SPARTAN

Engineer

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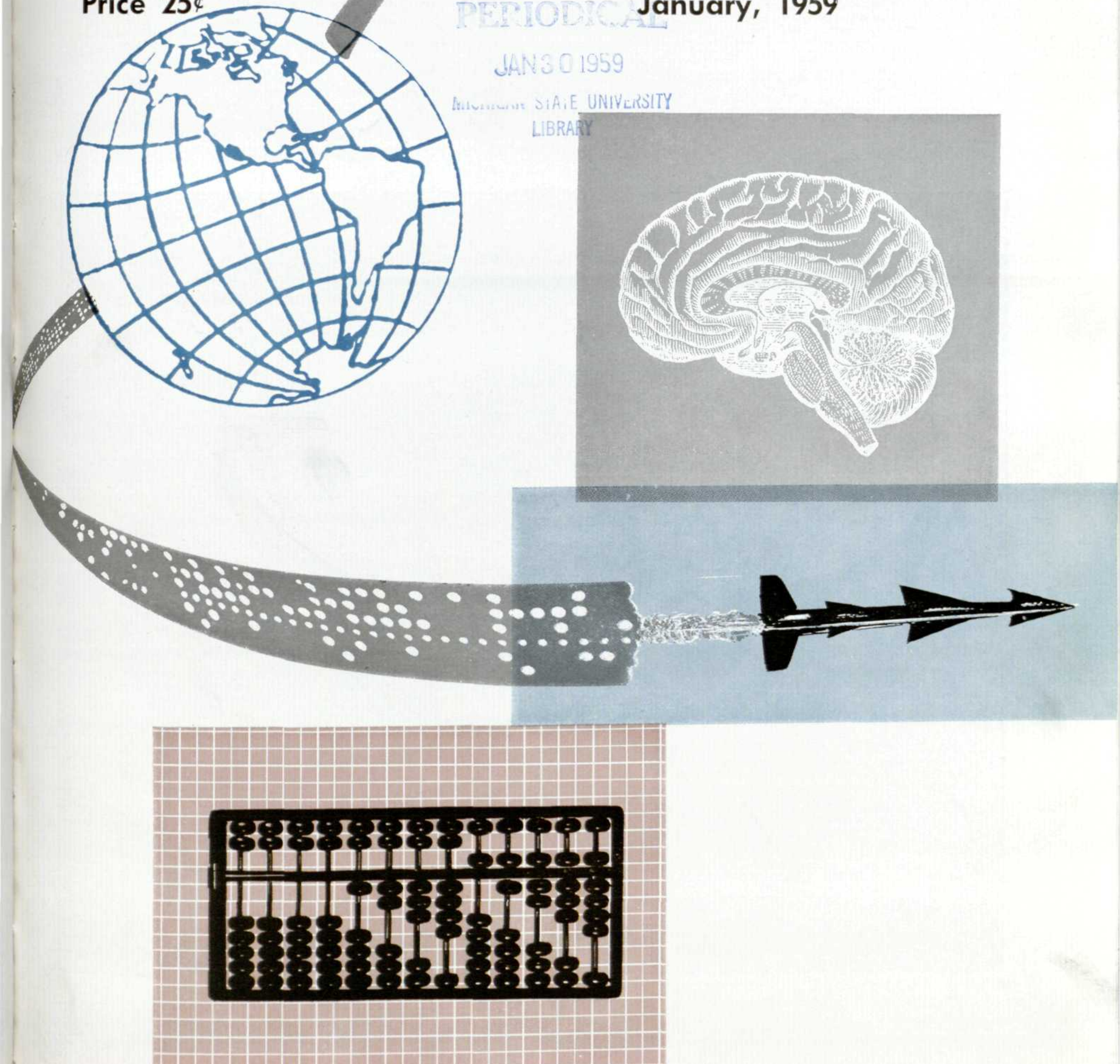
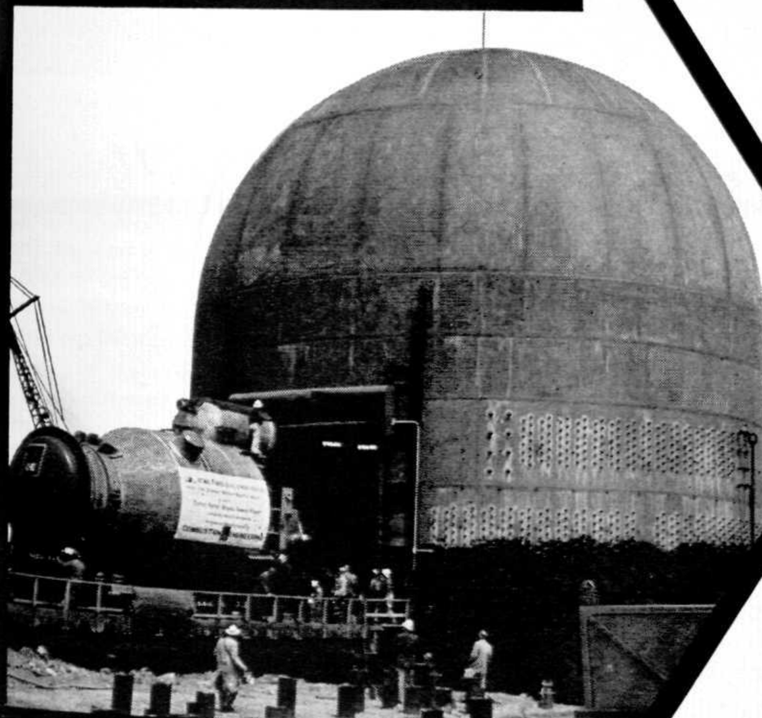
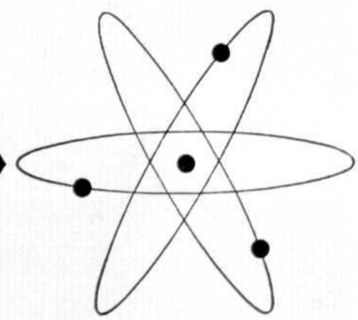
January, 1959



Into the atomic era of new engineering opportunities



The Enrico Fermi Atomic Power Plant under construction near Monroe, Michigan, will have the world's largest breeder reactor for the production of electric power.



To the young engineers of America's electric power systems, the hope and promise of the peaceful atom grows clearer day by day. In laboratories and on construction projects these young men are serving our nation's new atomic-electric power industry.

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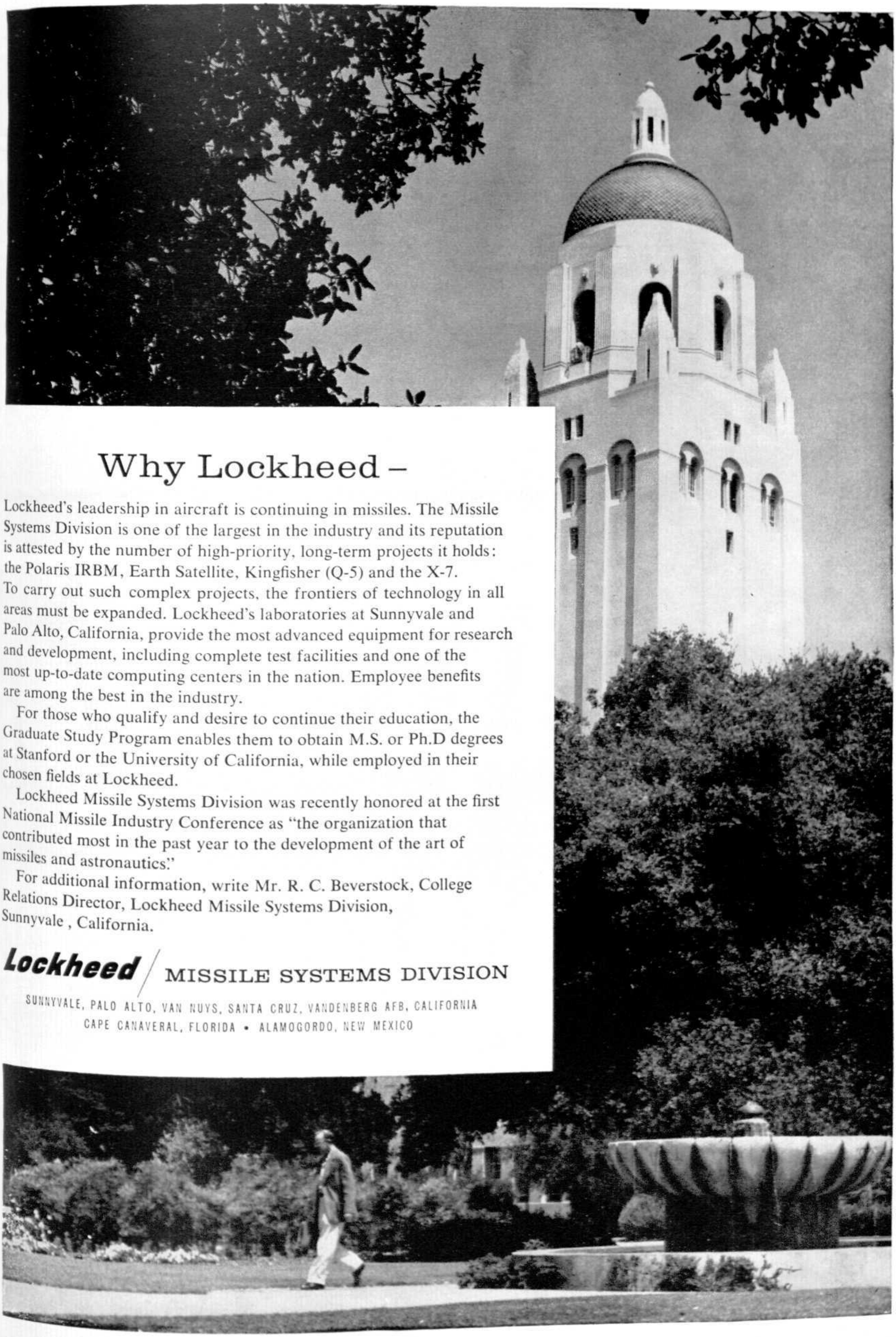

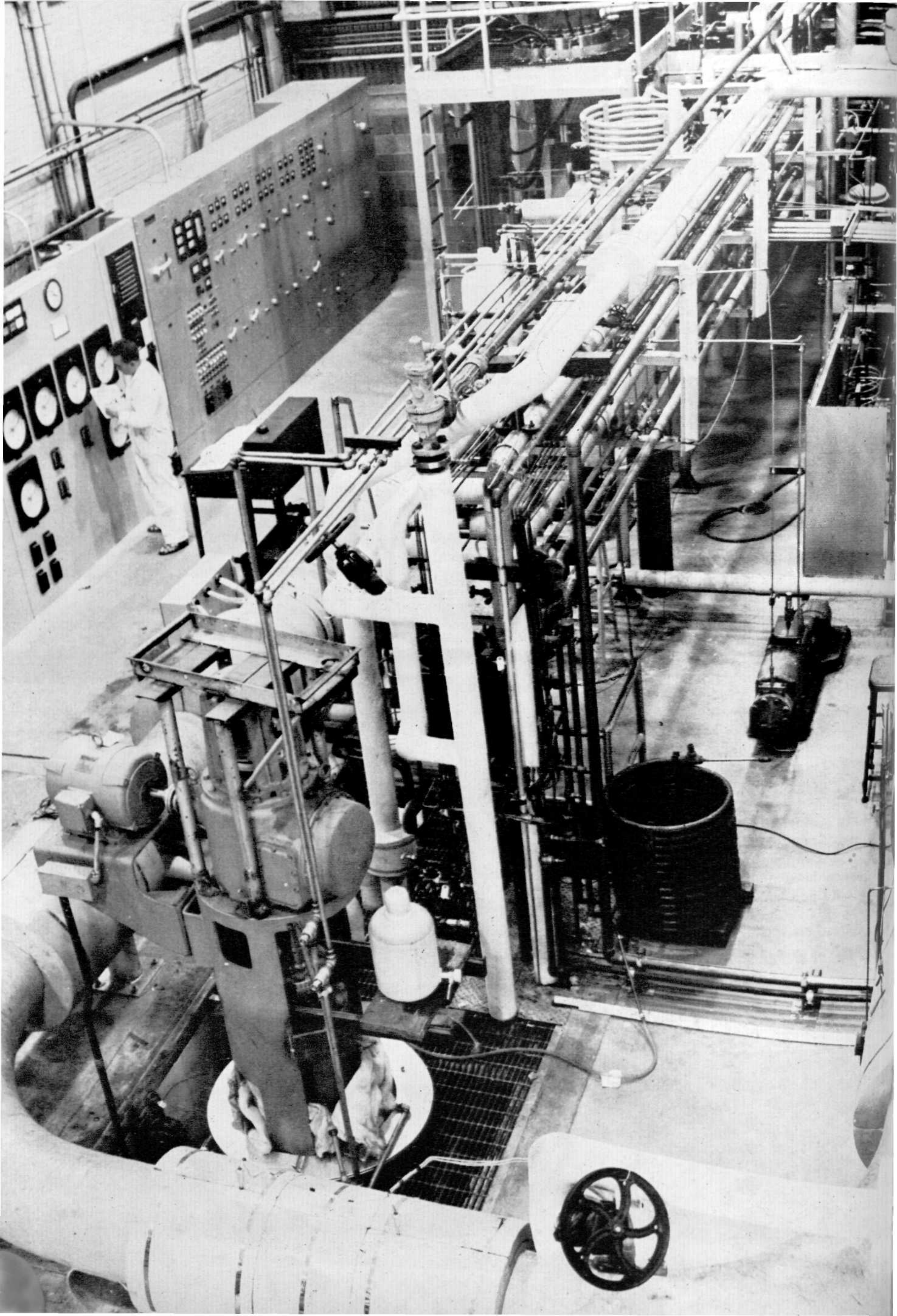

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Spartan Engineer

of michigan state university

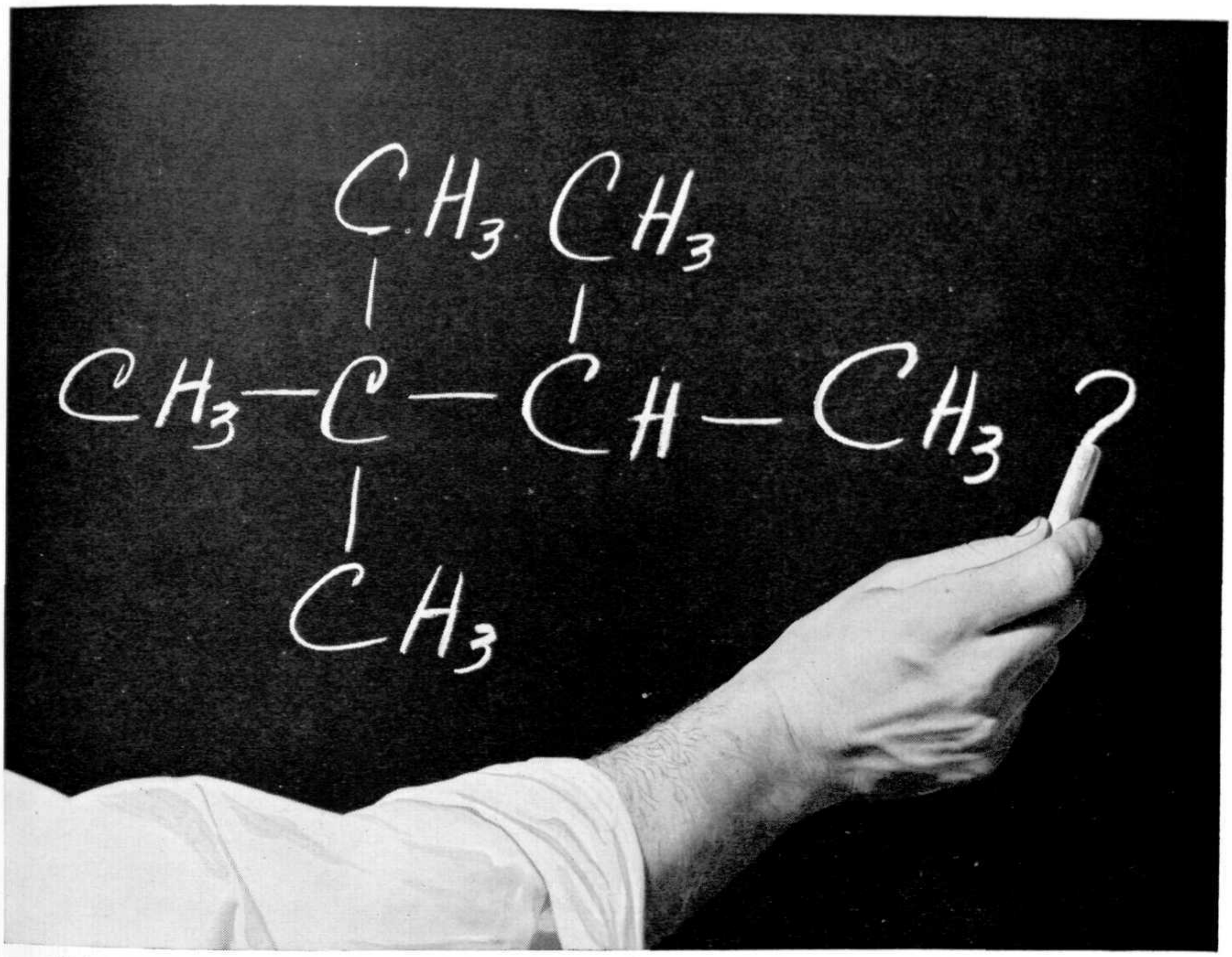
VOLUME 12 NO. 2 JANUARY, 1959

FEATURES

DEPARTMENTS

FRONTISPIECE: This giant piece of plumbing is the world's largest "test loop" for circulating a slurry of atomic fuel—in this case, thorium oxide and uranium oxide suspended in water. The loop is capable of circulating 4,000 gallons per minute at the same pressures and temperatures planned for an aqueous homogeneous nuclear power plant now under study by Westinghouse Electric Corporation and Pennsylvania Power and Light Company near Pittsburgh. The equipment is used primarily for component development, systems work, and verification of certain plant operating procedures.

COVER: This month's Engineer cover, conceived and illustrated for Spartan Engineer by Rogers W. Oglesby, east coast artist/illustrator, attempts to convey the January theme—computers. We feel Oglesby communicated this computerish concept and its binding influence throughout the world. Don't you?



Triptane, whose formula is shown above, represents one of the most important challenges in petroleum research. Although oil companies have been working with this valuable gasoline anti-knock component for 15 years, no method for low-cost commercial production has yet been developed.

We don't have all the answers...yet!

We already know quite a bit about triptane, whose formula is shown in the picture. It is a branched heptane. Scientists at Standard Oil's laboratories can tell you that its octane number is 113. It is one of the best gasoline ingredients ever discovered.

As far back as 15 years ago, triptane could be produced in tank truck quantities. But no one has yet developed a large volume commercial method of making this valuable material.

Triptane represents but one of the creative research challenges that exist in the oil industry. A commercial way to make cyclopentane, another anti-knock material, ranks high on the list of unsolved problems. The same is true of certain hydrogenated polymethyl naphthalenes; their high energy content and low pour-point make them ideal for jet fuel.

At Standard Oil, young scientists and engineers have the opportunity to help solve important problems such as these. Here they can use their skills and knowledge to build satisfying, lifetime careers.

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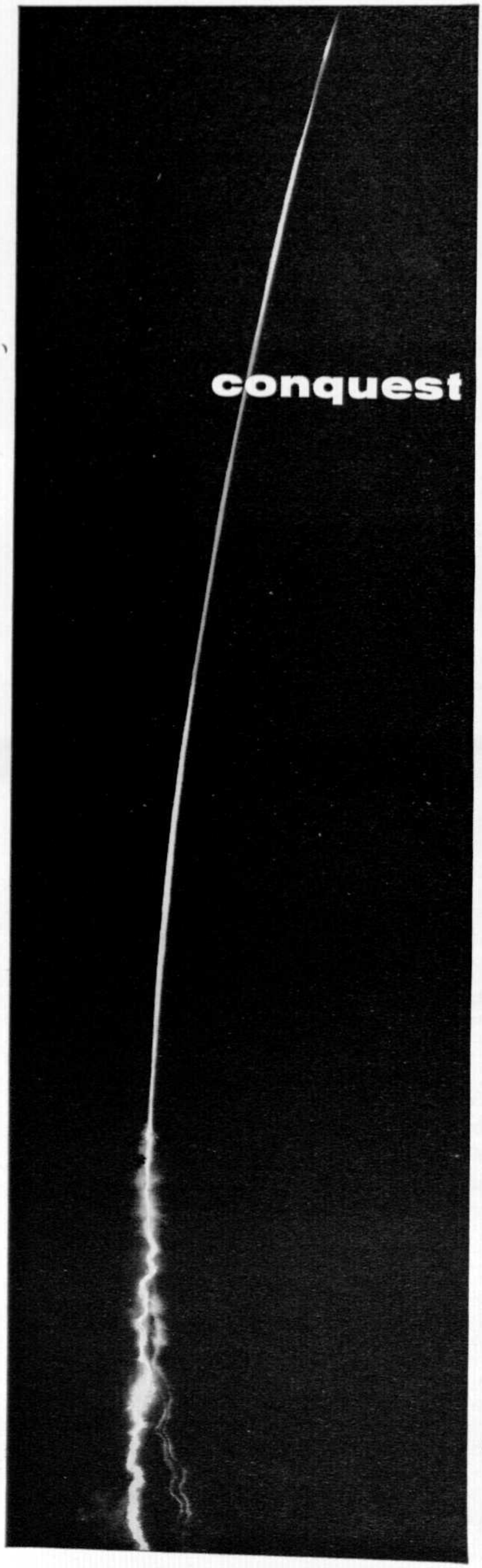

conquest of the thought barrier

Over the years, we have been hearing of many "barriers" in science . . . the sound barrier, the water barrier, the thermal barrier.

Of all the barriers, the hardest one to break through has always been the thought barrier. Every one of these "barriers" has been conquered by men to whom the word, impossible, means: "hasn't been done, *yet.*"

The sound barrier is a shattered concept, as discredited as the phlogistic theory.

Don Campbell's *Bluebird* stopped all talk of the water barrier.

The heat of air friction against the metal "skin" of an airplane was supposed to create a heat barrier at Mach 3. Materials now in production can safely withstand the much higher temperatures involved in flight at Mach 5.

Today the thermal barrier is being called the "thermal thicket"—evidence in itself that no barrier exists.

An interesting point that all of these "barriers" have in common: each was conquered with the help of nickel-containing alloys.

This is not surprising when you stop to consider how many useful properties and combinations of properties are offered by the various nickel alloys:

Corrosion resistance to a wide variety of solids, liquids and gases . . . strength at high temperatures . . . toughness at sub-zero temperatures . . . unusual electrical properties . . . ability to protect product purity . . . spring properties.

When you are faced with a metal problem, investigate Nickel and its alloys. Inco's List "A" and List "B" contain descriptions of 377 Inco publications which are available to you, covering applications and properties. For Lists "A" and "B", write Educational Service.

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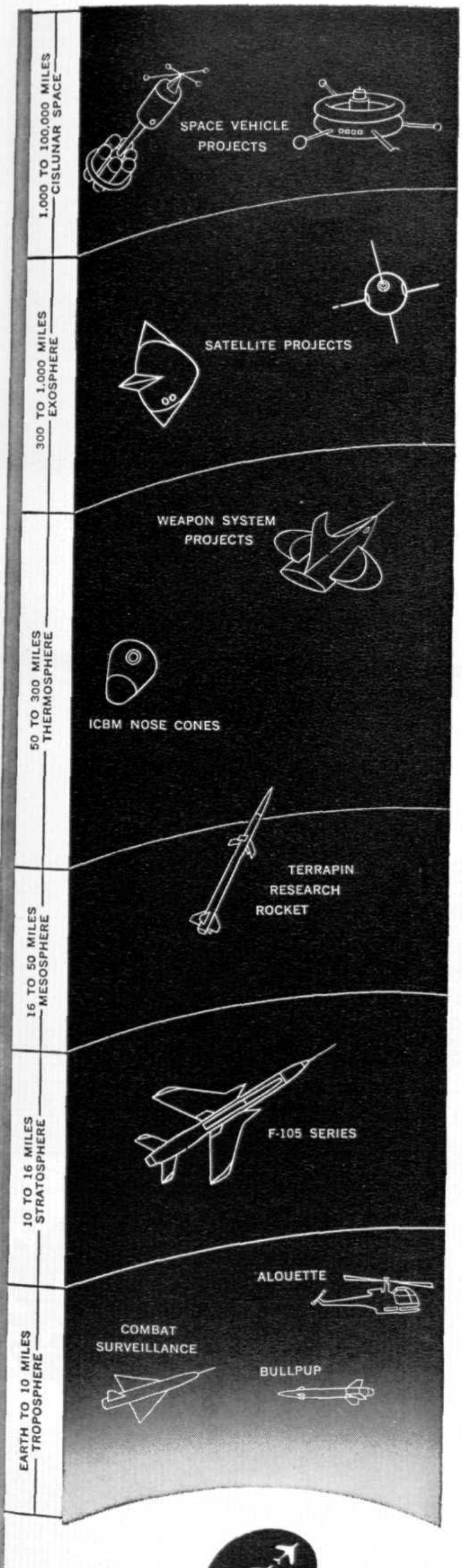

SCIENTISTS • ENGINEERS

at every altitude where vehicles now fly or men dream of flying them...

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Prelude to space
The U. S. Air Force's LOCKHEED F-104A STARFIGHTER, fastest production airplane in the world, is one of the current crop of military aircraft whose extreme speeds and operating altitudes typify the problems of projecting man into space and keeping him alive. HAMILTON STANDARD designs and builds the air conditioning, engine fuel control and engine starter equipment for the F-104A and other leading supersonic aircraft. This experience is now being used as the springboard for investigations into the problems of environmental control for human survival in space.
USAF
FG-786
The refrigeration package shown at the right which Hamilton Standard builds for the F-104A has the capacity to cool a seven to nine room house and weighs only 50 lbs.
If you are interested in sharing in the fascinating work that will help make possible man's new age of flight, contact:
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or arrange for an interview with your college recruitment officer.
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Dean's Letter

Some of you may recall that Shakespeare wrote that man went through five ages in passing from the cradle to the grave. It would also appear that an alumnus of an engineering college could expect to pass through five ages in his technical life as he goes from the academic halls to his ultimate reward.

The first age, which he enters immediately upon graduation, may be called that of the applied technologist, and may last from two to five years or so. In this age the young engineer is learning the practical tricks of his trade, finding out that not all problems have concise answers, that in fact not all problems are concise problems. In returning to his alma mater at Homecoming he will plead for more practical and applied courses—each suited to his field of specialization of the moment—or he will regret that no one ever told him that screws come in precise sizes or that 49½ pitch gears are not common.

If he is going to be a good engineer he manages to survive this early trying period and passes into his second age, that which may be called the scientific technologist. He has now learned the practical tricks of the trade, as employed in his own segment of the profession, and has advanced to a position where he is able to see a little more of the forest and not so many of the trees. His is now the position of selecting the methods of attack on some of the new problems facing his department, he is in a position to propose new techniques, and he is expected to plan the work for the latest generation of applied technologists from the colleges. He now wishes that he had studied harder in physics, chemistry, thermodynamics, fluid mechanics or electricity—or possibly that college had taught him the intricacies of inertial guidance and space orbits.

In his third age, which he may enter five to fifteen years after graduation, he becomes a technical supervisor. He has now become responsible for a section or a small department—he assumes some responsibilities of management as well as continuing his technical supervision on a higher planning level. He now realizes the advantages inherent in delivering on Tuesday the report requested by the boss for Wednesday, and he also learns that engineers and the clerical force are people. His regret is that he overlooked those courses in personnel supervision, accounting, and industrial organization that he could have taken as electives.

The fourth age—the next rung on the ladder—is that of technical manager. Here he is responsible for a large department or a complete plant, and he may report to a president, or a vice-president. He is concerned with profit and loss, labor law, marketing, management theory, and finance. His technical responsibilities lie largely in creating, encouraging, and guiding a good technical and research staff. He regrets not having taken corporation law, banking, and finance in college.

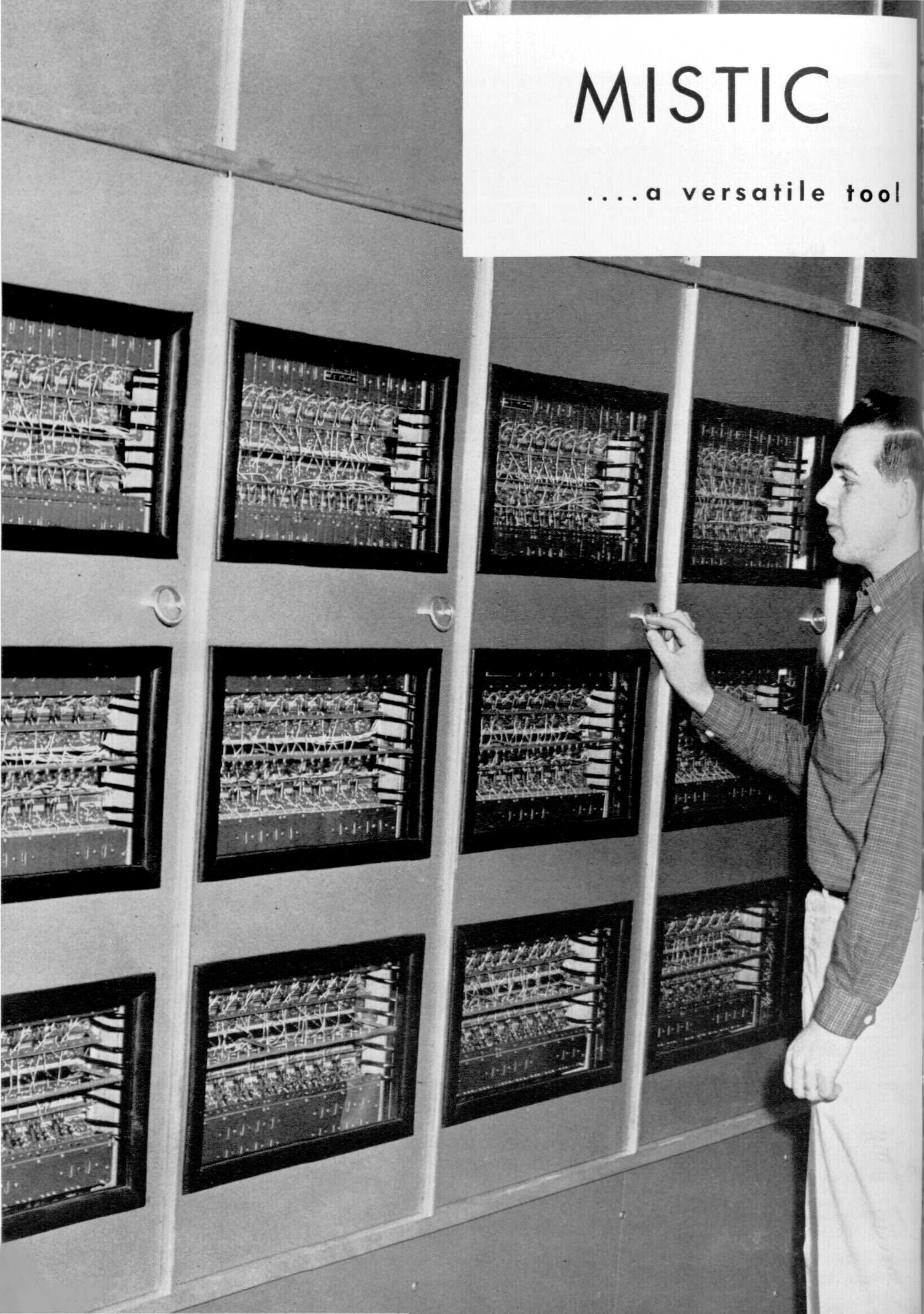
And in the fifth age he has reached the apex of his own organization—president or executive vice-president. He has developed a smooth running technical organization, and continues to impress upon his staff the need for further technical advances as he watches the world and his nearest competitor. He spends the winter in Florida or Arizona where he has prudently established branch plants or offices which may need supervision at such appropriate times. He develops interests in the community, the arts, travel, music, and regrets not having spent more time on these social-humanistic topics in college.

This is the age of the complete engineer.

John D. Ryder, Dean, College of Engineering

MISTIC

....a versatile tool



by Edward H. Scharmer, E.E., '61

"TELL ME, does the school have a computer?"

"Oh sure! They call it Mistic. It is located on the top floor of the E.E. building."

"Oh! Well what do they use if for?"

"You know. They use it for research and solving problems and that sort of stuff."

"I know that they solve problems with it but who are 'they' and what kind of problems do they solve?"

Has this type of conversation taken place between you and some of your visiting friends? Are you one of the people on campus who think that Mistic is a big black box that is used by the science departments for the solutions of the deepest and darkest of problems? Well, let me show how wrong you can be. The computer is a versatile tool used by many departments throughout the school. Here is a list from the Computer Lab Progress Report for October, 1958, of the distribution of machine time.

	Hours
Chemical Engineering	85:09
Agricultural Economics	11:01
Computer Laboratory	10:48
Mathematics 451	10:24
Psychology	7:45
Electrical Engineering	7:19
Communications Research	5:08
Political Science	4:57
Bureau Educational Research	4:25
Statistics	4:02
Civil Engineering	3:31
Demonstration	2:50
Physics	2:33
Sociology and Anthropology	2:05
Applied Mechanics	1:50
Economics	0:58
Chemistry	0:33
Agricultural Engineering	0:25
Mathematics	0:22
Bureau Economic Research	0:17
Evaluation Services	0:10
Dairy	0:08
Administration Services	0:05
TOTAL	166:45

You may wonder just who in these departments are using the computer. Dr. Koenig of the Electrical Engineering Department used the computer to solve a problem in design. He and a graduate student, Mr. Kesavan, are working on a problem inherrent to all DC rotating machines, that of commutation design. The problem has been with us since the invention of motors and generators which dates back to the time of Edison. The solution of the problem involves the completion of endless mathematical equations for each and every type of machine. Dr. Koenig has completed a solution and transformed it into the language of the computer, punched tape, to form a sort of master plan for commutation design.

It is now possible to introduce various parameters into the machine and note the results, or, better still, to design by repeated analysis. This process, also known as reiteration, consists of informing the machine of the solution desired and then letting it vary the parameters until this solution is obtained. This may seem like a lazy man's way of design. However, the computer is available for this purpose, and is faster, more accurate and cheaper.

As Dr. Koenig pointed out, this concept of design would change the type of engineer in demand. No longer will the "battery of slide rule pushers" be necessary. The type of person needed now is a responsible man with wide background who can grasp the complete picture of the problem and make the best possible use of these prepared tapes.

Research in Economics

I next ventured over to Morrill Hall, a place usually not connected with science or engineering, and spoke to Dr. Wolfson of the Economics Department. Dr. Wolfson had used the machine to perform a regression analysis, a standard type of research undertaken in the economics field. An example of such an analysis is the problem of trying to relate the distribution of employment in areas of various population. Dr. Wolfson compiled his data from Government statistics of areas within some twenty-two counties around New York City.

In analyzing data of this type, with such a large number of variables, the mathematical process is a job that could not be done with any amount of accuracy until the computer had been introduced. Even with the computer, the output was comprised of "bales and bales of paper."

The procedure used is a standard procedure for which there are programs on tape available in the computer library. Dr. Wolfson needed only to enter his data into the machine, which in this case was easy since it was on IBM-punched cards. The cards were run through a converter which automatically put them on tape. Although Dr. Wolfson did attend a short programming course, he feels that it was not at all necessary for his type of work.

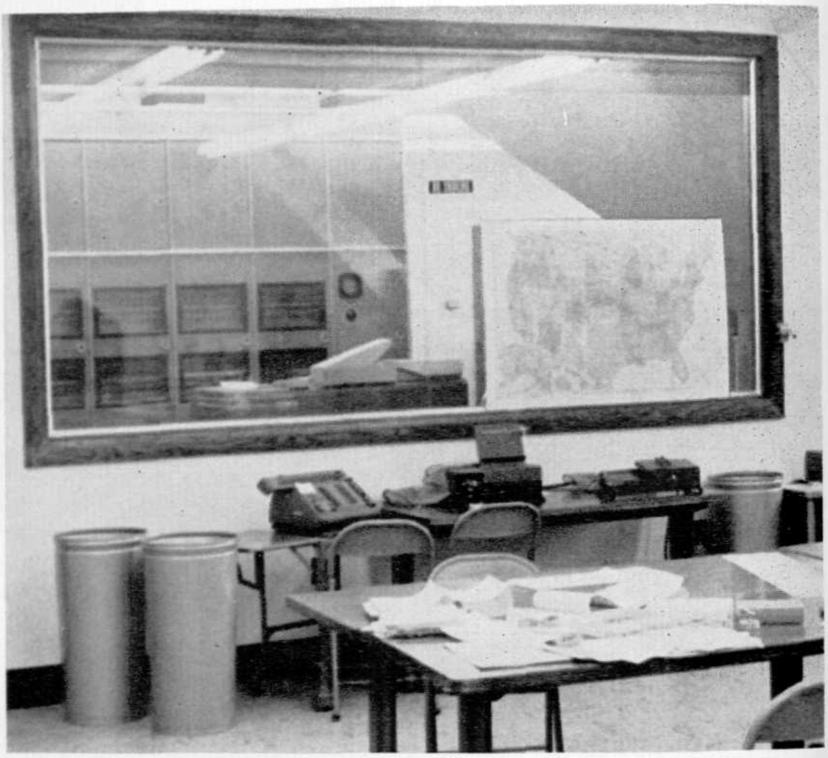
(Continued on Next Page)

The perforator provides a means of copying or correcting programming tapes.

MISTIC Designs Cyclotron

As you may or may not have heard, the University is trying to obtain funds to build a cyclotron on campus. Even though the time schedule for capitalization is still indefinite, the work has not been delayed. Design has been under way for about nine months now and will probably take another year and a half to complete. In speaking with Dr. Blosser of the Physics Department I found a number of interesting plans aside from what Mistic is doing to help in the design. First question asked when one hears that something new is to be built is: when? According to Dr. Blosser, construction should begin in the summer of 1960 and be finished in the winter of 1962. This is, of course, assuming that the necessary funds are available. Where will it be built? It will have its own building which will be connected to the south end of the Physics Math. building and extend slightly into the parking lot.

The use of the computer here is much the same as in any other field. It is used to do the lengthy computations that must be done repeatedly. This, as you may know, is the outstanding feature of the machine. Computers have some times been termed "brains." Morons would be the more appropriate name for them since they think of nothing new themselves. They know and do only what they are told.



The computer, located in a climate-controlled room, is always visible to the programmer in the adjacent working spaces.

Dr. Blosser has used the Mistic for about ten hours in conjunction with the cyclotron design problem. He has also made use of the Oak Ridge computer and the computer belonging to the Midwestern Universities Research Association located in Madison, Wisconsin. Although he would rather use the Mistic since it is so handy, he finds that this is not always possible. The memory unit of the Mistic is not, at present, large enough to handle his procedures.

"Dr. Blosser," I asked, "would it be possible for you to take programs that have been designed for computers other than the Illiac type (from which the Mistic has been designed) and use them to program the Mistic?"

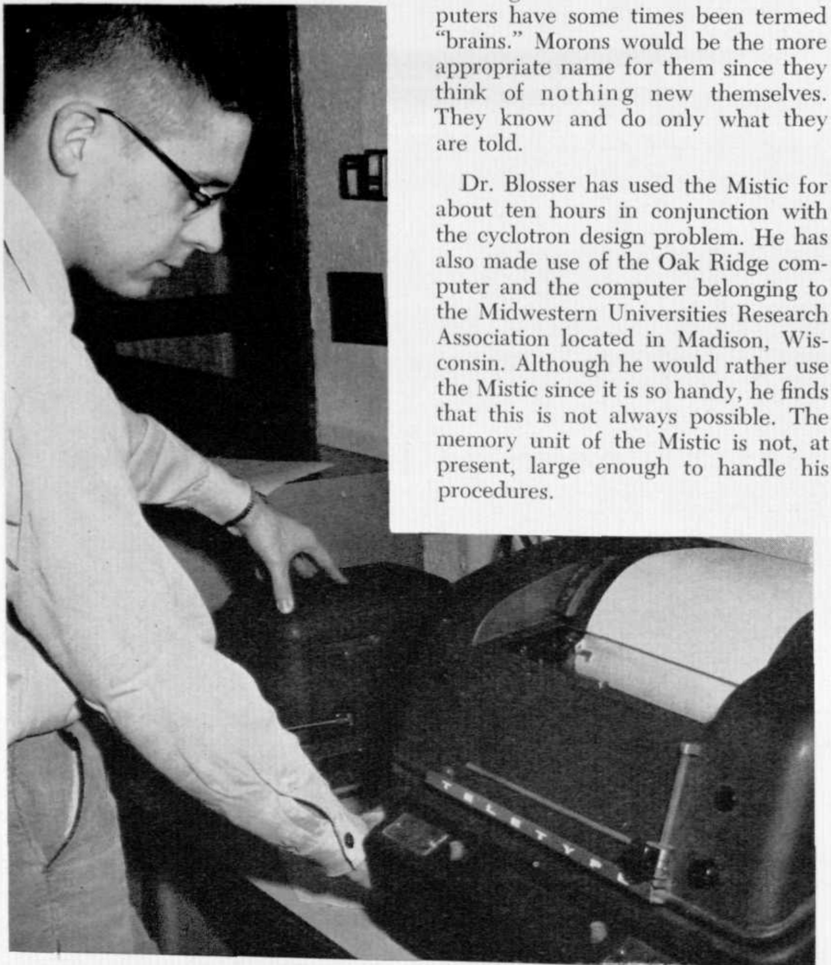
"No, not directly," he said. "The logic of the program could be used to compose a program for the Mistic, but the program as it stands could not be used."

Vibration Analysis Made

Switching over to the Applied Mechanics Department, I spoke to Dr. Mercer who had also been using the computer for research. He had been preparing a paper for the ASME which was published in the November 1958 issue of ASME transactions. The actual problem he was dealing with was a problem in vibration analysis. He was applying cam excitation to a spring mass system and noting the vibration throughout the system. This analysis, not unlike the problems in the other departments, results in the solution of repeated computations that, without the computer, would result in an endless webb of mathematical confusion.

Dr. Mercer felt that the programming of the machine to do his work was no problem, so little problem in fact that he had a high school student do it for him. Dr. Mercer himself first learned to program a computer at Purdue where he was a grad-

(Continued on Page 52)



The Teletype machine serves as an interpreter between the tape and the programmer.

One Jump Ahead

by Philip R. Humbaugh, Mth., '60

. . . when playing a game of checkers or chess.

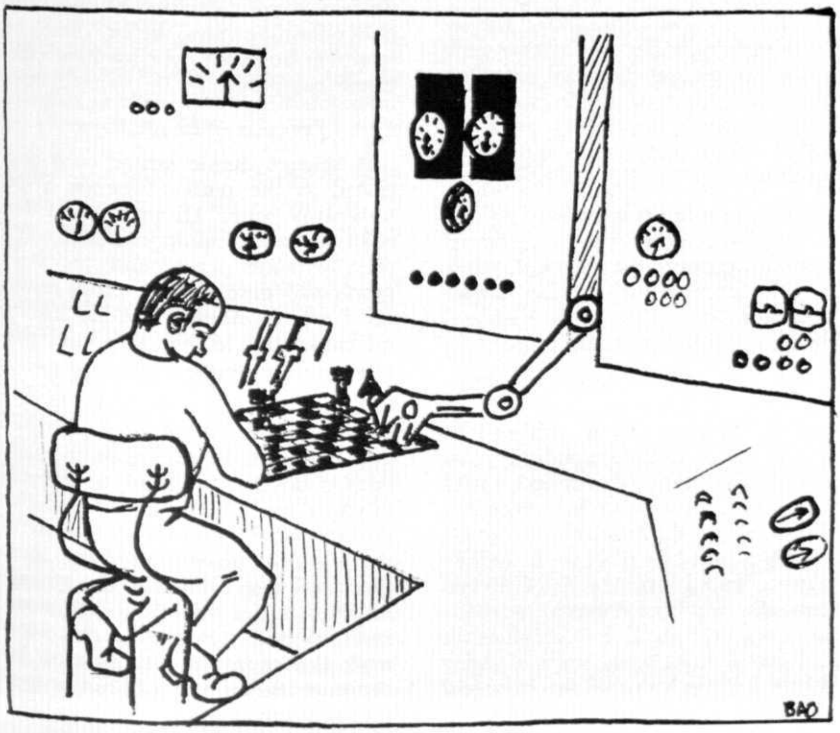
THE man sat in a quiet room opposite a large machine with flashing lights on a control panel. Between the man and machine lay a board marked off in squares. On the board were figurines, some black, some white. The man picked up a black piece and moved it one space on the board. He then typed up the symbols which represented the move he had just made.

When placed in the machine a great whirring of gears and flashing of lights took place. In less than ten minutes a printed card came out of the machine with a symbolized move stamped on it.

This same scene is repeated again and again until finally, the machine prints a card which reads "Thank you for an interesting game."

Years ago this would have sounded like a dream. Men have always thought it possible to build a machine capable of playing chess, but, lacking the background and knowledge required, were unable to conceive its construction.

One of the first and most famous chess playing machines was built in 1769 by Baron Kemplen. It toured all over the world, and managed to deceive thousands into thinking it played the game automatically. This machine, described by Edgar Allan Poe, is said to have defeated Napoleon, who was considered to be quite a good chess player. The machine, however, met its own Waterloo when, in the course of a game, someone yelled "fire" and the machine went into a fury of activity due to the efforts of the little man inside to escape.



Today there are machines, i.e. computers, in this country, as well as other parts of the world, which can play a respectable game of chess, checkers or the old standby, "tic, tac, toe."

Chess is probably the most interesting of the games a machine can be instructed to play. It has fascinated people of all ages for years. Chess champions are honored all over the world. The reason chess is such a vitally interesting pastime is because of the almost infinite number of different games that can be played.

The average number of moves in any given situation in chess is about thirty. The length of a game is about 40 moves. Therefore, there are approximately 10^{120} possible games. If a man could make a machine capable of playing a million games a second (a ridiculous assumption even looking into the future of computers) it would take 10^{108} years to play all possible games.

The idea that digital computers can be programmed to play a game of chess is no longer a matter of ques-

(Continued on Page 32)

PROGRAMMING . . .

responsibilities are now being assumed by management. The highly specialized engineer is not able to handle industry's problems on electronic business computers.

by Bob Slade, E.E., '59

AN executive with a taste for doing things his own way frowns on a small memo announcing the first cutback in his "empire" of seventy five clerical workers. Two floors below his office, in an air-conditioned chamber, electronic machinery hums and clicks in ceaseless activity.

A labor leader pounds his fist on the bargaining table over twenty new employees not yet classified as either labor or management. In the next building one of the twenty translates statistics into perforations on a long paper tape.

An eastern buyer is amazed to find that his latest order will be delivered four weeks sooner than the last, while a midwestern school teacher smiles to find in the mail a fatter dividend check from her insurance company.

Incidents such as these are becoming increasingly common. They are victories, defeats and skirmishes in a new revolution. Two hundred years ago man's industrial strength, with power and production far exceeding that of his hands, began the economic growth which has resulted in today's unprecedented standard of living. True, the changes then were costly in terms of general handicraft skills and certain traditional ways of doing things, but the gains of the industrial revolution have been obviously far greater than its losses. The revolution going on now may soon bring our economy as far again or farther than it has come in the last two centuries. The process should be just as profitable for many, and may be just as disastrous for some.

Within a generation much of the clerical work, decision-making and policy-forming now being done by men will be taken over by giant electronic computers.

Progress Without Paper

A science fiction writer once suggested as the perfect weapon a gas to destroy paper. He maintained that no organization, military or civil, could exist without paper, and his story graphically described the chaos resulting from a country's sudden loss of all banknotes, letters, files, and personal identification.

There is more truth than fantasy in such an idea. It has been estimated that over half of the labor in many large industrial concerns is devoted to paper work. In terms of the public pocketbook, this means that many of our common necessities from shoes to soap cost us over twice the expense involved in raw materials, production, and handling. But without this paper work the supply of our present day consumer demands would not be even remotely possible.

As business and industry grow bigger and more complex, this paper monster threatens to consume an even greater proportion of the total energy expended. Hence, the revolution. The threat is being met by a rapidly growing army of electronic computers.

In 1954 it was estimated that perhaps fifty companies could find use for an electronic computer. But the potential of these versatile devices was not reckoned with. Today there are over 1700 computers being used by some 1200 companies, the government and the armed forces.

What are these "brains?" How do they work, and what are their limitations? Purely technical answers to these questions can be tediously complex. A general approach, however, is not only fairly simple, but can be interesting as well. In principle there are four basic parts to an electronic computer. The first is an arithmetic device; the second, a control element; the third and fourth, numerical and program memories, respectively. The entire brain compares readily to a simple desk calculator with a human operator. The arithmetic part is comparable to the calulator itself and the control to the operator, while the numerical memory is similar to a worksheet containing intermediate results, and the program memory to the operator's instructions on how to perform the calculations necessary.

The process of giving a computer a problem along with instructions for its solution is called "programming." Such instructions are usually given encoded on a perforated paper tape, or on a magnetic tape. These instructions might read something like, "A 122 243 527" which means, "Add the number in element 122 to the number in element 243, then add the sum to the number in element 527." A computer can also make decisions such as that involved in the instruction, "If the number in element 2 is smaller than the number in element 3, continue with these instructions. If it is larger, follow the instructions in element 4, then come back to these."

All in all, a computer may be capable of performing over thrity different operations. It is most efficiently used in lengthy and repetitious calculations which would take a person, even using a desk calculator, a much longer time.

In addition to the 1700 computers now in use, there are over 3000 more on order at prices ranging from $300,000 to $2,000,000. Dozens of these are additions for companies already operating computers. Such success in growth implies an equal success in operation. Unfortunately, this has not always been the case.

Computers Are Often Not Practical

The advent of electronic computers in business four years ago was heralded with high, but not very wise, hopes. Since then there has been a good deal of disappointment. Three major causes of this exist: there has been a "band wagon" tendency for some companies to get a computer simply as a "good thing," costs have been misunderstood, and the machines have been frequently put to narrow use, restricted almost exclusively to rountine clerical functions.

> The Oakland Naval Supply Center has announced it plans to install the newest and fastest transistorized digital data processing system on the market today, the Transac S-2000.
>
> According to a Navy spokesman, this electronic "brain" can compute an entire payroll for 8,500 people and savings bond deductions for 14,000 people in just 22 minutes.
>
> The Transac S-2000 also can add 10 digits plus 10 digits 60,000 times in one second, read or write information on magnetic tape at the rate of 90,000 characters per second, and print reports at the rate of 900 lines per minute (120 characters each line).
>
> Rear Admiral R. J. Arnold, Commanding Officer of the Naval Supply Center, said the new data processing equipment will greatly facilitate the work at the Center, which provides 90 percent of the supply and logistic support to ships and shore stations in the Pacific ocean area. This involves processing over one million orders per year from an inventory of 635,000 different items of stock which have a $788,000,000 inventory value.
>
> The Transac S-2000 will replace another electronic data processor that has been in use at Oakland since February, 1957. The Transac will handle a wide range of data processing functions such as order control, accounting, stock control and payroll. Not only will accounting procedures be improved through greater accuracy and system integration, but the new Transac will save the government money.
>
> Since the Transac S-2000 is fully transistorized, it generates very little heat and occupies much less space than a conventional vacuum tube computer. It can be entirely enclosed in an area about 1,000 square feet.
>
> Transac data processors have almost unlimited storage capacity. Stock status records for all 635,000 items of material stored at the supply center can be stored on two and three-tenths reels of magnetic tape, 10½ inches in diameter.

It has been said that computer experts are those whose computers haven't been delivered yet. A number of companies desired to purchase a computer, and did so without careful appraisal of their needs. Filled with rosy hopes for vast, but ill-defined savings, they overlooked the fact that much of what they expected to gain could have been managed just as well by a reorganization of existing structures. On top of this in only a few cases were the computers able to perform at anywhere near "theoretical" capacity. From the beginning the outstanding exceptions to this have been insurance companies, utilities and banking houses. But such businesses contend with a large and continuous flow of numbers, and could easily shift existing systems over to a computer with a minimum of experimentation.

The costs involved in the installation and operation of a computer are actually much larger than they might appear at a glance. The total cost of an adding machine or desk calculator barely exceeds its initial price tag. There is no additional staffing problem because most of a company's regular clerical help can operate one. Installation is simply a matter of deciding which desk to put it on, and electric power costs only a few cents a month. A computer is another matter entirely.

Most large computers require a full time staff of from 13 to 17 trained technicians. In addition to this, 24 to 48 clerks are needed to handle information going into and coming from the machine. The total yearly pay for this staff averages $220,000. Other annual costs are power and spare parts—$15,000, and rental—$300,000 or more. On top of these, there are set-up expenses. Before the computer is even installed a feasibility study to determine the best use may amount to more than $150,000. Installation itself, involving such things as air-conditioning and special wiring, will come to another $150,000, while initial programming will cost in the neighborhood of $350,000. Once installed, parallel work necessary while the computer is adjusted to its job will call for a third $150,000. Amortizing these costs over five years adds a total of $160,000 to the annual expense.

In regard to expense, then, the computer is obviously no common office machine. If it were at all comparable, we would stop at the basic cost, the price tag of which, in this case, is the annual rental of $300,000, less than one half of the total.

Frequently a computer has been obtained with the idea that it will be nothing more than another office machine. As a result, it is used for little more than routine clerical work, and its potential as a computer goes to

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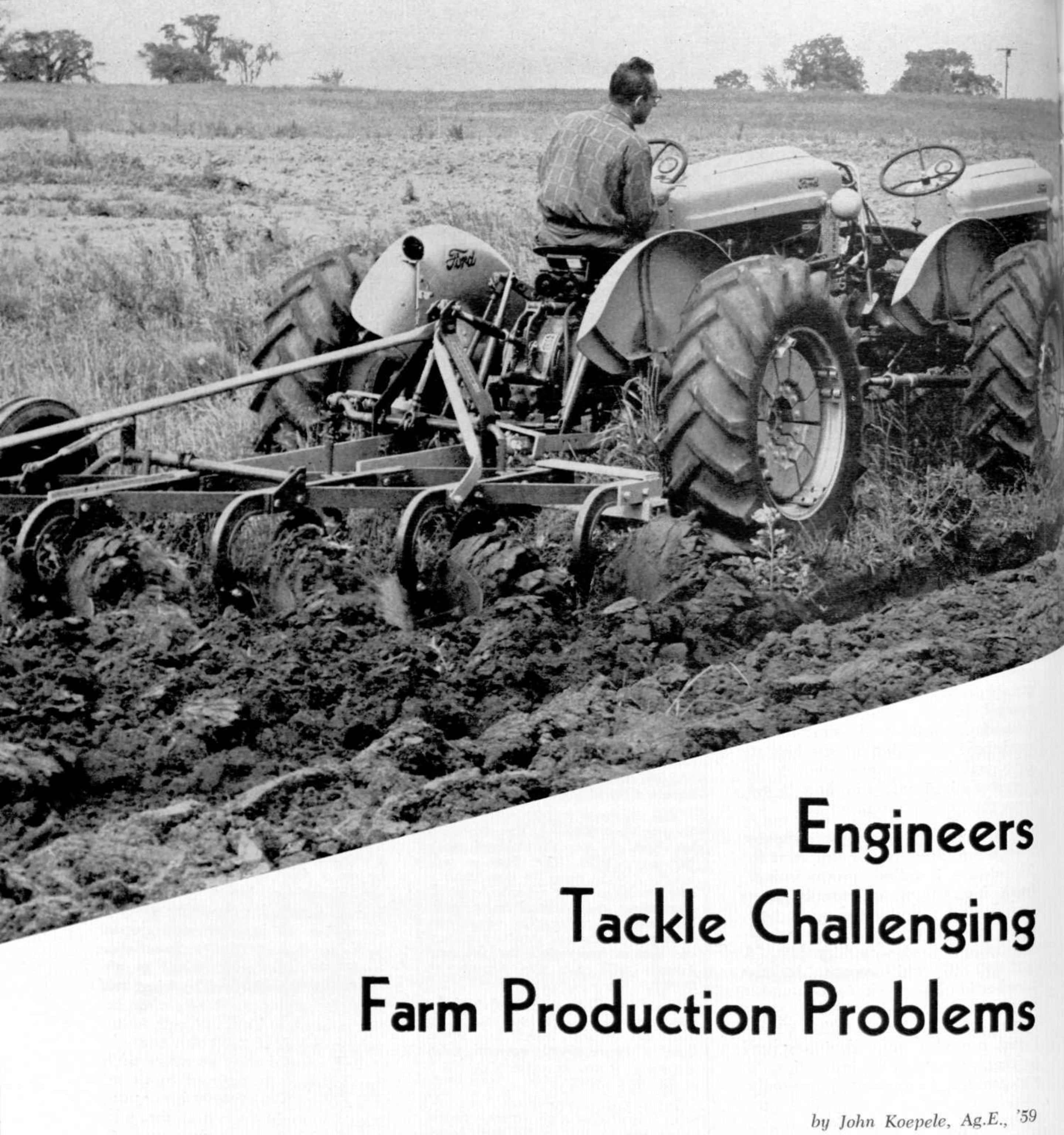

Engineers Tackle Challenging Farm Production Problems

by John Koepele, Ag.E., '59

THE Agricultural Engineering building on South Campus is a long way from Olds Hall. However, Ag. Eng. is an integral part of the engineering college, and these engineers have a real job cut out for themselves.

Agriculture, the production of food and fiber, is the oldest of all industries. Technologies in engineering and in agriculture have greatly increased the productive capacity of the land and farm. For example, in wheat production, it is possible to produce an acre of wheat with 1.82 man hours of labor instead of 57.7 man hours required 100 years ago. Today's farmer has at his disposal about 36 mechanical and electrical horsepower per worker to help him with his work.

To prove that agriculture is a big business, in 1955 it represented 40% of the gross output of the United States. Last year there were more tons of hay produced in the United States than tons of steel. The volume of a ton of hay is approximately 50 times that of a ton of steel. Last year the value of agricultural products was over 32 billion dollars at the farm level and 90 billion at the consumer level. The automotive industry was 26 billion dollars and petroleum products were valued at 25 billion dollars. It is this gigantic agricultural industry which the agricultural engineer serves.

The agricultural engineering profession is one of the younger engineering professions—slightly more than 50 years old. There are now 43 colleges and universities in the United States offering a professional agricultural engineering curriculum. Michigan State University first offered this curriculum in 1906 as a service department. The curriculum was accredited as agricultural engineering in 1950 due to the demands of industry for an engineer specifically qualified to work on agricultural problems.

Present trends in farming and in the entire agricultural industry as a whole focus more attention on the need for engineering service in agriculture. The number of farmers in the United States is decreasing, but more businesses than ever are involved in serving the farm and in working with farm products. In farm production, there are pressures to improve efficiency, to reduce labor requirements and costs of production.

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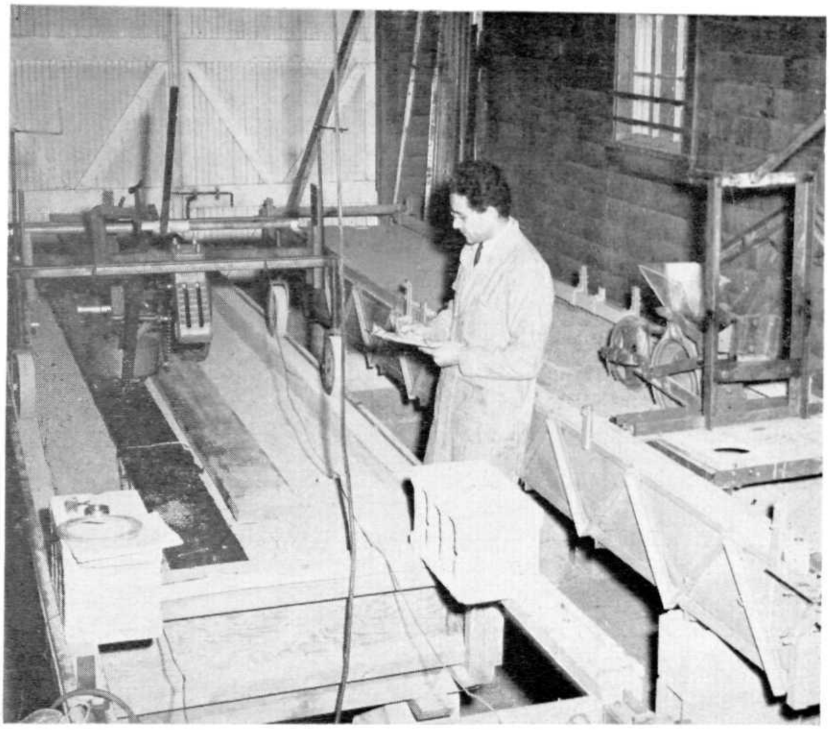
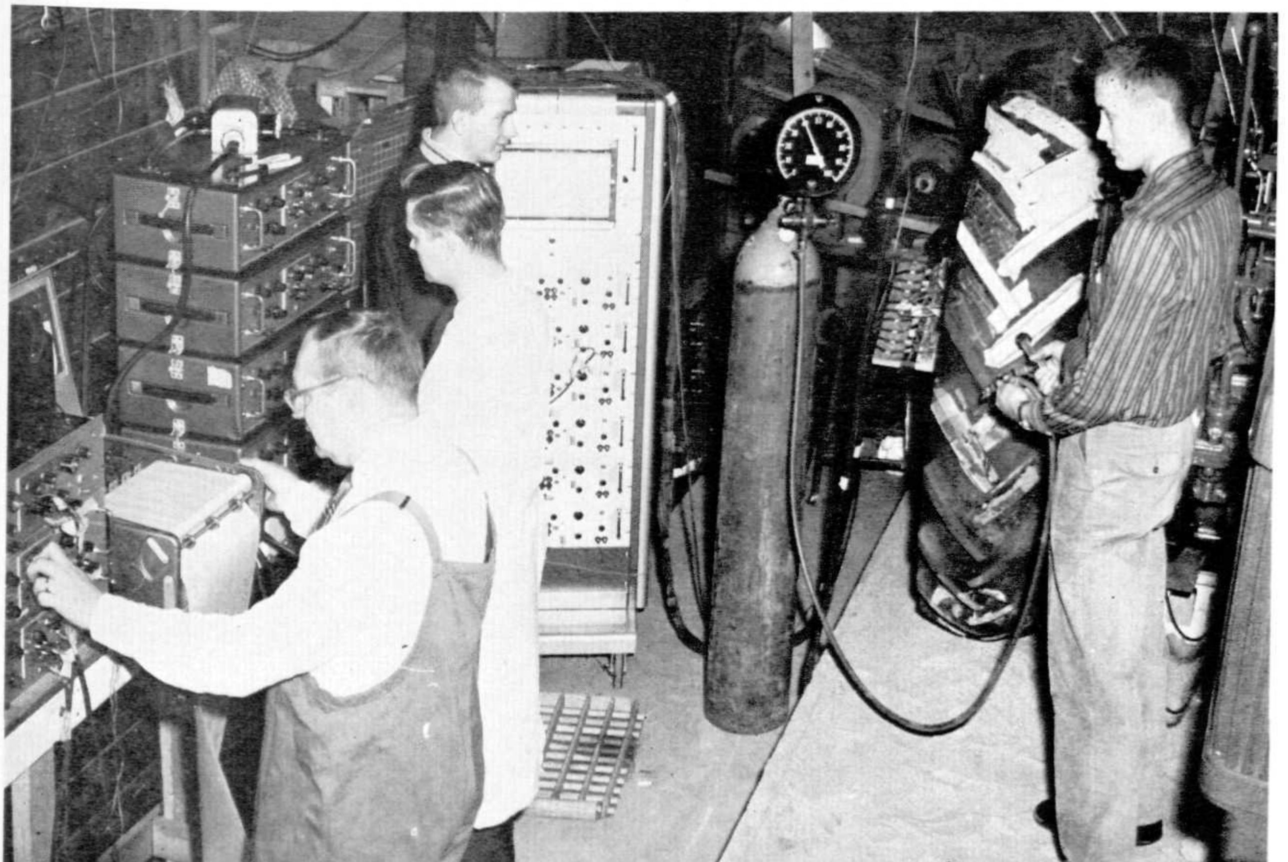


One of the research projects being run by the Agricultural Engineering Department is the redesigned sugar beet planter unit. After collecting data, Joe Molitorisz (above) will compare the spacing, evenness of depth, and number of seeds planted with the original design in an attempt to increase efficiency of planting and cut labor costs of the sugar beet grower.



The tractor tire in the background is undergoing tests to determine the magnitude and location of the soil forces exerted on it. Edward Binek and Cliff Schoeneman of the Ford Tractor Division are operating strain gage and recording equipment. J. Trabbic, who is using the data for his M. S. thesis, is watching the calibrating equipment being put to use by John Koepele.

More machines and power are being substituted for human labor. Optimum efficiency in livestock, poultry production and crop storage require the use of new and improved structures. More effective and widespread use of soil and water conservation measures are required to protect those vital resources to maintain productivity and to provide water for irrigation and domestic supply.

It is apparent that the work of an agricultural engineer requires knowledge of engineering and agriculture. For example, the development of a farm machine depends not only on a knowledge of machine design, but upon a knowledge of the crop if the machine is to function properly.

The agricultural engineer's application has many objectives—a few of which are: reduction in labor, better quality and safety, and higher returns. In order to obtain these objectives he works in close association with other engineers and agricultural scientists.

The educational preparation of an Ag. engineer at Michigan State is composed of courses from five divisions in addition to the basic requirements. They are: power and machinery, soils and water, agricultural structures, rural electrification, and agricultural crop processing.

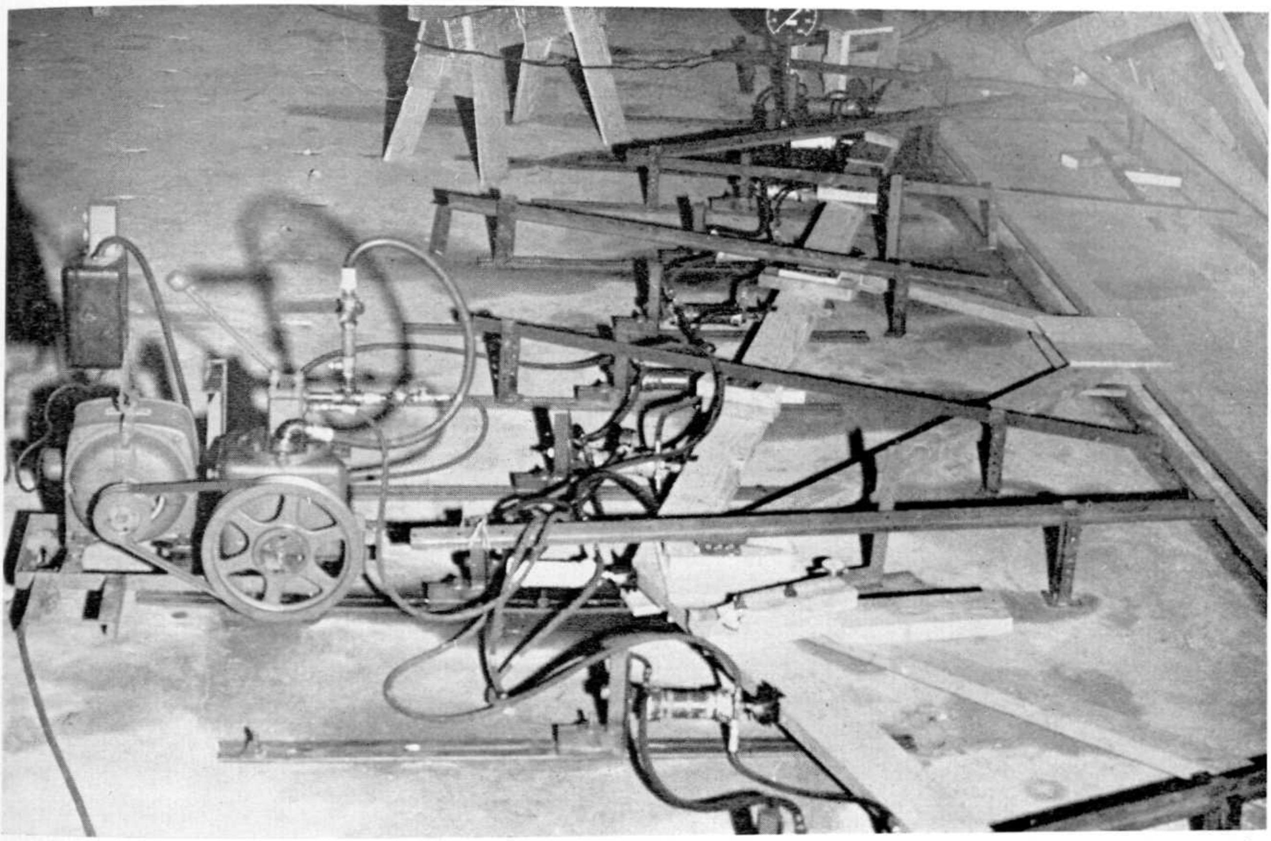
The power and machinery field includes all forms of energy used in agriculture except muscular activity. This mean machines, implements and devices for applying power for the production and processing of food and fiber. Generally speaking, the power and machinery division personnel design and develop the machinery, demonstrate its use, and counsel its selection by farmers.

The soil and water field is concerned with keeping soil and water where they belong. An engineer in this option may work with irrigation, drainage, water conservation structures and procedures, or land reclamation. In this option, the well-trained agricultural engineer has to have training in soils—the engineer's most complex material. Engineering studies of rainfall, runoff, and water flow are of particular importance in this area.

The agricultural structures division deals with the buildings and structures on the farm, as well as those used in the processing and storage of farm products. These structures include homes, silos, granaries, cellars, machine shops, storage, processing buildings, etc. The agricultural engineer is concerned with the function and economical aspects of these structures. Close cooperation exists between the architect and the engineer in this field.

Rural electrification deals with the use of electricity in rural areas. It is primarily concerned with uses in agricultural production, home modernization, power and control for equipment, and for more convenient living. Electricity in this area of the country is one of our cheapest sources of power. It is a premium form of energy because it can be easily and efficiently converted to heat, light or mechanical energy. One of the great challenges to the engineer in this field is to develop and apply this

The cucumber harvester, one of the many labor-saving farm implements, was recently developed and perfected at MSU by the Ag. Engg. Dept.



The glue-nail truss pictured above has been rigged with pressure gages to find the deflection, point of failure, and load required for failure. This apparatus is located in the Structures Testing Laboratory behind the Ag. Engg. Bldg.

convenient form of energy to its many potential agricultural uses, and to substitute it economically for human effort.

Agricultural crop processing is one of the newer fields. With the recent trends in frozen foods of all types, the processing and marketing of farm products call for the services of the agricultural engineer. The application of engineering methods and equipment, whether the product is a crop, fruit, or vegetable, is necessary. It calls for the insulation of cold storages, design of canning and locker plants and creameries.

Graduates in the field of agricultural crop processing work with dairies and food-processing concerns, design new equipment and adapt old equipment to new processes. Research work in processing is done for commercial concerns, colleges and government agencies. Graduates may also go into sales work for commercial concerns or for themselves. New machinery must be designed to handle recently developed processes, and methods of product transportation has to be constantly improved. These areas will become increasingly important as automation develops.

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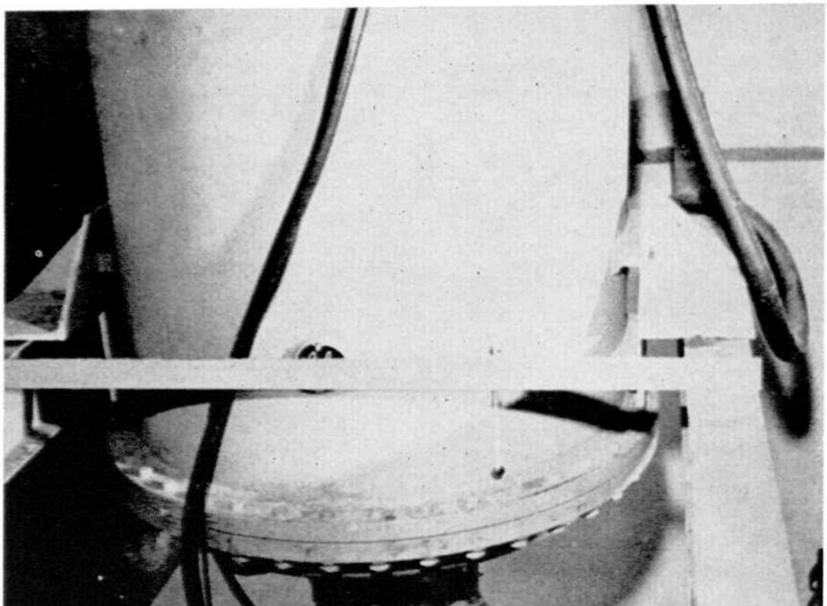
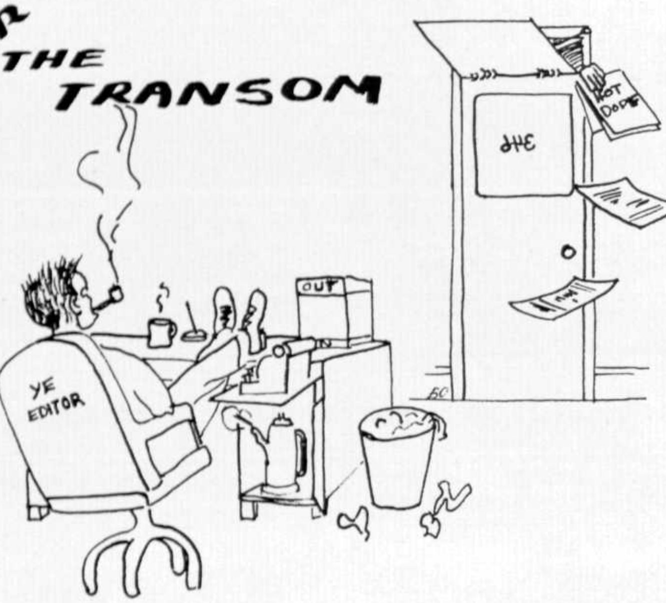


This large, bell-like housing holds the coils and windings of the 1,000,000 volt electron beam machine in the Ag. Engg. Bldg. By passing foodstuffs along a conveyer underneath the radiation emitter, they can be stored for a considerable length of time without perishing.

OVER THE TRANSOM



IN order to promote scholastic achievement among the underclassmen in mechanical engineering, the Tau Epsilon chapter of Pi Tau Sigma has established an annual award to the outstanding sophomore in mechanical engineering.

The award has been named the "Lorin G. Miller Award" in honor of Dean Emeritus Lorin G. Miller who cooperated in the establishment of the Tau Epsilon chapter at Michigan State in 1951.

Ernest Kollar was picked as the outstanding sophomore of 1957-58. His name will be engraved in a permanent plaque which is to hang in Olds Hall. Kollar received a copy of "Kent's Mechanical Engineering Handbook."

On July 1st of this year, Prof. Price, head, department of mechanical engineering, will begin a one year furlough with retirement to become official at the end of that period.

Prof. Price joined the MSU faculty in 1942, coming here from the University of Arkansas. A native of Lexington, Kentucky, he graduated and received his master's degree from Cornell University. In 1952-53, he took a leave of absence from MSU to tour engineering schools in the U.S. and Europe.

Come the Spring term, a bus load of engineering students will tour the Monroe reactor at Monroe, Mich. Any students desiring to take advantage of this trip sponsored by the ASME should check with LaVerne Root.

Engineer Graduates Cannot Communicate

(Michigan Education Journal, April 1, '58)

Hats off! to you, who favor a basic liberal arts background for college students regardless of major. Your stand is one hundred per cent correct, according to four engineering executives. They say that lack of liberal arts courses in curricula of engineering schools handicaps advancement of graduate engineers in industry.

The engineering executives said that "In general we find that engineering graduates are deficient in at least two aspects. They are the following:

- Engineering graduates are unable to get their ideas across to management in a concise, understandable manner either orally or in written reports.
- Their ideas of economics and general business are most inadequate, and they have a limited background in the arts.

These deficiencies in the liberal arts field results in their having difficulties in industry in the general field of human relations, particularly with other departments of their own companies, the executives said.

"Automatic control companies and others manufacturing highly-engineered products will be more successful if their top management is cultivated from broadly experienced men with a strong engineering background. Granting this, we feel recent engineering graduates, as a whole, have not received sufficient academic training in such management requirements as finance, law, marketing and sales in conjunction with their engineering training."

(Hooray for the four executives, but have they seen the inflexibility of the curricula at MSU, i.e., Ag. E. –7 electives, Chem. E.–none, Civil E.–9, E.E.–9, M.E.–6, and Met. 7? Good idea to have a liberal education, too, but must we remain another year to get one?)

In December, the Board of Ag. approved Mr. Ditsworth's appointment to assistant professor of mechanical engineering.

Attention all EE students. Have you been troubled by a tricky math problem, or a lab assignment that you couldn't even fudge? Well, Eta Kappa Nu may have a service for you. Ed Jenkins informs us that beginning this term the honorary will provide free tutoring in math and EE subjects. All EE students can avail themselves of this service. All the student has to do is make an appointment by calling Jenkins at ED 7-0523 or dropping a note in the Eta Kappa Nu box located in EE office, 2nd floor. Don't be proud, fellas, we can all use a little help occasionally.

Here are a few active M.E. students here on the campus.

Gerald Skeelenger, Grad. Student
Phi Kappa Phi
Tau Beta Pi
Pi Tau Sigma
Knights of St. Patrick
ASME

Jack Garter, M.E. '59
Phi Kappa Phi
Tau Beta Pi
Rec. Sec'y, Pi Tau Sigma
Phi Lambda Tau
ASME

Thomas Sandford, M.E. '59
Phi Kappa Phi
Pres., Tau Beta Pi
Pi Tau Sigma
Knights of St. Patrick

LaVerne Root, M.E. '59
Corr. Sec'y, Pi Tau Sigma
ASME
Spartan Engineer
Assoc. of Off-campus Students

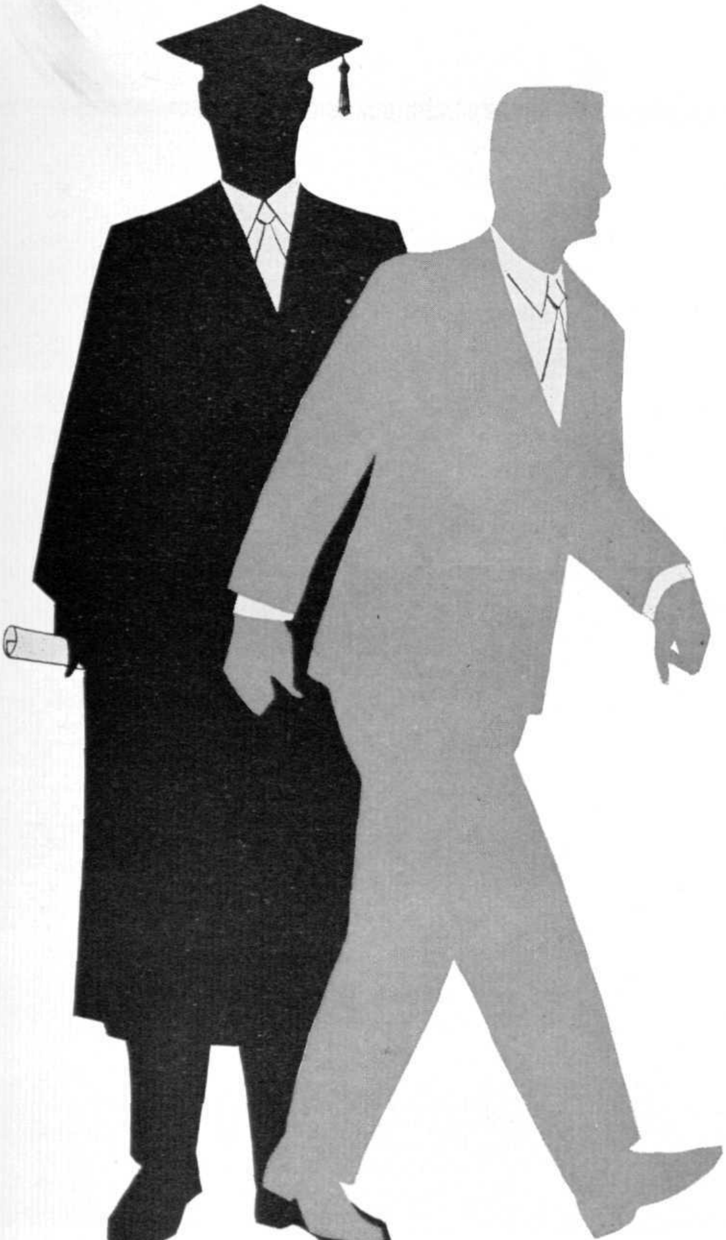
Can you add any names to this list?

Are you now . . .

Anticipating Your Future?

by LaVerne Root, M.E., '59

Opportunities await those who accept the challenge.



HAVE you considered applying for entrance to graduate school? Are you aware of the opportunities Michigan State offers in its engineering graduate program? Let's briefly examine the programs offered and the requirements necessary for advanced study in engineering.

The objectives of graduate study in engineering are the development of intellectual power, and the mastery of a large body of basic and broadly applicable scientific principles and methods. These objectives are met through continued course work beyond the undergraduate level and, in the case of the student choosing to write a thesis, a first taste of original research.

The course work consists of subjects dealing with the fundamentals of engineering science and their application for the enrichment of mankind. These courses are usually taught by the members of the faculty holding advanced degrees. Since class enrollment may vary from four to a maximum of fifteen, there is more opportunity for participation of the individual in the learning process.

Research projects may fall into any one of the several subdivisions i.e.—basic, fundamental, applied, etc. The research project will be directed by a member of the staff, and may range from a small two-man project to one using the talents of a number of faculty members and graduate students. Since in many cases the research is of a fundamental nature, it allows the graduate student to make use of the knowledge gained as an undergraduate and in graduate course work. He is also required to do a certain amount of original thought in the preparation of his thesis.

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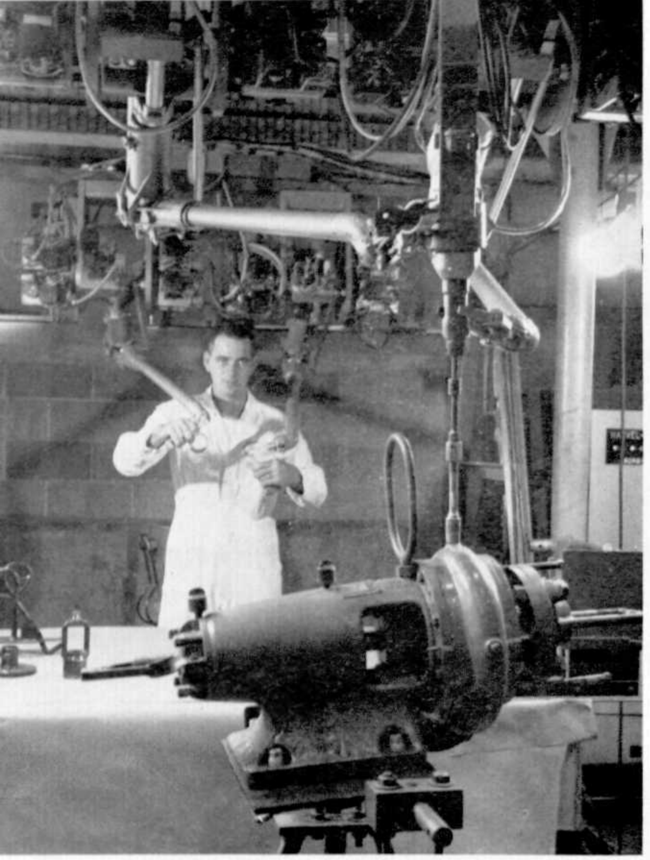
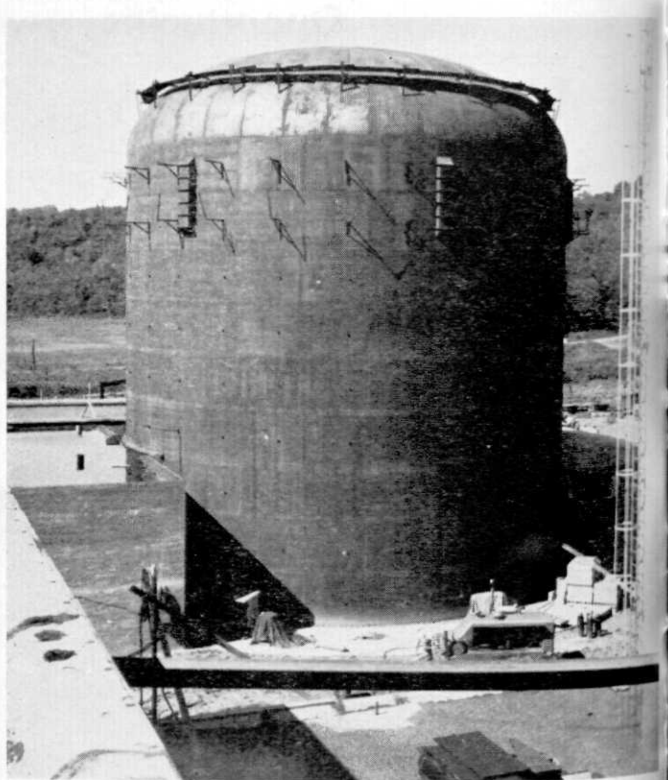
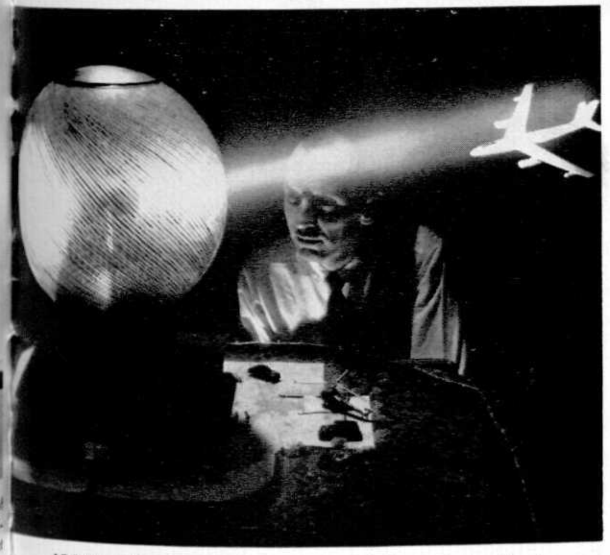
NEWS VIEWS



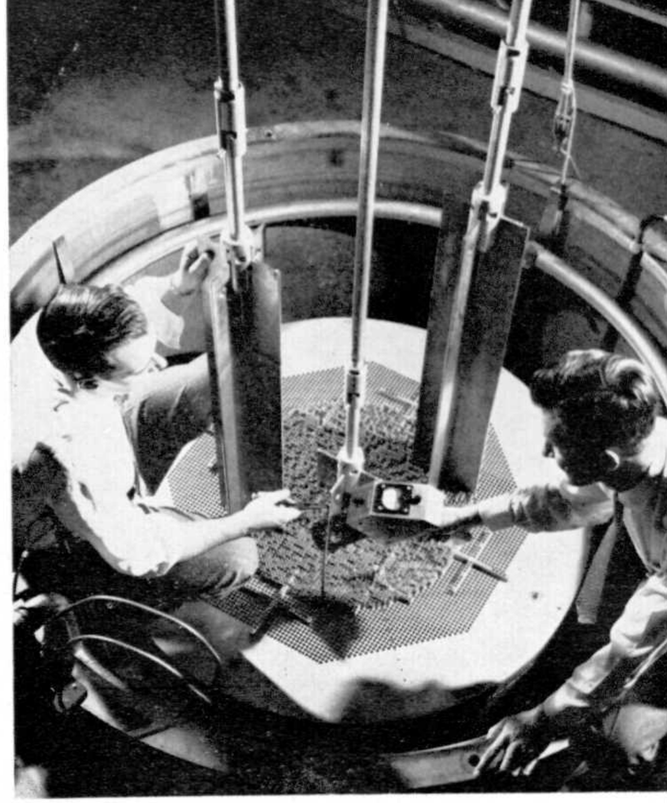
ABOVE—Techniques for remotely dismantling and assembling equipment in a nuclear power plant are under development at the Westinghouse atomic power department in Forest Hills. Here a technician uses a servo-manipulator to take a practice pump apart. Under actual conditions, the operator would work from behind shielding to protect him from radioactivity. The homogenous reactor program has been accepted by the Atomic Energy Commission as a basis for negotiation of a research and development contract.



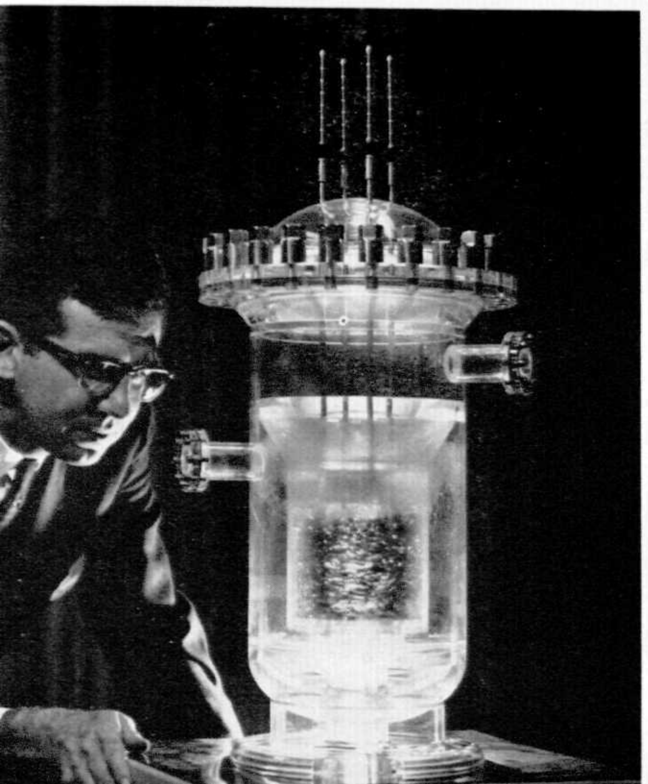
ABOVE—Housing the newest atomic research "tool" of Westinghouse Electric Corporation will be this mammoth 85-foot high vapor container. Located on an 850-acre tract at Waltz Mill, Pa., some 30 miles southeast of Pittsburgh, the WTR facility is nearing completion. This huge cylinder, which measures 70 feet in diameter and is made of three-eighths inch steel plate, will house the nuclear reactor itself. When the reactor is in operation the plant's air handling system will change the air in the vapor container once every four minutes. Air pressure in the container will be slightly less than the outside atmosphere so that any leakage will be inward. Directly below the container is a 100-foot long canal with a minimum width of seven feet. Filled with 18 feet of water, the canal leads to three "hot" laboratory cells located in the service building. Thus, transfer of materials from the reactor to the hot cells will be done entirely under water. WTR is scheduled to go in operation next May.



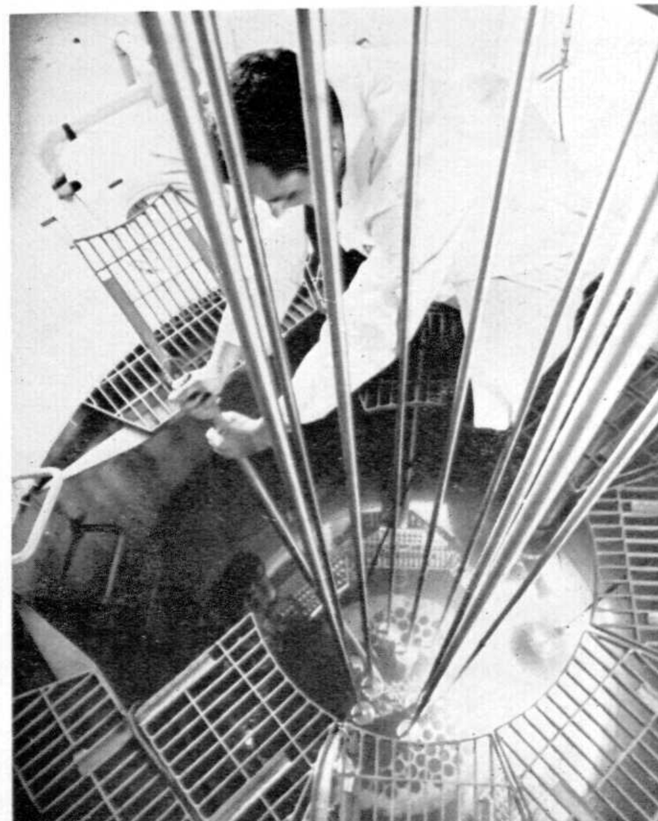
ABOVE—This functional scale model illustrates with a light beam the working principle of the world's most modern radar antenna. Radar waves from a rotating source are sprayed against the inside surface of the stationary balloon-shaped antenna, as the lighted section of the sphere shows at the left. The waves then reflect through the opposite side of the sphere to emerge as an intense, narrow beam resembling the light beam picking up the model plane. Called a Helisphere, the new antenna also has been made in a six-foot inflated model and is expected to result in 100-foot antennas for antimissile radars of the future. The model shown here actually was used for laboratory testing when fed with very short radar waves.



ABOVE—Experimental information obtained from the operation of this nuclear reactor helps scientists in the design work for the Yankee Atomic Electric Company's nuclear power plant now under construction at Rowe, Mass. The man on the right, is using a radiation monitoring instrument—known as a "Cutie-Pie"—to measure the radioactivitiy of one of the 3,000 fuel rods within the reactor core. Each fuel rod is filled with uranium oxide pellets similar to those which will power the Yankee station. Rising from the cluster of fuel rod tips are the control rods, x-shaped shafts which control the rate of nuclear reaction. This facility is located at Waltz Mill, 30 miles from Pittsburgh. Westinghouse is building a 134,000 kilowatt nuclear reactor plant for the Yankee Atomic Electric Company, which was formed by eleven major electric power companies in New England.



LEFT—A scientist examines a plastic scale model of a new concept in nuclear reactors. This advanced idea is an organic moderated fluid bed reactor (OMFBR) in which conventional control rods have been eliminated. It is being studied jointly by Westinghouse and the City of Burlington, Vermont, in connection with a 50,000-kilowatt power plant. In the cylindrical container, or center part of the model, fuel will be in the form of pellets similar to marbles. Surrounding the container is the reactor vessel. A chain reaction is attained by increasing the fluid flow through the reactor, thus lifting the pellets and dispersing them through the fluid in the reactor vessel.



RIGHT—Looking down into a water-filled steel tank, this photograph shows the top portion of the nuclear core for the Westinghouse Testing Reactor (WTR) now under construction. The core, which has been undergoing tests since last June 30 when it went "critical," is located in the Critical Experiment Station, situated on the same site as WTR. Shown rising above the top of the core are the control rod extensions which connect the control rods to the drive mechanisms located above. Fuel for the reactor is enriched uranium in the form of approximately 60 fuel elements arranged in the core-supporting structure which is 44 inches in diameter by 48 inches long. The testing program now underway on this core serves as a practical check of the theory which has gone into designing the uranium fuel elements. WTR is scheduled to go into operation next May.

Engineer's Girl For January

GAIL CRANDALL

Home town: Grosse Pointe Park, Mich.

Age: 20

Sorority: presently "rushing"

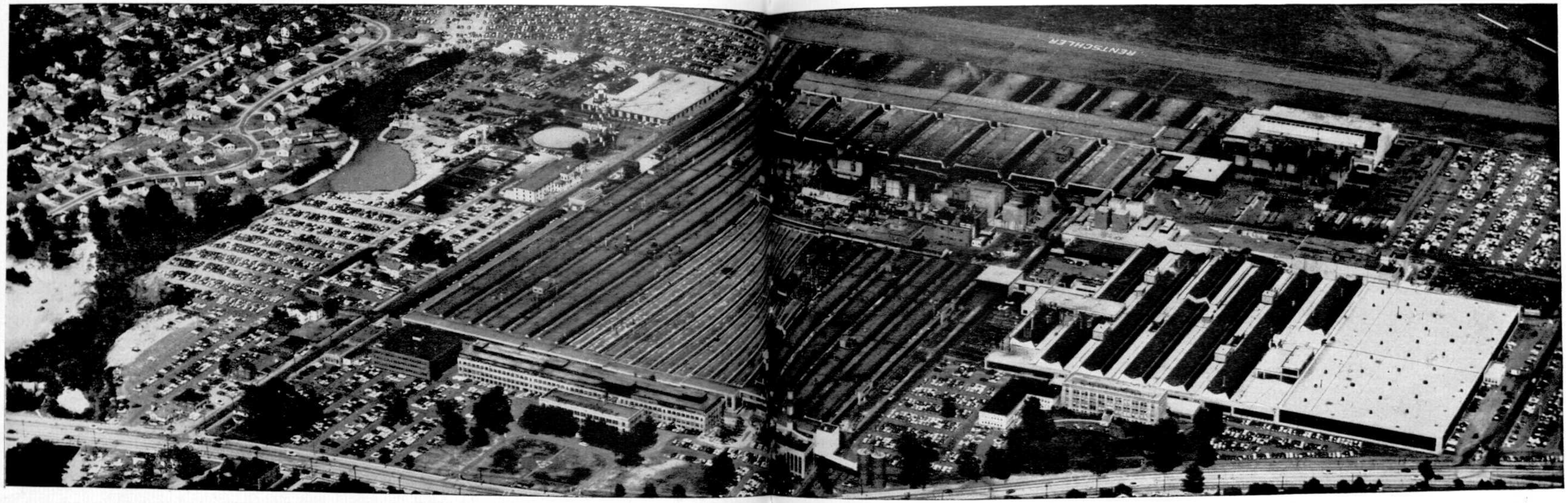
Specs: 5′ 4″
Blue eyes
Brown hair
34-22-34

Class: Junior (transfer student)

Major: Social Science

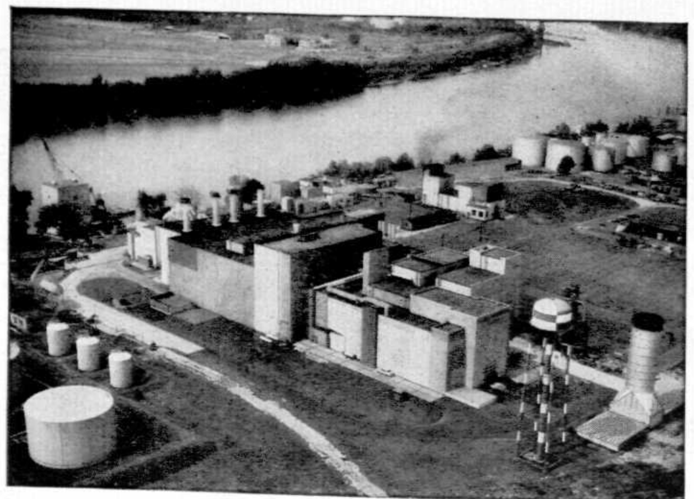
Status: Single

(Photos by Wally Hagen)

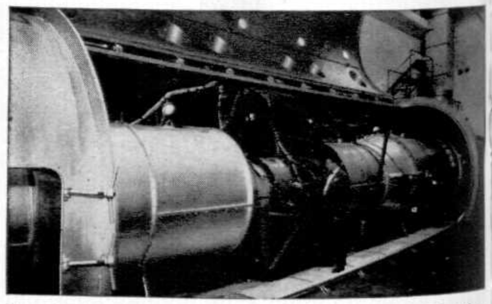


CONNECTICUT OPERATIONS

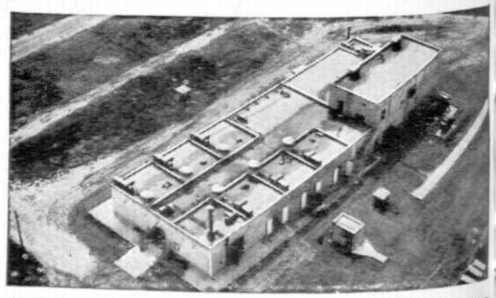
Unmatched Engineering Facilities for Developing Advanced Flight Propulsion Systems



The Willgoos Turbine Engine Test Facility is the world's most extensive privately owned turbine development laboratory. Designed and built specifically to test full-scale experimental engines and components in environments simulating conditions at extreme altitudes and speeds, it is currently undergoing expansions that will greatly increase its capacity for development testing of the most advanced forms of air breathing systems.



In chambers like this at the Willgoos Turbine Engine Test Facility full-scale engines may be tested in environments which simulate conditions from sea level to 100,000 feet. Mach 3 conditions can also be simulated here.



In the new Fuel Systems Laboratory engineers can minutely analyze the effects of extreme environmental conditions on components of fuel systems — conditions such as those encountered in advanced types of flight vehicles operating at high Mach numbers and high altitudes. Fuel for these tests can be supplied at any temperature from −65°F to +500°F.

Operations at Pratt & Whitney Aircraft are essentially those of an engineering and development organization. As such, an engineering atmosphere dominates the work being done, much of which directly involves laboratory experimentation.

In the past three decades, expansion at Pratt & Whitney Aircraft has been almost tenfold. In recent years, greatest emphasis has been on extending engineering facilities to meet the needs of advanced research and development programs in flight propulsion.

Among the Connecticut P & W A facilities are many that are unequaled in the industry. Thus today, Pratt & Whitney Aircraft is better prepared than ever to continue development of the world's best aircraft powerplants . . . to probe the propulsion future . . . to build and test greatly advanced propulsion systems for coming generations of flight vehicles – in whatever form they take.

The Connecticut Aircraft Nuclear Engine Laboratory, operated by Pratt & Whitney Aircraft, is situated on a 1,200-acre tract near Middletown. The Laboratory was specially built for the development of nuclear flight propulsion systems.

For further information regarding an engineering career at Pratt & Whitney Aircraft, consult your college placement officer or write to Mr. R. P. Azinger, Engineering Department, Pratt & Whitney Aircraft, East Hartford 8, Connecticut.

PRATT & WHITNEY AIRCRAFT

Division of United Aircraft Corporation

CONNECTICUT OPERATIONS — East Hartford

FLORIDA RESEARCH AND DEVELOPMENT CENTER — United, Florida

The necessary safe handling and transporting of missiles is a challenge to the ingenuity of the packaging engineer.

by William J. Switzenberg, Pkgg., '59

MISSILE PACKAGING

MENTION "packaging" to the typical layman, and he immediately gets a mental image of wrapping paper and ribbons used to wrap gifts. Little known to him are the many other kinds of packaging in the world today. All types of goods, from food to heavy industrial machinery, must be packaged.

In the past few years, packaging has grown until it has reached tremendous economic importance in the United States. The estimated total expenditures for packaging the output of our farms and industries exceeded 20 billion dollars during 1957. Today, some knowledge of packaging is essential for most engineers and businessmen. In an era of rising competition, the technical excellence of a package may well mean the difference between success and failure of a product. The history of packaging commercial items contains many examples of packaging advances which have resulted in longer shelf life for perishables, drastic reductions in damage during transit, the opening of new markets, and greater convenience for the user.

Included in packaging are the materials, methods and machinery involved in safely getting an item to its ultimate user. Also, preparing military goods for transport and storage has become a large industry.

Still lesser known among military packaging is a branch engaged in packaging guided missiles and their component parts. The components consist of such essentials as guidance and control units, gyroscopes and emergency power supplies. Most of the parts, whether assembled in a completed missile or separate, are extremely fragile.

After a successful missile launching the participating engineers, physicists, chemists and others start again planning another project. These men, and many others behind the scenes, have worked together in a gigantic team. Their undertakings are highly complex. The education and skills of these men have been carefully coordinated.

Although seldom praised or heard about, the men behind the scenes are instrumental to the success of our missile program. The packaging engineer is one of these men. It is his job to guard the intricate mechanisms, via packaging, from the moment it is produced until it is used. It must be assumed that each missile, or its components, must be shipped a very long distance, probably handled many times, and stored for an indefinite period prior to use.

If a shipping container fails to perform its function properly, the entire program for the specific missile involved is jeopardized and all the skills and man-hours which went into the production and transportation of the missile are lost. Also lost is the training of the personnel in servicing, firing, and control.

One has only to glance at a newspaper or magazine to realize the importance of military preparation and of inter-planetary travel. Guided missiles promise to play an important role in world politics during the next few years. New developments are constantly being made concerning guidance and control systems, propellants, fuses, timing mechanisms, to mention only a few. Each new development leads to different properties and characteristics of the item to be packaged. Therefore, changes must be made in the package design. The packaging

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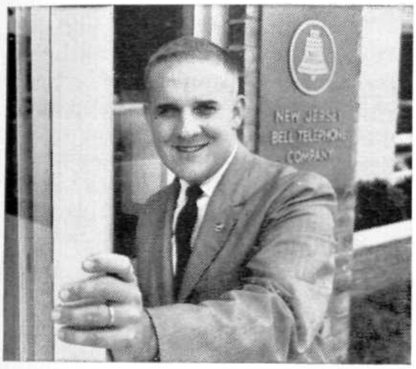


WILLIAM F. BLOOMFIELD, B.S.I.E., LEHIGH, '53, SAYS:

"Join me for a day at work?"

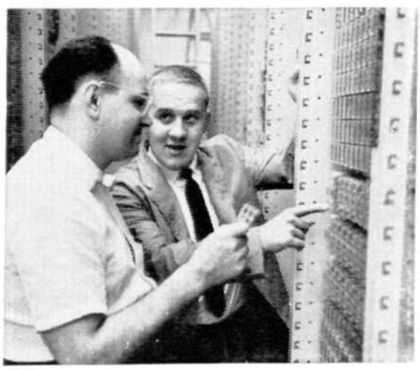
Bill is Plant Service Supervisor for New Jersey Bell Telephone Company at Dover. He joined the telephone company after graduation, has held many jobs to gain valuable experience. Now he has three foremen and 32 craft people working for him. "It's a challenging job and keeps me hopping," says Bill. "See for yourself."

"8:30 a.m. With my test bureau foreman, I plan work schedules for the coming week. Maintaining equitable schedules and being ready for emergencies is imperative for good morale and service."

"9:10 a.m. The State Police at Andover have reported trouble with a mobile radio telephone. I discuss it with the test deskman. Naturally, we send a repairman out pronto to take care of it."

"11:00 a.m. As soon as things are lined up at the office, I drive out to check on the mobile radio repair job. The repairman has found the trouble—and together we run a test on the equipment."

"1:30 p.m. After lunch, I look in on a PBX and room-phone installation at an out-of-town motel. The installation supervisor, foreman and I discuss plans for running cable in from the highway."



"2:45 p.m. Next, I drive over to the central office at Denville, which is cutting over 7000 local telephones to dial service tomorrow night. I go over final arrangements with the supervisor."

"4:00 p.m. When I get back to my office, I find there are several phone messages to answer. As soon as I get them out of the way, I'll check over tomorrow's work schedule—then call it a day."

"Well, that's my job. You can see there's nothing monotonous about it. I'm responsible for keeping 50,000 subscriber lines over a 260-square-mile area in A-1 operating order. It's a big responsibility—but I love it."

Bill Bloomfield is moving ahead, like many young engineers in supervisory positions in the Bell Telephone Companies. There may be opportunities for *you,* too. Talk with the Bell interviewer when he visits your campus and get the whole story.

BELL TELEPHONE COMPANIES

One Jump Ahead

(Continued from Page 15)

tion. In fact there are many programs available.

The problem of programming consists of stating unambiguously in English with the aid of mathematical symbols if necessary, how a calculation is to be done. This is the universal problem of programming any computer to do any task; not just a particular one to play chess.

Since it would be impracticable to program a machine to consider all possible moves, because of the time it would take for the machine to "make up its mind" about a move, only a small number of moves can be considered. On the IBM 704, which plays a respectable game of chess, this number is 30 moves.

It is commonly believed that a machine could be built which could win every game no matter what his opponent does. At this time it is not possible to build such a machine. A computer can do no more than the man who programmed it, but (and this is the big difference) it does the calculation a million times faster than the man.

So the machine must play the game on human terms. It must do what you do when you play chess—detect the strategy and anticipate the judgments of human opponents. In other words, it must try to outwit its opponent.

Since there are only two questions to which absolutely definite and unavoidable answers can be given; these being "Is this move legal?" and "Is the game over?" a method of evaluating positions and moves of each piece is necessary. This is what fascinates the mathematician and the chess-player alike.

To evaluate the merits of its alternatives the computer looks at each square individually and asks whether it is occupied and, if so, by whose man, whether it is attacked or defended and whether it can be occupied. This takes about one-tenth of a second, a long time by computer standards. Then it considers its best move.

Because it is impracticable to consider all possible moves, some method of limiting the number under consideration must be available. The digital computer IBM 704, for instance, selects its best move by limiting the number of moves considered from a possible 30 (average number) to the best 7. It does this by asking itself 8 questions on position and value of pieces.

It then takes each of these 7 and computes the moves its opponent is likely to make. From these it chooses 7 for further analysis. It then considers its next move and its opponent's next move.

At this fourth level of analysis it examines its opponent's 7 potential responses and computes the one which would net the highest value for its opponent. In other words it chooses its opponent's most likely move.

Values are given to moves according to four criteria: (1) gain of material (pawn counts 1, a knight or bishop counts 3, rook counts 5, and a queen counts 9); (2) defense of the king; (3) mobility of pieces; and (4) control of an important square. In all it examines 2800 possible positions. It then chooses a move which will give both itself and its opponent the highest score.

It does all of this in eight minutes. If it were programmed to consider the 7 best moves through one more level of analysis, it would require 6½ hours. Four stages therefore seems to be the best choice, if one doesn't want the game to lag.

The machine is never absent-minded. It never lets a piece be taken without knowing about it. It is capable of recognizing its opponent's errors and of taking advantage of them. Now and then it may make a move like a master but it is certainly not in the master class in the play of a complete game.

Its glaring weakness is a heavy bias toward moving attacked pieces rather than defending them. This could be corrected by allowing it more time to consider its moves. The machine, however, has a shortsighted view of the game. It must consider each square individually and cannot take into consideration the whole field of play.

Somewhere in between the complicated game of chess, and the all-too-simple game of tic, tac, toe, lies the game of checkers. This makes it rather suitable for programming, for, although there is no complete theory of the game available which make it necessary, as in chess, for the machine to consider several moves in advance, the number of moves is few and rather simple.

Many forms of checker strategy are available but they all have one purpose—reduce the time taken by the machine to consider each move. Since, as in chess, the time required to make a move increases very rapidly with the number of moves considered, a method of valuing positions is necessary.

Once a move-finding scheme is established (a rather complicated process) almost any strategy can be tacked on to it. It is often easier to combine a strategy not only with a move-finding scheme, but also with an overall game-playing routine which accepts the opponent's moves, displays the positions, prints the move, and generally organizes the sequence of operations of the game.

The simplest strategy, and the one tried at Manchester University in England, is that of allowing the machine to consider a certain specified number of moves on both sides. It then makes its final choice by considering only the material left on the board and ignoring any positional advantage. Storage space limits the Manchester computer to considering only six moves ahead—three on each side — but time considerations limit the number of moves considered even more.

Since there are about 10 possible legal moves at each stage of the game, the consideration of one more stage multiplies by 10 the time required. The English computer can consider three moves (two of its own and one of its opponent) in about two minutes.

This number of moves represents about the limit which can be allowed if one wants an interesting game. It is not, however, sufficient to allow the machine to play well, although it plays adequately until near the end.

One noticeable difficulty of the machine is its willingness to sacrifice men, rather than allow its opponent to form a king. This is perfectly logical from the machine's point of view. It loses two points if its opponent forms a king and only one point if it loses a man. It therefore goes along happily sacrificing all of its men when it becomes possible, rather than letting its opponent form a king. Any opponent therefore can hold his piece at the point of kinging while the machine, not seeing the inevitable disaster, sacrifices each of its men.

This fatal flaw might be avoided if the machine were allowed to consider the moves ahead, until it found two consecutive moves without a capture. This would enable it to recognize the futility of sacrificing to prevent kinging. The number of stages under consideration would have to be increased to four and more time would have to be allowed for each move.

(Continued on Page 38)

For Peaceful Purposes and the Benefit of All Mankind The National Aeronautics and Space Administration Announces its Authorization by the Congress of the United States

To Direct and Implement U.S. Research Efforts In Aeronautics and the Exploration of Space

"The aeronautical and space activities of the United States shall be conducted so as to contribute materially to one or more of the following objectives:

(1) The expansion of human knowledge of phenomena in the atmosphere and space;

(2) The improvement of the usefulness, performance, speed, safety, and efficiency of aeronautical and space vehicles;

(3) The development and operation of vehicles capable of carrying instruments, equipment, supplies and living organisms through space;

(4) The establishment of long-range studies of the potential benefits to be gained from, the opportunities for, and the problems involved in the utilization of aeronautical and space activities for peaceful and scientific purposes;

(5) The preservation of the role of the United States as a leader in aeronautical and space science and technology and in the application thereof to the conduct of peaceful activities within and outside the atmosphere;

(6) The making available to agencies directly concerned with national defense of discoveries that have military value or significance, and the furnishing by such agencies, to the civilian agency established to direct and control nonmilitary aeronautical and space activities, of information as to discoveries which have value or significance to that agency;

(7) Cooperation by the United States with other nations and groups of nations in work done pursuant to this Act and in the peaceful application of the results thereof; and

(8) The most effective utilization of the scientific and engineering resources of the United States, with close cooperation among all interested agencies of the United States in order to avoid unnecessary duplication of effort, facilities, and equipment..."*

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Lewis Research Center, Cleveland, Ohio
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*Quoted from the National Aeronautics and Space Act of 1958.

(Positions are filled in accordance with Aeronautical Research Scientist Announcement 61B)

NASA National Aeronautics and Space Administration

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Carroll W. Boyce, B.S. in Business and Engineering Administration, M.I.T., today is a key managing Editor of FACTORY Magazine

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Carroll Boyce is the author of numerous articles; guest lecturer at Graduate Schools of Engineering and professional societies, Consultant to the Administrator, National Production Authority; member, American Society of Mechanical Engineers, the National Press Club and other leading organizations.

"During my four years at M.I.T.," relates Carroll, "I was an editor of the Tech Engineering News. I discovered that I enjoyed both writing and engineering, so I decided to combine the two. Knowing that McGraw-Hill is the largest publisher of business magazines, I wrote a letter to the Personnel Department. In a way, it was probably the most important letter of my life. I was hired!

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What's in a brain? Carroll (standing) gets an advanced briefing on the latest developments in the Univac Electronic Computer from Charles Katz of Remington Rand.

Programming

(Continued from Page 17)

waste. On top of this, it has been found that a computer is often more expensive than older systems.

In spite of these disappointments, the situation is far from bleak. Not only have computers frequently helped companies avoid expanding work forces, but often secondary functions have proven of greater value than the work originally intended for the machine. The greatest good, however, has come from the disappointments themselves. Because of them, a realistic reappraisal is going on which is already paying off, and which will be a giant step in the progress of computer application.

Probably the largest commercial user of electronic computers in the country today is the General Electric Company. As of June, 1958, G. E. was using eleven large and thirty-two medium computers, and had thirty-eight on order. They have by no means found all of the answers in the exploitation of their computing machinery, but they have definitely made it pay off.

Company Payroll Turned Out By Computer

G.E.'s first computer, one of the earliest used in industry, was installed in Louisville, Kentucky in 1954. This was the beginning of a painstaking and sometimes costly exploration into the potential of such a device, a program still going on. One of the initial things learned was the error frequently found in transferring an entire existing system over to a computer.

Theoretically this first business "brain" should have been able to turn out an entire company payroll in only two hours. By the time the computer was programmed, information fed in, and additional supplementary work completed, the job took nearly 36 hours. It was soon found that the chore of sorting checks, then done by the machine, could be managed by two clerks in only four hours at less than one percent of the computer cost. From that point on the process was made increasingly efficient. Today the machine manages the job in about 16 hours. True, this is still a far cry from two hours, but in addition to paycheck processing, several other jobs are done. For one, the computer tabulates at the same time the labor cost per production item; for another, it maintains social security records. Originally these secondary tasks involved long hours of labor in several separate departments.

G.E.'s computer coordination of payrolls and other work calling for the same basic data points up a highly important concept in the current theory of computer use. The computer should be thought of as a "system tool" rather than a convenient office machine installed for independent use by several separate departments. In other words, it should be used to cut across the company's entire operation, tying in areas concerned with the same information and data.

Such application of a computer can bring out one of its most important characteristics, an ability which makes it distinct from all other calculators: properly programmed, a computer can make decisions. For example, if it is necessary that a certain number of a given item be in stock at a certain time of year, the machine can be programmed to decide what this number should be. It need not stop here either. If, knowing the number needed and the actual number on hand, the machine anticipates a shortage, it can order the replacement items. Furthermore, should the order be held up for any reason, the computer can send out an expediting order. Such a system would avoid the bottlenecks so often encountered in older and much slower approaches.

In some businesses, computers are actually beginning to change management policy. As can be seen in the illustrations already given, one kind of policy change comes from the reappraisal of methods in use, and the subsequent reorganization of departmental functions. Another way policy is affected by computers is through their clarification of the precise information needed by top management inorder to best do its job. Often top executives find their offices cluttered with superfluous detail which can be handled either at some lower echelon, or possibly even by the computer itself. Even the most efficient business organizations suffer from this problem to some degree.

In all revolutions wrought by change, the human element is by far the most difficult to predict or regulate. We have been given, so to speak, an electronic wand capable of untold wonders. But we must discover for ourselves the magic words to activate it. This could be managed in less than ten years, but a twofold fear holds us back. Some of us fear using the wrong words which might cause more damage than good, while others, secure in the status quo, hesitate to try any words at all. Because of this, the change may take over a generation.

Top Management Should Run Computer

One way to avoid many mistakes is by choosing the right boss. At first nearly all business computers were run by engineers. At the time it was felt that engineers with their intimate knowledge of a computer's workings were best qualified to handle them. This idea, however, overlooked the engineer's frequent ignorance of the company's business operations and needs.

The next chief, and the one still most often in control, was the company comptroller. Since usually the first application of a new computer is in payrolls and finances, this choice seemed most logical. Unfortunately it can lead to the old problem of limited clerical use and wasted potential.

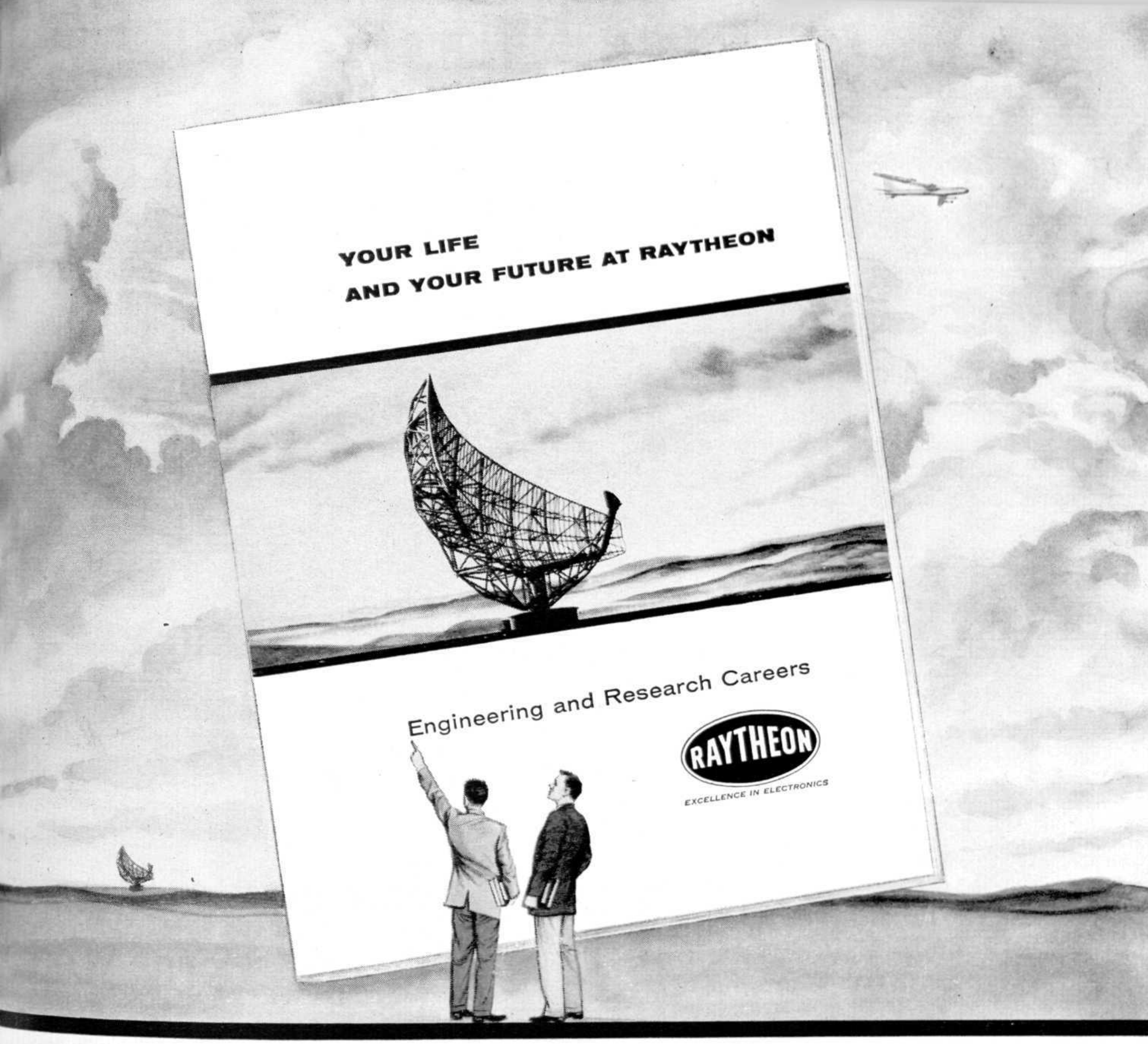
With these lessons learned, only one solution seems practical: the best boss for a computer is an enlightened top management man. Only these men, with their overall grasp of the broad aspects of the business, can apply the computer effectively as a coordinator between departments and as a true system tool.

"Computer men," those interested in the rapid and effective integration of computers into business and industry, are a young lot. Seventy per cent of them are under 37, and nearly half of these are under 32. There is a good reason for this. Older men are frequently much more firmly intrenched in traditional ways of doing things. On top of this, any change in established systems which shifts job responsibilities may be much more costly to an older man in a higher position. It could even mean his job.

Organized labor has also expressed the fear that jobs will be lost to electronic brains. They are equally concerned about the problem of jurisdiction over the new jobs created by computers. The first problem has almost no basis in fact. To begin with, not nearly as many jobs will be lost as might be expected. Only about 25% of the average clerk's job can be done by a computer. The other 75% consists of purely human work such as answering the telephone, filing, etc. Add to this reduced cutback the new jobs created by the computer, and very likely there will be an increase in the total labor force.

The problem of labor jurisdiction is far more real. Since many of the jobs to be taken over by computers now employ union members, labor will claim that personnel operating computers should also belong to the

(Continued on Page 38)



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One Jump Ahead

(*Continued from Page 32*)

With this modified strategy it can play quite an acceptable game even though it still may sacrifice men needlessly. It seems probable, however, that a whole new strategy will have to be worked out for the end of the game.

The ultimate in chess and checker programming and in all games-playing machine programming for that matter, would be the ability of the machine to learn from experience and eliminate its own errors. Such a machine would never make a mistake twice and would of necessity need quite a large storage capacity. It might even be programmed to think of plays on its own within the legal limits of the game. It seems probable that these and other developments in games-playing machines are not far away.

Programming

(*Continued from Page 36*)

union. Management, on the other hand, will hold that many of these persons are executives. Both sides will have their arguments, but the problem is by no means insoluble. Certainly greater difficulties have been equitably solved in the past.

Computers are definitely here to stay and no competitive industry can afford to ignore them, or relegate them to insignificant work. A reasonable man does not swat a fly with a steam shovel. Traditionalists in business and misinformed labor leaders will have to change their tunes, or risk being swept aside. Tomorrow's industry will lean as heavily on electronic computers as it does today on assembly line machinery.

Anticipating Your Future

(*Continued from Page 23*)

There are several important reasons for taking graduate work. Perhaps the most important is the sense of accomplishment one attains in acquiring an advanced degree. For the individual who is less interested in knowledge for knowledge's sake, the advanced degree may be considered an investment in his future which will bring added economic advantages as well as other benefits. Having a Master's degree will, in general, mean about $1,000 per year more than the starting salary of a man with a B.S. degree. A Ph.D. will usually mean $3,000 or more per year, depending upon content of his thesis, his ability to bargain, and the company hiring him.

There is a great demand for the services of those holders of advanced degrees in research and development due to the rapidly advancing technology and the increased complexity of the problems handled in engineering. A very good example of this may be taken from metallurgical engineering. At the end of World War I 12 metallic elements were used in the metals industry. By the end of World War II this had increased to 18 metallic elements. Today, however, with the advent of nuclear power, missiles, and other undreamed of advances, 43 metallic elements are used commercially while another 13 are used semi-commercially. These 56 elements are combined in different ways to produce a total of 19,280 alloys. Since no one could be expected to know the properties of each of these alloys, it is necessary to study the fundamentals of the 56 elements and their properties in combination rather than trying to master the entire group which is continually growing at a phenomenal rate.

Similar examples may be found in every branch of engineering. The fields of atomic energy and missiles have alone presented this generation with enough problems to keep our research men busy with challenging investigations for many years.

Here on the Michigan State campus the engineering college has a well-developed graduate program. At the present time there are 175 students enrolled for advanced degrees in engineering. This compares with 45 in the fall of 1952. In the same period the undergraduate enrollment has risen from 1,300 to 2,000. All departments are offering graduate programs leading to Master of Science and Doctor of Philosophy degrees.

Due to the extreme importance of the advanced degree in our technical world and the advantages gained by the holder of the advanced degree, the College of Engineering would like to see at least 50% of the upper half of the senior class in engineering go into graduate work.

For those interested in work beyond the undergraduate level, the following requirements apply in general to all departments: (1) applicants for regular admission to a Master's degree program must have a Bachelor's degree in an accredited engineering or related curriculum with a grade point average of 3.0 or higher (on a scale of A equals 4.0). This may be computed on the last half of undergraduate work to give the student added chance for regular admission. For those not meeting these requirements a provisional admittance may be possible. This allows one to start graduate work under the following conditions: a B average must be attained for the first 16 credits of graduate work taken. Those fulfilling this condition will then be admitted to the regular program.

(2) requirement for thesis: the requirement of a thesis at the Master's level is a matter of department policy.

(3) grades for course work taken: grades must average out to B with any grades below C being repeated in class.

(4) number of credits at Master level: at least 45 credits must be taken beyond the Bachelor's degree including 12 to 15 credits in a minor. An average of 3.0 must be maintained to receive an advanced degree.

For those needing financial assistance there are a number of programs to help cover expenses. These fall into five groups: (1) National Science Foundation fellowships, (2) Industry-sponsored fellowships, (3) research assistantships, (4) graduate assistantships, and (5) scholarships. These programs are handled by Mr. Hoffman and staff, Room 105, Olds Hall. Mr. Hoffman feels that anyone who is qualified and has the ambition and determination to continue in graduate study, need not pass up the opportunity for financial reasons. If you desire further information of graduate study, the following people can provide the information or can direct you to someone else who can be of assistance to you.

Agricultural Engineering:
Dr. Farrall

Applied Mechanics: Dr. Harris

Chemical Engineering:
Dr. Gurnham

Civil and Sanitary Engineering:
Dr. Cutts

Electrical Engineering:
Dr. VonTersch

Mechanical Engineering:
Professor Price

Metallurgical Engineering:
Dr. Smith

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, can not 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 excellant 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?

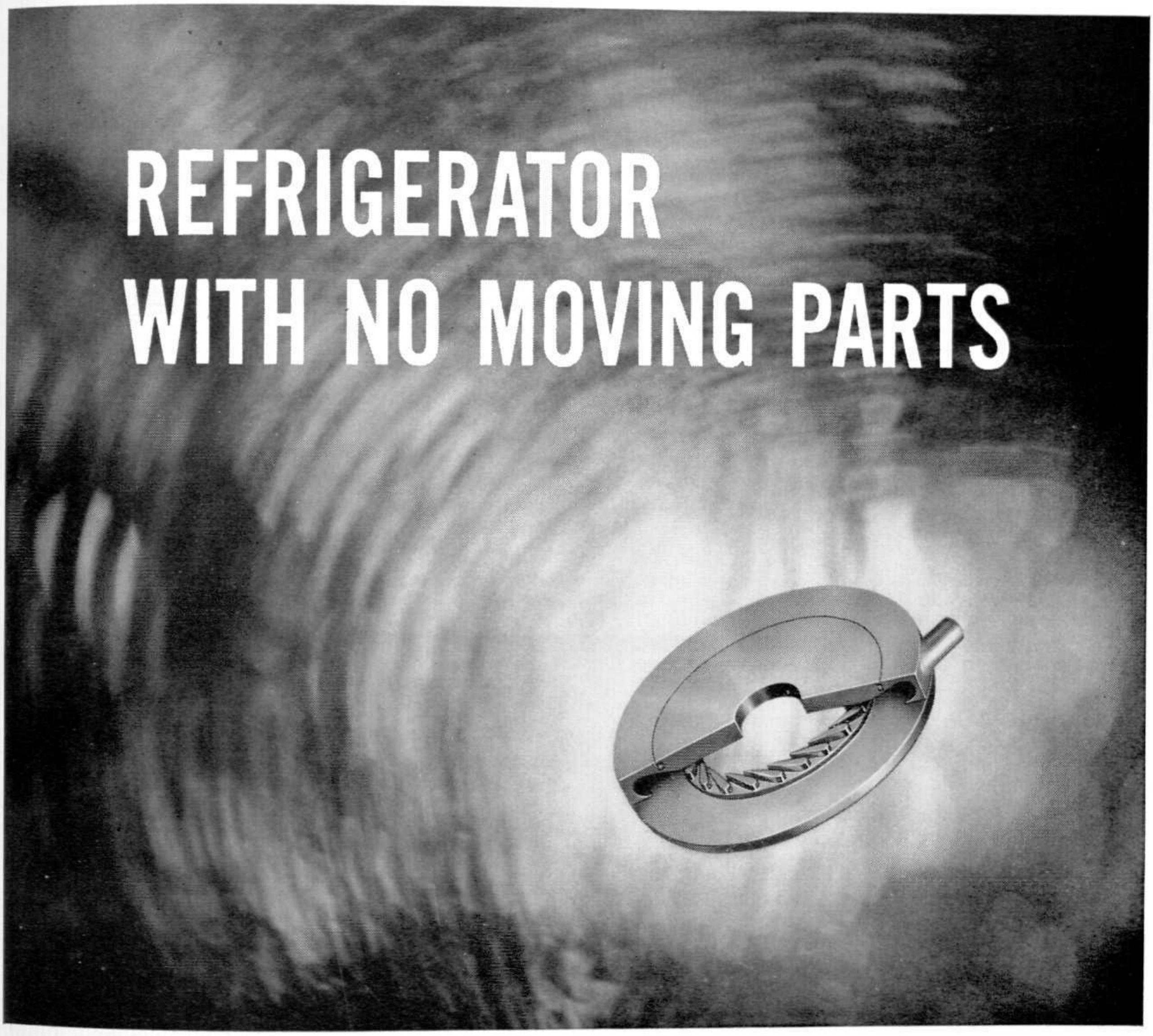
15. *PREPARATION*—A dangerous habit. Here again, let's don't anticipate. A heavy snow might make the work useless. And—the instructor might resent having you come to class one day knowing what he is talking about.

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 M.

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 vortex tube is a refrigerating machine with no moving parts. Compressed air enters the vortex chamber pictured here and spins rapidly down an attached tube. Pressure and temperature differences build up, forcing cold air out one end and hot air out the other. Requiring no maintenance, a large vortex tube developed by AiResearch scientists and engineers can be permanently sealed in nuclear reactors, and has many uses in industries with spot cooling problems.

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SIDETRACKED

Marriage may be the real road to happiness . . . but there are a lot of good side trails.

° ° °

"I kill flies with a bow and arrow," Jocko said.

"Isn't that kind of messy?"

"Nawww," said the Jock. "I only aim at their legs."

° ° °

"What are you doing, wearing a wastepaper basket for a hat?"

"Listen, if I wanna throw my head away it's my business."

° ° °

He breathed on the back of her neck . . . and bleached her hair.

° ° °

She dropped her handkerchief but I didn't pick it up. I use Kleenex.

° ° °

THE MOST GRUESOME ONE OF ALL: Cremators are selling ashes to cannibals to be used as "instant people."

° ° °

A nickel goes farther now than it ever did . . . you have to carry one for several weeks before you find anything it will buy.

° ° °

A group of freshmen taking astronomy had their first class in the observation lab one evening. The professor went to the telescope and began to make an observation. Just then a star fell.

"That was a fine shot, sir" one student said with admiration, "Why, we hardly had time to take aim at it."

° ° °

Two rabbits were being chased by a pack of wolves when one turned to the other and said:

"What are we running for, let's stop and out-number them."

The other rabbit said:

"Keep running, bud, keep running . . . we're brothers."

° ° °

A Texas oil man was visiting New York. His city friend showed him all of the sights including the Empire State building.

"Isn't that a magnificent structure?" asked his friend.

"Nothin'," said the Texan. "I got an outhouse bigger'n that"

The New Yorker looked him over. "You need it!" he retorted.

Baby Carriage: Last year's fun on wheels.

° ° °

Last summer at one of the ROTC summer camps one of the cadets was sent down to a stream to get some drinking water for the platoon, but had not been gone long when he came running back to camp empty handed and panting.

"Sir," he exclaimed, "There's a big alligator in the stream, and I'm afraid to get the water."

"Don't worry, son," said the sympathetic officer, "That alligator is probably four times as scared of you as you are of him."

"Well, sir," replied the cadet, "if that alligator's only half as scared as I am, that water ain't fit to drink."

° ° °

A smart girl is one who knows she can get more from Santa if she leaves her legs in the stockings.

° ° °

Visitor in Harem to the Sultan: "I'll have a short one just to keep you company."

° ° °

Irritated Prof: If there are any morons in this room, please stand up.

A long silence, and a lone freshman rose.

Professor: What, do you consider yourself a moron?

Frosh: Well, not exactly sir; but I do hate to see you standing all alone.

° ° °

Advice to professors: "Vary the monotony."

° ° °

"Unlawful" is against the law. "Illegal" is a sick bird.

° ° °

If ever a new Statue of Liberty is designed, it will be holding the bag instead of a torch.

° ° °

You can't fool all the people all the time . . . some of them are fooling you.

° ° °

A bosom companion sometimes turns out to be a false friend.

° ° °

Voice on phone: "Are you the desk clerk?"

Desk Clerk: "Yes, what's eating you?"

Voice: "That's what I'd like to know."

A sort of old-fashioned gentleman took his gal for a ride in his car and after finding a suitable spot to park, kissed her several times lightly on the cheek and then said, "This is called spooning."

"Okay," she said, "but I had much rather shovel."

° ° °

Bus. Ad. Stud: "Do you know what virgins dream about?"

Engineer: "No, what?"

Bus. Ad. Stud: "I suspected as much."

° ° °

Sign in front of crematorium: "We're Hot for Your Body."

° ° °

Instructor: "Before we start this final exam, are there any questions?"

E.E.: "What's the name of this course?"

° ° °

"Will you be free tonight," he asked.

"No, but I'll be reasonable," she said.

° ° °

Things men like to hear a girl say:

1. "No, I've never seen the golf course at night."
2. "Why bother, there's no one home here."
3. "You don't think this bathing suit is too tight, do you?"
4. "Let's go dutch!"
5. "Chaperone? What chaperone?"
6. "No, it really doesn't make any difference whether I get back at all tonight."
7. "My, but I'm cold!"
8. "Yes."

° ° °

Hi-Lifer: "I dreamed about you last night, sugar."

Sweetie: "Did you?"

Hi-Lifer: "No, you wouldn't."

° ° °

The waiter approached the attractive female customer and asked politely, "Do you like cocktails?"

"Yes," she said, "tell me one."

° ° °

And then there was the obviously sozzled fellow who was feeling his way around a lamp post and muttering, "S'no use, I'm walled in."

(Continued on Page 46)

More Finagle's Laws . . . . .

A mathematical notation of Finagle's work has also been developed. Here, however, there seems to be some confusion, because two other names enter the picture: "fudge" and "diddle" factors are also used to considerable advantage by scientists and engineers.

Years ago—when the universe was relatively easy to understand—the Finagle factor consisted of a simple additive constant (sometimes known as a variable constant) in the form:

$$x' = K_f + x.$$

where any measured variable, x, could be made to agree with theory, x', by simple addition of the F.nagle factor, K_f.

Later difficulties couldn't be solved so easily and so a fudge factor K_u, was added.

$$x' = K_f + K_u x.$$

Powerful as this adjustment was, World War II studies in servo theory indicated a need for a still stronger influence. The diddle factor K_d, was born and made to multiply the quadratic term.

$$x' = K_f + K_u x + {}_d x^2.$$

It is felt that, at least at present, reality can be made to conform to mathematical theory with reasonable agreement on the basis of these three factors.

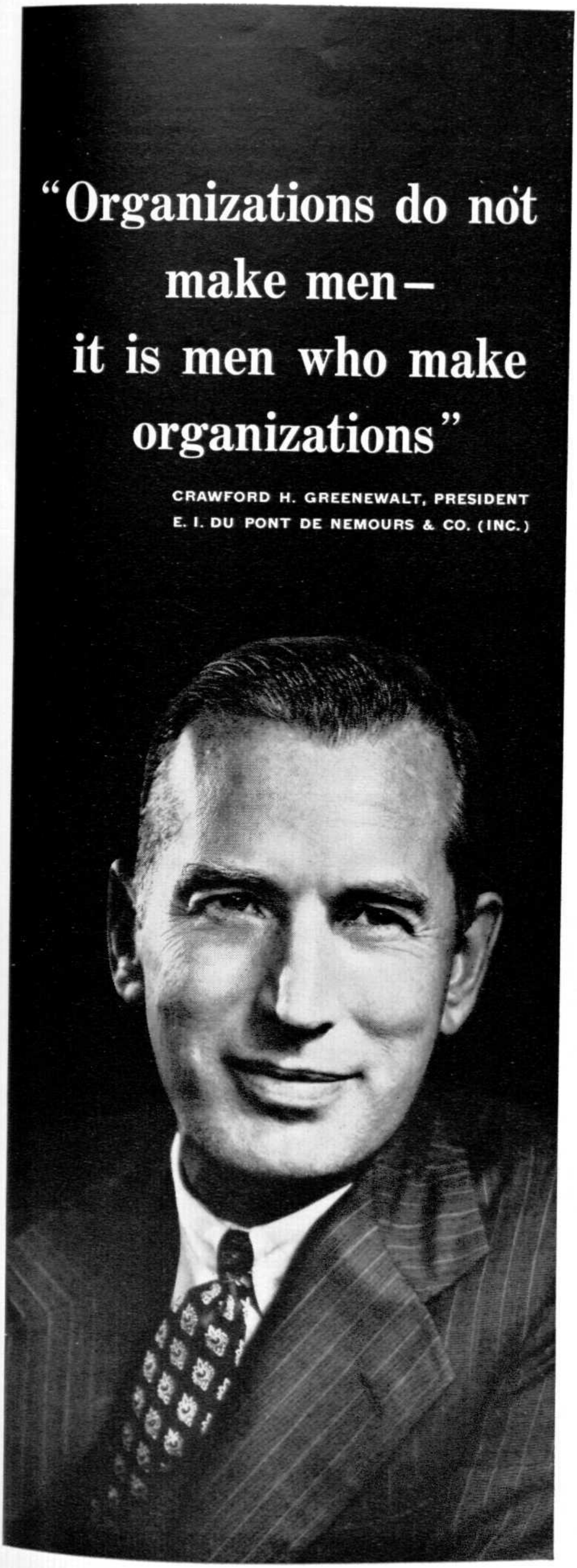
However, John W. Campbell feels there is a different basic structure behind the Finagle, fudge and diddle factors. The Finagle factor, he claims, is characterized by changing the universe to fit an equation. The fudge factor, on the other hand, changes the equation to fit the universe. And finally, the diddle factor changes things so that the equation and the universe appear to fit, without making any real change in either.

For example, the planet Uranus was introduced to the universe when Newtonian laws couldn't be made to match known planetary motions. This is a beautiful example of the application of the Finagle factor.

Einstein's work leading to relativity was strongly influenced by the observed facts about the orbit of Mercury. Obviously a fudge factor was introduced.

The photographer's use of a "soft-focus" lens when taking portraits of women over 35 is an example of the diddle factor. By blurring the results, photographs are made to appear to match the facts in a far more satisfactory manner.

To our knowledge, this is the first clear enunciation of the scientific method. All our vast sum of human knowledge has been derived with these as the basic tools. By having them in writing for the first time, perhaps our children can build even better futures than the best we envision today.



"It is what men bring with them in the way of character and adaptability and fresh ideas that enriches the organizational bloodstream and insures corporate longevity." This is the observation of Crawford H. Greenewalt, President of the Du Pont Company.

In a lecture given in the past year at Columbia University, Mr. Greenewalt outlined his views on the role of the individual in the organization. "The Du Pont Company's success over the last 150 years," he pointed out, "has come about in large part through devoted allegiance to two major themes . . .

"First, the realization that an enterprise will succeed only to the extent that all individuals associated with it can be encouraged to exercise their highest talents in their own particular way.

"Second, the provision of maximum incentives for achievement, particularly in associating the fortunes of the individual to that of the corporation.

"Men are not interchangeable parts, like pinion gears or carburetors. Individuals differ in approach and method, and, to perform to best advantage, they must never be fettered to approaches and methods not their own."

"Conformity" obviously takes a back seat here. As Mr. Greenewalt comments, "We conform as is necessary to good manners, good relationships and the highest use of individual talent. And bear in mind that these are strictures on behavior, not on creative thought."

If you find this kind of atmosphere challenging it will pay you to explore career opportunities with Du Pont.

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BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

SIDETRACKED

Who is the man who designs our pumps
With judgment, skill, and care?
Who is the man that builds them
And who keeps them in repair?
Who has to shut them down because the valve seats disappear?
It's the bearing-wearing, gearing-tearing
MECHANICAL ENGINEER.

Who buys the juice for half a cent
And wants to charge a dime,
Who, when we've signed the contract,
Can't deliver half the time?
Who thinks a loss of sixty-nine percent
Is nothing queer?
The volt-inducing, load-reducing,
ELECTRICAL ENGINEER.

Who is it, takes a transit out,
To find a sewer tap,
Who then with care extreme locates
The junction on the map?
Who it is, goes to dig it up,
And finds it nowhere near?
It's the mud-bespattered, torn and tattered,
CIVIL ENGINEER.

Who thinks without his products
We'll be in the lurch,
Who has a heathen idol
Which he designates Research?
Who tints the creeks, perfumes the air,
And makes the landscapes drear?
It's the stink-evolving, grass-dissolving
CHEMICAL ENGINEER.

Who takes the pleasure out of life,
And makes existence hell,
Who'll fire a real hot girl
Because she cannot spell?
Who substitutes a dictaphone
For a coral tinted ear?
It's the penny-chasing, dollar-wasting,
INDUSTRIAL ENGINEER.

Who is the man who'll draw a plan
For anything you desire,
From a transatlantic liner
To a hairpin made of wire?
With "ifs" and "ands" and "buts,"
Who makes his meaning clear?
The work-disdaining, fee-retaining,
CONSULTING ENGINEER.

The brains of a college student is one of the most amazing things known to man. It starts to function the moment he jumps out of bed and doesn't stop until he reaches the classroom.

° ° °

First Drunk: "Shay, do you know what time it is?"

Second same: "Yeah."

First Drunk: "Thanksh."

° ° °

The ME instructor held the chisel against the rusted bolt. He looked at the ME student and said, "When I nod my head you hit it."

They're burying him at noon today.

° ° °

For years the bum slept under bridges and in ditches. Then one day he switched to culverts and became a man of distinction.

° ° °

Some girls are cold sober. Others are always cold.

° ° °

Host: "There are my grandmother's ashes over there."

Guest: "Oh, so the poor soul passed away?"

Host: "No she's too damned lazy to look for an ash tray."

° ° °

Fellow to blind date: "I never really believed in reincarnation – but what were you before you died?"

° ° °

When the teacher asked little Jackie how he enjoyed Easter Sunday, he came across with the following tale:

"Pop and Mom painted some real pretty Easter eggs for sis and me, and hid them in the hen house so we wouldn't find them. About that time, Bob, our rooster came along and took one look, dashed over the fence into the next yard and kicked the hell out of the peacock over there."

° ° °

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

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

° ° °

People are like steamboats–they toot loudest when they are in a fog.

° ° °

Instructor: "I suppose you wish I were dead so you could spit on my grave."

Student: "Not me, I hate to stand in line."

An ME was very indignant at being arrested. He staggered into the police station and before the captain had an opportunity to say anything he pounded his fist on the desk and said: "What I wanna know is why I've been arrested."

"You were brought in for drinking," answered the captain.

"Well, thass different–thass fine–let's get started."

° ° °

"How can you keep eating this dorm food?"

"Oh, it's easy. I just take a tablespoon of Drano three times a day."

° ° °

Teacher (warning her children against catching cold): I had a little brother seven years old, and one day he took his new sled out in the snow when it was too cold. He caught pneumonia and three days later he died.

Silence for ten seconds.

A voice from the rear: Where's his sled?

° ° °

Then there's the touching story of the young man who said to his girl: "I'll betcha you wouldn't marry me."

The story goes that she not only called his bet, but raised him five.

° ° °

Ch. E.: "I just bought a skunk."

M. E.: "Where you gonna keep 'im?"

Ch. E.: "Under the bed."

M. E.: "What about the awful smell?"

Ch. E.: "He'll just hafta get used to it like I did."

° ° °

"Ah wins."

"What you got?"

"Three aces."

"No you don't. Ah wins."

"What you got?"

"Two eight's and a razor."

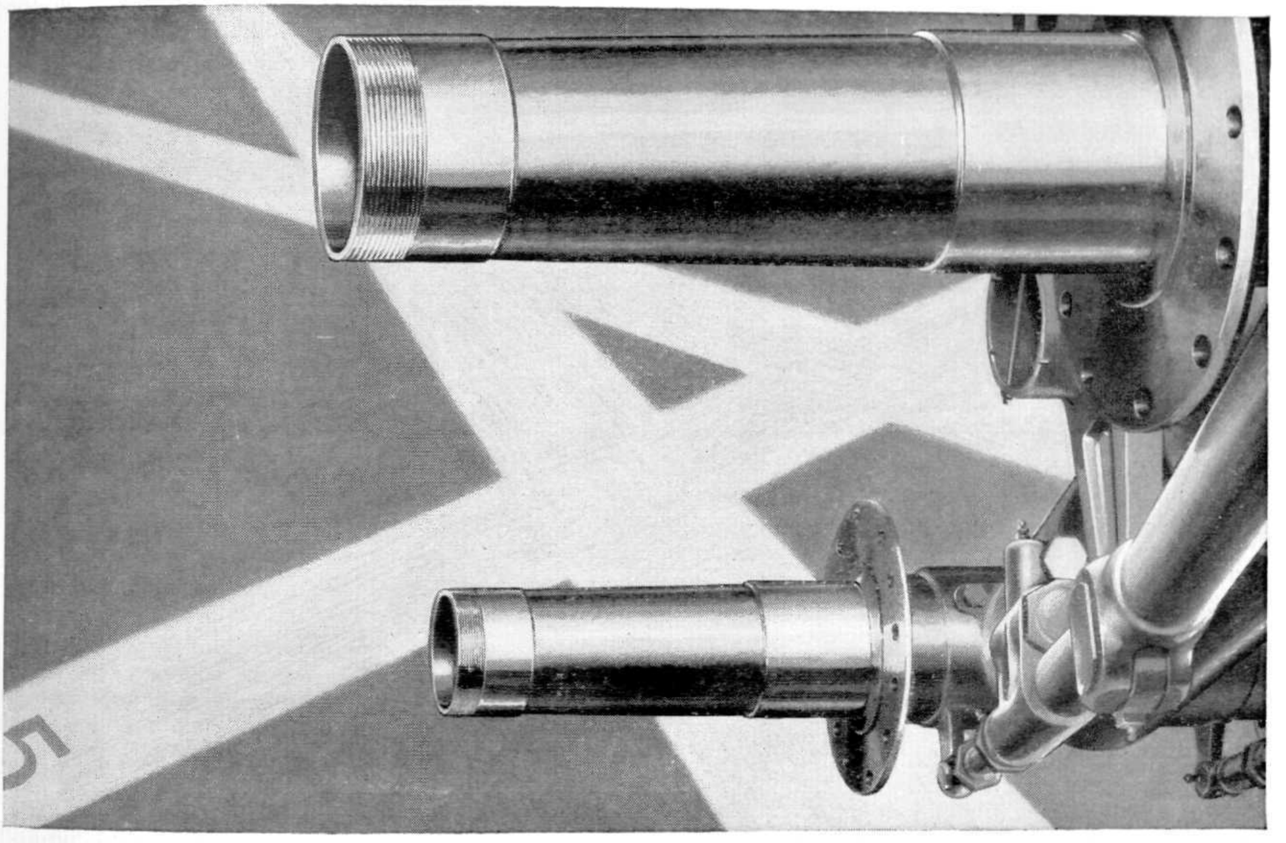
"You sho do. How come you is so lucky?"

° ° °

Co-ed: "I had a date with an absent-minded professor last night."

Co-ed No. 2: "How do you know he is absent-minded?"

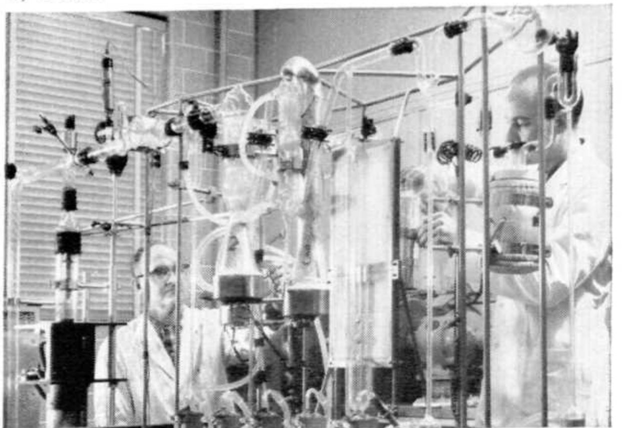
Co-ed: "He gave me a zero on a quiz this morning."



How to get steel tough enough to land America's first jet airliner

YOU see above the axles of the Boeing 707—America's first jet airliner. They have to be tough. A cross-wind landing could put the whole landing impact of this 122-ton plane on one wheel—instead of eight. And these axles have to be light. Manufacturers of the 707's landing gear had built landing gears for dozens of other models using an analysis of seamless steel tubing specially developed by the Timken Company. But to be strong enough for the much heavier 707, the steel would have to be cleaner. Any impurities in the finished part would cause its rejection. Timken Company metallurgists said the steel *could* be made clean enough for the 707. And it was—met highest specifications, stood up to the terrific landing impacts.

Timken steels have solved the toughest steel problems. Problems that you may face in your future job in industry. Our metallurgists will be ready to help you. And if you're interested in a rewarding career with the leader in specialty steels . . . with the world's largest maker of tapered roller bearings and removable rock bits . . . send for free booklet, "Better-ness and your Career at the Timken Company". Write Mr. Russ Proffitt, The Timken Roller Bearing Company, Canton 6, Ohio.



Vacuum Fusion Laboratory in our new steel Research Center, where small samples of new steels are analyzed—steels to answer today's problems, tomorrow's needs.

TIMKEN® Fine Alloy STEEL

SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS STEEL TUBING

Missile Packaging

(Continued from Page 30)

man is always striving to design the best possible container at the lowest possible cost.

The functions of a missile container, and the types of damage such a container is designed to prevent, are common to containers for all types of equipment. Viewed in this light, there are no fundamental engineering differences between the design of missile containers and the design of containers for other types of equipment, and the sole difference is the degree of difficulty in arriving at the correct solution. This difference of degree may, however, be of about the same order of magnitude as the difference between designing a model airplane and designing a jet bomber.

Over the years, standard rules have been developed for designing containers for the vast majority of military equipment. Reliance on these rules is not sound for most packaging problems today, but a detailed engineering approach is required. Missile containers are definitely in this category. Missiles are extremely delicate and a failure does not have to take the form of a drastic fracture or even a readily visible stretch or bend. It is sufficient that complex delicate assemblies be out of adjustment. Lack of alignment, for instance, could result in the missile missing its target or, in more extreme cases, misfiring at time of launching.

Missiles, because they are longer and thinner than other types of mechanical assemblies, present unique problems in shock and stress which the packaging man must contend with. Assembled missiles that approach forty feet in length often have to be shipped completely assembled. The combination of length, weight, and fragility must be accurately provided for in the container.

Before starting to design a container, the packaging engineer must confer with the missile designers to get full knowledge of its expected functions. This in turn demands an intimate acquaintance with many features of the entire missile system. The combined skills of a packaging engineer and a missile designer are seldom found in one person. Therefore, a cooperative partnership of the two technologists must be formed at the inception of the basic design.

Transportation is perhaps the most severe hazard to which guided missiles are subjected. Added to this are the possibilities of damage caused by depot handling and storage, corrosion, dust, temperature, humidity and pressure changes. Results obtained from analytical and experimental tests indicate ways to reduce some of the serious transportation problems.

Laboratory simulation testing is the re-creation, under scientifically controlled conditions, of certain physical forces or conditions in such a manner that a measurable result or effect is produced on a test specimen. In shock and vibration simulation the actual environment is rarely reproduced exactly in the laboratory. Engineers attempt to synthesize the natural environment into an artificial laboratory test that will produce a desired and controlled effect on the test specimen. The results of such tests are then evaluated, keeping in mind the actual service environment that the missile will experience.

Ideally, the laboratory simulation test should include *all* the physical forces and conditions found in the natural environment. Actually to perform such tests, however, would be too expensive and time consuming. Therefore, packaging engineers must

(Continued on Page 50)

STRAIGHT TALK TO ENGINEERS

from Donald W. Douglas, Jr.

President, Douglas Aircraft Company

The "Space Age" isn't going to become a fact by itself. We engineers have to make it happen. Here's what Douglas is doing about it:

We've formed a top level engineering council to bring all our knowledge and experience to bear on the new problems relating to extreme high speeds and altitudes and to outer space.

This council is composed of the heads of our six major engineering divisions and is chairmanned by our senior engineering vice president. It will map out the most important goals in aviation and mobilize the scientific and engineering resources required to achieve them.

If you would like to become a part of our stimulating future, we'll welcome hearing from you.

Write to Mr. C. C. LaVene
Douglas Aircraft Company, Box 600-X
Santa Monica, California.

Missile Packaging

(Continued from Page 48)

decide, on a deductive basis, the tests which are to be simulated and the results which are to be measured.

The gathering of shock and vibration environmental data, and simulation attempted in laboratories, both call for extensive instrumentation. Packaging men must have a working knowledge of the instruments used for both dynamic and static testing. Equipment, such as oscilloscopes, accelerometers, and drop-test apparatus become important tools of the missile packager.

Laboratory simulation of the shock and vibration environment of missile packages has an economic as well as an engineering significance. Careful package testing and selection mean a saving to taxpayers.

Information is obtained by well planned and accurately executed laboratory simulated tests. The value of these tests so out-weigh the costs involved, the government cannot afford to forego such tests. Engineers engaged in packaging work are likely to spend many hours in the lab analyzing container performance and comparing cost.

The lack of confidence in the so-called "educated guesses," time wasted, and high cost of full scale field tests are factors leading to more and more reliance on the lab simulation tests in missile research and development programs. The rapidity with which the results of such tests can be translated into engineering design or production changes also underscores their importance in complex design programs.

In order to translate the existing field measurements on common carriers into the language of the missile packaging designer, it is necessary to examine the shock and vibration data obtained on railroads, trucks, aircraft, and ships. The purpose of assessing these data is to determine the damage potential of shock or random vibration to a missile in the container while in transit. It also is necessary to know the capacity of each missile to withstand shock and vibration in its operational life. The difference between the field conditions which exist on the carrier, and the inherent ruggedness of the missile itself, is the extent of protection which must be provided by a suspension system.

Adequate protection for a missile in transit or in storage depends largely upon its container. There are no established practices in design techniques or material standards to guide missile packaging.

The experiences gained from a few initial developments should indicate to the designer a general approach to his particular needs. The design of containers and their shock and vibration isolators, in most cases, have to be intimately linked.

Shock absorbers and vibration mounts are placed between equipment and its base, so as to prevent damaging forces from reaching it. However, for adequate protection of the equipment, it is most important to design or select a suitable mount for a specific job. Certain factors must be established before a design can be considered. The materials used in absorbing shock are made from such things as steel springs, pads of fiberglas, and even animal hair dipped in molten rubber have good shock absorbing properties.

The employment of cushioning materials for missile packaging calls for efficient design, both to prevent damage and to limit cost. Formerly the selection of isolation material was accomplished mostly by trial and error. In recent years, due to new packaging materials being developed and a refinement in test procedures, new criteria have been established for systematically selecting the proper stiffness of cushion for efficient design.

A serious drawback to many cushioning materials is their failure at temperature and humidity extremes. Containers and their equipment must function satisfactorily at very high and low temperatures. The temperatures will range from -65° F to 165° F, and at varying humidities.

Technological innovation has long been the earmark of American ingenuity. Until recently, there seemed to be few reasons for most Americans to doubt that we were the masters of technological innovation in practically every field. This assumption was recently challenged when the Russians launched the first satellite. Suddenly, Americans were awakened. They began to see the strength of Russia and could no longer look down upon the rest of the world when comparing recent scientific achievments.

This is one of the main reasons why there has been the tremendous interest in satellites and guided missiles lately. As a result many essential allied industries have gained new importance too. The field of missile packaging is one of them.

Allis-Chalmers offers training course

In nucleonics, Andrew Selep, Brooklyn Polytechnic Institute, BME '53, is working on the problem of reactor safeguards.

Special engineering by Paul W. Clark, Iowa State College, EE '49, is of large job involving combined electrical equipment.

Sales manager, Robert Horn, Marquette University, EE '51, heads sales of voltage regulators used on power lines.

Electronics man, William E. Martin, Alabama Polytechnic Institute, BSEE '53, engineers applications of induction heaters.

plus wide choice of type and fields of

Design of generators for steam turbines is directed by G. W. Staats, Illinois Institute of Technology, Ph. D. '56.

Field sales of America's widest range of industrial equipment is career of Carl E. Hellerich, U. of Nebraska, ME '49.

Promotion man, Robert I. Carlson, Worcester Polytechnic Institute, ME '50, directs promotion of switchgear, and substations.

Application and sales of steam condensers for power plants are handled by William E. Ellingen, U. of Wisconsin, ChE '49.

work on equipment for many industries

THE outstanding training course started by Allis-Chalmers has proved a springboard to many worthwhile careers In fact, most of the A-C management team has stemmed from its ranks.

Up to two years of theoretical and practical training are offered. This experience leads to jobs in research, design, manufacturing, application and sales.

Even though you may not know exactly what you wish to do, the Allis-Chalmers training course is designed to help you find the type of work and the field to which you are best suited.

ALLIS-CHALMERS

A-5600

MISTIC . . . a versatile tool

(Continued from Page 14)

uate student. The Purdue computer it different from Mistic, but the basic idea of programming is the same for all digital computers. Dr. Mercer felt that the Purdue computer is about 100 times slower than Mistic, but is still plenty fast!

Dr. Mercer performed his analysis on a series of 15 different cases. The time necessary for him to set up the original program was a total of about three or four weeks, over a period of a couple of months. This included studying the procedure for the Mistic. Once the original program was completed, programs for each individual case took only a matter of hours. Each run took 17 minutes of computer time, and provided a total of about 200 numerical answers which, in turn, were used to plot curves.

I asked Dr. Mercer if he had any idea how long this analysis would have taken him without the use of the computer. He feels that he would not have attempted it without the computer but, if he had, each 17 minute run would have taken him a couple of months. The complete procedure, which took him one summer would have taken him several years with a desk calculator.

MISTIC Tackles Psychology Problems

If you should happen to pass the Computer Lab. and see your psychology professor in there, don't get the wrong idea. He is probably not trying to psychoanalyze the machine, nor to find out if it is suffering from a mild case of schizophrenia. More than likely he is having the machine analyze some of the many problems that arise in the field of research psychology.

There is a technique commonly called the scientific method which consists of experimenting with two identical units; identical, that is, except for one factor. Any difference in behavior of the two units recorded throughout the experiment may then be attributed to the one factor. This method is very systematic and enables the scientist to vary one factor at a time and to observe and to record the results as his work proceeds.

This method, however, is impossible to use in many psychology situations. Where could one find two identical people and, when he had found them, how would he vary one factor in one of them. The science of psychology may be likened to that of meteorology. Both must take the factors as they are and be content to observe and try to predict. Both must take into consideration a large number of factors simultaneously. In the case of psychology the number of variables introduced may be as high as forty or fifty. This means that in analyzing the data, a group of forty or fifty simultaneous equations must be solved. I'm sure that many of my readers have dealt with simultaneous equations and can conceive the work entailed with the solution of forty of them. Before the era of the computer it was not uncommon for the statistical psychologist to withdraw into a corner with his desk calculator and actually spend more time in the analysis than in the collection of his data. The plight of the psychologist has been reduced—thanks to electronic computers. His problems fit very nicely into the patterns of efficient computer usage, that of repeating similar problems that would take too much time by hand to be practical.

Dr. Charles Wrigley of the Michigan State University Psychology Department and formerly of the University of Illinois has spent much time in studying the application of computers to the psychological field. He started his work in computer application at the University of Illinois when the Illiac was first completed. From his work Dr. Wrigley has drawn various conclusions that may be applicable to other fields as well. He finds that computer usage must be considered in terms of its long term gains. Programs for the standard problems take time, but once set up, they are readily applied to specific problems. Electronic computation demands greater accuracy from the staff since computer time is valuable and mistakes are costly, time-wise and money-wise.

Computers may and should be programmed to provide desired answers and not intermediate steps. This variation from the desk calculator method of procedure reduces the bookkeeping necessary.

Accuracy may now be obtained where estimations were used before. Better methods, less time and greater accuracy are the desirable products of electronic computers. In short, "the psychologist gets more time for his laboratory or his couch, as the case may be."

Now that you have seen a sampling of the uses of the computer about the campus, you may wonder as I did, why are these people using them. Some of the cases are more obvious than others. Design work of the cyclotron has a direct relation with the uni-

(Continued on Page 54)

MISTIC . . . a versatile tool

(Continued from Page 52)

versity. Graduate students may be interested to know that the computer is available for use in connection with their theses. Why, though, would the school be interested in developing a program for the design of DC rotating machinery?

No, the school isn't thinking about producing motors or generators. The actual case is that the school is under contract to the Reliance Electric and Engineering Company to produce the program. This may be considered an ideal situation. The school is equipped with the staff capable of producing such a program which in turn provides excellent experience for graduate students expecting to enter the industrial field.

Not just a big black box nor an aid for those only who completely understand its operation, Mistic is a tool to be utilized by all departments. As the library stands now, an invaluable research tool, the day is here when schools as fortunate as Michigan State will turn to their computers as a tool for rapid calculation in all fields.

Farm Production Problems

(Continued from Page 21)

Interested students may earn advanced degrees in agricultural engineering. There have been over 150 M.S. and Ph.D. graduates since 1948, in agricultural engineering at Michigan State. Achievement of an advance degree provides additional opportunities for employment, particularly teaching and research positions in colleges and foreign countries.

Demand for graduates has grown rapidly in the last few years. There are more than three times as many new opportunities each year as graduates become available.

Whatever the reason for his choice, there is a challenging career ahead for the competent man choosing to apply engineering to agriculture.

Has gooseberries got legs?

No.

Then I just ate a fieldmouse.

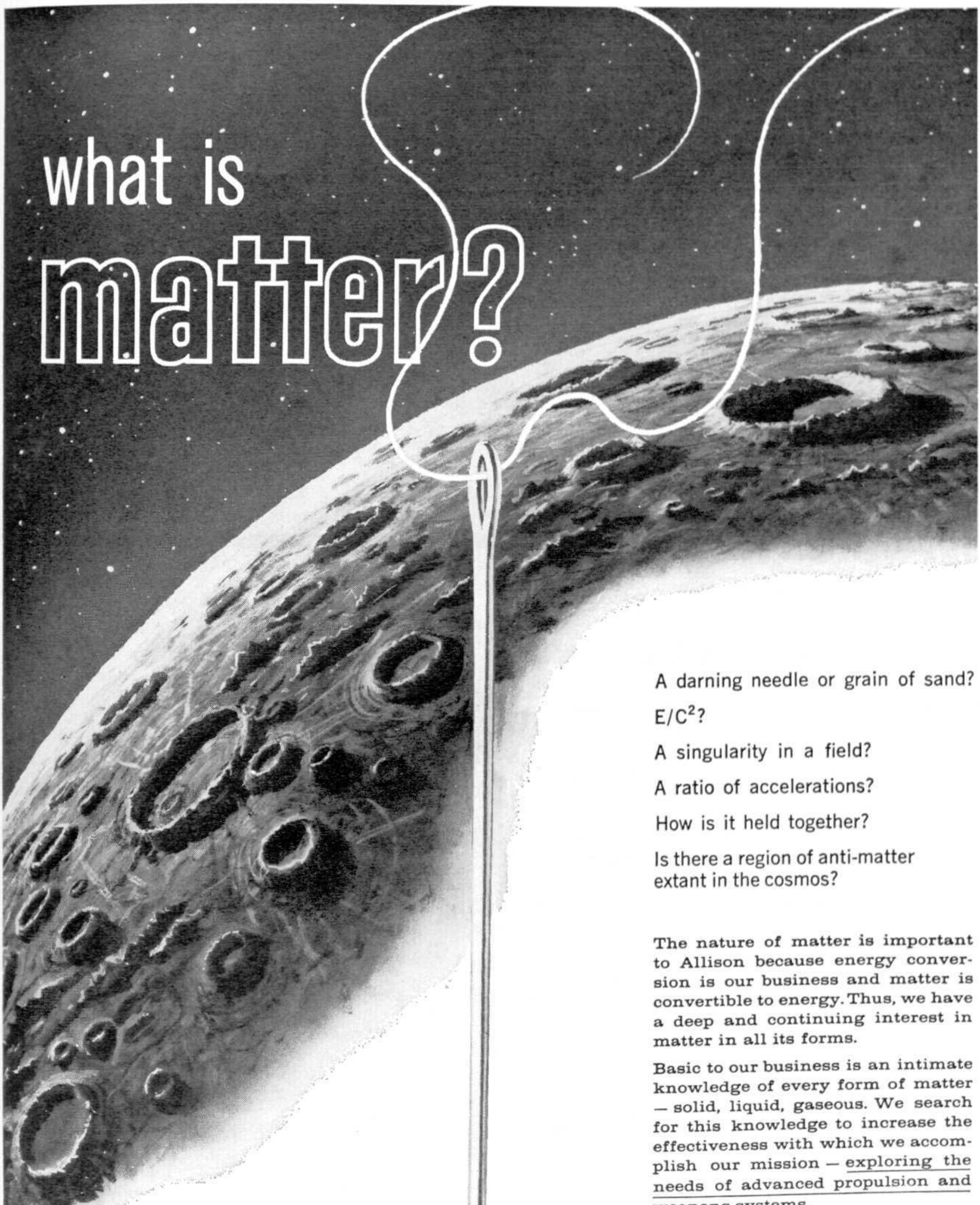
° ° °

She was only a photographer's daughter, but she was certainly well developed.

° ° °

Slave: "There's a beautiful maiden outside without food or clothing."

Sultan: "Feed her . . . and bring her in."



A darning needle or grain of sand?

E/C^2?

A singularity in a field?

A ratio of accelerations?

How is it held together?

Is there a region of anti-matter extant in the cosmos?

The nature of matter is important to Allison because energy conversion is our business and matter is convertible to energy. Thus, we have a deep and continuing interest in matter in all its forms.

Basic to our business is an intimate knowledge of every form of matter — solid, liquid, gaseous. We search for this knowledge to increase the effectiveness with which we accomplish our mission — exploring the needs of advanced propulsion and weapons systems.

Want to know about YOUR opportunities on the Allison Engineering Team? Write: Mr. R. C. Smith, College Relations, Personnel Dept.

Energy conversion is our business

ALLISON
Division of General Motors,
Indianapolis, Indiana

Starting Salaries

The Engineers and Scientists of America have conducted a study of the trends in starting salaries of new graduate engineers. From the data available we have prepared recommended minimum starting salaries for various levels of experience and class standing.

Copies of this recommended minimum standard have been sent to your Dean of Engineering, Engineering Library, Placement Director, and Chairmen of the Student Chapters of the various Technical Societies.

We would be happy to send you a complimentary copy.

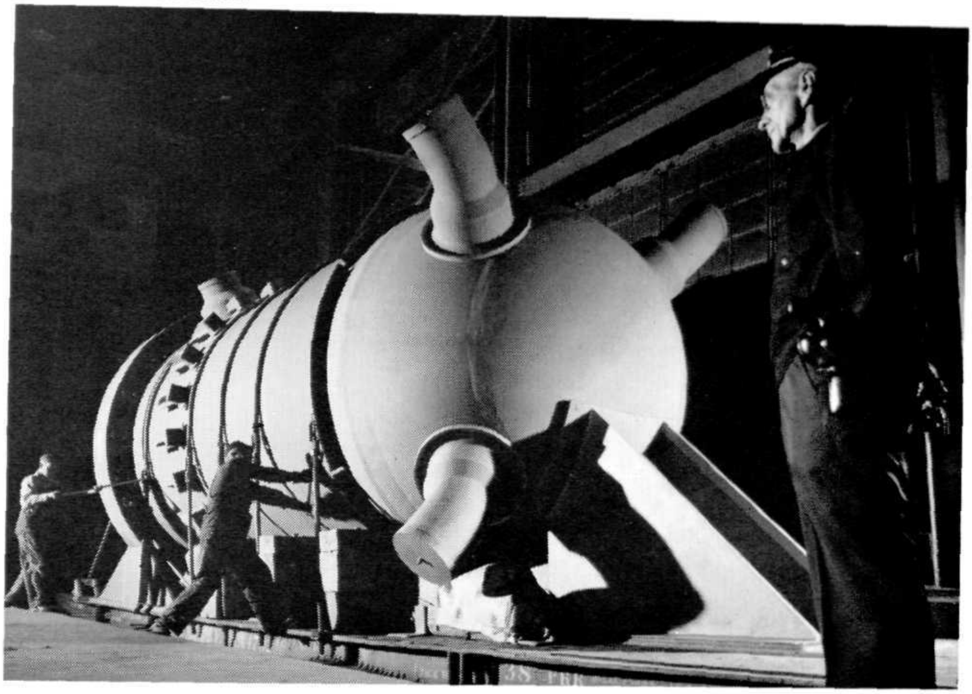
Engineers and Scientists of America
Munsey Building
Washington 4, D. C.

Sophomores and juniors are needed to fill vacancies in several editorial positions on the SPARTAN ENGINEER. Training in technical journalism is available to all interested engineering students who desire experience in the publication field. Come up and chat with us in Room 346, Student Services Bldg., any class day afternoon. Perhaps you, too, can reap the rewarding benefits of this extra-curricular activity.

ADVERTISERS' INDEX

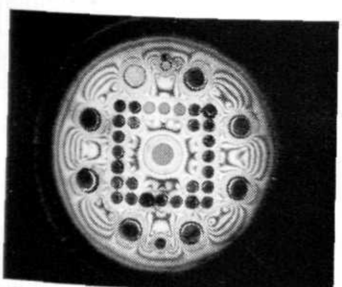
* Inside front cover
** Inside back cover
*** Back cover

PHOTOGRAPHY AT WORK—No. 25 in a Kodak Series

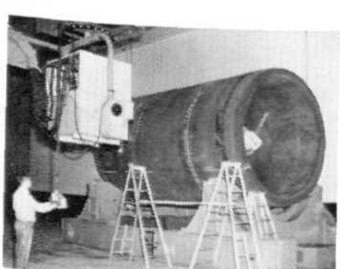


Nuclear reactor vessel for Shippingport, Pa. power plant designed by Westinghouse Electric Co. under contract with the A.E.C. for operation by Duquesne Light Company.

Where atoms turn into horsepower



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



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

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

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

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

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

CAREERS WITH KODAK

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

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

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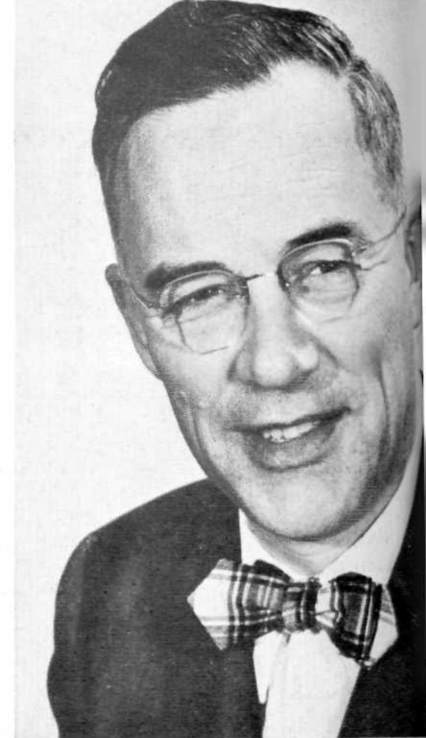

General Electric interviews

Dr. Richard Folsom, President of

Rensselaer Polytechnic Institute,

to explore . . .

Teaching— A Career Opportunity For the Engineer

Leading educators, statesmen and industrialists throughout the country are greatly concerned with the current shortage of high-caliber graduates who are seriously considering a career in the field of science or engineering education. Consequently, General Electric has taken this opportunity to explore, with one of America's eminent educators, the opportunities and rewards teaching offers the scientific or engineering student.

Q. Is there in fact a current and continuing need for educators in technical colleges and universities?

A. Colleges and universities providing scientific and engineering educational opportunities are hard pressed at the present moment to obtain the services of a sufficient number of well-qualified teachers to adequately carry out their programs. Projected statistical studies show that this critical need could extend over the next 15 or 20 years.

Q. Why is this need not being met?

A. There are probably three main reasons. These might be classed under conditions of financial return, prestige associated with the position, and lack of knowledge and understanding on the part of the college student of the advantages and rewards teaching as a career can afford.

Q. What steps have been taken to make education a more attractive field to engineering students?

A. Steps are being taken in all areas. For example, we have seen a great deal in the newspapers relating educators' salaries to the importance of the job they are doing. Indications are that these efforts are beginning to bear fruit. Greater professional stature is being achieved as the general public understands that the youth of our nation is the most valuable natural resource that we possess . . . and that those associated with the education of this youth have one of the most important assignments in our country today.

Q. Aside from salary, what rewards can a career in education offer as opposed to careers in government or industry?

A. The principal rewards might be freedom to pursue your own ideas within the general framework of the school, in teaching, research and consulting activities. As colleges and universities are normally organized, a man has three months in the summer time to engage in activities of his own choice. In addition, the educator is in direct contact with students and he has the satisfaction of seeing these students develop under his direction . . . to see them take important positions in local and national affairs.

Q. What preparation should an engineering student undertake for a teaching career?

A. In college, the engineering student should obtain a basic understanding of science, engineering science, humanities and social sciences with some applications in one or more professional engineering areas. He should have frequent career discussions with faculty members and his dean. During graduate work, a desirable activity, the student should have an opportunity to do some teaching.

Q. Must an engineering student obtain advanced degrees before he can teach?

A. It is not absolutely necessary. On the other hand, without advanced degrees, advancement in the academic world would be extremely difficult.

Q. How valuable do you feel industrial experience is to an engineering or scientific educator?

A. Industrial experience for a science educator is desirable; however, with a senior engineering educator, industrial experience is a "must". An ideal engineering educator should have had enough industrial experience so that he understands the problems and responsibilities in carrying a project from its formative stages to successful completion, including not only the technical aspects, but the economic and personal relationships also.

Q. What do you consider to be the optimum method by which an educator can obtain industrial experience?

A. There are many methods. After completion of graduate school, perhaps the most beneficial is a limited but intensive work period in industry. Consulting during an academic year or summer is a helpful activity and is desirable for older members of the staff. Younger educators usually need experience in "living with the job" rather than providing consultant's advice to the responsible individual.

Q. Based on your experience, what personal characteristics are possessed by successful professors?

A. Primarily, successful professors have an excellent and growing knowledge of their subjects, are interested in people, and transmit enthusiasm. They have an ability to explain and impart information with ease. They generate ideas and carry them out because they are devoted to developing their fields of knowledge. They desire personal freedom and action.

For further information on challenging career opportunities in the field of science and engineering education, write to: Mr. W. Leighton Collins, Secretary, American Society for Engineering Education, University of Illinois, Urbana, Ill.

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