Spring 1968

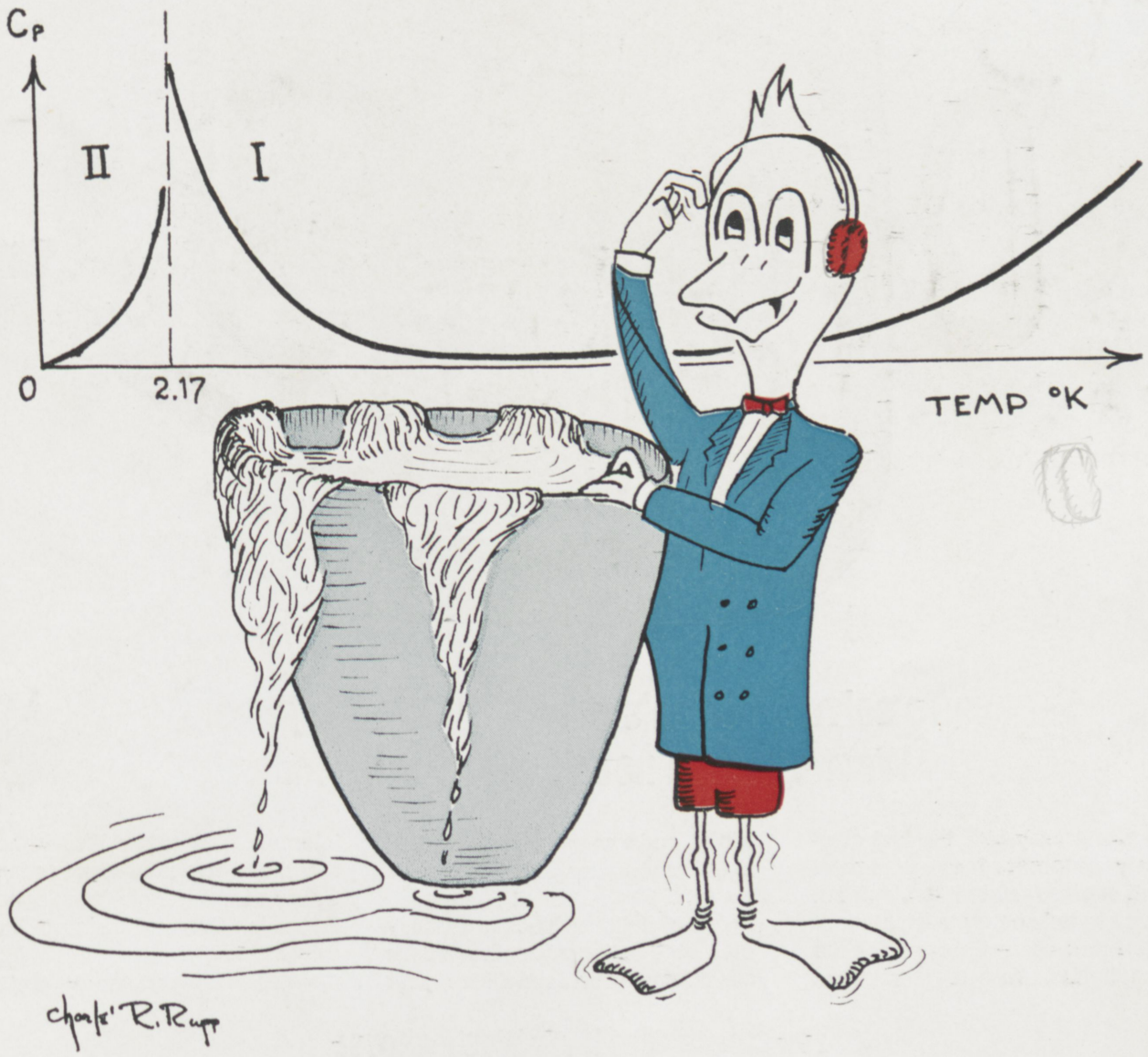
Volume 79 - Issue 1 - Spring, 1968

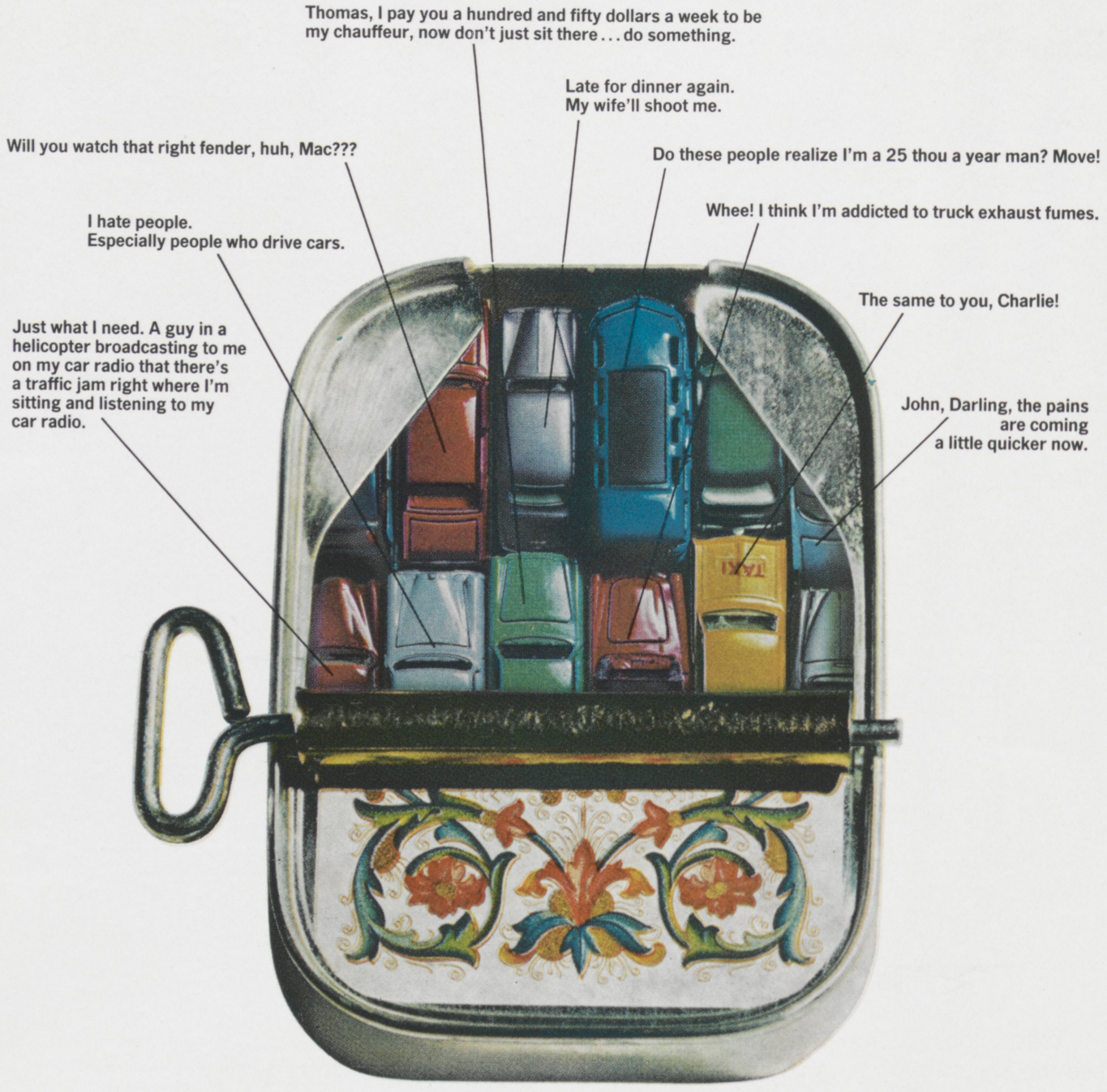
Rose Technic Staff
Rose-Hulman Institute of Technology

Rose Technic

Spring *1968*

CRYOGENICS





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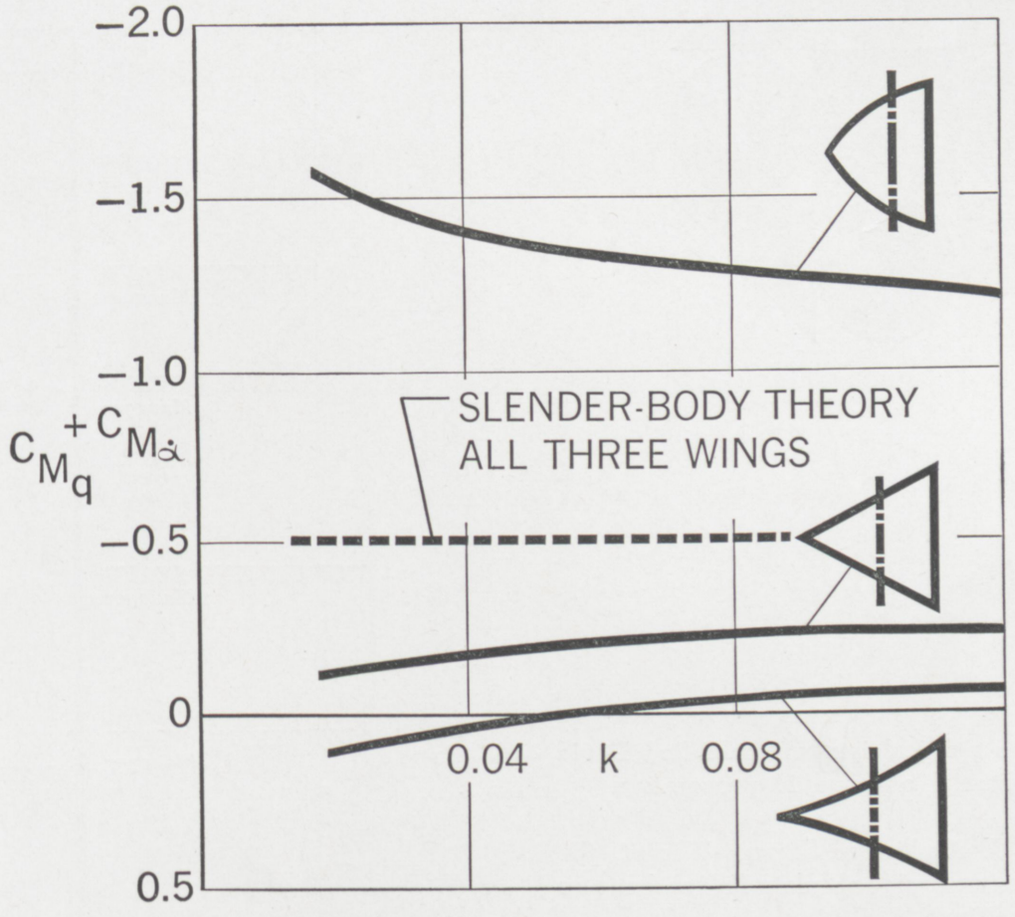

Like Captain.

Take a look at any campus. Big. Small. Rural. Urban. You see the same thing: guys and gals. Same books. Same looks. Same hopes.

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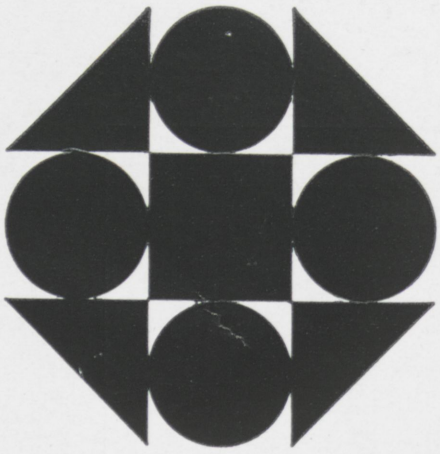

IN THIS ISSUE

Those inclined to political issues should find David Lawrence's guest editorial on page 10 provocative.

Courtesy of H. J. Minkus of Stewart-Warner, the Technic presents an analysis of plate-fin exchangers under cryogenic conditions.

Any Rose student who wants to find out what Rose stands for should enjoy the faculty statement on Rose education on page 14.

On page 18 Tony Tietz questions the need of mandatory R.O.T.C. in light of the aims of Rose education.

Draft conscious seniors can find some consolation in the A.S.C.E.'s letter to President Johnson regarding the new draft policy.

COVER NOTE: This month's cover expresses one of the extremely unusual phenomena which occurs in Cryogenic Science. Liquid helium when left in a flask will creep up the sides and flow over . . . "defying gravitation." The phenomena is a result of the "superfluid" characteristics of liquid helium.

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Rose Technic

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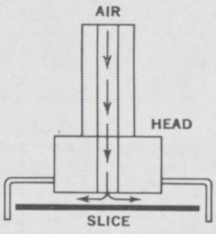
How Western Electric gets uplift from a downdraft

Picking something up by blowing a stream of air down on it may seem rather roundabout. But if you want to pick that something up without touching it, it turns out to be a most successful way.



The something in question is a paper-thin, eggshell-fragile slice of silicon destined for transistors. To touch it is likely to contaminate it, and probably to break it. Tweezers are extremely risky. Even a vacuum pickup is dangerous.

And so the engineers at Western Electric's Engineering Research Center invoked the Bernoulli principle and solved the problem. They developed a pickup device that directs a thin stream of air down onto the slice. The air flows out across the slice and since *it* is moving and the air below the slice is not, the pressure below is greater than the pressure above and the slice floats. And it doesn't touch the head because the air is, after all, blowing *down*. Wire guides keep the slice from slipping off.

So now the workers in our transistor plants can pick up silicon slices handily, without worrying about breaking or contaminating them. That our engineers reached back to a classical principle of physics to help them do it only shows the extent of the ingenuity Western Electric applies in its job of manufacturing communications equipment for the Bell System.

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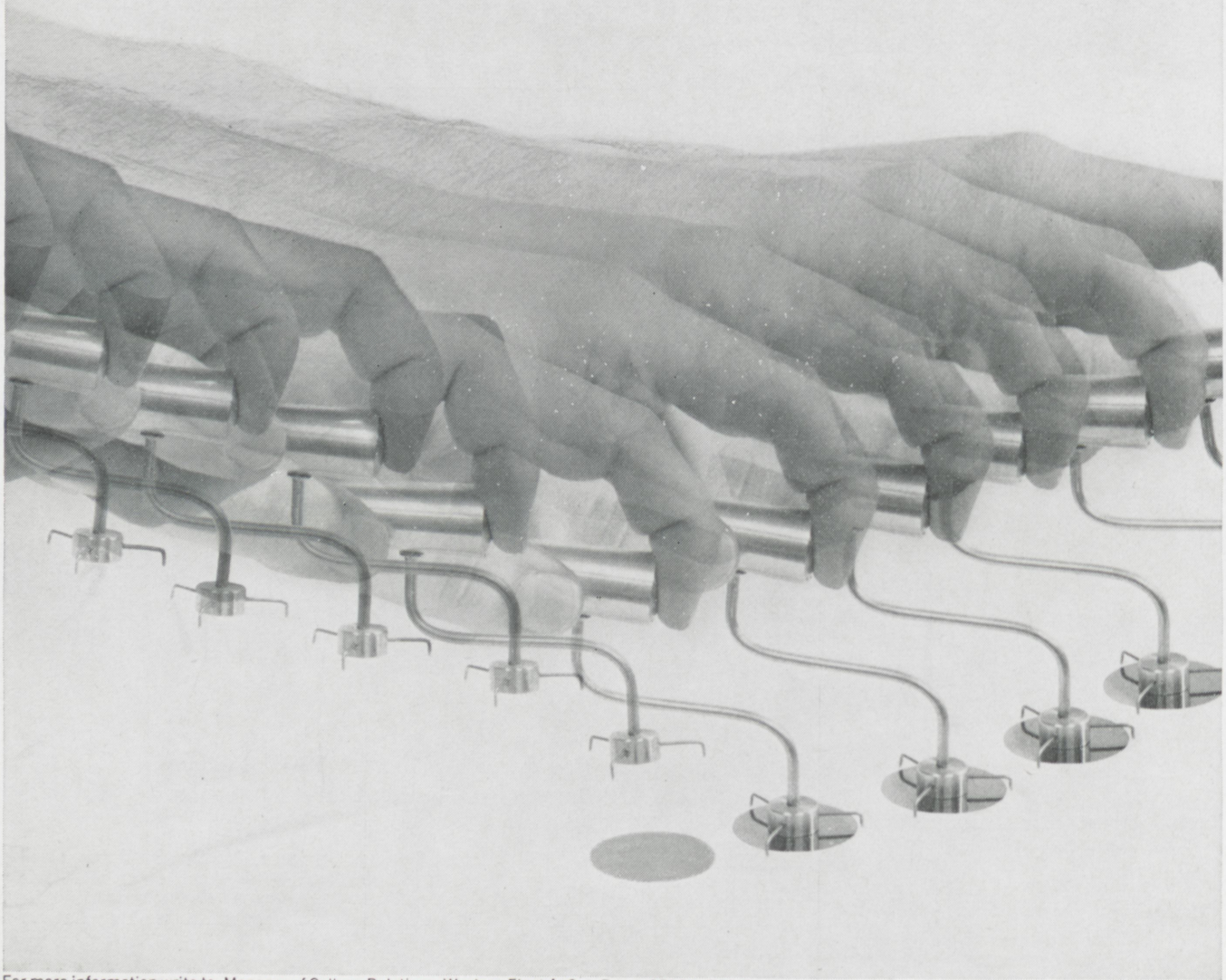

For more information write to: Manager of College Relations, Western Electric Co., Room 2510A, 222 Broadway, New York, N.Y. 10038. An equal opportunity employer.

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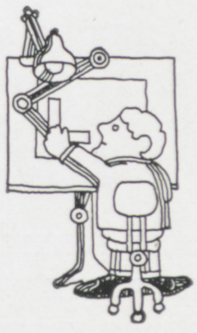
What's it like to engineer for a giant?

Rather enlarging!



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To Our Readers...

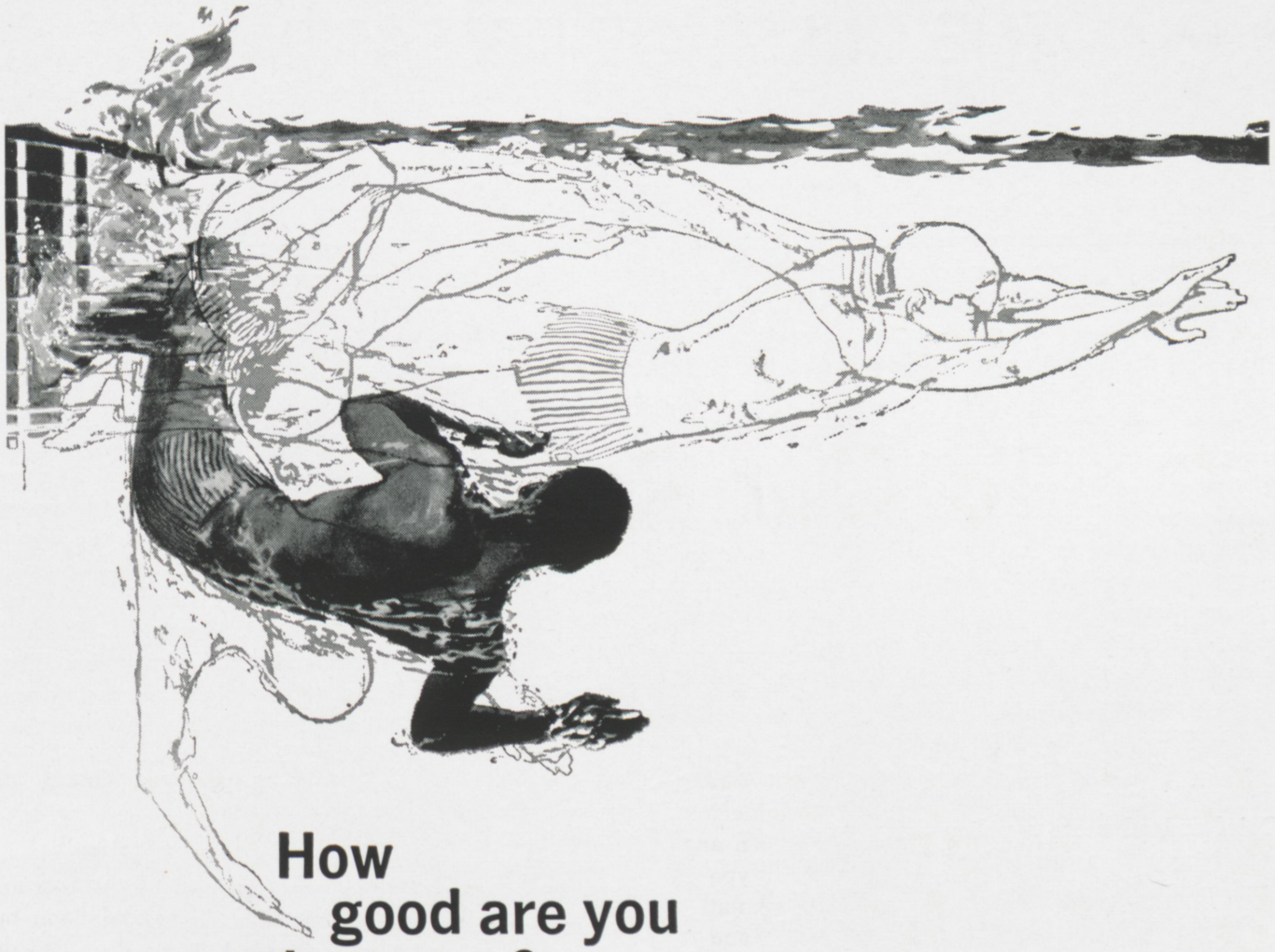
When a racing team places an entry in a race, they refrain from entering a Formula II machine in a Formula I race. I feel that the Technic has been analogous to a racing car entered in the wrong type of race. In the past, the Technic has been a combination of Popular Mechanics, Scientific American and a Mickey Mouse comic book. Few, if any students, bothered to read, much less comprehend, the technical articles. Most students merely paged to the center of the magazine to gaze upon the physical attributes of the Miss Technic or chuckle over the jokes in the rear of the magazine.

Realizing that these two aforementoned items are an integral segment of the magazine, I feel that the Technic could and should be much more. It should be the voice of the important and far-reaching aspects affecting our lives as engineering students at Rose It should be the springboard from which controversial and current opinions could be expressed openly and equally by both student and professor.

Many times I have heard both faculty member and student lament that "Something should be done but it's useless even trying". Remember, creating and destroying matter and pushing on a rope are about the only impossible things in the universe.

Therefore, I put a challenge to the members of the Rose community. See if you can make the impossible a reality by using this magazine to solicite the most powerful force in the world—public opinion. Write letters to the editor or articles and, even though the staff and myself are in disaccord with your opinion, we will gladly reprint them. Changes are requisite at Rose, maybe we can get the ball rolling.

D. J. R.



How good are you on the turns?

A strong stroke isn't enough to win in freestyle swimming. Experts say: "Watch the turns."

"A champion won't touch with his hand," they tell us. "He begins his overhead tumble with a downward stab of his right arm, twists as his feet hit, then explodes forward with a powerful pushoff."

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THE CURSE OF DEFEATISM

By DAVID LAWRENCE

Reprinted from U. S. News & World Report

What the American people are reading today in their newspapers or hearing on radio and television is that the war in Vietnam cannot be won, that the American and allied forces are being checkmated, and that many members of Congress, sharing the view of the "demonstrators," want the United States to pull down the flag and surrender.

Again and again in the last half-century, the advocates of a doctrine of "peace at any price" have created situations which have brought on a major war.

Apparently we have not learned the lessons of history. It seems incredible that any member of Congress would desert the Commander-in-Chief and advocate a policy that is tantamount to a surrender. Yet several members have openly called for retreat and withdrawel from Vietnam.

At the recent hearings held by the Senate Foreign Relations Committee, one Senator told Secretary of State Rusk, in effect, that a nation which cannot defend itself does not have a right to exist and that there is no obligation upon any other nation to come to its rescue. Another member of the Committee insisted that, before the President makes any important decisions of a military nature, he must consult Congress. Divided authority when a war is in progress is self-defeating.

What is the natural reaction of the enemy when its major opponent becomes irresolute, wobbly and vacilating? What is the effect on the spirit of the troops at the battle front when they are told over the radio that they are not being supported at home?

The United States stands at the crossroads. Will it honor its pledges, or forsake them? In treaty after treaty covering committments in Europe, Asia and Latin America, the United States has promised to come to the aid of countries which are the victims of aggression. The Charter of the United Nations itself provides for collective action by its members. But, except for the policies of the United States and some Asian nations, the concept of collective defense against aggression has not been effectively supported. Indeed, many countries have assumed they are immune from a Communist takeover. Yet if we fail in the Vietnam war, this can only open the way for the Communists to infiltrate and subvert the governments of small nations.

The right of self-determination cannot be ignored without serious consequences to the strong as well as the weak. The United States has not had in the Vietnam war the help it deserved from other nations. There are many countries which are wavering because they do not know whether the United States intends to go through with its commitments or will in a moment of expediency abandon them.

Moscow was doubtless pleased to read that one member of the Senate Foreign Relations Committee actually charged the United States with having been the aggressor in Vietnam. Also, the Chairman of the Committee declared in the presence of the Secretary of State that the resolution adopted by Congress in 1964, authorizing the use of our armed forces thereafter in Southeast Asia, was really based upon false information given to the Senate by the executive departments.

What is surprising is the amount of defeatism in America today. There was a time when patriotism was an overriding influence. It restrained American from openly giving aid and comfort to the enemy. But nowadays defeatism prevails in Congress itself, some of whose members think this is the best way to please the voters in an election year.

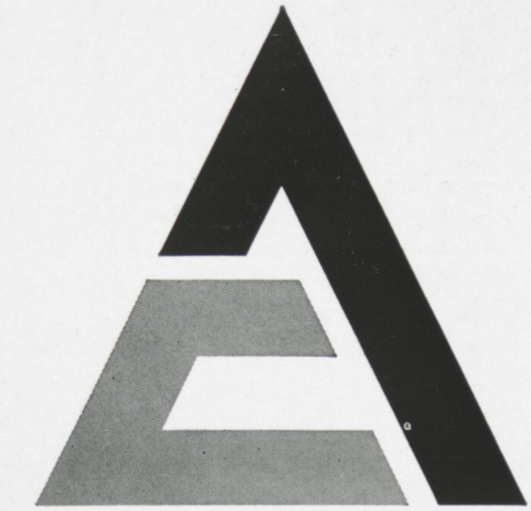
Despite the dignified and convincing way in which the Secretary of State presented the American case to the Senate Foreign Relations Committee, as he gave evidence that the United States was not an aggressor, criticism of the American position in the Vietnam war continues. We still hear demands for withdrawal and virtual surrender. These are couched in ambiguous phrases, but can lead the enemy to conclude that the United States doesn't possess the will to fight on and will settle at almost any price in Vietnam.

We are confronted today with a spirit of defeatism not unlike that which prevailed 30 years ago. At the Munich Conference in 1938 the Western powers tried to appease Hitler by acquiescing in the Nazi occupation of more territory. He thereupon took it for granted that he could enlarge his aggression. This miscalculation led 12 months later to World War II.

Winston Churchill, in a book written after the war ended, spoke in unequivocal language against appeasement and defeatism. He wrote that if a nation will not fight when victory will not be too costly, "you may come to the moment when you will have to fight with all the odds against you and only a precarious chance of survival." He added:

"There may even be a worse case. You may have to fight when there is no hope of victory, because it is better to perish than live as slaves."

Will our curse of defeatism encourage the Communists to challenge us and bring on World War III?



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CRYOGENICS AND THE PLATE-FIN EXCHANGER

By H. J. MIKUS

H. J. Mikus is the Sales Manager of the Industrial Products Division of Stewart-Warner Corporation in Indianapolis, Indiana. This report was presented at the Natural Gas Processors Association 46th Annual Convention in Houston, Texas on March 15, 1967.

Have you ever taken a moment to reflect on the word reliability? Webster defines this as trustworthiness, as dependability, or as a measure of confidence but, however it is defined, reliability as something that everyone of us looks for every day of our lives.

Reliability influences our choice of automobiles, of doctors and of major appliances for our homes. Reliability is the basis of hundreds of decisions we must make in widely diverse areas, ranging from finance to furniture, or from medicine to machinery.

It's no wonder then, that reliability is the word used to sum up the prime considerations of an operating plant and its component equipment as well, with particular emphasis in the critical heat exchange areas of low temperature processes. This word, reliability, certainly has a special meaning to each of us. With this in mind, choice of a material of construction for Plate-Fin, Extended Surface Heat Exchangers designed to operate in the cryogenic range was given particular consideration. These exchangers are fabricated exclusively of aluminum primarily because of its physical properties, such as ductility and tensile strength, which actually improve with decreasing temperatures. Depending upon the alloy, improvements of from 20% to 50% in these properties at cryogenic operating temperatures have been realized. The 5 to 1 safety factor incorporated into the exchanger designs at ambient temperatures is also improved accordingly.

In addition, the comparative light weight and high thermal conductivity of aluminum contributes greatly to unit compactness. This same compactness of heat transfer surface in a plate-fin heat exchanger is further compounded by the unit's flexibility in multi-streaming. By multi-streaming, it is meant that the Brazed Aluminum Heat Exchanger can accommodate up to seven (7) different fluids simultaneously in heat exchange as compared to the two (2) fluids normally handled simultaneously by the more conventional, shell and tube type units. One Plate-Fin Heat Exchanger having four (4) streams could perform the same duty as would require three conventional two-stream, shell and tube exchangers. Economically, there are savings to be realized in eliminating multiple shells plus associated valves, supports and interconnecting piping. Further reduction of initial cost comes in the obvious savings of installation space or coldbox size. Less obvious, is another important feature of the plate—that is, depending on the choice of fin, up to 600 square feet of heat transfer surface can be put into one cubic foot of exchanger volume. This is more than ten times the heat transfer surface area per cubic foot of exchanger volume than that obtainable with shell and tube construction, so you can readily understand this third major advantage of a brazed aluminum heat exchanger.

To summarize, those three important advantages to remember are: first—high surface to weight ratio (another way of saying light weight): second — multi-streaming capability: and third—compactness. In addition, the high effectiveness that can be achieved with these exchangers, (offering temperature approaches as close as one 1° Kelvin), reduces refrigeration horsepower in cryogenic service to a minimum.

But to return to our original theme of reliability, what makes the brazed aluminum heat exihanger so reliable in operation? To be sure, the answer is that it is built in strict accordance with section VIII of the ASME code for unfired pressure vessels, although our concern starts long before the final code stamp goes on the unit. In fact, our concern begins when the raw material, aluminum sheets, bars, plate, and coil stock, is checked in at the receiving inspection department.

The plate-fin heat exchanger as the name implies, is made up of heat exchange surfaces obtained by stacking alternate layers of corrugated, die-formed aluminum sheets (termed fins) between flat aluminum "separator" plates which can vary

(*Continued on page* 30)

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Cross-section of Full-Depth T_A Deep-Strength Asphalt pavement

THE ROSE PHILOSOPHY

The Pursuit of Excellence In Engineering and Science Education

By a Faculty Committee

Editor's Note:
It seems that we, the students, should be cognizant of the philosophy affecting our lives at Rose.

The famous Socratic admonition, "Know thyself," applies to institutions as well as to individuals, and it is fitting that from time to time an educational enterprise re-examine its philosophy, taking stock of its heritage from the past and its position in the present in order to find substantial guidelines for its role in the future. This statement is the product of such an examination. Its purpose is to set out briefly and in language as concrete as possible:

1) The fundamental purpose of this educational institution.
2) The special means by which the goals defined by that purpose are achieved.
3) The special qualities of the Institute that make achievement of those goals possible.

The tradition of pragmatism in American education provides ample justification for the school that defines its educational purpose in terms of career preparation. It must be clear, however, that such a definition should not be construed too narrowly. Hence two important qualifications must be placed on it.

First, while the four-year Rose curriculum lays emphasis on education for the scientific and engineering professions, it also provides a broad and valuable analytical background for those graduates who choose to pursue careers in such fields as economics, business, the social sciences, biology, medicine, and law. As a graduate, the Rose student is prepared equally well to pursue immediately a productive professional career or to continue his studies in graduate school.

Second, Rose defines its program as a "liberal education in science and engineering." This means that sound preparation in scientific and engineering principles is set within the context of a study of the cultural and humanitarian dimensions of our society and of the Western and Non-Western traditions. Rose is concerned with graduating scientists and engineers who are technically and creatively competent. Rose is also concerned with developing in its students an awareness of the roles of engineering and science in solving social problems.

Doubtless there are many ways in which the goal of career preparation might be achieved, but at least four can be singled out for special attention.

First, Rose provides the student with the basic knowledge and fundamental principles on which science and engineering are founded. In addition to providing this sound theoretical base, we constantly stress the utility of these principles, including their practical application to real problems.

Second, Rose encourages the student to be a critical thinker, and places great emphasis on this aspect of his education. Innovative curiosity, scientific problem-solving ability, disciplined habits of mind—all are vital to the student's clear thinking and to his zest for learning.

Third, Rose encourages the student to recognize and fully exploit his potential, as well as to evaluate his abilities realistically. While many students survive in college by exerting only a fraction of their capabilities, Rose strives to motivate an increasing number to full achievement. At the same time, every student is encouraged to develop a spirit of healthy realism about himself and his abilities, including an awareness that humility can be very humanizing.

Finally, Rose provides the student with the elements of a liberal education. The responsibilities of an engineering and science school to acquaint the student with the great traditions of Western civilization, indeed of the world, are squarely met by a strong Humanities & Social Sciences program. By this means the student is introduced and made sympathetic to the large social and philosophical issues with which he must necessarily be concerned, both personally and professionally.

We intend to state here those special qualities that identify Rose Polytechnic Institute and that make the fulfillment of its educational purpose possible. Of the many distinguishing characteristics that might be mentioned, five seem most important.

First, Rose maintains significant standards. Academic admission requirements are high but realistic, with the result that the student who is admitted should be capable of completing the program and earning his degree. The Rose tradition has always included an insistence on performance, measured in terms of intellectual achievement. We are devoted to solid academic work

(*Continued on page* 38)

School was out and no one had to call you . . . you were up at dawn. So many things to do—get out and work on the bike, find the rest of the gang and take off to explore your own private universe.

The universe is bigger now, you think ahead instead of back. At Teletype we're thinking ahead too. As a part of the Bell System and one of the world's largest message and data communications equipment manufacturers we have to. Maybe you'd like to join in—we need inventive young minds in our engineering group to help make our future as great as our past. You can find a future as bright as those memories at Teletype. Contact your Bell System recruiter when he visits your campus, or write to:

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"Well, that's the stereotype. When you look at the reality, things are a lot different. (This is Gene Hodge, B.S.E.E., an IBM Manager in Development Engineering.)

"IBM has over 300 locations. They believe in decentralization, and they delegate the authority to go with it. To me, it's more like a lot of little companies than one big one.

"Take my own situation, for example. I act as a kind of entrepreneur for my department. I decide if we should bid on certain government contracts for my group and then develop the proposal strategy. Of course, upper management reviews my decisions, but to a great extent I run my own show.

"Another thing that makes this like a small company is the close relationship with your boss. You're almost always hired by the manager you're going to report to. And you work for him on your own or in a small team. It's part of his job to know your long term goals and help you reach them.

"This same interest in the individual also shows up in IBM's educational programs. I'm getting my Master's now, and IBM's paying the entire cost, and some of the class time is on company time."

Gene's comments cover only a small part of the IBM story. For more facts, visit your campus placement office. Or send an outline of your career interests and educational background to I. C. Pfeiffer, IBM Corp., Dept. E, 100 S. Wacker Dr., Chicago, Illinois 60606. We're an equal opportunity employer.

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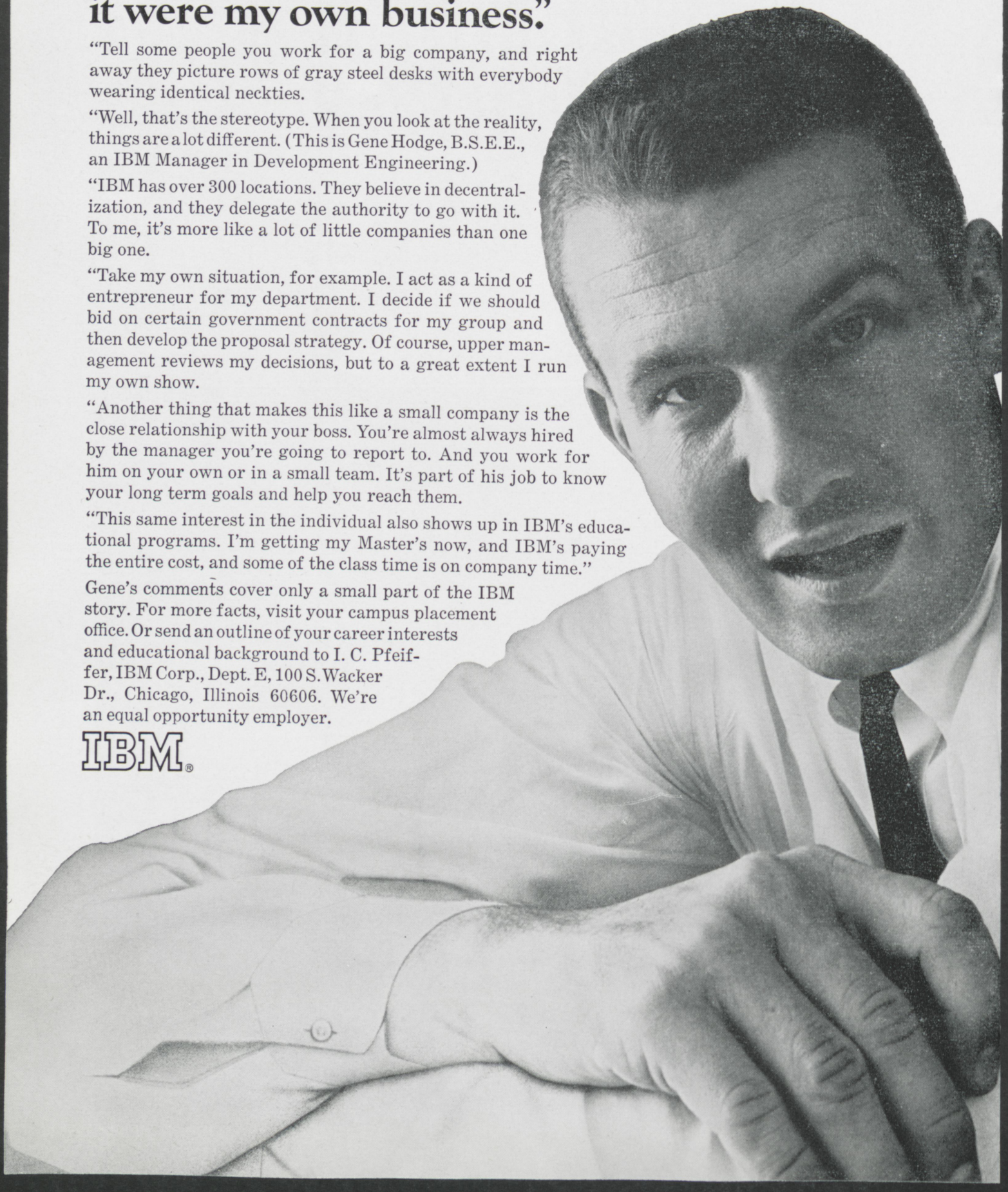
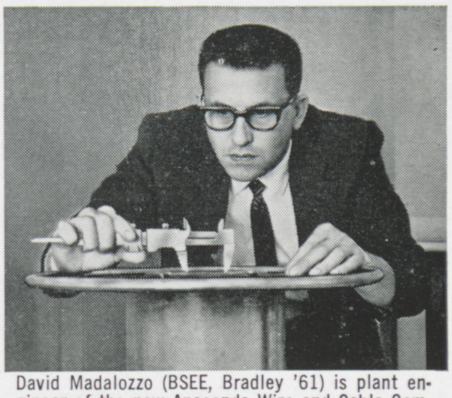


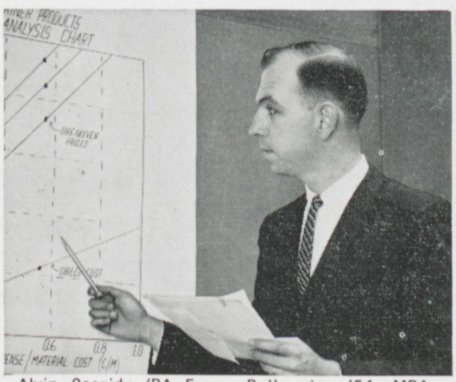
There is a growing need for nonferrous metals. To grow with it, contact Anaconda.

Robert Lindsay (BSME, U. of Kansas '64) is quality control supervisor of Anaconda Aluminum Company's plant in Louisville, Ky.

Joel Kocen (BS Commerce, Wash. & Lee '59; LLB, Wash. & Lee '61) left, is senior tax analyst at New York headquarters of Anaconda.



David Madalozzo (BSEE, Bradley '61) is plant engineer of the new Anaconda Wire and Cable Company mill in Tarboro, N.C.

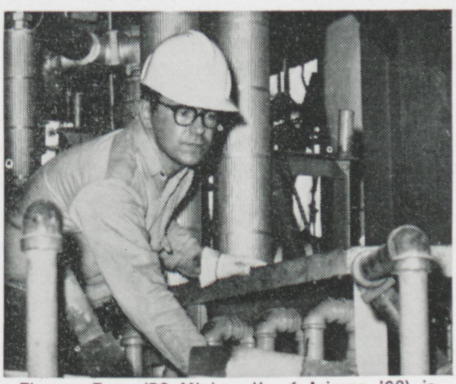


Alvin Cassidy (BA Econ., Bellarmine '54; MBA, U. of Louisville '59) is director of financial planning of Anaconda Aluminum Company, Louisville, Ky.

Robert Zwolinski (BSME, Rutgers '57) is chief mechanical engineer with Anaconda Wire and Cable Company, New York.

Willard Chamberlain (BE Metal. Eng., Yale '53) is manager of Anaconda American Brass Company's Valley Mills, Waterbury and Ansonia, Conn.

Robert Ingersoll (BS Geol., Montana Tech. '51 MS Geol., Montana Tech. '64) right, is senior geologist, Anaconda's mining operations, Butte, Mont.

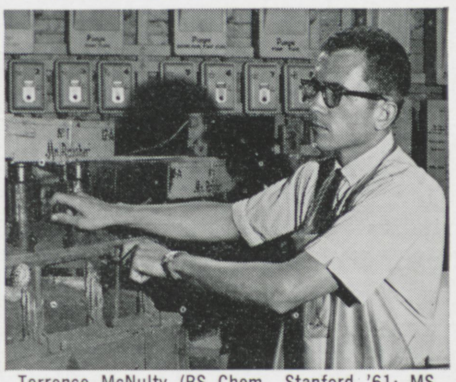


Thomas Tone (BS Mining, U. of Arizona '62) is foreman of the furnace dept. at the electrolytic copper refinery in Perth Amboy, N.J.

Richard Symonds (BS Metal., U. of Nevada '57) is superintendent of the lead plant at Anaconda's smelter in Tooele, Utah.

Jay Bonnar (BS Met., M.I.T. '57; MS Ind. Mgmt., M.I.T. '62) left, is research administrator of Anaconda American Brass Company's research and technical center, Waterbury, Conn.

Wilson McCurry (BSc, Arizona State '64) is an assistant geologist in Anaconda's new mines dept., currently working on development of the Twin Buttes mine near Tucson, Ariz.



Terrence McNulty (BS Chem., Stanford '61; MS Metal., Montana Tech. '63; DSc Metal., Col. School of Mines '66) is senior research engineer, extractive metallurgical research, Tucson, Ariz.

Anaconda American Brass Co., Anaconda Wire & Cable Co., Anaconda Aluminum Co.

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ROSE EDUCATION AND MANDATORY R.O.T.C.

By TONY TIETZ

Spring has arrived. One need only look outside to see the evidence; the sunbathers are back at their familiar post on the lakeshore, bermuda shorts and the corresponding pale hairy legs are back in the classrooms, and of course, the R.O.T.C. brigade has resumed its mission of molding Rose students into soldiers on our drill field. And, although the majority of underclassmen probably regard R.O.T.C. as a thorn in the side, most accept it as an integral part of the Rose education. Few have really questioned the reason for its presence at Rose.

The purpose of R.O.T.C. in general, according to the Rose catalogue, is "to produce junior leaders who, by their education, training, and inherent qualities will be suitable for commission in the United States Army upon attainment of a baccalaureate degree. The aim is to provide a basic military education, and, in conjunction with other college disciplines, to develop individual character and leadership attributes essential to a leader. It is recognized that the national security of the United States depends heavily upon the services of college-trained officers. The Reserve Officer Training Corps program (ROTC) offers the student an opportunity to earn a commission in the United States Army at the same time as he is earning his degree. The attainment of this second objective is, in large measure, dependent upon the student's willingness to become involved in the affairs of his country and to serve her in peace and in war."

This carefully worded statement conceals some assumptions that ought not to have been made. Although the country's need for college trained officers is certainly obvious, the goals of military training are *not* identical with the goals of the Institute, as stated by the administration; in fact, they are at times in opposition to the goals of the Institute.

The R.O.T.C. program attempts to "develop character", but who is the judge of the "character" they seek? —the military establishment. The Army builds "character", *its* character, dictated by its own values. Rose, however, has deliberately refrained from a statement of this nature in its statement of goals in the Rose Philosophy, since a true liberal educational institute cannot dictate the character of the students and still maintain the proper open-minded atmosphere that is described in the Rose Philosophy.

The R.O.T.C. program stresses the importance of the "student's willingness to become involved in the affairs of the country", but they are concerned only with military indoctrination of their students in conjunction with government policy, rather than the free and open evaluations of questions affecting the welfare of the country. Such practices, which preach only one side of highly debatable issues and teach these opinions as facts, jeopardize the atmosphere necessary for proper education. Whether or not the students are sympathetic to these opinions is irrelevant. The method of presentation is still anti-educational.

When viewed in this light, there seems no justification for making even the first two years of R.O.T.C. required of all Rose students. The school should honestly attempt to educate the student in conjunction with the goals it set for itself. Forcing the student to submit to non-educational activities such as R.O.T.C. is, in effect, a breach of contract with the student. Some may argue that the student is aware of R.O.T.C. before admission, but the school also "promises" to provide him with a liberal education, in its stated goals, which it cannot do by requiring R.O.T.C.

The only solution to this situation is the removal of two years of R.O.T.C. as a graduation requirement. Since there is a definite need for officers, the program should be allowed to remain on a voluntary basis as long as it does not interfere with the basic education process. If this is not done, the school should include as one of its goals the preparation of students for commission as military officers. All foreign students would have to be banned, and, of course, no American conscientious objectors would be admitted as is already the policy. In effect, Rose has already officially approved religious discrimination by refusing admittance to those who refuse to accept military training on religious grounds.

The "practical" problems involved with making R.O.T.C. voluntary are

(*Continued on page* 36)

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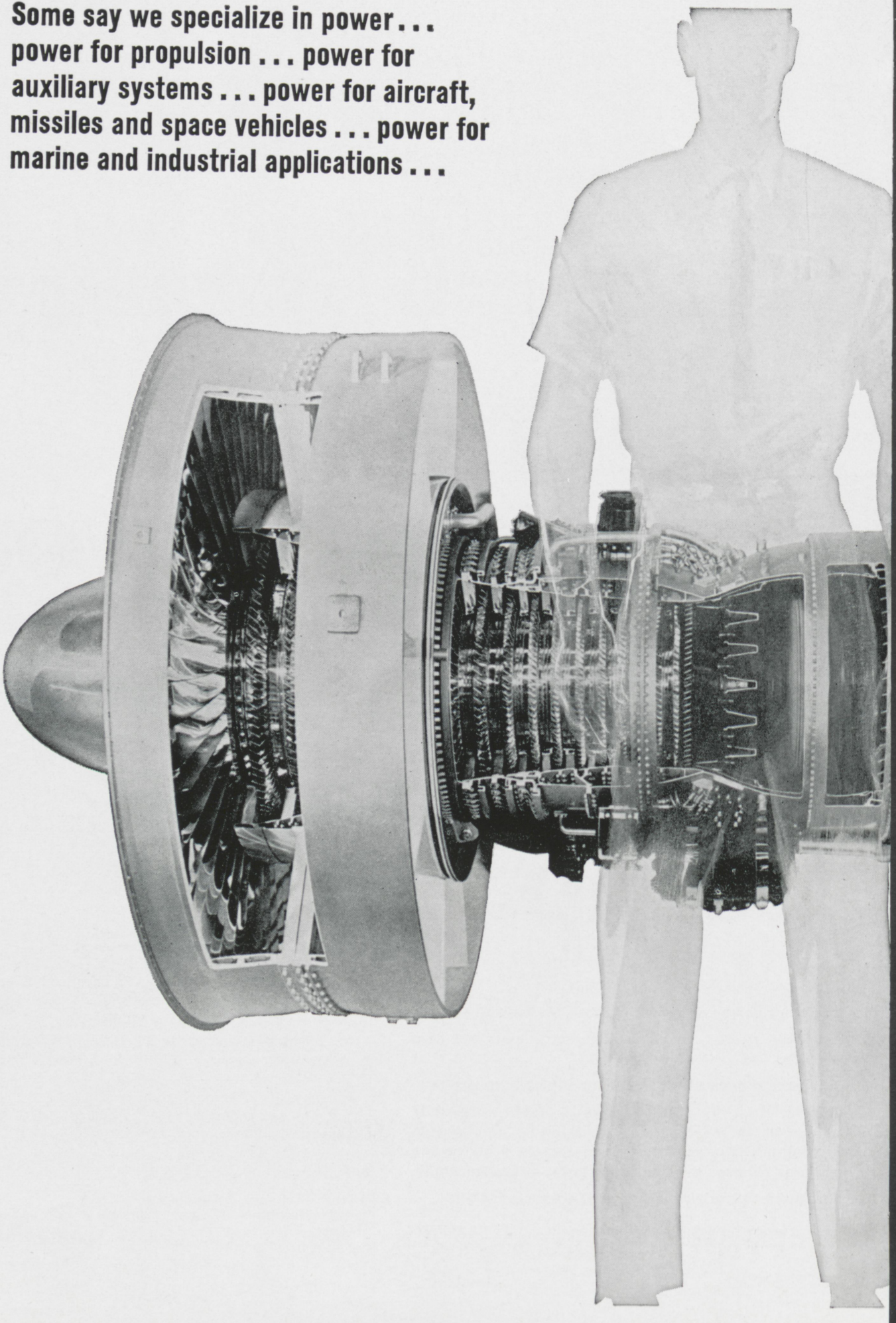
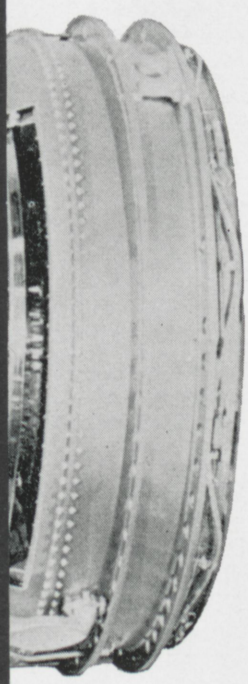


...they're right. And wrong.



It might be said, instead, that we specialize in *people,* for we believe that people are a most important reason for our company's success. We act on that belief.

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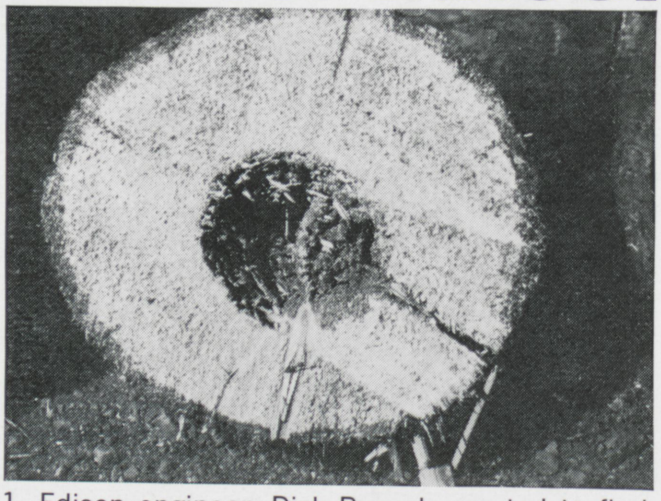
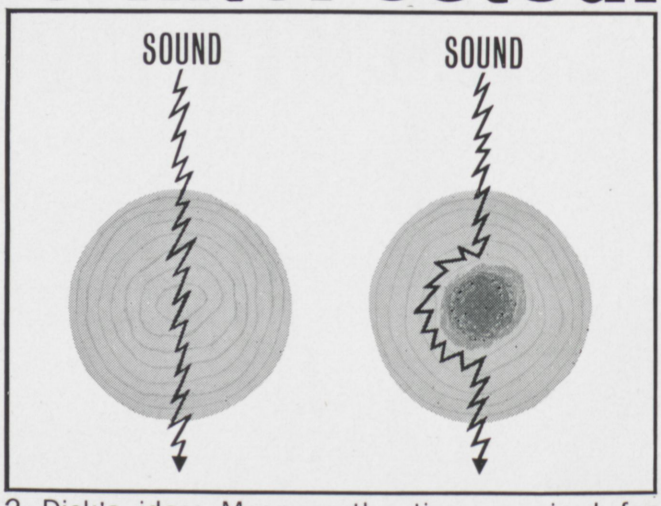
Got an idea?

Detroit Edison's interested.



1. Edison engineer, Dick Popeck, wanted to find a more effective method of determining the amount of pole decay.



2. Dick's idea: Measure the time required for sound to travel through a pole. Sound takes longer to traverse a decayed pole.

3. Transistorized circuitry was designed. And a Sonic Pole Tester was built and tested.

4. Ed Hines, Director of Research, (left) discusses patent coverage with inventor Dick Popeck.

New ideas grow at Detroit Edison. The picture story here shows the progress of one, from its conception through its development, to finalization.

The development of the sonic pole testing device* has benefited the company and the young inventor both economically and professionally. The device helps Detroit Edison serve the electric industry's customers better and more economically.

Uses for the sonic pole tester range from the examination of wooden railroad bridges to the determination of the soundness of standing timber.

Detroit Edison's forward looking management . . . its engineering and research facilities . . . along with its liberal patent policy . . . make it an ideal place for the young man with ideas.

If you are interested in putting your ideas and energies to work—write to George Sold, The Detroit Edison Company, 2000 Second Avenue, Detroit, Michigan 48226, or better yet, visit him when he interviews on the campus.

*U.S. Patent Applied for

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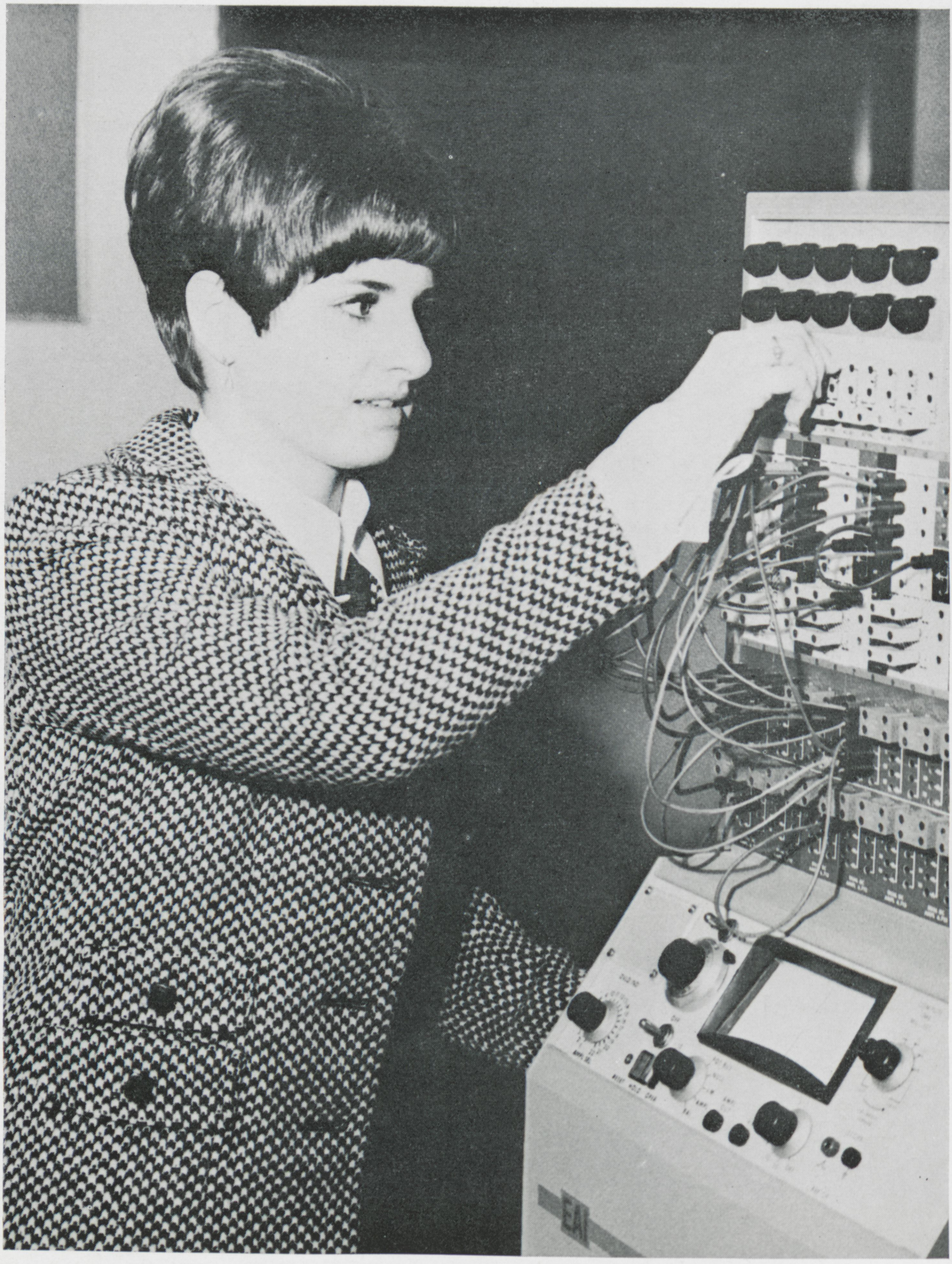
DG'S AT ROSE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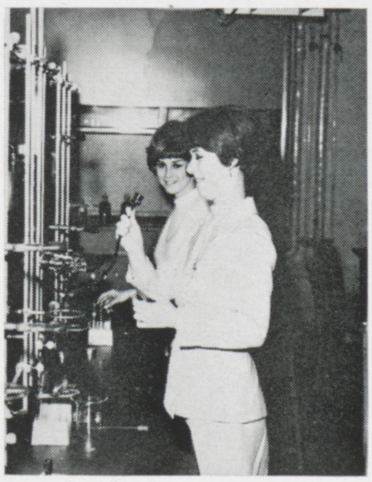

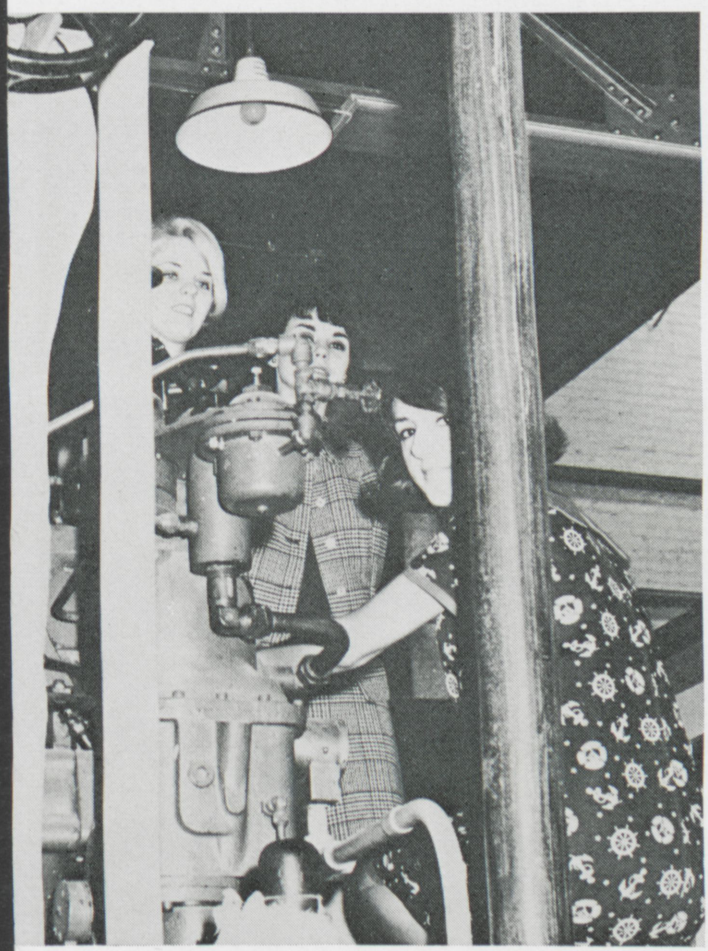

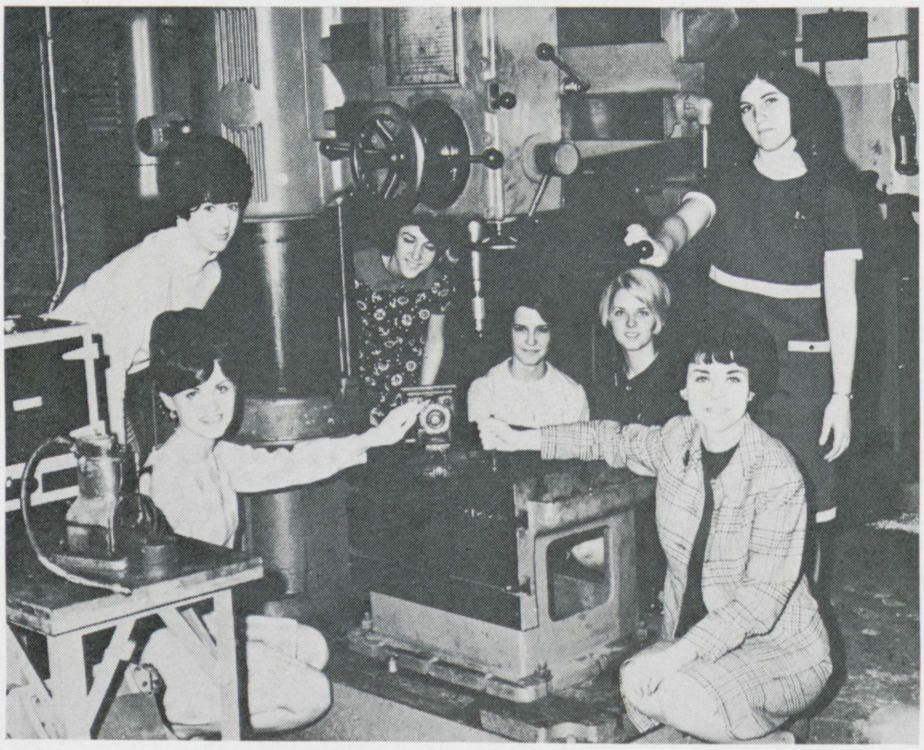

Dear Mr. President

Reprinted from
A.S.C.E. correspondance

The President
The White House
Washington, D. C.
Dear Mr. Johnson:

This Society, which speaks for the civil engineering profession in behalf of its 60,000 civil engineer members, is deeply concerned over the National Security Council's February 15, 1968 Memorandum for Director of Selective Service.

With regard to occupational deferments, we submit that many civil engineers in both public and private practice are engaged in activities essential to the maintenance of the national health, safety and interest. We are concerned that Selective Service Directors may view the suspension of the lists of critical occupations, which included engineering, as an indication that civil engineers are not engaged in essential activities. Thus, local boards may be reluctant to grant the essential occupational deferments which are, in fact, left to their discretion.

The nation's manpower need for civil engineers in both military and civilian positions has never been questioned. Their contributions to the military effort of all branches of the service continue to be essential. Their work at all levels in the civilian realms of urban planning and development, transportation, water supply, waste disposal and the abatement of water and air pollution is clearly essential for the maintenance of the national health, safety and interest.

With regard to graduate students, we submit that the drafting of engineering students after they have received their bachelor's degrees and before they have completed graduate studies will seriously disrupt the educational programs of many of our most essential engineering educational institutions and will interrupt the studies of a great many promising civil engineering students before they have completed the academic program considered necessary for civil engineering careers.

The fact that an engineering student has received a bachelor's degree no longer indicates that he is prepared to undertake engineering work. The important final report of the Goals Committee of the American Society for Engineering Education on the Goals of Engineering Education recommends that ". . . basic engineering education be extended to include at least one year of graduate level education leading to the Master's Degree." Our Society has taken the position "that more and more students will pursue the five-year B.S.-M.S. combination or its equivalent, eventually making it the accepted standard of education in the engineering profession."

In view of the facts and convictions presented above, we submit that this is, indeed, essential for the maintenance of the national health, safety and interest to extend student deferments for post-baccalaureate study in civil engineering. We request that the National Security Council identify civil engineering as an area of graduate study that warrants qualifying for deferment in the national interest and advise the Director of the Selective Service System accordingly.

Respectfully yours,
William H. Wisely
Executive Secretary

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CRYOGENICS

(*Continued from page* 12)

in thickness from 0.032″ to 0.064″ depending on the design pressure. The separator plates supply the primary surface and the fins supply the secondary, extended surface. In normal design practice, the secondary surface varies from 67% to 88% of the total heat transfer surface provided in an exchanger. Each layer is closed at the edges with solid aluminum bars of appropriate shape and size. The elements of one layer are joined by the brazing operation. This stack, including the sidebars, is bonded together by a carefully controlled brazing process to yield an integral rigid structure with a series of fluid flow passages. The corrugated aluminum sheets (fins) which actually form the fluid passages and provide the extended heat exchange surfaces can be varied widely with respect to quality, shape, spacing, size, and type depending upon both thermal and hydraulic design as well as manufacturing economy. Dependent upon the fluids being handled, pressure drops through the exchanger of less than 1 PSI are not unusual.

However, it should be noted that unnecessarily low pressure drop specifications will require low fluid velocities with consequently low heat transfer coefficients and therefore large heat transfer surface area. This in turn means large exchanger cross section with attendant higher cost. On the other hand, pressure drop represents compression power loss which is an important factor in operating costs so an intelligent balance must be achieved. From such considerations as this, it can be seen that generally, there can be no unique solution to a given design problem.

Fins are normally furnished with straight corrugations in "plain" "perforated" or "lanced" configurations. For instance, the lanced fin will offer the best heat transfer coefficients but on the other hand, will require the highest pressure drop of the three types. Conversely, the plain fin offers the lowest heat transfer coefficients and requires the least pressure drop. Fin height can be varied from 0.200″ to0.375″, metal thickness from 0.008″ to 0.025″, and fin density from 6 to 25 fins per inch. The actual selection of the most suitable fins for any particular application is therefore dependent upon the maximum working pressure, plus other variables such as heat exchange rates, allowable pressure drops, fluid properties, and fluid flow rates.

Because of the physical characteristics of the plate-fin exchanger, the fluids handled must be compatible with aluminum and relatively clean. A fouling factor of 0.002 is the maximum allowable in normal application. The upper limit of design pressure is currently in the 750 PSI range, and operating temperatures have been as low as -452°F in helium liquefaction plants.

Design of the blazed aluminum plate-fin exchanger then resolves into selecting a geometry and surface arrangement to give a product UA of the right magnitude to satisfy the equation $Q=UA\triangle T_{ln}$ where Q (total duty) and $\triangle T_{ln}$ (log-mean temperature difference) are known. The fluid flow rates, free stream areas, and fin types as mentioned previously, largely influence the convective heat transfer coefficients (which define U) and in turn determine the required heat transfer surface. Pressure drop considerations, as discussed earlier, also influence exchanger cross section and free stream area showing the complex interdependency of these various quantities.

Each of the several different fluids being handled simultaneously in a given exchanger is accordingly assigned a certain passage geometry also based on a careful optimization of calculated thermal and hydraulic performance. Then the different passage geometries are stacked up similar to a sandwich, alternating symmetrically into one of the several flow patterns available. The most common of these used in process plants is the counter-flow pattern. For simplicity, two fluid flow is shown with A & B designating the fluids in their respective layers. Gas-to-gas and liquid-to-gas boiling or boiling or condensing applications often use a cross-flow pattern which minimizes pressure drop in the exchanger, an important process consideration in the boiling stream.

The quality of all fabrication, assembly, and joining processes must be rigidly controlled by the manufacturer. Extremely close tolerances must be held on all fins and sidebars to insure a perfect fit. Each part is carefully checked during all phases of the exchanger assembly process. Following the brazing and cleaning of the exchanger core, the collectors and nozzles are then welded onto the unit. Then another assurance of reliability is applied namely a pneumatic test at 125% of the design pressure to detect any interpass or external leakage. following this, the exchanger is subjected to a hydrostatic pressure test at 150% of the design pressure which proves the structural integrity of the unit. It should also be noted here that not only do brazed aluminum heat exchangers comply with the ASME code but also that each exchanger is registered with The National Board of Pressure Vessel Inspectors.

Plate-fin exchangers can be supplied as single units or as manifolded assemblies which consist of multiple units connected together in parallel or in series. A typical exchanger is 30″ square in cross section by 124″ in length and weighs over 3000 pounds. This unit is arranged for three fluid flow with flanged connections. Also available are straight nozzles for welding directly into the piping system. Assemblies are installed into a field erected coldbox structure. As many of you know, the enclosure housing cryogenic vessels and equipment in a plant is termed a coldbox. A differ

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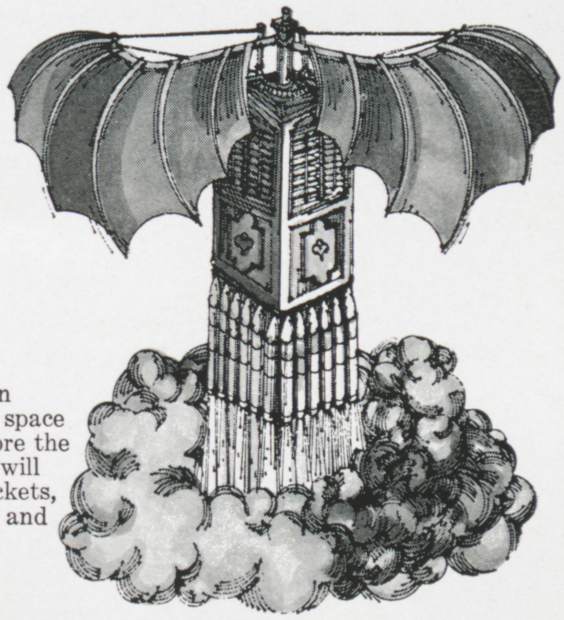
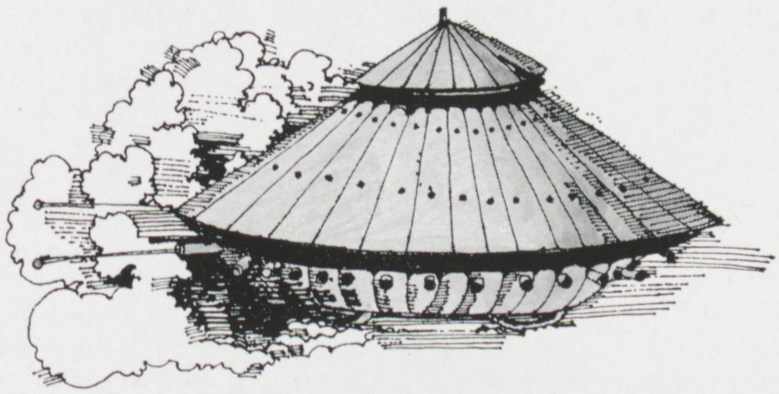
They had the right idea.

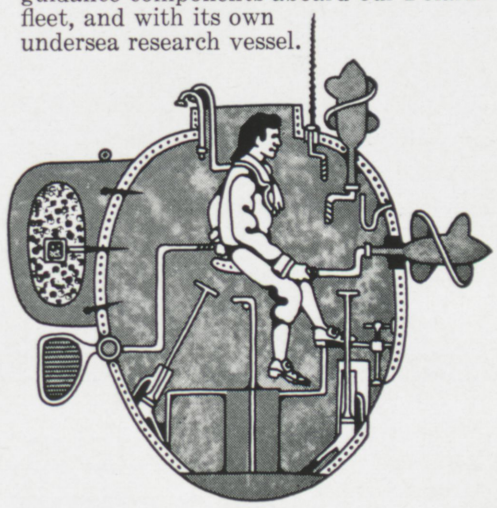


17th-Century Space Flight. Cyrano de Bergerac's science fiction fantasy about a box propelled into space by rockets came close to fact. Before the end of this decade, Apollo and LM will indeed be thrust to the moon by rockets, guided by AC Electronics guidance and navigation systems.

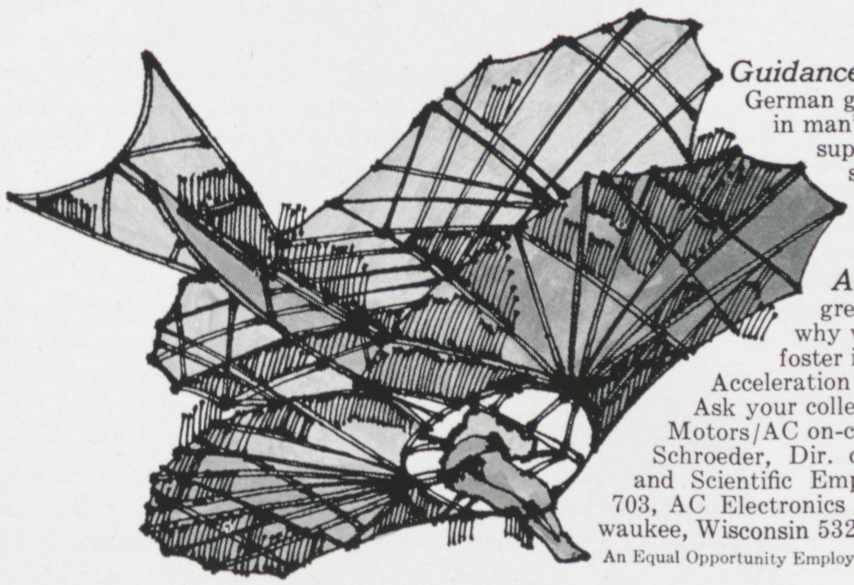
Navigation, Second-Century B.C. Hipparchus's second-century astrolabe was used for celestial navigation until the mid-18th century. Today, ships still depend on stars for guidance . . . through such sophisticated help as AC Electronics' computerized Ships' Self-Contained Navigation System.

Turtle vs. Eagle. In 1776, the American "Turtle" attacked the British flagship "Eagle" in the first wartime submarine action in history. Today, AC Electronics contributes to both the defensive and the scientific role of the submarine...with guidance components aboard our Polaris fleet, and with its own undersea research vessel.





Leonardo's Tank. Leonardo da Vinci was one of the first to envision the use of tanks in warfare. Contributing to the advanced state-of-the-art in tanks, today, is AC Electronics, with a computerized fire-control system for military land vehicles.



Guidance Gets a Lift. Otto Lilienthal, 19th-century German glider, proved that the future of flight lay in man's ability to guide the aircraft. Tomorrow's superjets will be guided inertially . . . by systems like AC Electronics' Carousel IV, chosen for the Boeing 747.

At AC Electronics we believe every great achievement starts with an idea. That's why we put a premium on creativity, and foster it through such innovations as our Career Acceleration Program which lets you learn as you work. Ask your college placement officer about a General Motors/AC on-campus interview. Or write: Mr. R. W. Schroeder, Dir. of Professional and Scientific Employment, Box 703, AC Electronics Division, Milwaukee, Wisconsin 53201.

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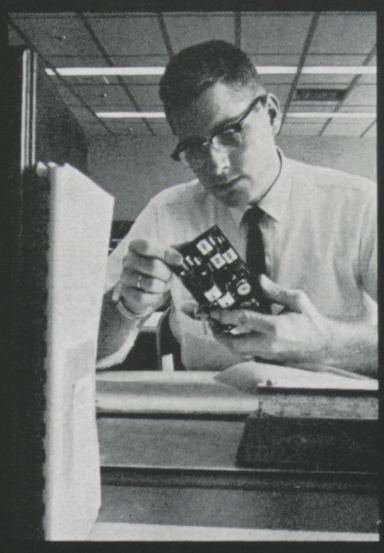

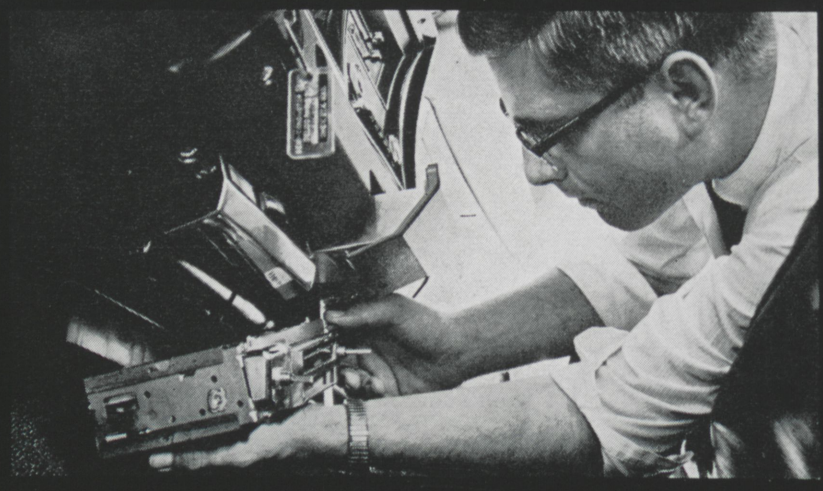

Mondays never look the same to Bob Byse

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CRYOGENICS

(*Continued from page* 30)

ent type of exchanger assembly configuration is commonly used in air separation plants. This is called an inverted "U" arrangement and minimizes field erection time and cost, since a major portion of the interconnecting piping has been done before the exchanger assemblies are shipped. Each leg of the "U" stream consists of nine units so the comparative sizes of coldboxes housing forty and thirty-six units respectively may be seen. The overall size of these assemblies is generally limited by the capacity of suitable transportation facilities and available field erection equipment. Still, the compact design of aluminum plate-fin heat exchangers makes it possible to furnish over 400,000 square feet of heat transfer surface in one manifolded assembly.

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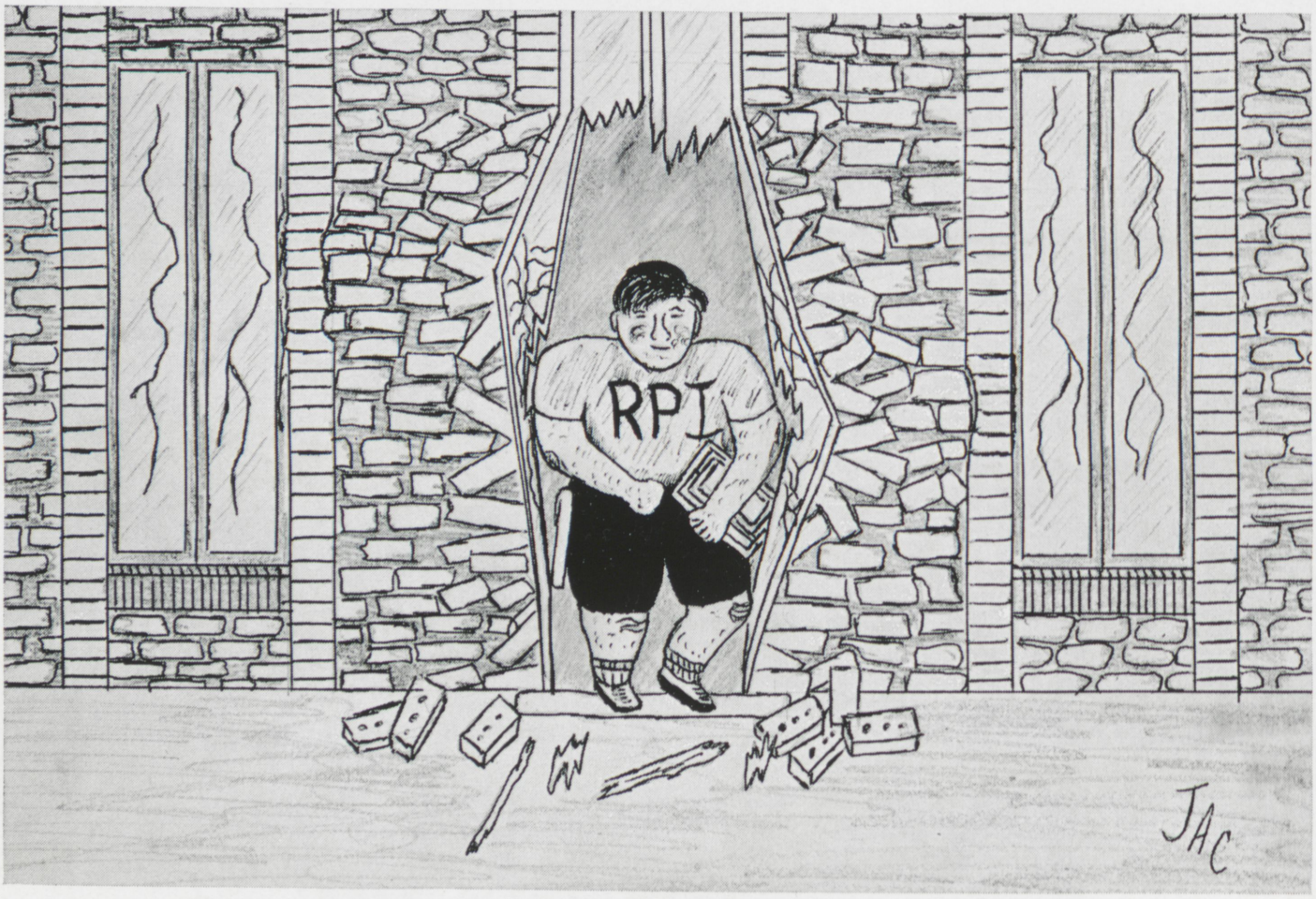

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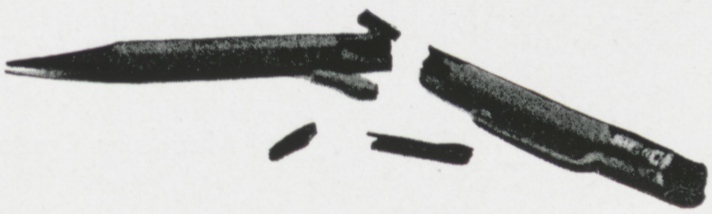


R.O.T.C.

(*Continued from page* 18)

perhaps not as serious as some fear. One common misconception is that the school must have R.O.T.C. or a physical education program to retain accredation. Neither is required. Moreover, the school receives no direct monetary benefit from R.O.T.C. Only scholarship and advanced students benefit monetarily from the program. This money would still remain to help these students finance their education if a voluntary system were adopted.

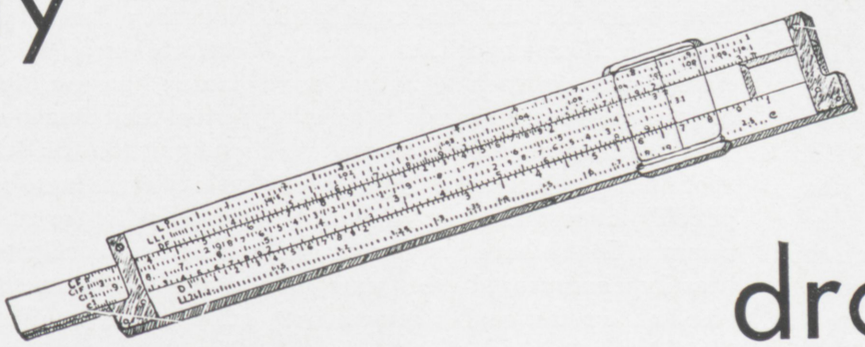
Undeniably, due to the small size of the school, a voluntary system might lead to a situation where too few students entered the program to meet the minimum annual graduation of 25 officers necessary for continuation of the program. The average enrollment at most schools with voluntary R.O.T.C. is 10% initially. Assuming normal dropout rates this could leave the R.O.T.C. program short. However, due to the conseraative nature of the Rose student body, it is likely that a larger percentage would apply. And the large enrollment of Indiana State provides another source of potential officers to meet the minimum requirement.

Of course, there would definitely be a smaller number of Basic students on which Advanced students polish their leadership techniques. But the departure of these unwilling guinea pigs would improve the morale of the program as a whole, increasing its effectiveness and brightening its image at Rose.

In a final analysis, it must be determined whether it is worthwhile, or even just, to require all students to submit to a program only a minority benefit from. The school can justifiably require all students take humanities or calculus, because these courses are a definite requirement in achieving the educational goals of *all* the students. R.O.T.C. is not an educational goal of the Institute; Rose is not a military academy. The idea of offering the program in the interest of national security is noble, but this is a non-essential sideline and should be treated as such.

If a voluntary program did finall result in the collapse of the program due to lack of interest, it would b unfortunate, but Rose would no suffer severely, financially or edu cationally. Certainly some member of the faculty and administratio feel that it is unfortunate that stu dents be *required* to take R.O.T.C but since no serious opposition ha been raised, the program is contin ued on the rationale that as long a no one feels wronged, why bother t change? And on the other hand Rose students have not been anxiou to voice any opinions publicly con trary to the established policy. The know such behavior just isn't con sistent with the conservative ident ty some powerful, established facult members would like to see main tained at Rose. Such an attitude unhealthy, not being in the be interests of the students or Rose atmosphere in general. Both studen and faculty should attempt to e tablish better communication to a rive at a greater realization of th atmosphere suggested in the Ros Philosophy.

sly



droolings

Stolen by Gary Kelm, Soph, M.E.

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

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

* * *

An impatient old lady making a trip by bus became irritated at the many stops. "Such a slow bus," she snapped. "I believe we stop at every telephone pole."

"Why not, lady?' replied the driver. "This is a Greyhound."

* * *

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

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

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

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

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

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

* * *

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

* * *

A lunatic was leaning out the asylum window watching the gardner.

"What are you doing there?' he asked.

"I'm putting manure on the strawberries."

"I usually put sugar on mine, but of course, I'm crazy!"

* * *

Jim was a devoted Chemical Engineering student whose life revolved around test tubes and bunsen burners. This was true to the extent that he was slightly dense in everyday affairs. Thus, when he was trying to cash a check at the bank one day, he became quite perplexed when asked if he could identify himself. He momentarily excused himself and went to the men's room and looked in the mirror. Returning with an enlightened look upon his face he replied, "It's me alright."

* * *

Then there's the fellow who bred his parakeet to a tiger. He doesn't know what he's got; but when it talks, he listens-

* * *

Two men and a young lady on a pullman going to New York decided to get acquainted. One of the men said, "My name is Peter, but I'm not a saint."

The other man said, "My name is Paul, but I'm not an apostle."

The girl muttered, "My name is Mary, and I don't know what to say."

* * *

Whoever said, "Live and Learn" was a dreamer. At this institution, we have time to do one or the other, but not both.

* * *

At a county fair a strong man squeezed a lemon dry and then offered a prize to anyone who could get another drop from it. Many tried, but the lemon appeared dry. Finally a little man said he could squeeze some more juice from the lemon. Amid laughter the Hercules gave the lemon to the little man who squeezed a jet of juice.

"Extraordinary!" exclaimed the muscle man in admiration.

"Not at all," the little man replied, shrugging his shoulders."You see, I work for the Bureau of Internal Revenue."

* * *

E. E. Prof. (to student who is half an hour late): "You should have been here at seven-fifty. '

Student. "Why, what happened?"

* * *

Two drunks wandered into a zoo and as they staggered past a lion's cage, the king of beasts let out a terrific roar.

"C'mon, let's get out of here," said the first drunk.

"You go ahead if you want to," replied his more inebriated cohort. "I'm gonna stay for the movie."

ROSE

(*Continued from page* 14)

without resort to educational gimmicks.

Second, Rose has a real concern for the student as an individual. Consequently, we are an educational community for a limited number of well-qualified students. We are small by choice. Further, what we offer the student is a total experience that goes beyond the formal curriculum. Each student receives the individual attention necessary to his healthy educational development and as much personal guidance as he needs or desires. Each student has the opportunity and is encouraged to participate in a broad program of extracurricular activities.

Third, Rose is proud that it has been and is a distinctively undergraduate institution. We believe that there is a place in our educational society for a science and engineering school that dedicates its program to the undergraduate student; hence graduate study is encouraged only in those areas where a modest graduate program will enhance the effectiveness of the undergraduate

Fourth, Rose emphasizes teaching. Every effort is made to recruit and to encouragre professors who believe that teaching is their primary responsibility. There is no "publish or perish" atmosphere on the Rose campus. To be sure, professors are heartily encouraged to maintain their professional competence through continuing education, consulting, research, writing, and participation in other professional activities. But the qualities most encouraged in our professors—enthusiasm, concern, dedication, a willingness to innovate and pioneer—are qualities that identify the good teacher.

Finally, Rose strives to maintain a healthy balance between tradition and innovation. Colleges and universities must change with the times, and Rose is no exception; it is not the same kind of school it was when it was founded, nor indeed is it the same as it was ten or even five years ago. The basic purpose has, however, remained unchanged. In 1874 Chauncey Rose conceived his new institute as a school of industrial science, "an institution for the intellectual and practical education of young men." So it remains today: an undergraduate institution, concerned with the student as an individual, and dedicated to excellence in the performance and the character of its students and teachers alike.

Rose Prepares Students for Careers in Engineering and Science

- —by developing technical competence
- —by inspiring clear, critical thinking
- —by stimulating humanitarian concern
- —by maintaining significant standards
- —by demonstrating concern for the individual
- —by emphasizing good teaching
- —by balancing tradition and innovation

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(Robert Frost)

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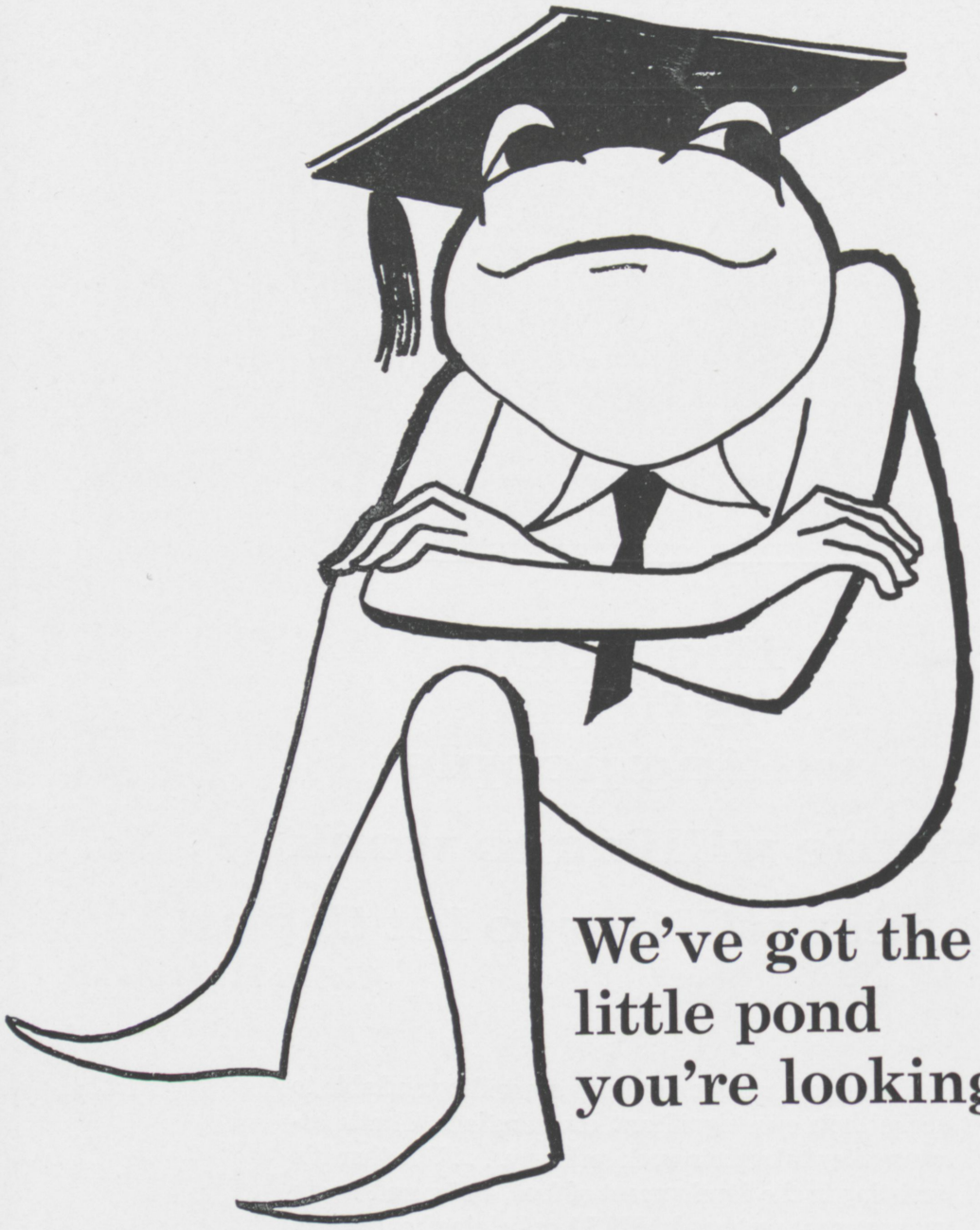

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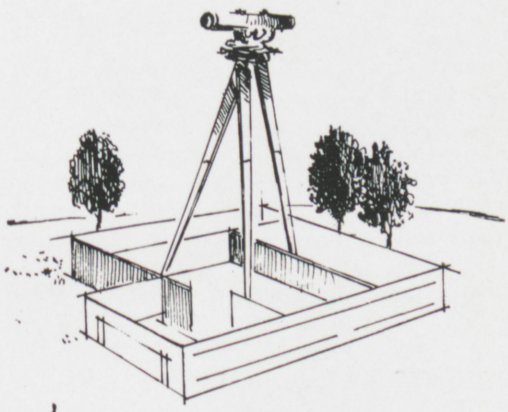

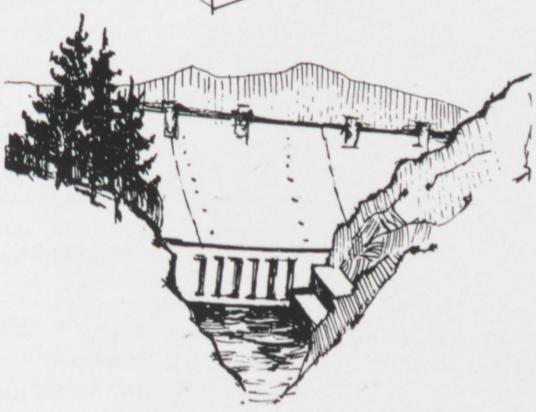

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