SPARTAN ENGINEER

JANUARY, 1968

25¢

SPECIAL ISSUE ON
FEMALE VIEW OF
ENGINEERS
Pages 14 & 19

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Put power stations on the moon with the company that is developing atomic power plants to operate in remote areas with no external fuel. On the moon — or on other stations in deep space — these units will provide the power to sustain life over long periods of time. There are few precedents to lean on in space project work. Which indicates the type of individuals Westinghouse is looking for.

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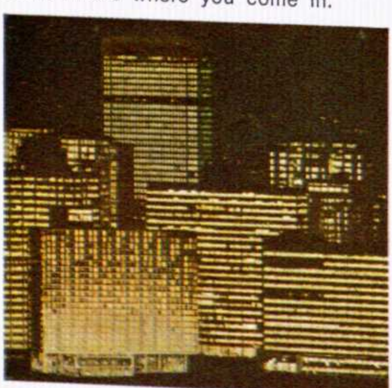

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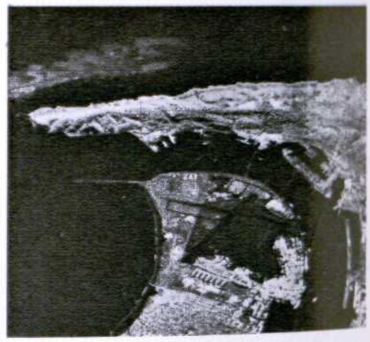

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SPARTAN engineer

VOLUME 21 NUMBER 2 JANUARY, 1968

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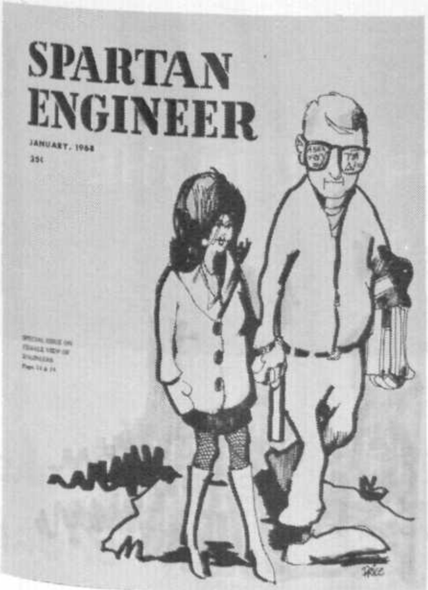

The engineer is thought of by most people to have trouble when it comes to the opposite sex. The feature articles on pages 14 & 19 show how this is definitely true. Cover by Tom Price.

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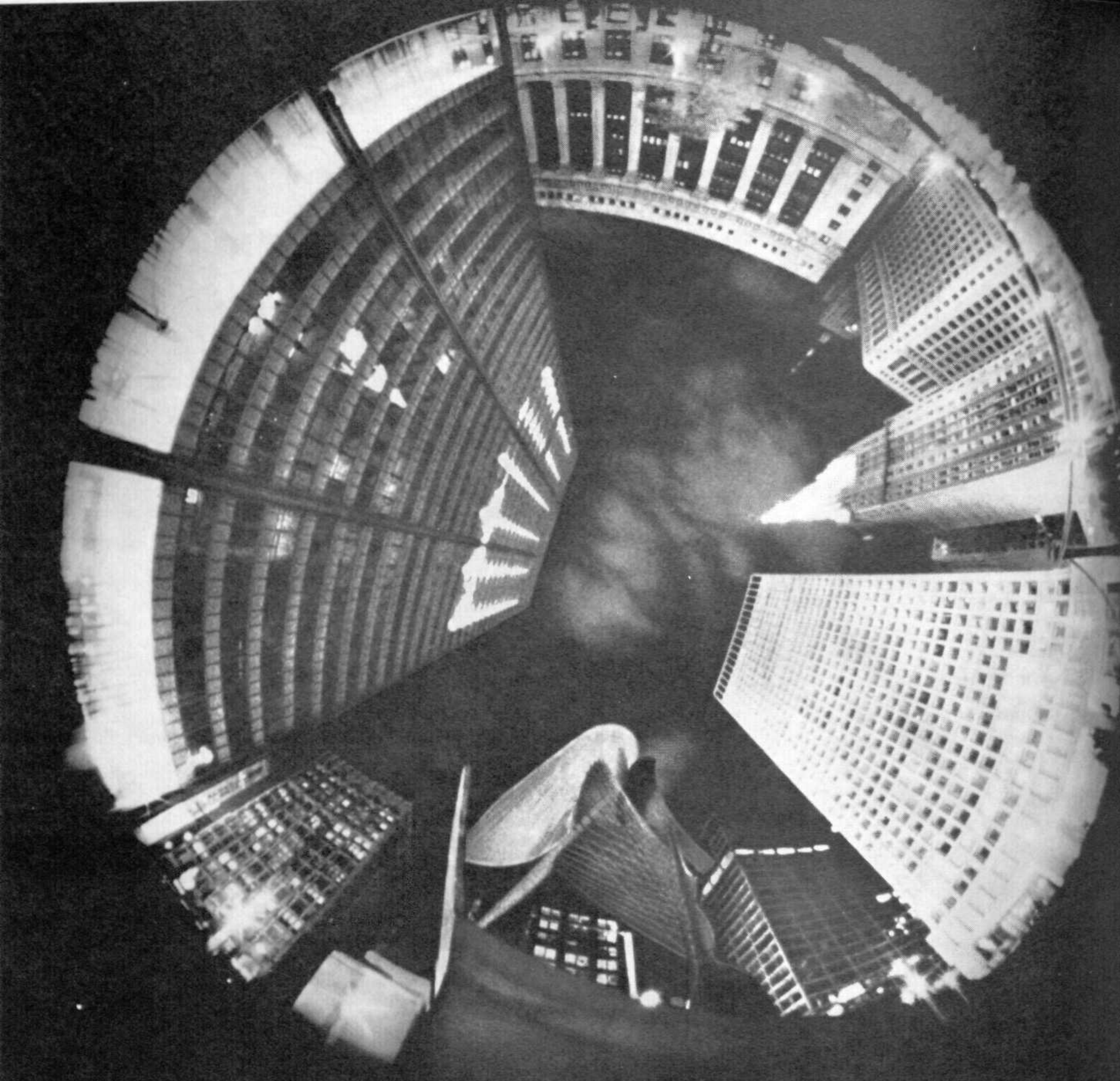

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Editorial

WINGTIPS FOREVER

It seems that our policy of belittling the "engineer looking" engineer has paid off. Every term I see less slide rules and more grubs. I don't know if there is any relationship between this change and the **Spartan Engineer** but I hope so.

The thing I am sad about, however, is that after three years of consistently winning the title of "Grubbiest Electrical Engineer" it is getting close to the time when I must sell out for good and clean up.

Being a senior, I have started the normal senior chore of job interviewing. The days have come when I have put aside my boots, jeans, and turtleneck, and have walked into class with my suit on to be greeted by cries of "Hey, Romans must have a job interview today!"

I am not looking forward to the day when I will put down my campus wear for the last time and begin the 9-to-5 white shirt whirl, but I know it must happen if I want to work. It is scary to think of the day when I must go out and start buying white shirts and ties to make myself look like the business "Image of an Engineer".

I enjoyed dressing grubby in college, and it was worth it just to see the "He's in my class?" look of professors the first day of classes. There are still a few months left, however, and I plan to enjoy every day that there is no job interview. At Christmas I went out and bought my last pair of cowboy boots. But as I was leaving the salesman said, "How about some wingtips?" It was sad. I almost bought them.

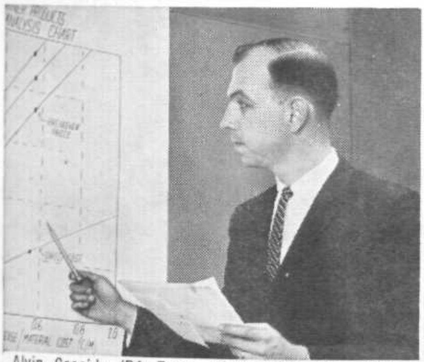
Gary Romans

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.



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

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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.

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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.

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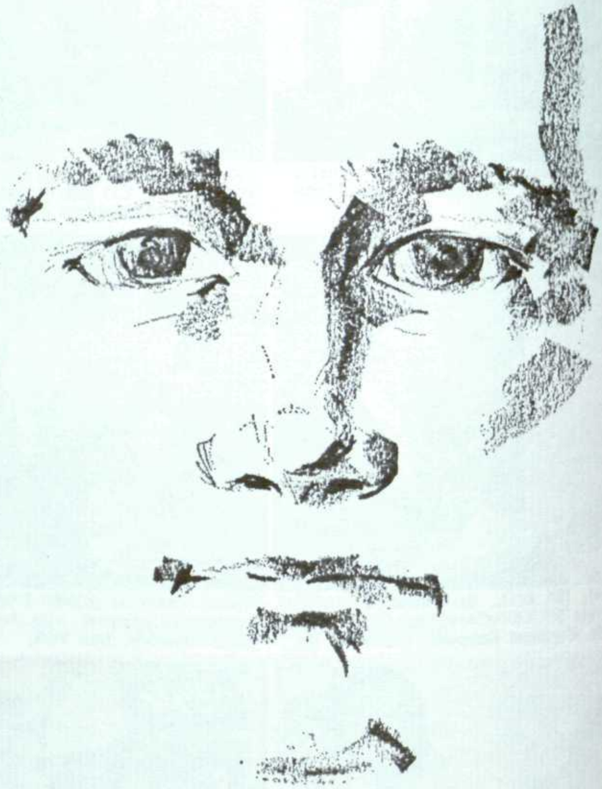

Turn page

NEW DIRECTIONS IN LABORATORY INSTRUCTION for engineering students

This is a report on laboratory instruction for undergraduate engineering students. It represents the findings and recommendations of an ad hoc group,[1] organized by the Commission on Engineering Education, to study and reveal:

1. The need for new developments and new thinking in laboratory instruction.
2. Some of the efforts by schools to improve their effectiveness in laboratory instruction.
3. Some techniques for injecting new life and vigor into the engineering laboratory.

Report of the Commission on Engineering Education

TREMENDOUS CHANGES have taken place in engineering education since 1945. An exploding technology, a dissatisfaction with the high degree of departmentalization of knowledge, and a desire to experiment with new educational methods to meet expanding enrollments have all been contributing factors.

At the core of this change, however, has been an increasing emphasis on the engineering sciences and a new concern for system, as well as component, design. Courses in mathematics that were once reserved for graduate study have become a required part of the undergraduate curriculum. More abstract and theoretical concepts, such as the modeling and dynamic representation of systems. have become necessary elements in the educational program.

These changes have undoubtedly made young engineers better able to meet the challenges of advancing technology. Nevertheless, there is an important gap in their training. Generally speaking, little has been done during these years of change to prepare students for gathering factual knowledge and verifying theories, hypotheses, or judgments through experimentation—whether in the laboratory, on a computer, or with an existing system. Despite the progress made in theoretical concepts, experimentation remains the cornerstone of the scientific and engineering methods and a fundamental path to future technological advances.

Developing an experimental capability should be the fundamental concern of the engineering instructional laboratory. It is this area of engineering education which is the focus of this critical study and report.

[1]Chairman of the ad hoc group was Richard J. Grosh, Dean of Engineering, Purdue University. Members were: William B. Cottingham, Professor of Mechanical Engineering, Purdue University; Edward W. Ernst, Associate Professor of Electrical Engineering, University of Illinois; and Bruce Lusignan, Stanford University.

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The Visible Problem

The problem which motivated this study will not be surprising to many. It states in essence: the engineering laboratory is in serious trouble. The symptoms are quite visible:

1. The amount of laboratory instruction is being drastically reduced in many institutions.
2. Professors are abandoning the laboratory to graduate teaching assistants.
3. Many students seem to develop an apathy toward the laboratory, and some indicate that report writing is the most useful part of the laboratory experience.
4. In many cases, the instructional laboratory, both in facilities and tasks, bears little resemblance to the real world.
5. The resources, in manpower and funds, applied to instructional laboratories, are usually inadequate for maintaining a reasonable program and are completely inadequate for carrying out new developments and improvements.
6. Those who evaluate the work of faculty members give little if any recognition to their efforts in instructional laboratories.

A more compelling reason for this study was to find possible cures as well as to understand the sickness. A goal was to seek out and identify several ideas for improving not only the effectiveness of laboratory instruction, but also its efficiency. In many ways, the efficiency of a laboratory, when measured in man-hours and resources, is probably the key to a general renaissance in laboratory instruction over the next decade.

Functions of Laboratories

Laboratory instruction is of necessity highly diversified. It is essential to understand this diversity in order to get at the fundamental nature of the laboratory problem. Therefore, the study first attempts to define the role of laboratory instruction, and to describe it as it is presently. From this, some of the immediate needs and some of the specific programs of action can be identified and illuminated.

The basic functions of experimental work performed by engineers can be described as:

1. Familiarization
2. Model identification
3. Validation of assumptions
4. Prediction of the performance of complex systems
5. Testing for compliance with specifications
6. An exploration for new fundamental information.

The role of the undergraduate instructional laboratories is to teach student engineers to perform these six functions. Hence, the *primary goal* of undergraduate laboratories is to inculcate into the student the theory and practice of experimentation. This includes instrumentation and measurement theory. The undergraduate instructional laboratory should be designed to develop the engineering student into an experimenter. It should provide him with the basic tools for experimentation, just as the engineering sciences provide him with the basic tools for analysis. The experimental approach is increasingly important, because engineers in practice must continully find, accept, and apply new ideas, methods, and materials. It is essential if the engineer is to maintain a dynamic, inquisitive, and experimental attitude toward his profession.

Each of the six functions listed needs some further clarification, although some overlap appears unavoidable.

Familiarization is that type of laboratory work most commonly found in university activities. It is directed at illustrating principles and behavior and fixing these principles and behavior in the student's mind. These concepts may or may not have already been treated in the classroom or in reading assignments. This form of laboratory might also be used to introduce the student to the real world—for example, the demonstration of a basic concept fundamental to a familiar system.

Model identification is applied equally to devices and systems. If one cannot quantitatively identify materials, components, or systems by analytic means, which is usually the most economic method, experimentation must be employed. Clearly, an important aspect of model identification is the determination of the range of validity of the model. Many engineering systems being synthesized are far ahead of the state of the art in the technology of the system. In such cases, quantitative information may be obtained only by experimental means.

Simplifying assumptions must be carried out in many engineering endeavors to make the analysis of the device or system tractable. Ultimately, these assumptions must be shown to be tenable. Skillfully constructed experiments to validate the assumptions are needed, therefore, to assure the designer that he is within the realm of reality.

Prediction of performance by means of simulations using computers, models, or mock-ups must often be carried out because a system is too large, too complex, or too non-linear to admit performance calculations using analytic methods. While simulation techniques are quasi-experimental methods, they do involve work on equipment, using other than pencil and paper, and generally are of an experimental nature.

Testing for compliance of completed systems against contractual, proprietary, and industrial or government specifications must be performed in an experimental atmosphere, often on the manufacturer's or customer's premises. Such acceptance tests usually have legal overtones. Reliability and quality control, involving as they do probabilistic phenomena, can be effected only as a result of experimental studies in many cases. Finally, failure trends may be established in certain areas only by experimental procedures.

The *fundamental information* for which an experimental search is appropriate is of a wide variety. It can include physical, thermophysical, or electrical properties of materials as well as other coefficients or transfer functions necessary to complete an analytical model of a problem. Or it can be concerned with the need to relate defined coefficients with more fundamental parameters to generate an analytical model.

Types of Laboratories

At first glance, it would appear that there are as many types of laboratories and laboratory programs as there are engineering schools. The characteristics of any one laboratory are usually strongly tied to the individual responsible for its organization and operation as well as to the boundary conditions under which he must work. This diversity and uniqueness is probably both necessary and good. It is clear that no one type laboratory could begin to meet the markedly variable demands of engineering education. However, an attempt to categorize existing laboratories in a quite general way would probably suggest the following:

1. The *set laboratory* with specified experiments using detailed instructions and equipment. The experiments are repeated each semester with minor change or in some cases, major change.
2. The *take-home laboratory* in which a significant part of the work is done by the student away from school, and the results of his work reported to the instructor. This may include some use of laboratory facilities either on a scheduled or non-scheduled basis.
3. The *problem laboratory* in which a student is given a specific, well-described task to undertake.
4. The *project laboratory* in which the project to be undertaken may be somewhat general in description and may be broad of scope.

Each of the different types of laboratories is used for instruction in all of the different aspects of experimental studies. Some types, however, are more commonly directed at a specific form of laboratory use. For example, the *set laboratory* is often devoted to demonstration and testing, whereas the *problem* and *project laboratories* are often involved with verification and confirmation. However, the actual appearance any one laboratory takes is dictated by many factors: school, instructor, facilities, capital equipment available, etc.

Observations of Laboratories

The types of activities carried on in a representative group of laboratories visited by the study group cover a wide spectrum. However, two broad classes serve as convenient categories:

1. Demonstration experiments
2. Student participation experiments

The breadth of laboratory activities carried out at the many universities visited makes it difficult to describe these in depth. However, some feeling for the more frequently found characteristics of these programs can be achieved by reviewing a few of the most obvious modes of operation.

Although most laboratories employ student participation experiments, many place a strong emphasis on demonstration. Demonstration experiments encompass a wide range of specific activities. Included are live classroom demonstrations carried out by the instructor; group demonstrations guided and led by the instructor; movies, TV tapes, and other forms of canned demonstrations; also, student-operated demonstrations which are more properly referred to as self-demonstrations. In the other category are student participation projects which can be more readily recognized as fulfilling the purposes which have been outlined earlier for laboratory experiments. In these experimental investigations, the goal of developing the student's capability as an experimenter is clearly paramount.

Similarly, in the administration and operation of instructional laboratories, a variety of methods and techniques has been found. The program of laboratory instruction has a relationship to the entire curriculum which may be either a separate function or may be integrated and serve a service role for the remainder of the curriculum. The faculty that participate in a laboratory program may be full-time senior faculty, part-time graduate assistants, or some mixture of the two. Methods of scheduling laboratory classes, size of the laboratory squad, and policies affecting the availability of laboratory facilities for both faculty and students are some of the factors which vary widely from school to school.

One of the most interesting highlights on the general state of equipment in undergraduate laboratories is provided by an unpublished, confidential survey of a large number of institutions of higher education completed recently. First, the combined 1959-60 budgets for all permanent or capital equipment used in teaching undergraduates (including cost of expendable supplies, building facilities, and library needs) were estimated at 60% of the funds desired for 1962-63. These funds would be for scientific apparatus, instruments, and construction parts for demonstration and laboratory instruction. They exclude funds for furniture, fixtures, refurbishing laboratories, books, and machine tools. Second, the combined 1959-60 inventory value of all permanent or capital equipment, excluding expendable supplies, building facilities, and shop facilities, was estimated at 160% of funds desired for 1962-63, and of which only 35% could be furnished. These figures give some indication of what has been spent on laboratories in the past, what is presently being spent, and what would be desirable for the immediate future.

From these figures it appears that, in general, most schools feel a need to completely re-equip their present laboratories. However, in view of the recent funds made available for this task by various foundations and acts of Congress, it appears more likely that the best that can be hoped for is just the amortization of present facilities. Nevertheless, laboratory equipment from various agencies is having a beneficial effect. This emphasizes the essential role of a greatly increased efficiency of laboratory instruction so that the resources presently available can be used for developing more useful laboratories in the future. However, this task will be difficult until the proper role of the laboratory in the educational process is set down and new methods and ideas are developed to make laboratories economical and continuously contemporary. A desirable trend is the present-day emphasis on obtaining modern instrumentation of good quality for laboratories being re-equipped. It is expected that the instrumentation will have a wide range of usefulness and will apply to a spectrum of problems. Thus, the dangers of obsolescence of the laboratory will be less than they have been in the past.

Areas for Improvement

In the course of this survey, it has become clear that several distinct problems exist in laboratory development. They detract from the efficiency and the effectiveness of laboratory instruction, and tend to cause the laboratory approach to be de-emphasized in curriculum planning. Three specific problems are:

1. The communication of ideas and methodology
2. Laboratory instruction aids
3. Laboratory faculty

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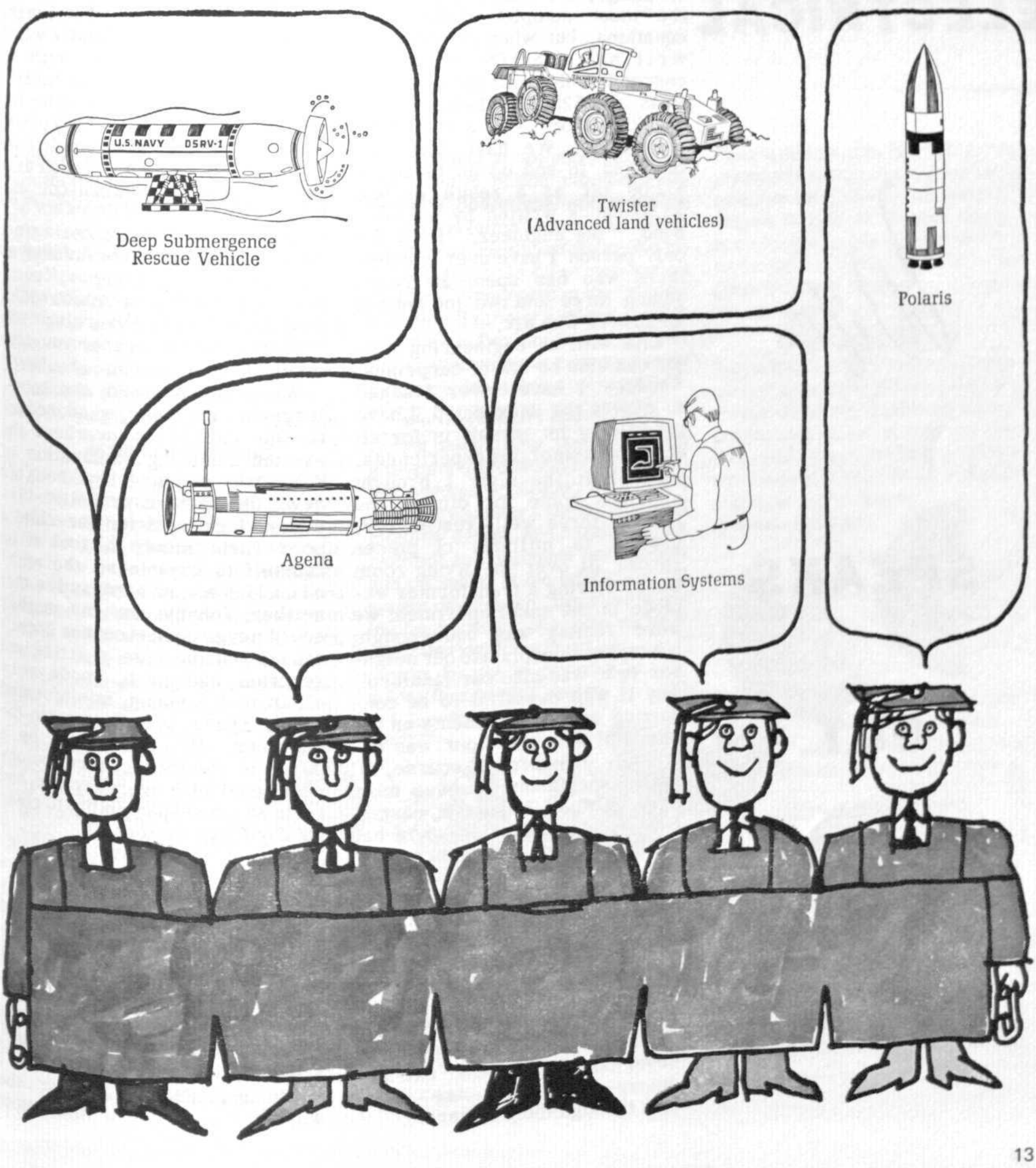
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AN ELECTRICAL *Wife* SPEAKS OUT

Married to an engineer? That doesn't sound too unusual. There is, however, a lot more behind that eight letter word than one might imagine. At least a lot more than I had imagined as a bride. I was soon going to learn the true, everyday meaning of what one dictionary describes as being "one who contrives, designs, and manages skillfully." I found the word meant a lot, lot more in my small collection of definitions.

Yes, my husband is a number of things. He can easily solve the most complex differential equations, but when it comes to writing a $10.00 check and correctly subtracting that amount from the $25.00 balance in our check register -- he's at a complete loss. We have somehow managed to end up as much as $12.00 off as a result of one $3.00 check written by my husband, "the engineer." He's the only person I have ever encountered who has spent 20 years adding three and two and getting an answer like six.

Life with an engineering major can also be full of surprises. Because I have never learned to expect the unexpected, I have unwittingly let myself in for all sorts of memorable experiences. How about the night I brought a friend home for dinner and found three well-rusted T.V. chassis in millions of pieces spread all over the living room floor? Having a transformer explode in the small apartment we were renting was bad enough; but trying to explain to our neighbor (who was also our landlord!) why it was essential to be conducting such experiments on his beautiful new tile floor was extremely awkward. Of course, all such experimentation was most assuredly an important part of HIS general education, and I had to learn to keep an open mind and not frown on HIS ambition.

Married life has taught me that it is necessary to collect large quantities of valuable resistors, wiring, tubes, capacitors, etc. from various friends' basements, rummage sales, junk yards and Salvation Army stores. The donators of such gems, of course, never know just what extraordinary value they are letting slip through their fingers!

Have you ever hurried home, bursting with excitement, to tell your husband some wonderful news, only to have him reply joyously to your announcement of a $5,000 inheritance, "Look, Honey -- I solved the problem! How about that! Uh -- Did you say something?"

And, oh, what good times are in store spending an entire Sunday afternoon leafing through old copies of ELECTRONICS ILLUSTRATED -- looking for a perfect way to spend next Sunday afternoon!

Little did I know, when I married, that the whole family would consider my husband such an electrical genius. He is invariably called upon to rescue his helpless inlaws from every perilous challenge from malicious electrical systems -- such as a blown fuse or a worn-out extension cord.

There inevitably came a time when I committed the unforgiveable sin of labeling a "complex receiver", a common radio. And I've heard the refrain of, "That's not a switch, you layman! It's a circuit breaker!"

When my husband, the knowledgeable engineer, wandered into the kitchen to overhear the excited babbling explanation of our little neighbor boy about his new rubber-band-propelled airplane, I cringed for the child's poor little mind. He took it on himself to explain all the technicalities of aeronautics that neither Johnny nor his mother could never care about nor understand. But the laws of action and reaction had to be made very clear to his young, misinformed mind. There is no fantasy to the engineer. He refuses to be a party to the inexact terminology connected with everyday life, and feels it his responsibility to clear up any foggy notions.

When I can separate my husband from my engineer from time to time, we experience a very happy, eventful, challenging, and almost normal marriage. I sometimes feel that it's like trying to take Dr. Jekyll from Mr. Hyde, but I know that my husband and my engineer are essential parts of one another. I love my HUSBAND. I wouldn't trade my ENGINEER for the world.

— ANONYMOUS

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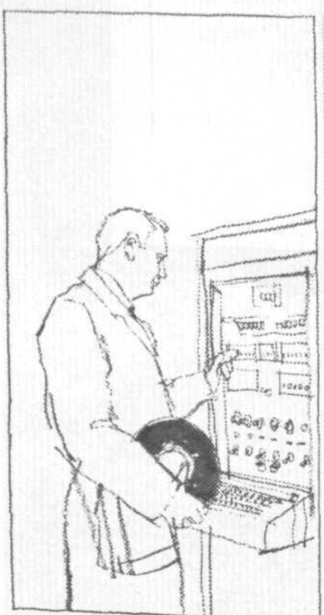

. . . where imagination is the essential qualification

AN ENGINEERING ENGAGEMENT

"An engineer, huh? Yeah, I've dated two or three of'em. Heavy, heavy, heavy! Honestly, you'd think they couldn't tell me from one of their creepy classmates! How do you ever stand being pinned to one?" My girlfriend gushed at me, and I mentally girded myself for battle. Why do these silly girls think this of engineers? Aren't engineers men just like any other? Then I stopped to think a minute of some of the minor problems "John" and I have had, wondering how many of these things could be attributed to his being an engineer; if other girls who dated engineers had the same problems; if this "heavy" stereotype assumed by the uninitiated was actually justifiable.

First, I suppose you deserve some background -- you'd like to know why I'm writing this article, why I'm qualified to write it. I have been asked to look at some of the problems I think you as engineers might have in your "Love Life", because the editor wanted someone to consider the problem who had had more than just casual dates with engineering students. This last point brings me to my qualifications. "John" and I have been dating now for two years; we are presently engaged. We are both seniors, he in Electrical Engineering; I, in Elementary Education. I'm not trying to write a history of our relationship, I'm merely trying to draw from a few of the experiences we've had to maybe answer your questions about, "Why can't I get a date?" or "Why won't she go out with me again?" I'm not "Dear Abby" answering questions on boy-girl relationships -- the answers to the above questions may very probably be outside the realm of what I'm talking about. But if it's bad breath, two fresh, too brotherly, etc, you'll have to figure that out for yourself, Charlie -- that's not what I'm here for! I do want to give you a girl's viewpoint about some of the things you may have never thought about.

Let's consider this "heavy" bit first. I know you bury yourselves in facts and figures daily, that they may be very interesting to you, that you may want to "talk shop" at a party. But let's face it, fellas -- very few of you date female engineers, and the rest of us just aren't up to discussing La Place Transforms, Fortran programming, or any other technical subjects on your Level. So give "the light one" a break -- if she doesn't ask, can't comprehend, drop it, and talk about the fluffiest thing that comes to your mind. If you can't stand that you can always drop her, you know.

I've never had that problem to any great extent -- I've fought just the opposite. Elementary Education majors are inevitably considered light -- I guess I can't fight it. But I truly resent it when I ask "John" a question about his work, and he brushes me off with, "You'd never understand." That hurts! I'm not stupid, I'm just uninformed! Several times, though, he has taken time to bring what he's doing down to my level, (even if it meant high school algebra) told me why he's doing it, or what the figures would practically be used for. It made me feel great -- like he felt maybe I had a brain under all the fluff. So-o-o, the moral of the story is, boys -- if she's really interested, give her some credit for brain power and really try to explain. You may both be surprised at yourselves.

This "give-me-credit" syndrome brings up another problem engineers may have in dating girls in other majors. I know and understnad that you have to book and book heavy to keep up with your class, let alone attain good grades. So why not sneer at Miss Elementary Education's 4.00 that she got by sitting on the floor cutting pictures from magazines, making flannel boards, and thinking of "cute" ideas for children? Yes, I know it must be frustrating, fellas -- but realize that at 2.0 in Engineering and a 3.5 in El Ed are approximately comparable, in my opinion. Yes, your work is harder, more demanding; our work is in a different sphere -- more reading and "projects." (which do, by the way, require a good deal of time and ingenuity.) Don't, for Heaven's sake, be jealous of our grades and study needs -- you picked your major, (I assume?) and we picked ours. Don't quibble over grades -- you can make a girl feel pretty lousy because her grade-point is higher than yours and you keep reminding her that it doesn't mean a thing. Even in the College of Education, 4.00's are not handed out for sitting on your hands. Give her credit -- don't resent her.

Different study habits -- yes, they exist, but what about them? I'd just like to warn you boys that you may get some strange reactions from gals on whom you spring changes of plans. What about the times when the pressure is on and you've vowed to yourself and to her that you'll do nothing but study for the next three evenings? So she washes her hair , then decides to get pizza, and meets you at Varsity, playing pinballs. You explain that you were working on your problems, but your mind blew, and you had to get some air. All right, this time she understands. The next evening, you do book like hell, but by Friday night, you just can't face those reports, so you call her. It seems that she's right in the middle of something and can't leave it, so you lose your temper -- "Why can't you study like normal people?" Yes, Joe, it's hard for us to understand how you can book so heavy, how we must scrupulously schedule our time not to bother you, and then have you suddenly need release so desperately that we're worthless if we're not available. I have no solution to offer, no advice to give -- I just think you should be prepared for some perhaps unexpected, unexplainable reactions from the illogical female.

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CAREERS WITH
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CAREERS WITH
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STEEL
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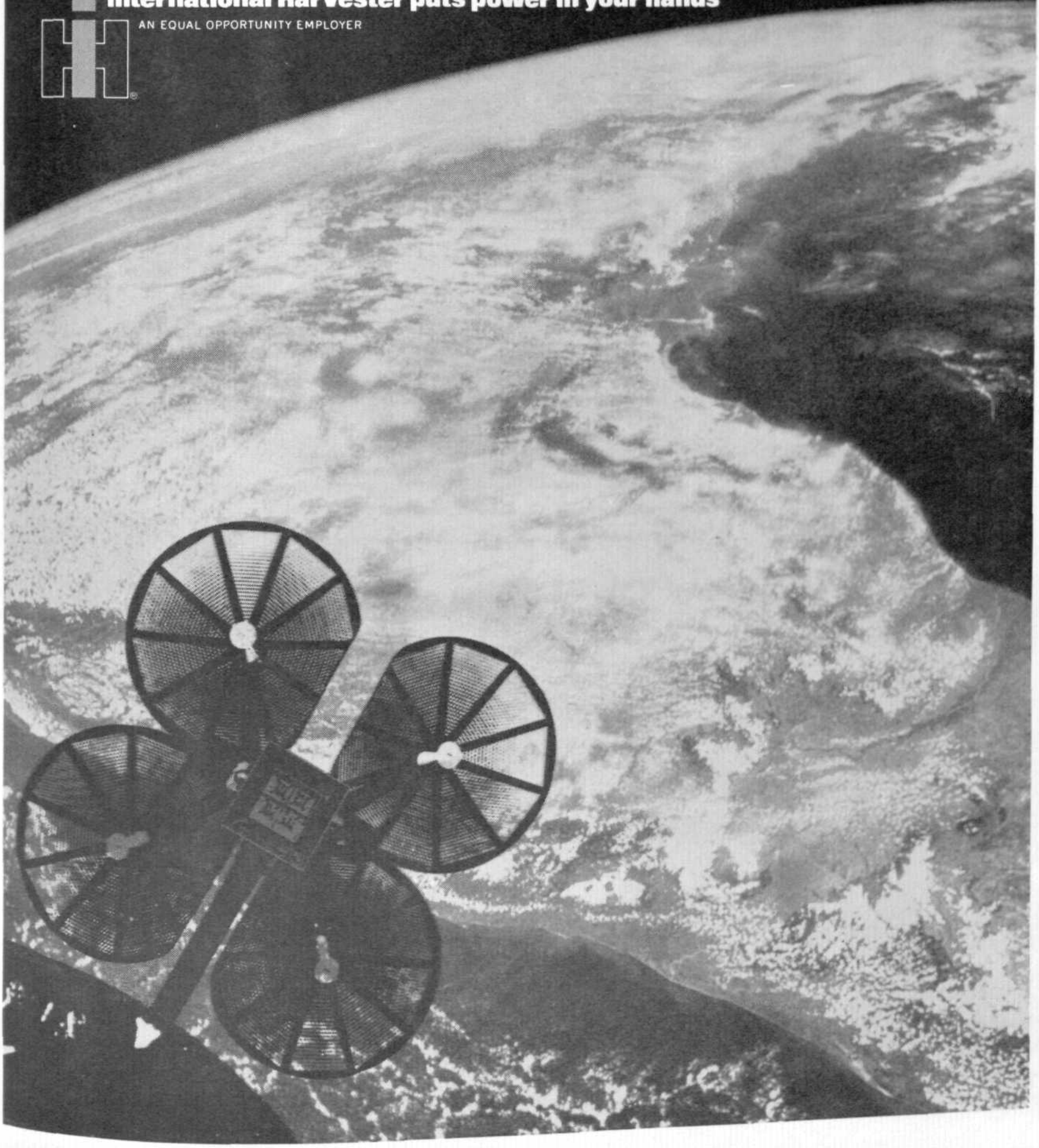


CONTEST "WHERE IT'S AT"

if

you know

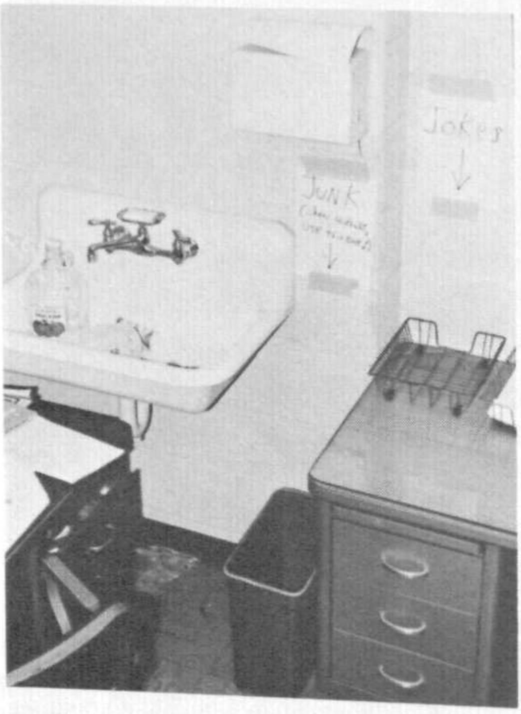
you could be

$10 richer

The Staff of the **Spartan Engineer** has noticed for some time that there are a large number of engineers wandering around looking like they don't know where they are. In order to test, in a scientific manner, whether you are, in fact, lost, we are sponsoring a contest to see if you know where you're at. Motivation will be provided by one ten dollar bill. Identify the following ten photographs, taken in the Engineering Building and you may pass GO and collect $10.

The Rules are as follows:

1. Identification of objects must be by both
   a. Name
   b. Location
2. Entries must be submitted to either Rm. 144 E.B. or Rm. 210 E.B. on or before Feb. 29, 1968.
3. Winner will be determined by most correct answers. Ties will be decided by drawing.
4. First prize is Ten Dollars.
5. Contest is open to all undergraduate students except Staff members of the **Spartan Engineer** and their families.
6. Winner will be announced in the March 1968 issue of the **Spartan Engineer**



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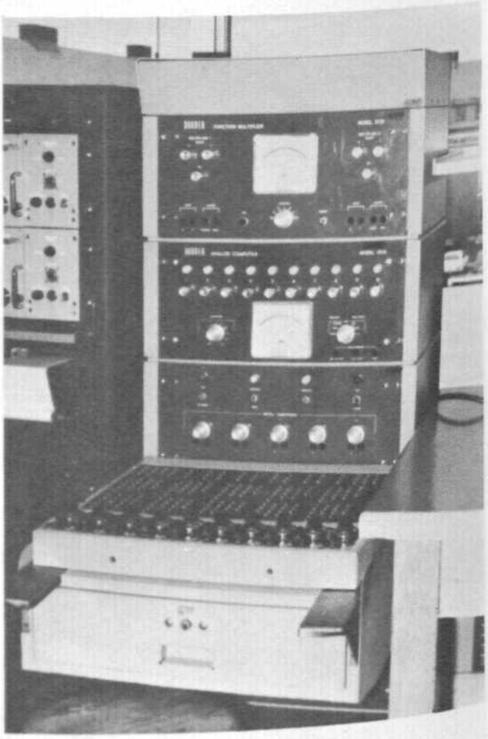

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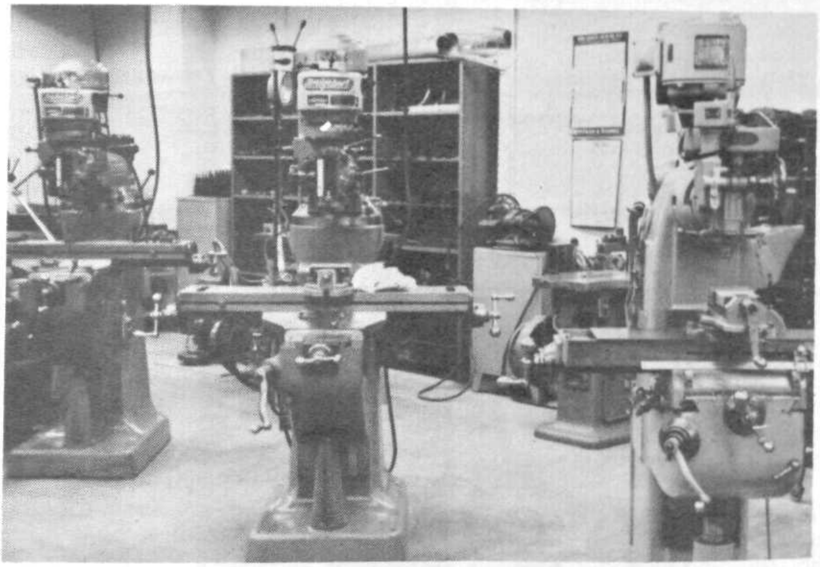

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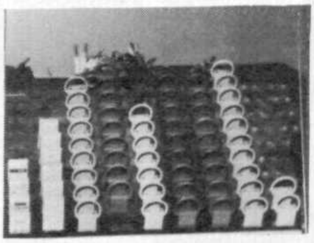

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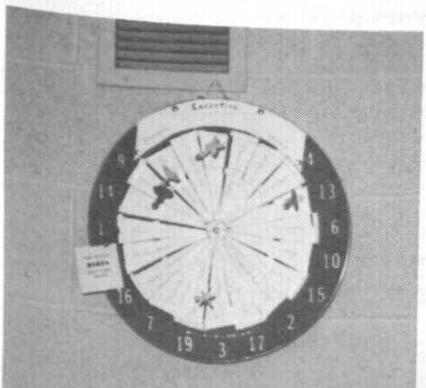

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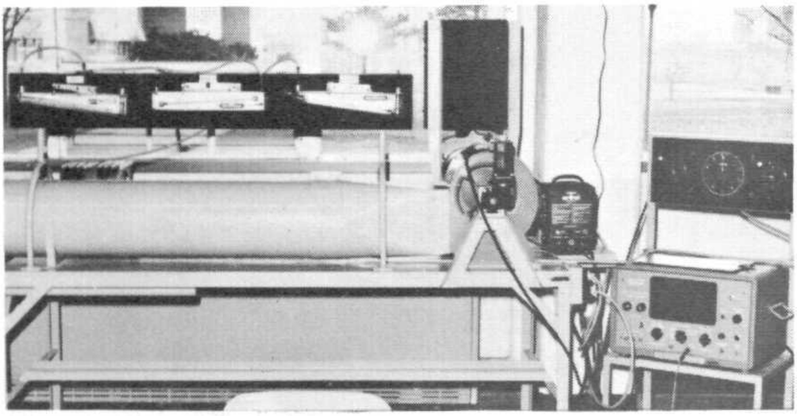

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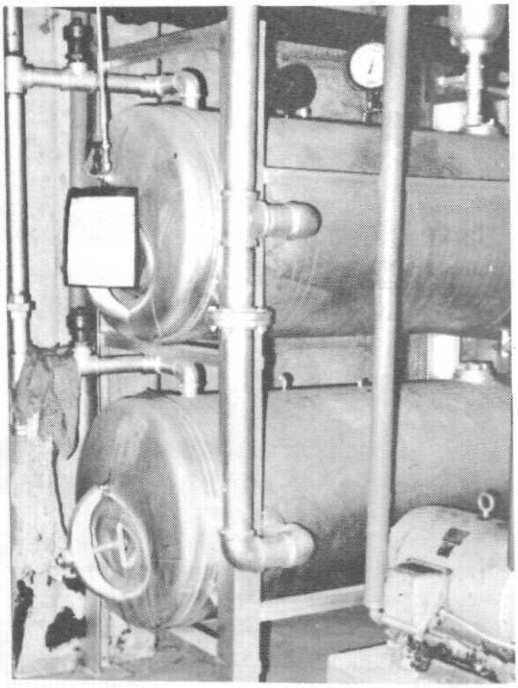

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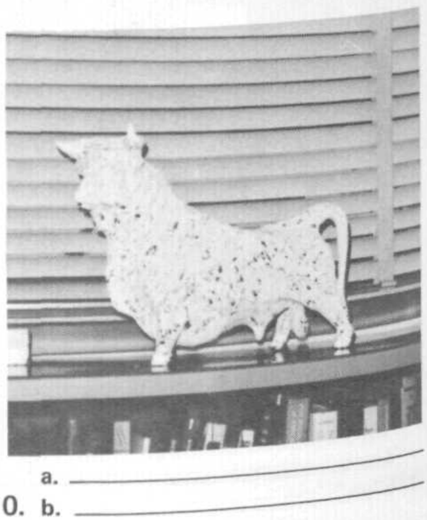
b. ____________________________________



10. a. ____________________________________

b. ____________________________________

owning a stereo MADHOUSE

Some people do not have stereophonic, tru-life music in their homes because they believe that selecting the proper components is difficult.

Such fears are foolish. My own experience proves that it is quite simple if you take the time to get good advice.

Before setting out recently to buy a home music center and enrich my life, which is what it is supposed to do, I consulted a friend who is something of an expert.

He said that the best equipment for the money would be a Whipfrax S-333VC amplifier, a Fritzback turntable, a Gruginhurst AM tuner, a couple of Boomsruth JA662 speaker systems, and a Wacke tape deck with three heads.

"The Whipfrax will give you a maximum push-pull on the franis with a maximum peak on the frex," he said, "And a lot of them won't do that."

"And be sure to have them put a Chibley arm on the turntable with a Strilbam cartridge."

At the store I relayed the request to a sales man who asked:

"Do you have rugs on your floor?"

"Why? You got a special on puppies?"

"The type of room is a factor in getting the proper equipment."

"I got rugs."

"Well then, I don't think you want the Boomsruth speakers. I believe you'd be happy with the Wembly-CK921 speaker systems."

"I want to be happy."

"And, of course, with the Wembley speakers you should have the Franingraw amplifier -- the MM-6321G -- instead of the Whipfrax amp."

The Franingraw was a beauty. It had 13 knobs, nine switches, two lights and 38 holes in the back for plugs. The Whipfrax had one less knob, one less switch, and three lights, so he was right.

"Do you have stuffed furniture?"

"Some. And we have a washer and drier, all paid for . . ."

"Then I doubt if you'd want the Strilbam cartridge. The Whixhurst will give you finer response."

"I want finer response."

"Good. And how high are your ceilings?"

"We don't have to crouch."

"Then I'd say we can go along with the Fritzback turntable."

He plugged it all together and turned it on.

The showroom was 60 feet long, which made it slightly longer than my living room by about 42 feet. He turned up the volume so that I bounced up and down whenever the bass notes came through, going as high as three feet on one passage of Lady of Spain I Adore You.

By the way his lips moved, I could tell he was asking me how I liked it. I shouted that it sure was loud.

He looked displeased and said that it had brilliance and fullness and richness, which it sure did, besides being loud.

"Now," he said. "about the Gruginburst tuner. It is a good unit, but this Grabobeam-63V might suit you better."

"Solid state," he muttered.

"Yes, it is," I said, "And Gov. Romney says it will get even better with more industry and employment and . . ."

"Solid state means that it has no tubes. Transitors instead."

It was a fine looking tuner, even though it didn't have any tubes. It had 41 knobs, each one surrounded by numbers ranging from minus zero to 40,000. It had a hush button and an evil eye.

"Can it see us?" I whispered.

"All that remains," said the salesman, "is the tape deck. Frankly, with these components, I don't think that the Wacko deck would be compatible."

"Then I don't want it in may happy home."

"Stramblow makes a good four-head model. Do you want sound-on-sound and echo chamber?"

"Who doesn't?"

The equipment was delivered and in just a few hours it was all plugged together.

"Look how beautiful the living room looks," I said to the woman.

"Yes," she said. "Like an ICBM control chamber."

"Let us turn it on at full volume with full treble and bass. Each speaker has 24-inch woofers and teeny tweeters, not to mention the magnificent mid-ranges.

The set glowed all over the room and came to life in full voice, tweeting, woofing, mid-ranging and everything.

It was really something. Mr. Franski next door ran outside with out shoes and started screaming that the Russians were coming. A bottle of gin exploded. The cat stood on its hind legs in front of the left speaker, twirled once, and fell dead.

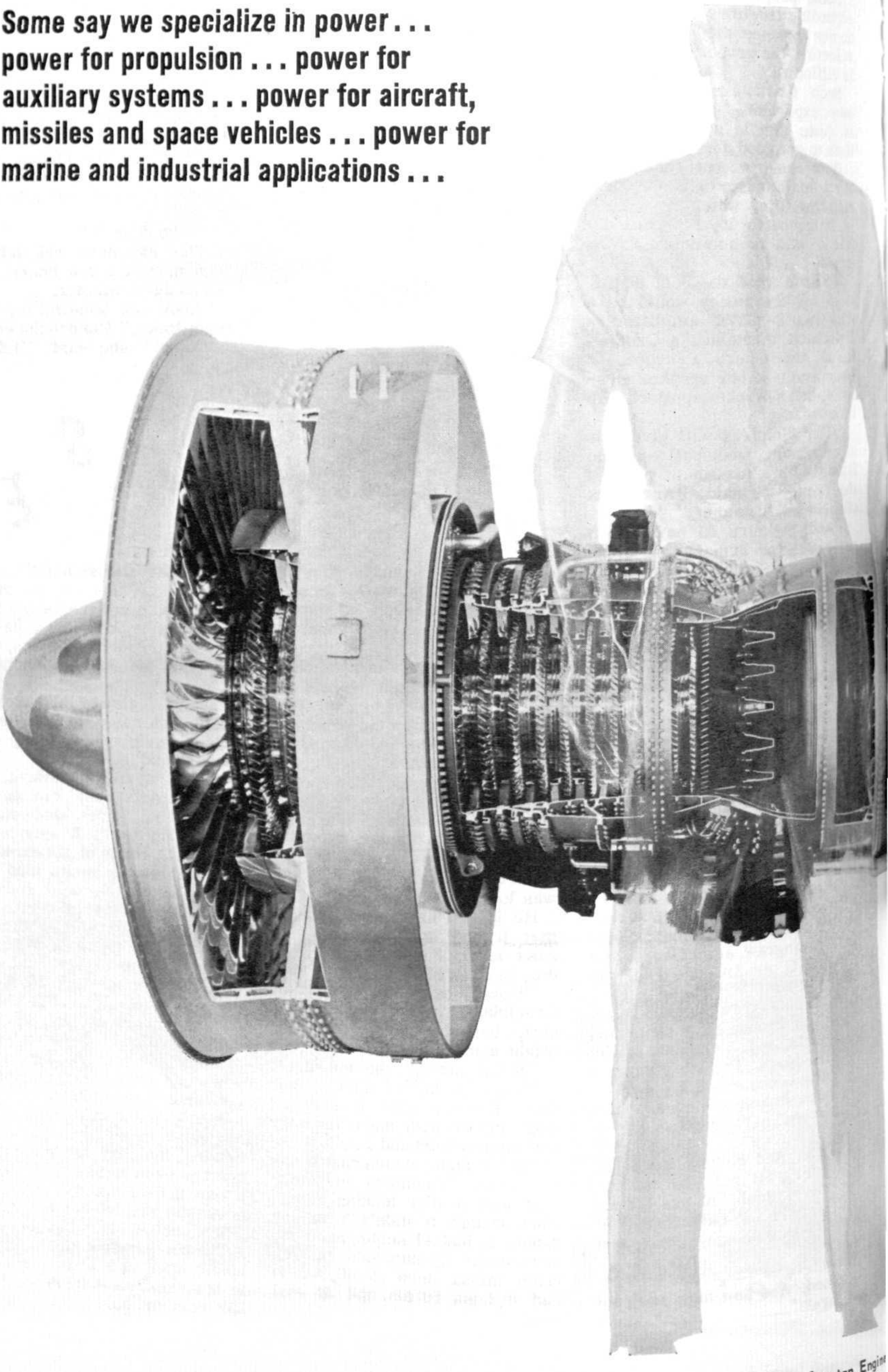
Outside, the street lights began popping, one by one. A sewer cover flew up 50 feet and landed on Mr. Franski next door. The baby leaped out of his crib, ran out the door, and sprinted down the alley.

"Can . . .you. . . detect . . . any . . .flutter . . .or . . .wow?" I shouted toward my wife.

Her lips began foaming as she struggled to get through the vibrating, tumbling furniture to the control switch. She came within a foot before she went mad. She never did have an ear for music.

It's not a bad set to start with, but I'm told that there is more woof and a bigger tweet in the Popdome-CR829 -- if you like real stereo.

Some say we specialize in power... power for propulsion... power for auxiliary systems... power for aircraft, missiles and space vehicles... power for marine and industrial applications...



The Philosopher - Engineer

STEVEN FARRELL

He sits at his desk with a general layout for a long-term project in front of him. His mind is focused on a specific idea relating to the problem. He is trying to form a synthesis between the problem and a linear model; he is trying to bridge the gap between the idea and reality by making the problem conform to a pattern which he has been taught, a pattern which he can manipulate and understand. This is his job; the meaning of his effort rests on his ability to find a synthesis that will enable him to solve the problem. To do so is success; to fail must therefore be a source of deep frustration to the engineer.

The engineer is often accused of being too lightly grounded in basic subjects of the sciences to have an adequate understanding of what he is actually doing; however, this is not necessarily a contradiction to the engineer's drive to understand a problem.

To be more specific, an engineer's frustration begins where the mathematician's satisfaction leaves off. A mathematician could be given a system and be satisfied in being able to prove it was stable. An engineer confronted with the same problem would not necessarily be elated by this result, and, on the contrary, might be deeply frustrated if he could not analyze the system model and design and build a useful system from the model. The frustration of the engineer is therefore the inability to derive a concept and bring it into reality.

The engineer probably does not rate highly among the general public as a philosopher. For instance, the range of conversation of many student engineers does not often go beyond the results of a certain concept of systems analysis or the results of a mathematics mid-term test, for example. This does not necessarily imply that engineers are complete eggheads without much common knowledge, but it does point out that philosophical viewpoints are generally of lower priority on the engineer's thinking schedule than general everyday engineering tribia. Thus the probability is increased that an engineering trivia. Thus the is wearing an orange tie, white socks, two different socks, etc. Somehow this stereotype is more entrenched in engineering than in other fields.

The question may be raised as to whether or not the engineer's basic desire to understand and to actualize an idea is a contradiction the idea that engineers would tend to be overly one-sided. Must an engineer be, on the average, a one-sided personality? Suppose the engineer's desire to actualize is turned from his physical environment to his psychical environment. To be more specific, what is in store for a philosophical engineer, a man with the conscience of a philosopher and the mind of an engineer?

Now the engineer is no longer concerned with building a useful system, but with being a useful system; he wants to "fit" correctly into the puzzle of humanity and the universe. He wants to be happy, and there are obstacles in his way. Again, the same pattern emerges; he has a problem to solve using whatever tools are available to him. The most obvious tool to be used is technology. With technology, he can conquer heat, cold, disease, and possibly even weather. He does all this to achieve happiness, and this is his place in the puzzle.

In the laboratory, an engineer may build and observe a system he has designed on paper to compare expectrd to actual results. Likewise, the philosophical engineer observes the results of technological progress as carefullv as he can. The following passage illustrates Freud's observation of the effect of technological progress on society: "During the last few generations mankind has made an extraordinary advance in the natural sciences and in their technical application and has established his control over nature in a way never before imagined. The single steps of this advance are common knowledge and it is unnecessary to enumerate them. Men are proud of those achievements, and have a right to be. But they seem to have observed that this newly won power over space and time, this subjugation of the forces of nature, which is the fulfillment of a longing that goes back thousands of years, has not increased the amount of pleasurable satisfaction which they may expect from life and has not made them feel happier. From the recognition of this fact we ought to be content to conclude that power over nature is not the only precondition of human happiness, just as it is not the only goal of cultural endeaver; . . . . If there had been no railway to conquer distances, my child would never have left his native town and I should need no telephone to hear his voice; if traveling across the ocean by ship had not been introduced, my friend would not have embarked on a sea-voyage and I should not need a cable to relieve my anxiety about him. What is the use of reducing infantile mortality when it is precisely that reduction which imposes the greatest restraint on us . . what good to us is a long life if it is difficult and barren of joys, and it is so full of misery that we can only welcome death as a deliverer?" [1]

I'm sure that Freud would not have said that technology is the root of all evil and suffering, but this example does support the premise that there is good reason to challenge technology as being the solution to all of our problems. Recent articles in newspapers and magazines indicate that the arms race is stepping up again. In an age where we already have more than enough atomic power to destroy both sides should a war ensue, it seems not only un-humanitarian

1 Freud, Sigmund, Society and Its Discontents

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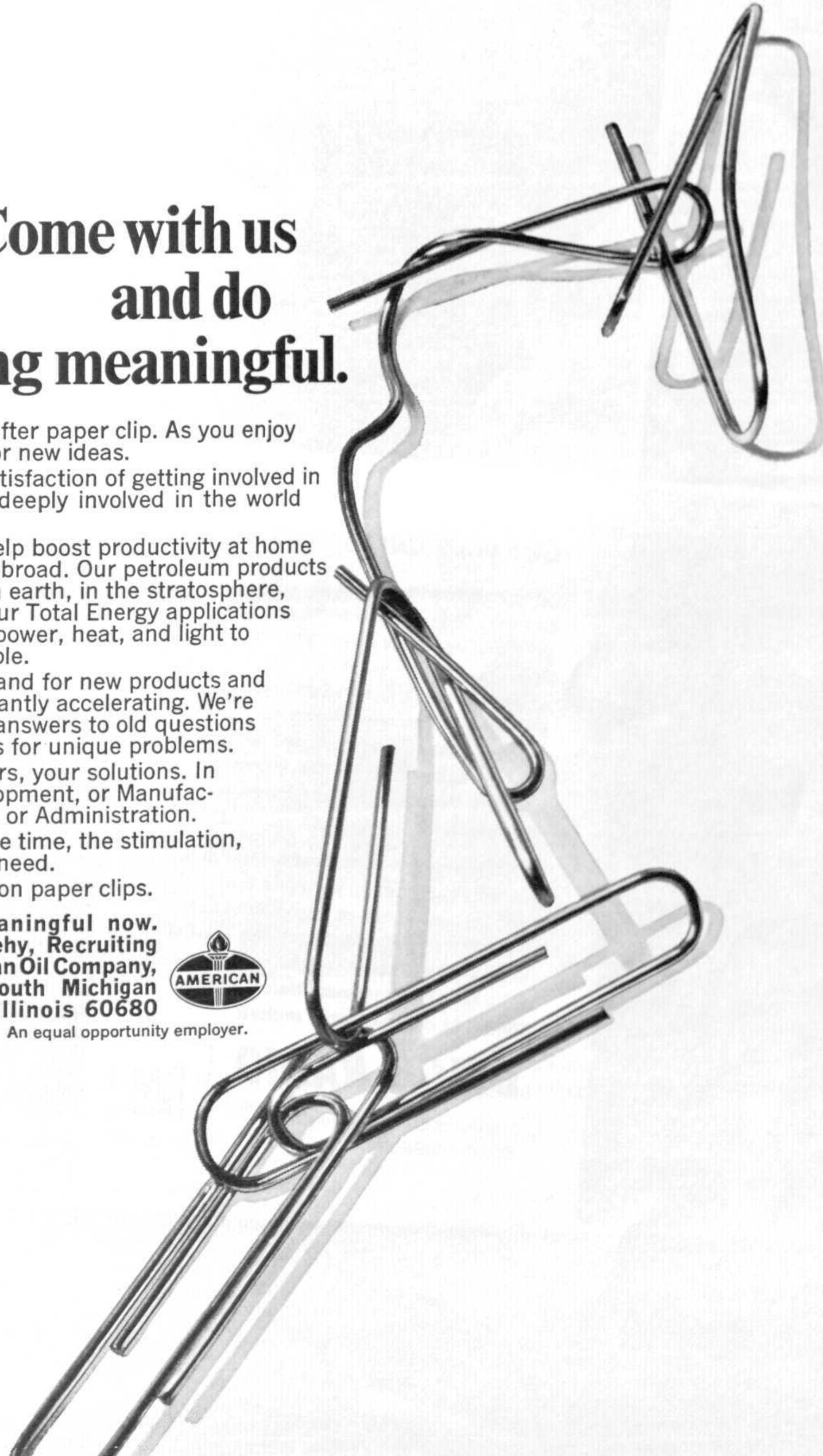
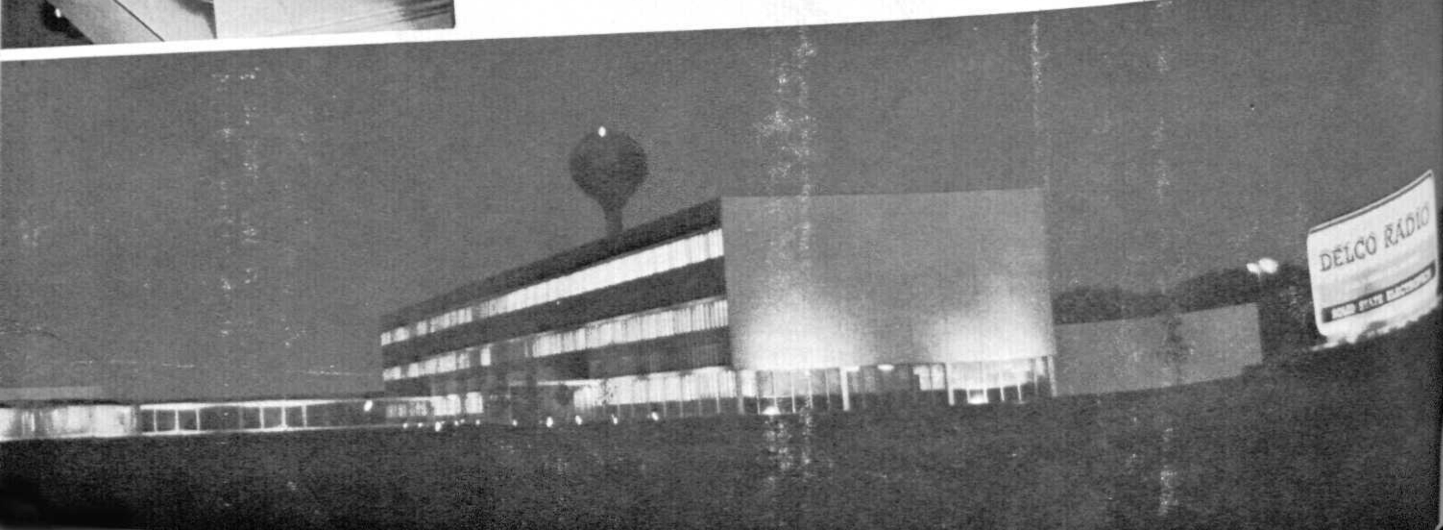



DELCO RADIO

CONTINUED FROM PAGE 11
Each of these is discussed in some detail in the following sections.

Communication. The concept of communication underlies much of the problem in the laboratory. Communication between the laboratory instructor and his students, between the faculty and the administration, and between faculty colleagues, is a highly necessary ingredient for an evolutionary, effective, and efficient status for future undergraduate engineering laboratories. Unfortunately, there appears to be a great disparity in *educational circles* concerning the type of information which gets communicated.

In more theoretical or analytical work, several excellent communication media exist for the instructor to use in maintaining the effective status of his instruction. The foremost of these is the constant development and distribution of text materials, but there are also technical meetings, journals, and workshops or institutes for dissemination of information. On the other hand, in the more experimental or laboratory type work, the people involved seem to be operating randomly because of the absence of effective lines of communication. There are few textual materials for laboratory studies, and even fewer of these are under constant development and distribution.

The survey indicated a unanimous concern over the lack of communication among engineering schools and their faculty on laboratory practice, teaching techniques, projects, and problems. Many suggestions were obtained for improving communications, such as:

1. Summer laboratory workshops
   (a) Invited papers
   (b) Laboratory development
   (c) Demonstrations of laboratory hardware and exercises
2. Visiting laboratory faculty program
   (a) Bring faculty to a home institution
   (b) Send faculty to another institution
3. Visiting distinguished experimenter lecturer program
4. Publications in journals
   (a) Journal of Engineering Education
   (b) Publication of particular society: ASME, AIChE, IEEE, etc.
   (c) A new journal
5. A national depository of laboratory information
6. A traveling laboratory (bus or truck) with new laboratory equipment and ideas
7. A mutual assistance program between two or more universities specifically directed to the improvement of the laboratories
8. Demonstrations of equipment at national meetings
9. Improved textual materials
10. Communication of the importance of laboratory instruction to the department heads at meetings of national societies.

The needs of this area were voiced so often that this must certainly represent a problem in laboratory development, to which some effort and influence should be directed. The study group concludes that the problems of communication and dissemination of information have limited the effectiveness of laboratory instruction and suggests four programs to improve the situation.

The *first* of these is the establishment of a program of laboratory workshops and conferences. This was also the most frequent suggestion in the survey. The workshop should be staffed by competent individuals with notable success in the various areas of laboratory instruction, such as laboratory techniques, demonstrations, problems, and projects, administration, and equipment development. It would be held at an institution or institutions which have emphasized the development of laboratories and have made significant contributions in this area. The sessions might consist of lectures, equipment operation and practice, studies of meaningful laboratory problems or projects, development teams, re-education of staff members, or some combination of these techniques. Faculty could attend the workshop for the purposes of training in new techniques, finding new ideas, or just being rejuvenated and inspired.

The *second* program is the visiting distinguished laboratory lecturer. The use of talent presently available in laboratory instruction or development, or simply experimental engineering, as a seminar speaker or consultant, could be an effective means of communication. The service of a specific group to discover the talent and to organize and encourage such a program appears to be necessary because of the constantly changing leadership in laboratory development. Little success in this sort of program has been found when individual institutions try it on their own.

A *third* program for enhancing communications is the development and distribution of textual materials suitable for use in the laboratory. If there are strong differences between experimental and theoretical studies, then such material may well take on a form different from the more traditional types. For example, a series of monographs on measurements may be useful. These might be "how-to-do" texts: how to measure temperature, electrical current, magnetic field strength, flow, etc. To be effective, such material should be up-to-date, inexpensive, authoritative, and have broad coverage. Other textual materials could include a group of texts on the theory and philosophy of experimental measurement of compendiums of laboratory problems or projects.

Finally, a *fourth* program which might be useful to the continued development of engineering laboratories is the mutual assistance pact between two or more universities or colleges. Such a program (BUILD) has been in operation between the University of Illinois and the University of Colorado and appears to be very successful from the viewpoint of both institutions.

Laboratory Instruction Techniques and Aids. Some problems which affect faculty and administrative enthusiasm for laboratory studies and, therefore, the efficiency of laboratory instruction, are connected with many of the necessary but time-consuming duties of the laboratory. These include instructions in the use of specific instruments, repetitive testing procedures, equipment set-up, grading, etc. Means for reducing the burden of these tasks would be significant contribution.

Another problem is the lack of curricula which recognize the laboratory as a discipline. Little attention is given to the development of the student as an experimenter. This task—the development of the student as an experimenter—would appear to be a prime objective of an undergraduate laboratory curriculum.

The application of programmed learning, or self-learning, to the laboratory is a tool which might significantly affect both of these problem areas. In the survey much awareness and interest in this topic was found. Several schools use or are planning programmed experiments or demonstrations. These include Syracuse University, Carnegie Institute of Technology, Purdue University, and the University of Illinois. Others employ programmed material for instruction in the use of instruments. Do-it-yourself experimental kits or equipment and a controlled amount of pre-wiring or planning by the student are among the techniques found. Filmed instruction appears popular in some areas of laboratory instruction. It should be noted, however, that the sub-set of the schools active in laboratory development is concerned that programmed learning can be a return to the fill-in-the-blank type of experiment. Those groups who were involved in such self-instruction techniques felt that they not only improve the effectiveness of the laboratory but also the efficiency. Increased laboratory efficiency is paramount to meaningful upgrading of laboratory programs, and continued attention to these methods will also result in improved efficiency as measured by:

1. More use of a given set of experimental set-ups,
2. Lower maintenance costs for equipment,
3. Freeing of faculty time so they might provide more profound guidance, and
4. Better use of existing capital equipment.

The need to increase the efficiency of laboratory instruction was mentioned earlier, and perhaps programmed learning can make what little funds are available for laboratory improvement go much further.

Laboratory Faculty. The enthusiasm, capability, and interest of the faculty members involved in teaching laboratories varies widely and is one of the most significant single factors for a successful laboratory program. However, it does not appear that this has been given adequate recognition. Therefore, a current problem of laboratory development is to involve the most competent faculty members in laboratory development and recognize them for their efforts.

It hardly seems necessary to comment that qualified, interested staff are necessary to the success of an undergraduate laboratory program, yet this fact seems to have gone unnoticed for far too long. Staff with few qualifications for, or interest in, experimental work seem to get involved frequently.

Many of the department heads interviewed recognized the existence of this situation but, in general, felt helpless to change conditions in their province because of lack of staff, staff loading problems, university policies for staff recognition, publication and research policies, and a lack of conviction of the importance of the undergraduate laboratory program. These factors, either individually or in combination, appear to relegate the undergraduate laboratory to a second-class status. Perhaps accreditation procedures of the Engineers' Council for Professional Development could stimulate a greater awareness by the university administration, and particularly the department administration, of this problem.

Laboratories which had the appearance of being worthwhile, successful, and meaningful for the student in terms of the demands of the world on an engineering curriculum were handled by staff who were:

1. Experimentally oriented,
2. Highly interested in this aspect of education,
3. Encouraged by their administration,
4. Given promotional and professional recognition, and
5. Not overloaded with other responsibilities.

Delegation of prime responsibility to graduate students in the more aggressive and successful laboratories is quite rare. The majority of such programs use the graduate student as an assistant to the professor, not as a replacement.

It is important, then, that administrators concern themselves in detail with the faculty involved in laboratory instruction. Not only must they be concerned with present faculty, but they must also begin development of new faculty. Improvements in other facets of the laboratory will help relieve the problems of the faculty. For example, text materials will introduce some of the formalism and organization that appeal to faculty; workshops will serve for inspiration and training; and aids such as programmed learning can remove much of the drudgery. However, the problem remains that the more qualified faculty members will not involve themselves in laboratory instruction or development unless they are adequately compensated and recognized.

Recommendations of the Study Group

It is clear from the findings of the study that there is an intensifying awareness of the critical nature of laboratory instruction on our engineering campuses and of the need for improvements to overcome the widespread existing problems. It is also clear that this need is especially acute in the understaffed and financially poorer schools, and that the more fortunate schools have a desire to help. Even the schools with outstanding programs would like to see improved channels of communications, so that they can further improve the efficiency, effectiveness, and content of their laboratories.

This study group concludes that the interest and awareness on our engineering campuses of the needs of laboratory instruction could best be served by a coordinated national program to promote and support the following kinds of activities:

1. *Workshops and Conferences.* A series of laboratory workshop programs and national conferences on laboratory development should be established.

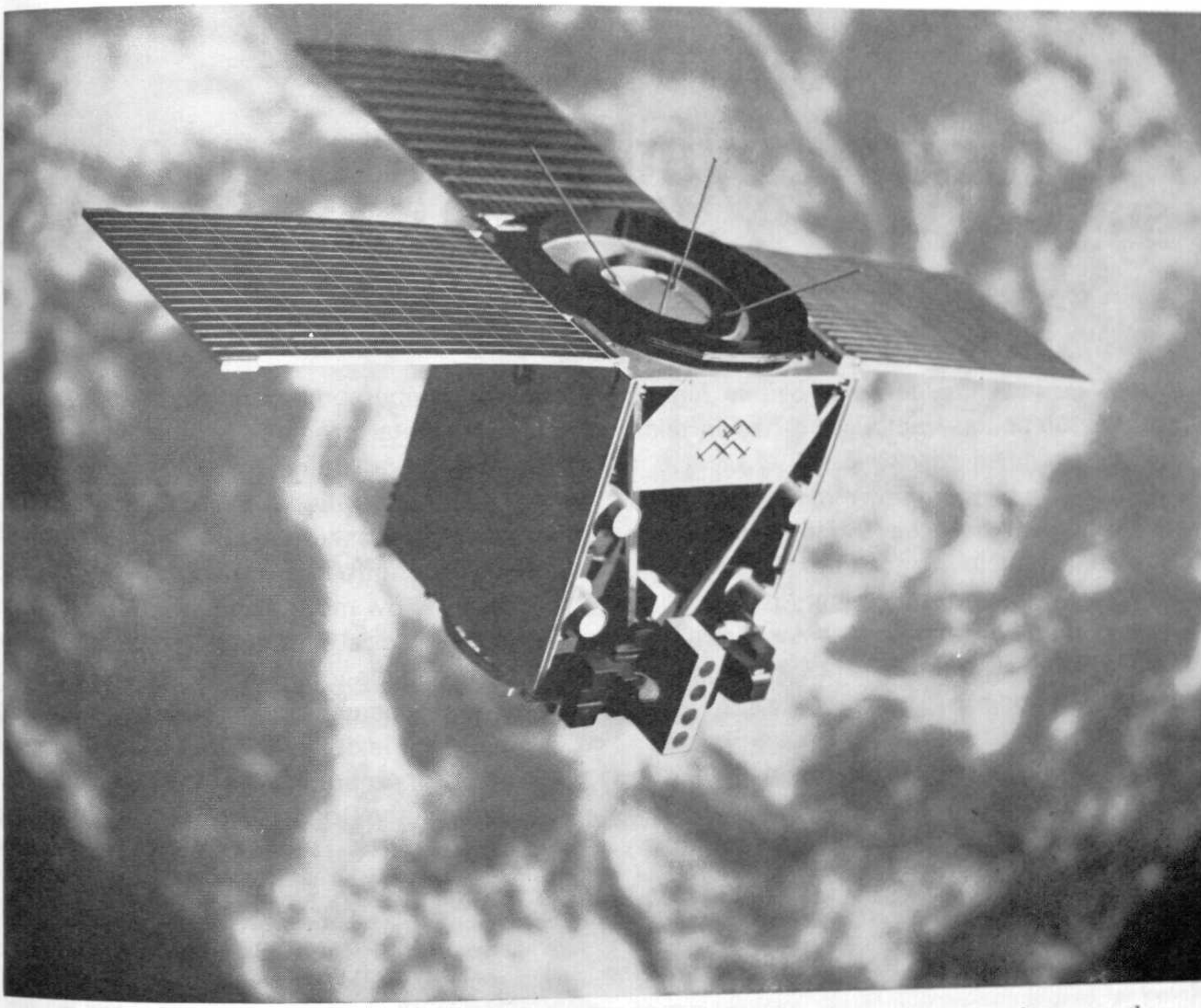
2. *Publications.* Individuals and/or publishers should be encouraged to produce a series of monographs on laboratory practice, procedures, and theory.

3. *Self-Study Techniques.* The continued development of self-study, auto-instruction, or programmed learning techniques for the laboratory should be encouraged.

4. *Campus Visits Program.* A program of distinguished visiting laboratory instructors or outstanding experimentalists should be established.

5. *Mutual Aid Programs.* Effort should be directed toward encouraging mutual assistance pacts between colleges and universities wishing to upgrade or enhance their laboratory programs.

6. *Broader Support.* Private industry and foundations should be encouraged to increase their support of undergraduate laboratory programs. △



Model of TIROS M—an RCA second generation multisensor, earth-stabilized spacecraft. The primary meteorological mission for the TIROS M system is to provide a combination of the daylight cloud-cover missions of the two types of TOS (TIROS Operational System) spacecraft and, in addition, to provide a night-time cloud-cover observation capability for both real time and global data.

19 Ways to Flunk Any Course

Learn now that society will provide for you. Just because you are you. Just because you are paying for an education doesn't mean you have to get your money's worth. Don't be ridiculous. "If the learner hasn't learned," it isn't your fault, surely.

1. GENERAL ATTITUDE—The B.B.A. degree is valuable. Successful grads have made it so. It is valuable because they produced. Let them keep up the good work, but don't prepare to rob them of their glory, to increase the value.

2. BE YOUTHFUL—Be young while you can. Why discard those good old high school days—and ways? Don't grow up until you just have to. People will always be understanding and appreciative of your adolescence.

3. DRESS—Be yourself, dress naturally. Those business people can be very stuffy about sartorial matters. On that first job, they'll probably start you off as a porter anyway, so why not look like one?

4. AROMATICS—The pungency of the locker room can be carried with you. A gamey "athletic" odor is a great personal asset—in class and out, in business and out—and fast. Carry your own atmosphere—be "aromatic."

5. RELAX, ENJOY IT—A stiff posture restricts absorption. Spread yourself figuratively. Chairs in front, occupied or not, are fine for parking feet, thus facilitating relaxation.

6. MENTAL EFFORT—Some say that brain cells, like liquor bottles, cannot be used twice. Save them, coddle them, spare them—in class and out. The mind (?) you save may be your own.

7. DON'T ANTICIPATE—Who knows what might happen tomorrow—or for that matter next week, when the paper is due? Don't do it ahead of time—nothing might happen. Then you'd have no excuse.

8. ACCURACY—Is for the birds. A misplaced decimal point is embarrassing but not critical. You can always do it right when and if you get a job (on the basis of your excellent school record, of course).

9. DON'T WRITE, TELEGRAPH—Legibility went out with long underwear. None of the really big wheels like Napoleon, Hitler, or even Confucius—could write good English.

10. SPELLING—Why bring that up? Phonetics are out, "word picture" didn't work, so your generation just can't spell. Everyone understands and is sorry. You are unique—now don't go and spoil it.

11. LATE PAPERS—Promptness here is a sign of servility. Be independent. Be different. A few days late shouldn't matter, especially if you use a good standard explanation.

12. BE LATE—A "fashionable" entrance, after everyone else is seated, and the class is moving along—this calls attention to one, definitely. You can also be so ignorant about what has gone before and get the spotlight again.

13. ATTEND IRREGULARLY—That's the stuff. Always being there is dreadfully boring. After all, one meeting is like another and the instructor gets tired of your face, too.

14. BE CONVERSATIONAL—Talk it up. If the old buzzard doesn't make it interesting, it surely can't be interesting to your neighbor, can it? Competition is good for business, so why not for business educators?

15. PREPARATION—A dangerous habit. Here again, let's don't anticipate. A heavy snow might make the work useless. And—the instructor might resent having you come to class one day knowing what he is talking about.

16. (BUT OTHERWISE) CLAM UP—Don't ever venture an opinion, don't defend a point; let some other jerk stick his neck out. Remember it may be better to remain silent and be thought ignorant—than to open one's mouth and remove all doubt.

17. ON YOUR MARK—Don't get left at the post when the bell rings. A rustling of papers and plopping of books indicates alertness on your part to the hour of parting and reminds the Professor accordingly.

18. REPETITION—A powerful force. If the files show that someone did a good paper on the topic last year, why should such a gem be discarded? The instructor will never recognize it if your pal was at U. of N.

19. PLAGIARISM—If in preparing a paper you find that some author has said it better than you can—and a long time ago—don't dull initiative. Let him have his way—in your paper, too. It should be flattering to him.

—THE THEORY JACK BUILT—

This is the Theory Jack built.

This is the Flaw
That lay in the Theory Jack built.

This is the Mummery
Hiding the Flaw
That lay in the Theory Jack built.

This is the Summary
Based on the Mummery
Hiding the Flaw
That lay in the Theory Jack built.

This is the Constant K
That saved the Summary
Based on the Mummery
Hiding the Flaw
That lay in the Theory Jack built.

This is the Erudite Verbal Haze
Cloaking Constant K
That saved the Summary
Based on the Mummery
Hiding the Flaw
That lay in the Theory Jack built.

This is the Turn of a Plausible Phrase
That thickened the Erudite Verbal Haze
Cloaking Constant K
That saved the Summary
Based on the Mummery
Hiding the Flaw
That lay in the Theory Jack built.

This is Chaotic Confusion and Bluff
That hung on the Turn of a Plausible Phrase
And thickened the Erudite Verbal Haze
Cloaking Constant K
That saved the Summary
Based on the Mummery
Hiding the Flaw
That lay in the Theory Jack built.

This is the Cybernetics and Stuff
That covered Chaotic Confusion and Bluff
That hung on the Turn of a Plausible Phrase
And thickened the Erudite Verbal Haze
Cloaking Constant K
That saved the Summary
Based on the Mummery
Hiding the Flaw
That lay in the Theory Jack built.

This is the Button to start the Machine
To make with the Cyberenetics and Stuff
To cover Chaotic Confusion and Bluff
That hung on the Turn of a Plausible Phrase
And thickened the Erudite Verbal Haze
Cloaking Constant K
That saved the Summary
Based on the Mummery
Hiding the Flaw
That lay in the Theory Jack Built.

This is the Space-Child with Brow Serene
Who pushed the Button to start the Machine
That made with the Sybernetics and Stuff
Without Confusion, exposing the Bluff
That hung on the Turn of a Plausible Phrase
And, shredding the Erudite Verbal Haze
Cloaking Constant K,
Wrecked the Summary
Based on the Mummery
Hiding the Flaw
And demolished the Theory Jack built.

Stolen from *The Atlantic*, Dec. 1956

ENGAGEMENT . . .

Another problem for which I have no solution is that of hopelessness and desperation. All of us hit points in our study at which there seems no way out -- the work may be just too difficult and totally incomprehensible. You fail an exam, can't work the problems, nothing seems to go right. I seems to go right. I guess engineering, with all its complexities that build on one another, is more prone to this than other fields. You've no place to go for help, no escape, so you give a girl a call. You "cry on her shoulder" for a while; she's (hopefully) sympathetic and understanding, but remember, boy, she can in no way help you out of your difficulties! (Remember? -- she's the one you had to explain differential equations to in terms of simple algebra!) If you're lucky, she'll do everything in her power to take your mind off the problem. Try to force yourself to play along -- she may then work as an escape. But, if you can't play along, it might be better to go drinkin' with the boys -- alcohol may erase what she can't, and you won't hurt the bottle with your bitterness. A couple can have some pretty shaking discussions under the influence of hopelessness -- a person's whole view of the world may be influenced.

"View of the world" -- I wonder, too, if that isn't influenced a bit by engineering. Engineers work so much with laws and rules and absolutes -- "figures don't lie." I think this may sometimes make you see the inexact, unpredictable relations of one human being with another as being somewhat worthless. I don't want to delve into philosophy or even logic, but I feel that some of you may need to look at the world with a little more warmth, a little more understnading for its many imperfections. The illogical feminine mind is rather a trademark for my sex, but sometimes I feel that we have a more livable idea of the world than you who consistenly "measure" and compartmentalize it according to the absolutes you know. Live with us, be human, understand and accept our weaknesses even as we accept yours. Don't stand on the pedestal of superior minds and scorn us -- one day you may find that you need to be down here beside us, and it may be too far to jump at that time.

And so I close, with the words "beside us." Because I think that nearly all of you, whether you admit it or not, do want one of us beside you. I hope that this article may in some way help some one of you attain that goal. Go get'em, boys!

The inexperienced young backwoods teacher just scratched his head when a school kid asked him for a definition of the word, "alabaster."

Finally he admitted, "I'm not down right sure, but it might be an illegitimate Mohammedan."

PHILOSOPHER . . .

to be developing more weapons, but completely illogical, for our only hope of happiness lies with preventing a war. There are other ways in which technology can get out of control. The stock-market crash in 1929 is an example, for without the necessary communication and transportation facilities, the events of that year could never have occurred at a sufficiently rapid pace to bring about the resulting crash.

The philosophical engineer is, therefore, a square peg in a round hole. He would like his technological achievements to be consistent with his philosophical goals of happiness and world peace. He would like to object to war and killing, while, at the same time, his technology is being used to increase a war effort or to create a mechanization on such a large scale that is begins to interfere with peoples' lives, sometimes so subtley that it may create uncontrollable situations before they are discovered and curtailed. As an example, the recent riots in the big cities of this country are somewhat a result of technology out of control. People were incited to loot stores; they were excitable because the mass-media communication had shown them goods and created within them a desire to have things which some of them could not afford.

In conclusion, the engineer who choses to be concerned and responsible for the world's problems with the same desire that he possesses to solve challenging problems in his field will probably be very frustrated. It is no small wonder that courses are not offered in philosophical engineering, though many would probably enrole in such a course of study if it were offered.

A manufacturer of ladies' garments introduced a new line of brassiers called the 'Embargo". It doesn't make sense until you spell it backwards.

A soldier with the occupation troops in Germany received a cable from his girl:

It read, "Couldn't wait for you so have married your father.
Love, Mother."

Math Prof: "What is the square root of 69?"

Pet E: "Uh . . . . 8 something . . ."

Hear about the new "doggie-bra"? . . . It makes pointers out of setters.

Confucious say: "A bosom companion sometimes turns out to be a false friend.

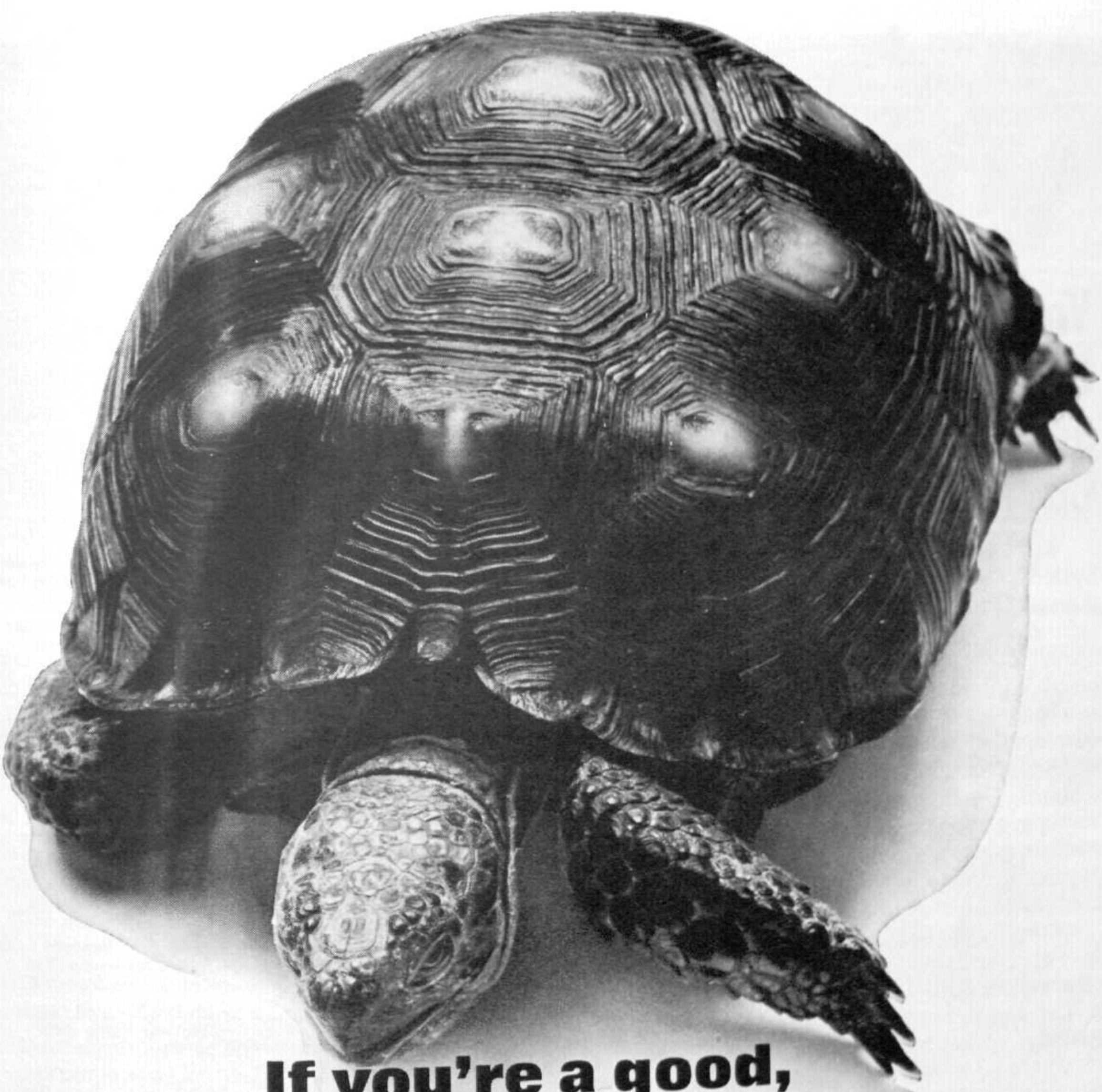
A tobacco company executive ran across a man, 94 years old, who had been smoking four packs a day since he was 12 years old. The old-timer was in excellent health.

"We are filming some television commercials," he told the old fellow. "If you will let us put your story on film we'll pay you a thousand dollars."

"Okay, when do you want me?" the old-timer asked.

"Can you be at the television station at nine in the morning?"

"Nope, too early," he replied, "I don't stop coughing until noon."



If you're a good, play-it-safe thinker, with a step-at-a-time philosophy...

you're not geared for the pace of things at Celanese.

No other major corporation in our industry has grown so fast. In the last ten years, sales have zoomed from $286.4 million to over $1 billion.

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We have a lot of serious growing to do. Right now. And some substantial, ground-floor opportunities to offer you. If you can help us grow.

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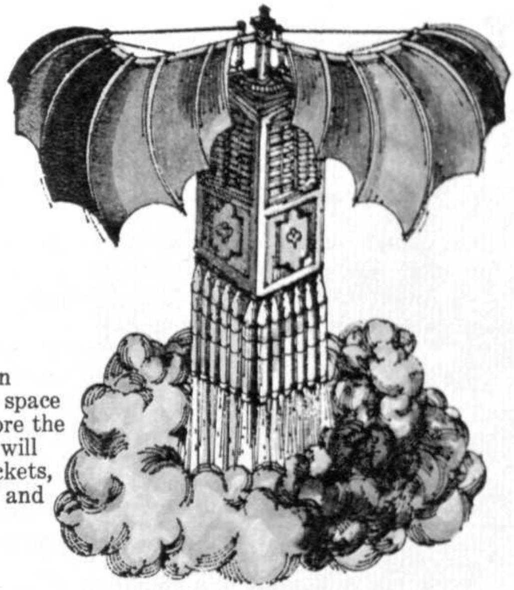
CELANESE

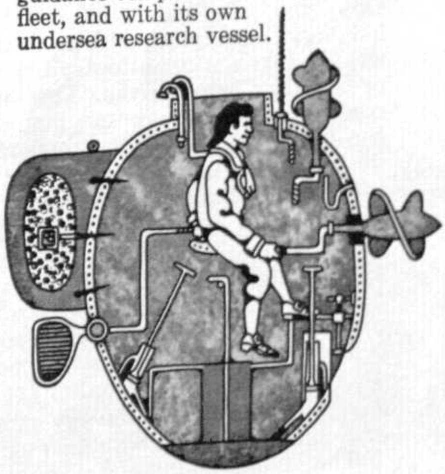
They had the right idea.

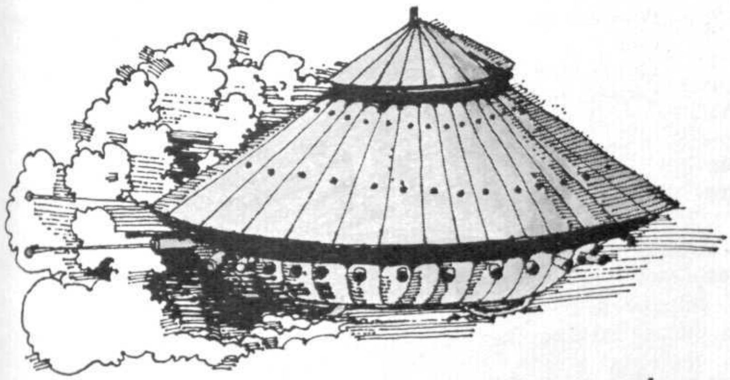


17th-Century Space Flight.
Cyrano de Bergerac's science fiction fantasy about a box propelled into space by rockets came close to fact. Before the end of this decade, Apollo and LM will indeed be thrust to the moon by rockets, guided by AC Electronics guidance and navigation systems.

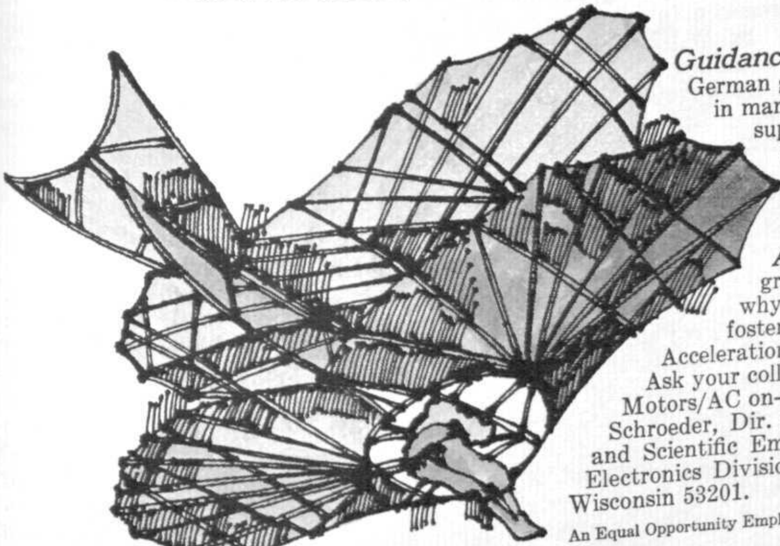
Navigation, Second-Century B.C.
Hipparchus's second-century astrolabe was used for celestial navigation until the mid-18th century. Today, ships still depend on stars for guidance . . . through such sophisticated help as AC Electronics' computerized Ships' Self-Contained Navigation System.

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, AC Electronics Division, Milwaukee, Wisconsin 53201.

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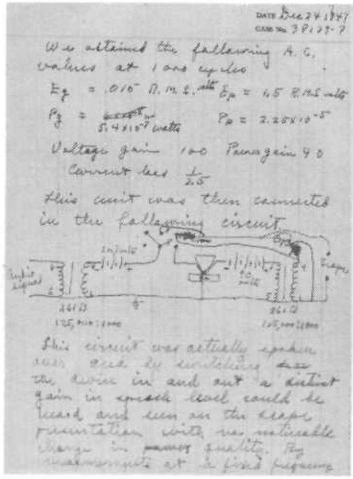
Transistor Is

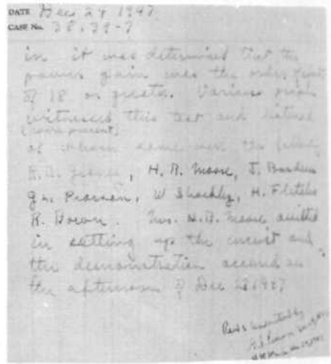
Twenty Years Old

Just twenty years ago the transistor was invented at Bell Telephone Laboratories, research and development unit of the Bell System.

On December 23, 1947, Bell Labs scientists John Bardeen, Walter Brattain, and William Shockley showed that a small piece of the element germanium could be made to amplify a speech signal about forty times. Later, in 1956, the trio was given the Nobel Prize for discovery of the transistor effect.

The invention has resulted in the growth of the multibillion-dollar transistor industry, with scores of companies employing hundreds of thousands of people. Transistors are everywhere -- in homes, banks, automobiles, factories -- even on the ocean floor and in outer space. They activate radios, TV sets, hearing aids, and telephones. They control industrial equipment. They drive wristwatches, power tools; big ones even drive locomotives. They make complex calculations in giant computers, and process TV pictures from the moon. They even prolong life with "Pacemaker" heartbeats.





The laboratory notebook entry of scientist Walter H. Brattain records the events of December 23, 1947, when the transistor effect was discovered at Bell Telephone Laboratories. Dr. Brattain, J. Bardeen, and W. Shockley, all of Bell Laboratories received the Nobel Prize for the transistor's invention. The notebook entry describes the event and adds: "This circuit was actually spoken over and by switching the device in and out a distinct gain in speech level could be heard and seen on the scope presentation with no noticable change in quality.

Transistors have played a vital role in communications and information processing. In telephony; the underseas cables, new central offices, and radio transmission are either made possible or greatly improved by transistors. Today's giant computers contain over 100,000 transistors, connected together to enable the machine to make millions of calculations per second.

Transistors are able to perform all of the functions of vacuum tubes. They can amplify electrical signals, act as oscillators, or control and combine pulses of current. For practically every application they are less expensive, more reliable, smaller, and consume less power than vacuum tubes.

The transistor is not only one of the great inventions of the twentieth century, it has also lead to a host of advances in other scientific fields. For instance, zone refining, invented at Bell Labs by William Pfann to purify transistor materials, has made ultra-pure materials available for all sorts of technical and scientific purposes. The increased interest in the properties of solids has led to other "quantum electronic" devices, such as lasers, light amplifiers, and light modulators. The study of surface properties of materials, vital to transistor technology, has progressed to a point where active atoms can be detected in single layers in one-in-a-million concentrations.

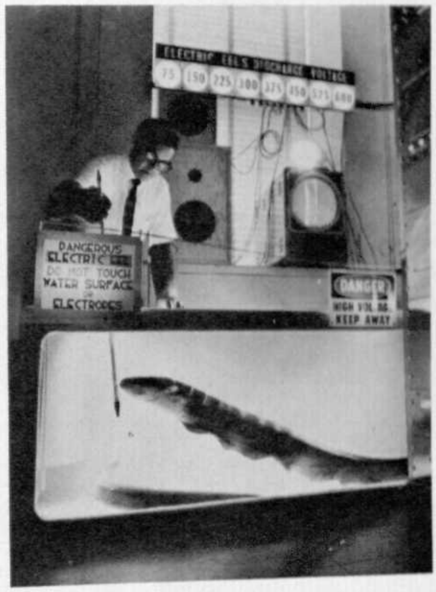
Recently, transistor technology has been applied to making "integrated circuits" -- complete electronic circuits fabricated on one paper-thin wafer of material. An integrated circuit containing 50 to 100 transistors and other circuit elements can fit on the head of a pin.

This miniaturization is important for compact equipment like the telephone; moreover, along with size, it means reduction in cost and increase in operating speeds. Today, tiny transistors and other components in an integrated circuit can perform a function at 100 times less cost and with 1000 times the reliability of doing the same job with vacuum tubes.

Through the invention of the transistor and its resulting development, the future of our society has been profoundly affected. Better worldwide communications, automatic control equipment, and the ability to process large amounts of information are vitally necessary to modern life.

WESTINGHOUSE EEL-ECTRIC

Zap! An electric eel lights up his tank and takes his own picture with a 600-volt strike. The eel is attacking the rod waved in front of him by engineer Cedric R. Bastiaans at the Research Laboratories of the Westinghouse Electric Corporation. Mr. Bastiaans is testing equipment Westinghouse developed for the electric eel exhibit at the new Pittsburgh Aqua-Zoo. The electricity shoots through the water to electrodes at the ends of the tank. It turns on all the lights of the voltmeter at the top of the picture, flashes the strobe light just below the meter, creates the pattern on the oscilloscope screen and sets off flash lamps to take the picture. Mr. Bastiaans wears big rubber gloves to insulate himself against the lethal voltage. The tail of another electric eel can be seen on the bottom of the tank.

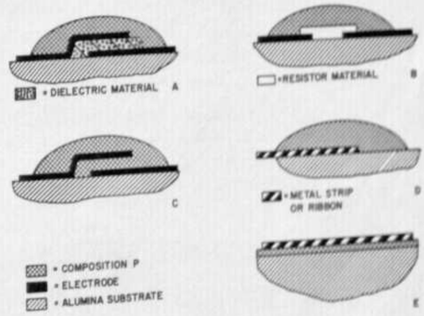


Atomic Scattering Coincidence Measurements

ONE OF A KIND . . . The 54-inch coincidence scattering chamber, designed and constructed at High Voltage Engineering's Robert J. Van de Graaf Laboratory, provides unique information about the dynamics of excited electron shells. The apparatus is the only one in the world capable of conducting these studies at energies above 0.5 MeV.

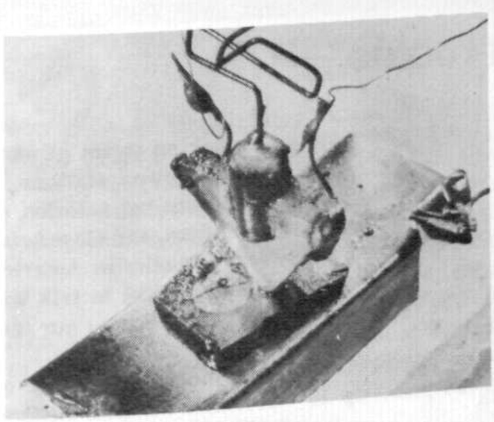
VERSATILE ELASTIC CERAMIC MATERIAL

Developed by IBM for use as Encapsulant, Dielectric and Bonding Cement



Composition P -- a mixture of lead titanate lead zirconate and borosilicate glass -- has been developed by International Business Machines Corporation for a variety of Microelectronic component applications. As shown by the drawings at left, the material can be used as a hermetic encapsulant for printed thick film capacitors (a); a hermetic encapsulant for printed thick film resistors (b) a dielectric substance for printed capacitors (c); and "elastic" clamp for joining a metallic ribbon to a ceramic substrate (d); and a bonding cement for a metal-to-ceramic seal (e). Details of the development and use of Compositions P were given by IBM engineers in a paper entitled, "Multiple Lead-IVB Oxide Elastic Ceramics," presented at the American Ceramic Society 20th Pacific Coast Regional Meeting.

The first transistors assembled by their inventors at Bell Laboratories 20 years ago were primitive by today's standards. Yet, they revolutionized the electronics industry and changed our way of life. This first transistor, a "point-contact" type, amplified electrical signals by passing them through a solid semiconductor material, basically the same operation performed by present "junction" transistors.



ENGINEERS

"My, but Joe is getting round shouldered!"

"Too much study, I guess."

"Study nothing! The trouble with him is that he's been kissing too many short girls."

Editor: "That co-ed draws well, doesn't she?"

Asst. Ed.: (absently) "Yep, there were ten of us there last night."

One moonlit night, after a dance, a fellow begged to drive a beautiful young girl home. She accepted and got into his roadster. As they were driving along, he sighed deeply.

"You're beautiful!" he murmured audibly. "That golden hair!"

"Thank you," she replied.

"And your big blue eyes! They are beautiful, too!"

"Thank you."

"And your lips -- and pearly teeth."

She thanked him again. As they rode along he continued to shower her with compliments, but she remained silent. Suddenly she spoke.

"Can you drive with one hand?" she asked softly.

"Sure," he replied in nervous anticipation.

"Well," she suggested, "why don't you cover your mouth."

A career girl's mind moves her ahead, while a chorus girl's mind moves her behind.

Dressed as a pirate for Halloween, the small boy knocked on a door and was greeted by a matronly woman. "Aren't you a cute pirate," she said. "But where are your buccaneers?"

To which the little boy replied, "Under my buccan hat."

Two men were working on the White House lawn in Washington. Each had a small trash can on rollers, and was walking about picking up bits of paper with a pointed stick. As one spied a piece and was about to stab it, a gust of wind came up and blew the paper into the White House through an open window.

Frantically the man rushed inside of the building. He returned shortly afterward and said to his companion: "I was too late. He had already signed it."

Many engineers think that a good time is going places and undoing things.

Then there was the E.E. who loved the beautiful cellist especially when she was on her Bach.

A little bear went tripping through the woods one spring morning. "I'ma ready teddy, I'ma ready teddy", and gently swaying her graceful body in time with the tune. Suddenly from behind a big tree came big, hairy arms.

Some time later she continued on her way singing, "I'ma ruined bruin, I'ma ruined bruin."

"How did Pat get his black eye?"

"He was leading the life of Riley when Riley came home."

But mama, I'm not hungry. I ate all the raisins off the flypaper.

Spartan Engineer defines a low neckline: Something you can approve of and look down on at the same time.

It's amazing what some girls get away with and still keep their amateur standing.

She doesn't drink,
She doesn't pet,
She doesn't go
To college yet.

Engineer in a drug store: "Is your ice cream pure?"

Clerk: "Pure as the girl of your dreams."

Engineer: "Gimme cigarettes."

Little Boy: We've got a new baby at our house.

Neighbor Lady: How nice. Did the stork bring him?

Little Boy: No, he developed from a unicellular amoeba.

Wife: "I'm so mad I could kill that storekeeper for sending me a bra two sizes too small!"

Husband: "There, there, dear, try to pull yourself together."

jokes . . .

A New Orleans priest was explaining the Church's views on birth control to one of his parishioners, a Bourbon Street musician. "There are two alternatives," the priest stated. "Periodic abstinence and complete continence."

The musician stood silent for a moment, apparently translating the words in his mind. Then, with sudden enlightenment, he said, "I get it, Padre. Rhythm and blues."

A sophisticated girl is one who knows how to refuse a kiss without being deprived of it.

Coed: "I'd like to see the Captain of the ship."

Sailor: "He's forward, Miss."

Coed: "That's all right. This is a pleasure trip."

A shiny XK-E screeched to the curb where a tough-looking co-ed stood waiting for a cab.

"Hi," said the E.E. at the wheel. "I'm going west."

"That's beautiful," came the cool reply. "Bring me back an orange."

The waitress was wondering why the elderly man was eating while his wife was staring out the window.

"Aren't you hungry?" asked the waitress.

"Sure am," was the reply, "I'm just waiting till Paw gets through with the teeth."

Overheard in a M.E. class: "On the last quiz, I got docked five points for having a decimal point upside down."

As he felt his way around the lamppost, the overloaded chemical engineer muttered, "S'no use, I'm walled in."

An EE was in an exclusive jewelry store and was being shown some of the merchandise. The salesman first showed him an emerald and platinum brooch costing fourteen hundred dollars. Feeling it was a bit expensive, he asked to see something else. The salesman showed him a diamond stickpin which cost nine hundred dollars. Getting rather annoyed at the steep prices, the EE asked to see something else. The salesman was about to show him a necklace when the EE spotted a small round object. "What is that?" he inquired.

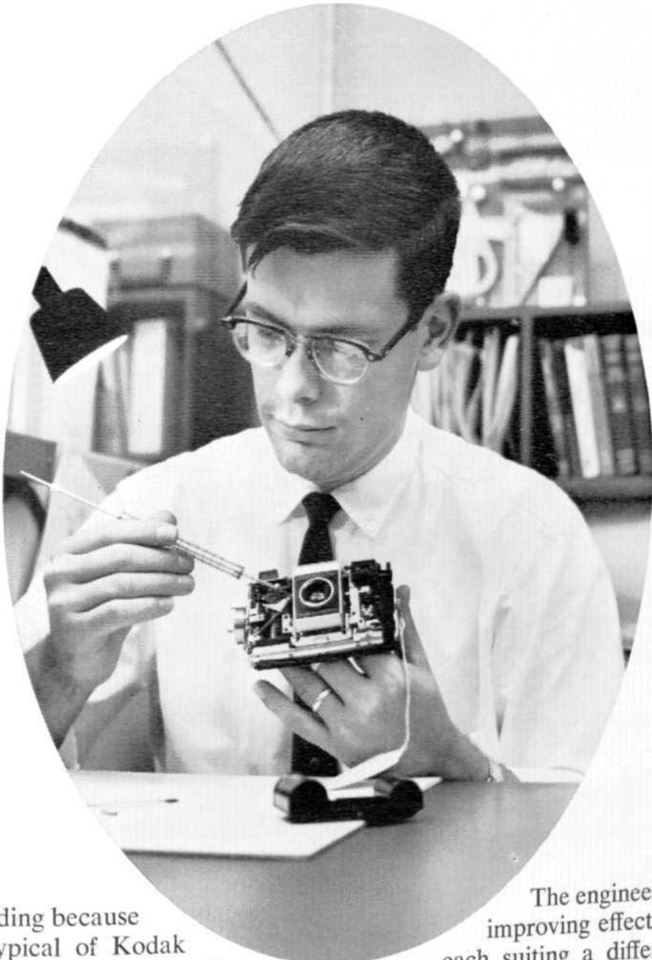
"That is a solid gold pill box selling for $350," replied the salesman.

After thinking for a second, the EE queried, "Wouldn't it be cheaper to have the baby?"

THE ADVERTISERS INDEX

Kodak

This is the image of a Kodak mechanical engineer



Correct, literally. But misleading because Larry Wood's job is not typical of Kodak engineers in general. Most of them get to handle a camera—assembled or disassembled—only at home or on vacation. Unless they happen to be personally hipped on cameras (which Larry once told us he is).

Diversification has been going on here for a long, long time. That's why we can give an engineer plenty of solid ground for choice—at the outset and later. If his personal feelings incline him away from devoting his talents to fun things like cameras, he gets just as good a chance to demonstrate his capacity for higher responsibility through work in the 72% of our business that has nothing to do with fun cameras. He may be solving problems in the packaging of bulk vitamins for dairy cattle or designing spinnerets for polyolefin hay baler twine or making x-ray processing machines run faster so that society can get more use out of its short supply of doctors.

Kodak itself really serves as a magnificently effective machine through which M.E.'s and other engineers can apply their talents against society's demands. There can be no more valid excuse for Kodak's continued existence.

The engineer's duty consists of constantly improving effectiveness. Here are five ways—each suiting a different personality makeup—to fit in:

1. Designing new products and better performance into the established ones.
2. Figuring out the best possible ways to manufacture the products.
3. Applying pure reason through mathematical tools to make the laws of physics serve human needs, not oppose them.
4. Creating the right physical tools, the right plants to house them, and the right services to keep them functioning.
5. Getting out to where the products are being used, showing the users how to get their money's worth, and bringing back word on how to do even better in the future.

If you want more specific details than that, we are very glad. Just communicate with

EASTMAN KODAK COMPANY
Business and Technical Personnel Department
Rochester, N.Y. 14650

An employer that needs mechanical, chemical, industrial, and electrical engineers for Rochester, N.Y., Kingsport, Tenn., Longview, Tex., and Columbia, S.C., and offers equal opportunity to all, choice of location, and geographical stability if desired. A policy of promotion from within has long been maintained.