutting), ultrasonic counting, ultrasonic burglar alarms, and even ultrasonic microscopes and television are within the sphere of reality. Although yet experimental in many facets, ultrasonics shows indication of developing into one of the most powerful and flexible implements ever invented by man.

Library Notes

(*Continued from page* 30)

ant and colorful, he fought for years to give air power its rightful place in war and peace. His turbulent army career ended, of course, with his famous court-martial.

Maloney, Terry
Other Worlds in Space

With the great interest today in space travel this fascinating book goes a long way to give the science-minded student a clear introduction to our universe and all that we currently know about other worlds in space. This book is concerned with one of the newer branches of the oldest sciences: Astronomy.

Here are the fundamentals of modern astronomy explained in a captivating manner that one can visualize both the design of our solar system and the conditions believed to exist on the planets. Also, *Other Worlds in Space* presents the latest information on artificial satellites and space travel.

Progress in Pakistan

(*Continued from page* 27)

and worked in the west, is not suited to the countries like ours. This is so, because such a democracy can work effectively and efficiently on the basis of some conditions which are fully fulfilled in the west, and not in countries like ours. These conditions, or rather these assumptions, imply that there should be full freedom. By full freedom I mean intellectual freedom, the ability to consider national problems individually, and freedom from want and hunger. We are far from that position. There is grave illiteracy in our country. Economic conditions are, to say the least, bad. Due to existence of different conditions prevailing in our country, we must carve out a different sort of democracy which is more in conformity with our conditions. In the words of our president, Mohommad Ayuh Khan, we need "a democracy which our people can understand and work." In pursuance of this aim we have established political institutions called Basic Democracies in every corner of the country. Their function is to attend to the public grievances in their respective regions and to convey them to the respective government officials. The large number of such institutions has thus established a strong link between the people and the government.

A commission has also been formed to suggest the type of constitution that the country should have. Its report is expected soon and it is hoped that the report will help in creating political stability in the country, which we need most.

In the end I may state that my country is today faced with various problems, some threatening its very survival, but with a strong and patriotic government at home (like the one we have at present) and with the continued helpful co-operation of sincere friends like you, we are confident of tackling these problems effectively in a way to build our country into a strong and prosperous one.

Epoxy Resins

(*Continued from page* 29

tools and dies, jigs and fixtures, electrical and electronic potting and encapsulation, automotive body filling and repairing, do-it-yourself home repair kits, and miscellaneous low initial investment article forming. When an article is cast in a mold, the excellent adhesion of these materials becomes a distinct problem; and careful attention must be paid to mold release agents. Silicone greases and oils, and plastic films are recommended as release agents. Due to the exothermic nature of the curing reaction, problems involving excessive temperature rises are encountered with large castings.

One of the large uses for epoxy resins is as a component of varnishes and finishes. These finishes show superior adhesion to metal surfaces, and are quite resistant to abrasion and to chemical attack by alkali, sea water, or detergents. They also have an advantage in that they can be made to be very quick drying.

Epoxy resins fall into two general classes, solid and liquid. The solid resins are modified with other resins, usually unsaturated fatty acids for coating materials. The cost in the general neighborhood of 60¢ per pound. The liquid resins are the ones that we are most familiar with. These are the ones that require the addition of a hardener. They cost around 80¢ per pound.

Coatings of epoxy resins are applied as solutions of the modified resins in hydrocarbon solvents. After vaporation of this solvent, the material is baked to bring about the oxidation, polymerization, and condensations that produce the desired properties.

Two disadvantages of epoxy resins are their high cost and difficulties with parting from the tooling used, due to their unique adhesive ability. In addition, this general class of resins, unfortunately has relatively low creep resistance at elevated temperatures. It is expected that further development work will improve this weakness as well as lower the cost.

Greek Briefs

(*Continued from page 23*)

the week. That's okay with me, because last night I spent $2\frac{1885}{3508}$ hours chopping my way home.

I was informed today by a reliable source, that there is a sheepherder two ranges down the 6th trail. All I can say is that he had better be careful about keeping his herd on his own range. We cattlemen will not tolerate any sheep on our range. If we find any sheep around here, we will be forced to wire for T-238 from the Stanford Chapter of T. X. His card says "Have gun, will travel, wire Paladin, San Francisco." I am sure he will assist us in the rangewar against the sheep-herders.

We are shore regretful that the hunting season has opened. Three of our prime steers have been blown apart by mad hunters. I personally almost had my cranium penetrated with #8 shot by a hunter chasing a pore little jackrabbit. Luckily, he got hung up on a barbed wire fence.

We hate to say it, but a couple of our ranchhands, namely wrangler McClure, brander McGivern, and possibly bulldogger Andis may be leaving us. It seems the US government wants to give them free tickets to some place called Berlin, or something like that. They seem pretty anxious to take the trip.

Other than that, everything is fine on this range. Everyone seems to be roping all sorts of wonderful grades. Everyone is studying an amount of e^t, to wonderful avail.

QUASIMOTO

Curt Yee

ALPHA TAU OMEGA

Dreaming of a white Christmas? Well, if this Christmas is like most there will be several feet of snow on the ground the day you start home. Just think of all the wonderful gifts your profs have given you to make the season brighter. A term paper assignment complete with padded reference sources, a physics lab formal, one or two problem sets, and several other joyous assignments. Now that you've decided that yours is perhaps the hardest lot, remember semester exams are just around the corner.

On the lighter side. After being a mechanical major at Rose, Bill Volkers found his minor, Marilyn Minor, that is. They are pinned. Another State girl got her man when Jack Spitler pinned Carol Schonfield. Soon to join the ranks of married men is John Modesitt who is now engaged to Diane Gardner. Already a member is Jerry Heiniger who married Loretta Dillard.

On November 17 we had our first set of get acquainted parties at Rose. Since we have a closed rush this is the first opportunity for the freshmen to meet the fraternity men as such. It also afforded them the chance to see the fraternity houses. Strangely, though, in no house were they invited to see the closets, probably for fear that someone would be smothered in an avalanche. One feature which I'm sure was noticed was the bevy of lovely ladies. Sorry fellas, they don't belong and aren't permanent occupants of the house.

The ATO's were very busy that weekend, for the next night along with the Sigma Nu's they presented the VMI dance. It is given annually to celebrate their founding at VMI, and this year everyone had a twisting good time.

Merry Christmas and a Happy New Year.

Bronis de Supinski

LAMBDA CHI ALPHA

On Sunday, November 19, the brothers enjoyed one of the highlights of the fall semester, the annual Thanksgiving dinner. Many brought guests to color the event and good food and a fine atmosphere were the order of the day. Also on the social calendar were the "Get Acquainted" parties, during which the chapter introduced themselves to some 125 interested freshmen.

The Inter-fraternity football season closed for the men of Theta Kappa on a good note, as the chapter squad clicked for a rousing 27-0 count against ATO. The brothers would like to congratulate Coach Joe Andel and the members of the squad for fine performances during the season.

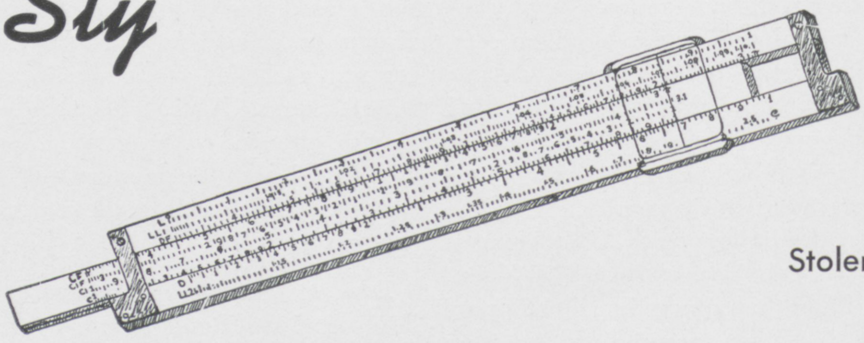
Due to the efforts, in main, of Brother Dave Randolph many new projects have been undertaken at the house. The revamping of the interior began with the painting of the vestibule closet and the phone areas. Not letting their quest for knowledge overtake their fraternity spirit, some of the brothers are planning to put away the books of learning to redecorate the hall and stairway with Kem-Tone color.

Brother Dennis Karwatka popularized the chapter in the eyes of the alumni by presenting the accomplishments of the chapter in the form of the fall edition of the Theta Kappa News.

Bob Valle

John Stockton

Sly Droolings



Stolen by Rick Rapson, Junior Electrical

Then there was the man named Carr who went into the used plumbing business. The sign in front of his establishment read: "Honest Carr, Used John Dealer."

* * *

The automobile motor pounded and suddenly wheezed to a stop on a lonely road. "I wonder," mused the ME, "what that knock is."

"Maybe," suggested the blonde companion, "it's opportunity."

* * *

Don't worry if you start losing your memory — just forget about it.

* * *

The little old lady bent over the crib: "Ooooo, you look so sweet I could eat you."

"Like hell you could," the baby muttered. "You haven't got any teeth."

* * *

A sweet young thing breezed into a floral shop, dashed up to an elderly chap puttering around a plant and inquired, "Have you any passion poppy?"

The old boy looked up in surprise. "Gol ding it!" he exclaimed. "You just wait until I get through prunin' this rose!"

* * *

"Farmer Brown, I can't come out to see you any more."

"Why, what's the matter, doctor?"

"Why every time I come out, your ducks insult me."

* * *

"I want you to do just as I tell you," said the doctor to the young lady patient.

"That's what my boy friend said," replied the gal. "That's why I'm here."

Two girls were being followed by a lone male on a beautiful spring day. Finally one of them, in apparent indignation, turned to the young man and exclaimed, "Either you quit following us or-or-or go get a friend!"

* * *

Housewife, cashing check at Supermarket: "I just couldn't get along without you people, since the bank stopped cashing my checks."

* * *

Traffic Cop—Hey, you, didn't you hear me whistle?

Sweet young thing—Yes, darling, but you're wasting your time. I'm already engaged.

* * *

A small boy was seated on the curb with a pint of whiskey in his hand, reading Esquire and smoking a big cigar. An old lady passed and asked, "Little boy, why aren't you in school?"

The infant replied, "Dogonit, lady, I ain't but four."

* * *

Sign on door of the Marriage License Bureau: "Out to lunch. Think it over."

* * *

M.E.: "I like mathematics when isn't over my head."

Ch.E.: "I feel the same way about pigeons."

* * *

The best way to get ahead is to be like a swimming duck. Keep calm and cool on top but paddle like hell underneath.

An ROTC officer approached a young man sporting a neatly fitting green uniform and asked, "What's the eighth general order?"

"I don't know," the fellow admitted.

"Have you ever been out for drill?"

"Nope." ,

"Don't you know enough to say 'sir' either? What outfit are you in?"

"Me, I'm the Coca-Cola man."

* * *

"You beast!" cried the pretty blonde. "I'm going back to my mother!"

"Never mind," said he, "I'll go back to my wife."

* * *

Prosecuting Attorney: "You mean to tell me you had sixteen beers and didn't move from the table once the night of the murder."

* * *

The dam burst, and the raging flood quickly forced the town people to flee to the hills.

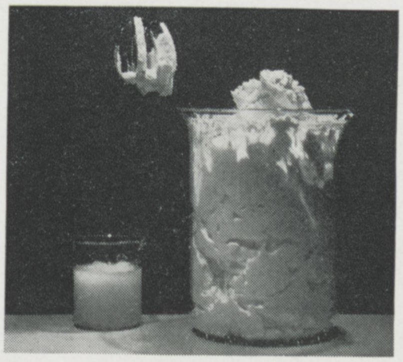
As they gazed down sadly at their flooded homes they saw a straw hat float gently downstream for about fifty feet. Then it stopped, turned around and plowed slowly upstream against the rushing waters. After fifty feet, it turned and moved downstream again. Then upstream again. "Say," said one of the townfolk, "What makes it act so durn funny?"

"Well, I ain't sartin sure," spoke up a youth, "but last night I heard Grandpa swear—come hell or high water he was gonna mow the lawn today."

Kodak beyond the snapshot . . .

(random notes)

Light as air



Both beakers contain the same quantity of applesauce. The picture should interest the millions who face the problem of avoiding more calories than their doctors say are good for them while enjoying the delight of good eating.

The one on the right contains only two additional ingredients: 1% of a certain type of monoglyceride fat we distill for the food industry and 1000% of air. Both added ingredients are harmless as applesauce itself.

One adds the monoglyceride, warms, and whips. If the result is a bit too airy for the common taste, one can either use more strongly flavored applesauce, freeze while mixing (as in making ice cream), or both.

It doesn't have to be applesauce. We have made the idea work just as well with bananas, tomato juice, etc.

Mind you, expect no applesauce from us. We offer no foods in family-sized quantities. We work closely, however, with companies that do.

THIS paper

"My husband sells oscillograph paper. Competition is fierce. He comes home beat every night."

Few overhearing her would know what the poor soul is talking about, yet she speaks the truth. Oscillographs probably outnumber pickle barrels in this country at present. Oscillographers are correspondingly numerous. Methods that one sect of oscillographers prefers above all else another sect can't see for dirt. One sect prefers automatic oscillogram processors. Paper manufacturers like us find their favor worth competing for. Therefore we announce a new advance in media for their use.

An advance in the old art of papermaking came first. Then new emulsions were devised to work properly with the new base. Then proper processing chemicals were devised for the new emulsions. Then the combination was extensively proved out under practical conditions of use by parties interested only in end-results and hardly at all in the how and why.

They found that THIS paper dries thoroughly at high processor speeds without creases, doesn't crack or distort, isn't fussy about how long it sits around *before* use, and gives trace lines that stand out black as the ace of spades.

"THIS" won't do for a trademark. We call it Kodak Ektaline Paper. Kodak Ektaline Chemicals come as liquids. The stabilization principle used in the automatic oscillogram processors came from Kodak, too.

Smart hardware

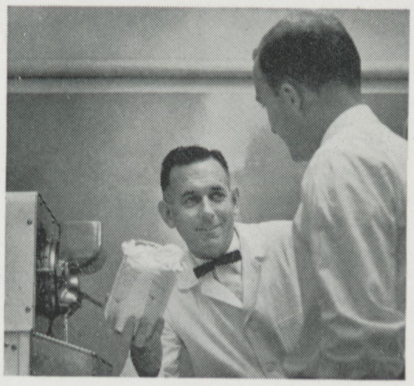
Alarm prevails over the nation's bill for research unwittingly repeated. We have an answer. Even the hardware is all built. It uses little chips of film 16mm by 32mm, which are never touched by human hands.

Each of the millions of chips carries both a) language the machines can use in classifying information to almost any depth of detail and b) microreproduction of documents, photographs, manuscripts, drawings, or whatever for the human user to examine with his natural-born eyes as soon as the machine has "remembered" it and restored it to size.

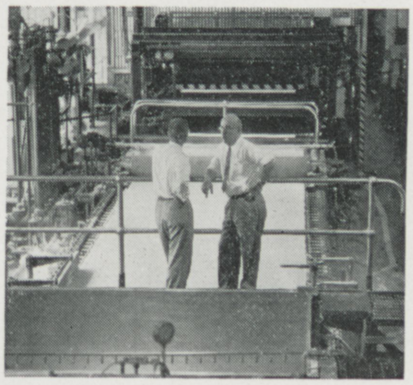
The machines search very fast. They further save searching time because of the incredible information-packing density and copying speed of photography. It is practical for the machinery to duplicate each complete chip for every pertinent sub-classification. The sub-classifications can therefore be made so fine that each contains relatively few chips for the machinery to zip through.

This is called the Minicard System. It can occupy legions upon legions of creative minds with very sharply relevant information from the whole recorded past while the stroke of genius is patiently awaited.

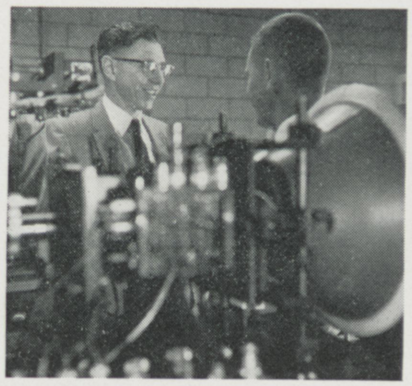
Note: Whether you work for us or not, photography in some form will probably have a part in your work as years go on. Now or later, feel free to ask for Kodak literature or help on anything photographic.



FOOD TECHNOLOGY NEEDS GOOD PEOPLE



ADVANCED PAPER-MAKING NEEDS GOOD PEOPLE



INFORMATION RETRIEVAL NEEDS GOOD PEOPLE

From solvents to slide projectors, plenty of lively careers are to be made with Kodak in research, engineering, production, marketing. *Address*:

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One of a series . . .

Interview with General Electric's Dr. J. H. Hollomon

Manager—General Engineering Laboratory

Society Has New Needs and Wants—Plan Your Career Accordingly

DR. HOLLOMON is responsible for General Electric's centralized, advanced engineering activities. He is also an adjunct professor of metallurgy at RPI, serves in advisory posts for four universities, and is a member of the Technical Assistance panel of President Kennedy's Scientific Advisory Committee. Long interested in emphasizing new areas of opportunity for engineers and scientists, the following highlights some of Dr. Hollomon's opinions.

Q. Dr. Hollomon, what characterizes the new needs and wants of society?

A. There are four significant changes in recent times that characterize these needs and wants.

1. The increases in the number of people who live in cities: the accompanying need is for adequate control of air pollution, elimination of transportation bottlenecks, slum clearance, and adequate water resources.

2. The shift in our economy from agriculture and manufacturing to "services": today less than half our working population produces the food and goods for the remainder. Education, health, and recreation are new needs. They require a new information technology to eliminate the drudgery of routine mental tasks as our electrical technology eliminated routine physical drudgery.

3. The continued need for national defense and for arms reduction: the majority of our technical resources is concerned with research and development for military purposes. But increasingly, we must look to new technical means for detection and control.

4. The arising expectations of the peoples of the newly developing nations: here the "haves" of our society must provide the industry and the tools for the "have-nots" of the new countries if they are to share the advantages of modern technology. It is now clearly recognized by all that Western technology is capable of furnishing the material goods of modern life to the billions of people of the world rather than only to the millions in the West.

We see in these new wants, prospects for General Electric's future growth and contribution.

Q. Could you give us some examples?

A. We are investigating techniques for the control and measurement of air and water pollution which will be applicable not only to cities, but to individual households. We have developed, for example, new methods of purifying salt water and specific techniques for determining impurities in polluted air. General Electric is increasing its international business by furnishing power generating and transportation equipment for Africa, South America, and Southern Asia.

We are looking for other products that would be helpful to these areas to develop their economy and to improve their way of life. We can develop new information systems, new ways of storing and retrieving information, or handling it in computers. We can design new devices that do some of the thinking functions of men, that will make education more effective and perhaps contribute substantially to reducing the cost of medical treatment. We can design new devices for more efficient "paper handling" in the service industries.

Q. If I want to be a part of this new activity, how should I plan my career?

A. First of all, recognize that the meeting of needs and wants of society with products and services is most important and satisfying work. Today this activity requires not only knowledge of science and technology but also of economics, sociology and the best of the past as learned from the liberal arts. To do the engineering involved requires, at least for young men, the most varied experience possible. This means working at a number of different jobs involving different science and technology and different products. This kind of experience for engineers is one of the best means of learning how to conceive and design—how to be able to meet the changing requirements of the times.

For scientists, look to those new fields in biology, biophysics, information, and power generation that afford the most challenge in understanding the world in which we live.

But above all else, the science explosion of the last several decades means that the tools you will use as an engineer or as a scientist and the knowledge involved will change during your lifetime. Thus, you must be in a position to continue your education, either on your own or in courses at universities or in special courses sponsored by the company for which you work.

Q. Does General Electric offer these advantages to a young scientist or engineer?

A. General Electric is a large diversified company in which young men have the opportunity of working on a variety of problems with experienced people at the forefront of science and technology. There are a number of laboratories where research and advanced development is and has been traditional. The Company offers incentives for graduate studies, as well as a number of educational programs with expert and experienced teachers. Talk to your placement officers and members of your faculty. I hope you will plan to meet our representative when he visits the campus.

A recent address by Dr. Hollomon entitled "Engineering's Great Challenge — the 1960's," will be of interest to most Juniors, Seniors, and Graduate Students. It's available by addressing your request to: Dr. J. H. Hollomon, Section 699-2, General Electric Company, Schenectady 5, N.Y.

GENERAL ELECTRIC

All applicants will receive consideration for employment without regard to race, creed, color, or national origin.