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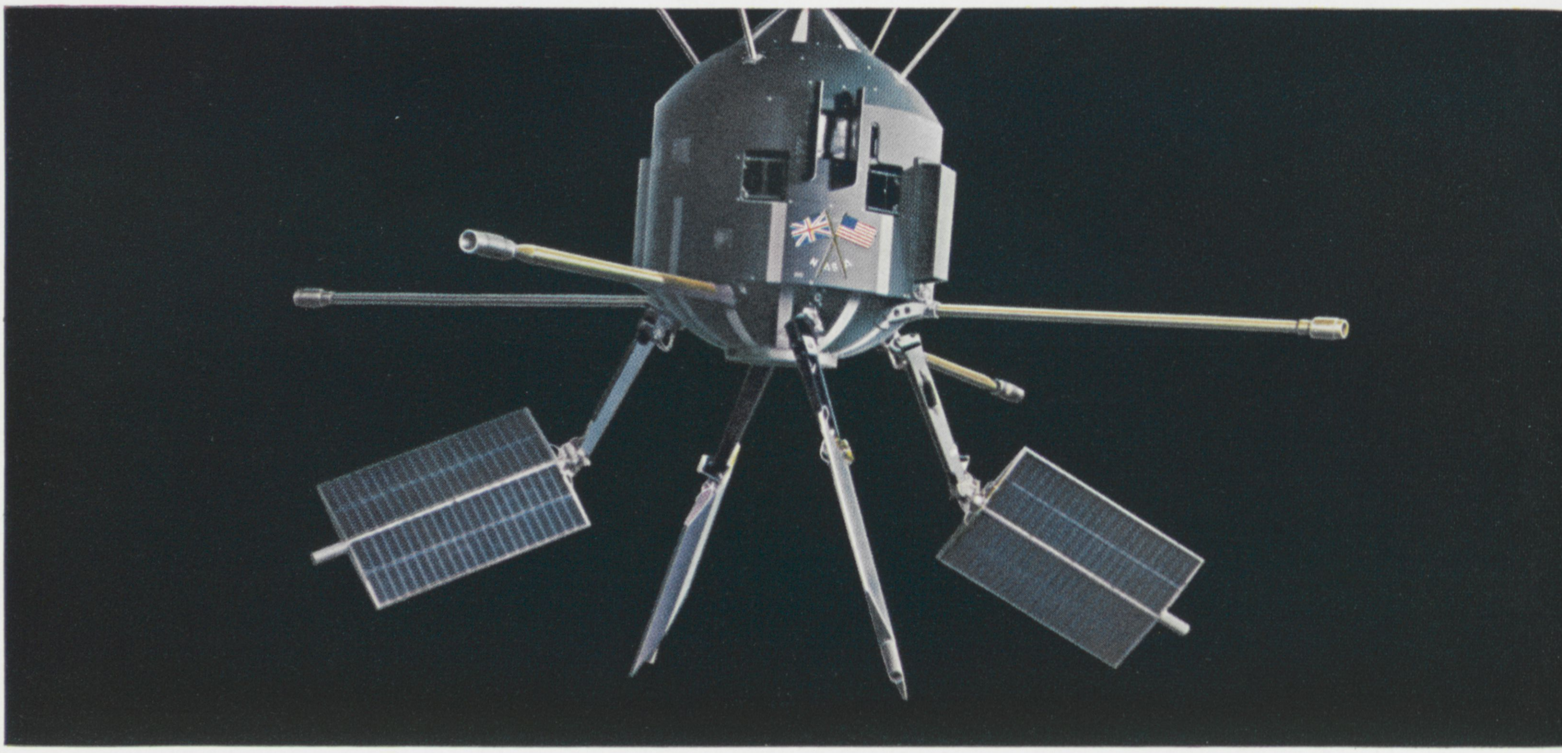
Rose Technic Staff
Rose-Hulman Institute of Technology

Rose Technic

October 1964 50c

THE ENGINEER'S RESPONSIBILITY TO COMMUNITY, STATE, AND NATION

Scientists are listening to sounds from the stars



through a satellite built by Westinghouse

Almost all we know about deep space we learned by studying light . . . the faint, flickering light from distant stars. Now, suddenly, a whole new universe is opening up to us through *sound* from the stars. It comes via a satellite in which the British Government, NASA's Goddard Space Flight Center and Westinghouse each had a share.

This sound comes from millions of stars which we never knew before, because they emit no light. We couldn't hear them, either, because the earth's atmosphere shut off these noises, but now we can. The satellite, Ariel II, also tells us how the earth's heat balance affects weather and how micrometeoroids erode space ships.

The British developed the scientific experiments. Westinghouse built the satellite and integrated the system. NASA launched it.

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AMERICA'S OLDEST ENGINEERING COLLEGE MAGAZINE IN CONTINUOUS MONTHLY PUBLICATION — 1891-1964

IN THIS ISSUE

In his address to the Consulting Engineers Council, entitled "The Engineer's Responsibility to Community, State, and Country," Utah's Governor George D. Clyde describes the role of engineers in our society.

Mars Gralia explores the realm of Cybernetics and the use of the computer in communications, in "Don't Think—Imagine."

The structure of the atom is X-rayed in Howard Alm's "The Power Within the Atom."

COVER NOTE

This month's cover is an original drawing by Greg Samoluk, junior math major, entitled "Man's Ability Is Unlimited."

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Rose Technic

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ROSE

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Terre Haute, Indiana

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The Rose Development Program

John L. Bloxsome - Vice President for Development

"Development" is a relatively new term in the college vocabulary. In most instances Development Officers are not new people on college campuses; almost all of them have academic backgrounds, and many of them were former college teachers. An organized Development Program came to the Rose campus in September, 1960, and a Development Office was established at that time. Some of the areas of this program had been in existence at Rose for many years, but from 1960 on an effort was made to coordinate more efficiently all aspects of Development.

Beginning November 1, 1960, the Rose Board of Managers entered into a contract with Gonser & Gerber, a Chicago Development Consulting firm, and for a period of three years Mr. Robert Tinker, a representative of that firm served as a consultant to Rose, visiting the campus two days each month. During that period the Development Office was organized into an efficient operation. Complete and accurate records were made and centralized in this office. The Board of Associates and Parents Association were organized. The committee structure of the Board of Managers was reorganized into three major committees: academic affairs, business affairs, and development. The college began issuing Annual Reports and an attempt was made to improve the quality of all publications.

Development has many different meanings, but at Rose the Development Office is concerned with three major areas of responsibility.

The first of these is public relations or image building and communications. As an important part of the development program, the Office of Information Services must see that the proper image for Rose is built and then communicated to our publics. Mr. Donald A. Flathman, who came to Rose in September this year, is the Director of this office. Mr. Flatham is a graduate of New York University with a degree in journalism. He has had experience as a newspaper reporter, and he came to Rose from Cazenovia College near Syracuse, New York, where he was the Director of Public Relations.

The second area for responsibility for Development at Rose is that of admissions and placement. We must see that Rose is provided with the kind of students that we want and in the numbers that we have planned for on our program. It is also the responsibility of the Office of Admissions and Placement to help our graduates find positions after graduation. Professor Paul B. Headdy, a former professor at Rose heads this important office, and Mrs. Shirley Brown is his secretary. Since the Development Program began at Rose, two additional men have been added to the staff in the Admissions Office; they are William R. Brown, a Rose graduate in 1962, and Duncan Murdoch, who came to us from Hanover College, where he was graduated in 1961 and where he had served as an Admissions Counselor. These men brought to the campus this fall the largest—248 students—and one of the best, if not the best, freshman classes ever to enter Rose or any other Indiana college. Next year our plans call for a freshman class of approximately 300.

The third role of the Development Office is to see that funds are made available for Rose. We seek dollars to underwrite education, for we have nothing to sell at Rose except quality education. The dollars are tools, not an end in themselves. But it is very important to a growing college that it have a distinguished faculty who are paid salaries comparable with other good colleges of its kind, that it have adequate equipment and facilities for teaching and research, and that it have administrators who are competent, fair, and farseeing—men who can plan and direct the progress of the institution.

All of these cost money and the tuition which the students paid last year amounted to less than half the budget expended. The difference came mostly from endowment income and gifts to the college. Last fiscal year received more than $355,000.00 in gifts from our alumni, from industries, and from foundations. To raise this amount of money requires much time and effort, not only by the staff at Rose but also by many volunteers who give many hours of time and effort for Rose.

Our president, Dr. John A. Logan, spends a month each year making calls for the Associated Colleges of Indiana, and, in addition, he devotes many other days to calling on foundations and corporations in the cause of Rose. In the Development Office, Professor Richard A. Hahn functions as Assistant to the Director of Development, besides teaching debating and speech. Dick came to us July 1, 1963, from Florida State University, where he directed their debate program with a great deal of success. Miss Helen Mahley is Secretary for Alumni Affairs and organizes the Alumni Fund campaign. In this, she has been most successful, for Rose for the past three years has led every other engineering college in the country in the percentage of alumni contributing to the annual alumni fund. She also edits the *Alumni Quarterly*. Miss Anna Mary Turner, who is secretary in the Development Office, keeps records of hundreds of gifts from all sources and mails hundreds of receipts each year to donors.

This then is a brief story of Development at Rose and the people who play a part in it. The Vice President for Development supervises the program and reports monthly to the Development Committee of the Board of Managers and more often to the President of the Institute.

editorial

IS IT FAIR?

The present philosophy of the Supreme Court of the United States is epitomized by Earl Warren's question, "But is it fair?" While the Supreme Court has been under heavy criticism of late, the attitude *is it fair* is so inherently close to the American ideal of democracy, that this philosophy is relatively untouched by the Court's critics.

The Judicial Council of Rose Polytechnic Institute has recently been initiated with a case of some controversy. In a personal examination of the circumstances concerning this incident, I have come to the conclusion that the decision reached and the procedures used by the Judicial Council were in complete agreement with The Constitution of the Student Body of Rose Polytechnic Institute. But the nagging question remains in my mind, *"was it fair?"*

Specifically;

Was it fair to not inform the defendents of the charges brought against them by the students and faculty members until after the Judicial Council had met and reached a decision.

Was it fair to allow no defense by the defendants against the charges until after the Judicial Council had met and reached a decision.

Was it fair to the student body to not make public the charges against the defendents and to allow the student body no view of their student government in action.

These questions are of such a nature that any other decisions by the Judicial Council may be subject to similar questions in the future.

Why are such questions raised? The answer is simple. The procedure used by the Judicial Council is not the same as is used in the United States federal court systems. It is not even similar to that used in the Supreme Court. *If the Judicial Council's decision does not seem fair, it is because of how it was made, not because of what the decision said or because of those who made it.*

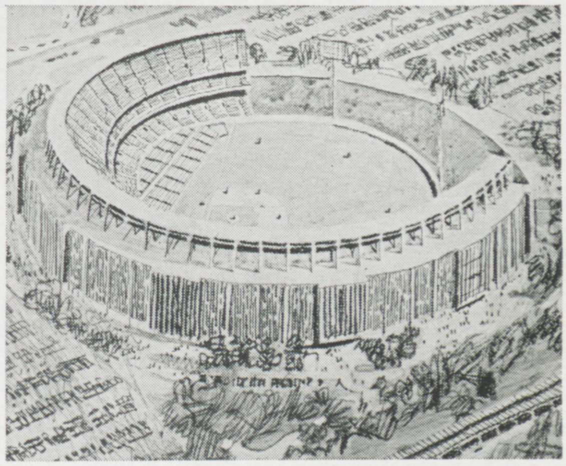
The procedure used by the Judicial Council was based on that used by the Faculty Committee on Discipline. The faculty of any college is the government of the particular college community. But a government by faculty is not a democratic form of government. The governed majority (students) accept and acknowledge the faculty as being superior to them and do not demand a voice in the selection or operation of this government. This social order is right, proper, and customary, and is easily justified by noting that the main object of a college faculty's labor should be the education of students, with the exercise of authority for the maintenance of law and order only necessary as befitting the circumstances.

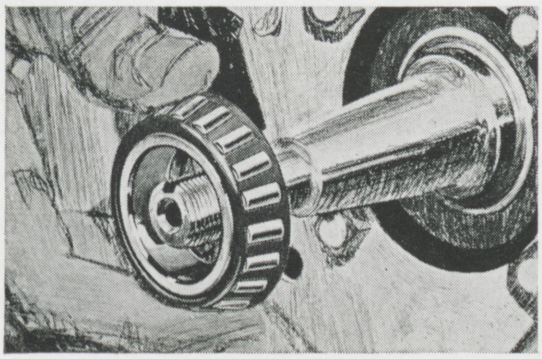
The philosophy of the new Student Body Constitution is that of a democracy. In this case, it seems proper to me for the Judicial Council to pattern its procedures after those commonly associated with democratic forms of government. To this end I would suggest amending the Constitution in the following general manner.

1. At least four hours notification to the defendant of the case, including a full copy of the charges filed against him.
2. The option of the defendant to defend himself or not to the Judicial Council *before* their deliberation on their decision.
3. Press or public session for the court during the time for the reading of the charges and the defendant's defense.

It should be pointed out that there is an *ad hoc* committee of the Student Congress to make recommendations on amending the constitution. If you feel similarly on this subject, I suggest that you bring any particular proposals to their attention and your general feelings on the subject to the attention of your Congressman.

R. F.





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The Engineer's Responsibility To Community, State, and Nation

HON. GEORGE D. CLYDE
GOVERNOR OF UTAH

ED. NOTE: THE FOLLOWING IS A SPEECH DELIVERED BY GOVERNOR GEORGE D. CLYDE OF UTAH BEFORE THE CONVENTION OF THE CONSULTING ENGINEER'S COUNCIL. AMONG THOSE PRESENT WAS DR. JOHN A. LOGAN, PRESIDENT OF ROSE.

Mr. Chairman — Honored Guests and Fellow Engineers. I have been asked to discuss with you the engineer in government — the engineer in politics — engineering statesmanship or the engineer's responsibility to community, state and country. These are somewhat intriguing titles due to the fact that engineers have not often been cast in government roles at policymaking levels. The seeming paradox of placing the two words "Engineering" and "Statesmanship" side by side, the one applying to the other, is challenging.

For too long most of us have thought of the two things as entirely separate and having nothing to do with the other.

This generally adopted attitude is fallacious, as I hope in some measure to demonstrate. Particularly in this complicated age of scientific progress and enormous public works, the tasks and problems of government are often engineering rather than legal or philosophical problems. There is real need to have trained engineers, not only at staff level where they exist in abundance, but also at the policy making level they are rare to the point of almost seeming incongruous.

With respect to the engineer's responsibility to his community, state and country, I must assume that we consider the special responsibility of the engineer, above and beyond the normal responsibilities of good citizenship which devolve upon the members of every professional and occupational group in the nation.

Actually, I am afraid that engineers, as a class, tend to fall below rather than rise above the norm in their acceptance of their responsibility to the community. By this, I am not implying that engineers are poor citizens; but it does appear that they too seldom concern themselves with the affairs of government, particularly in the matter of making themselves available to hold public office. Just why this is so, I am not prepared to say, but I have been impressed since I, myself, have been an office-holder that I have been regarded as something of a rarity in being, at the same time, an engineer and the governor of a state.

Engineers are, of course, active at every level of government, but almost always it is in their professional capacity and at staff level.

It is essential that engineering training background and thinking be incorporated in government, not only at staff level but also at policy-making level. Engineers should be professional not only in their own specialized field, but also in their approach to civic and governmental responsibilities.

In essence, the engineering approach to a complex problem is to ascertain and thoroughly analyze the facts, then build a solution which comprises not only a master framework but also provides for every detail down to the tiniest. Is not this type of thinking essential to good statesmanship in a society as complicated as that in which we live? Particularly so when so many of the specific tasks and problems which confront modern government are technical ones which fall into the realm of engineering in even the narrowest definition of the word.

In a primitive society, government is comparatively simple. If one person were living alone on an island, there would be no government or need for government. The individual could make his own rules, or indeed live without rules, for his conduct would affect no one but himself.

As soon, however, as two or more people attempt to live in the same community it becomes essential to formulate a set of rules to protect the rights of each against the other and to provide for a fair division of labor. This is government in its simplest form. As the community grows larger and as the demands for community effort— that is for the services of government—grow larger, the structure of government grows correspondingly more complex.

In our own beginnings as a nation, the problems of government were relatively simple — I emphasize the word "relatively". The problems faced by the people were tremendous, particularly in relation to the tools with which they had to be attacked, but most of them were approached by individuals, or as groups of individuals. We did not then, as now, look to our government to solve most of our problems for us.

Families and groups of families literally hewed their homes and farms from the wilderness, by dint of tremendous physical effort, unshakable determination and dauntless moral courage. In the furnace of this all-but-superhuman effort was forged the majestic spiritual strength which was, and has remained, the

backbone of our nation.

With all their hard physical work and ever-present preoccupation with subduing the wilderness and pushing the frontier westward, the people of young America found and took time to participate in community affairs and decisions—that is to say, the affairs of government.

The great men who conceived our system of government "By, of and for the people," who painstakingly resolved the broad, breathtakingly beautiful principles to a written formula culminating in that greatest of all political documents, the Constitution of the United States of America. These men were not specialists in government who had devoted their lives to schooling in this particular field.

Rather, they were truly representative of the people of their time and their country. They were a true cross section of America. They were themselves pioneers in the age of pioneering. They spoke authentically for their contemporaries because they lived like them, suffered the same hardships, shared the same dreams and aspirations.

Jean Jacques Rousseau, one of the world's great political philosophers, said in his classic "Social Contract":

"Good laws lead to the making of better ones; bad ones bring about worse. As soon as any man says of the affairs of State, what does it matter to me? The State may be given up for lost."

Rousseau was speaking, of course, of a state composed of a society of free men. Under an absolute monarchy, or an absolute dictatorship in the modern pattern of tyranny and oppression the power of decision is concentrated in one or a few men. The totalitarian state can and does operate irrespective of the interest which individual citizens take in their government, or perhaps in spite of it—but, to our way of thinking this type of state from the beginning can "be given up for lost." Nevertheless, absolute rule does have certain purely technical advantages in its unity of outlook and superficial efficiency of operation. We must never forget that we are engaged in a grim contest with totalitarianism on the world-wide stage, and for the highest of all possible stakes: the freedom and dignity of man. If we are to succeed, we must all assume the full responsibilities of citizenship, take an active interest in the conduct of our government, and not say "What does it matter to me?", leaving it to others to make the vital decisions.

If this is the obvious and essential duty of every individual citizen, how much more important that those especially trained and educated to deal with the complex technical problems with which modern society is so much concerned fulfill their duty. In this age of science and engineering the scientist and engineer are particularly essential to the cross section of population on which we must draw for effective government.

We are living in a rapidly changing world. It has shrunk in terms of communications and transportation. Its population is increasing at an explosive rate. Its expendable resources are being discovered, processed and utilized in every land. Its renewable resources are being recognized, developed, conserved and used as never before.

The advancement of knowledge in the fields of science, technology, human relations, medicine and economics has been phenomenal. Our spiritual development and growth in the fields of government has not kept up.

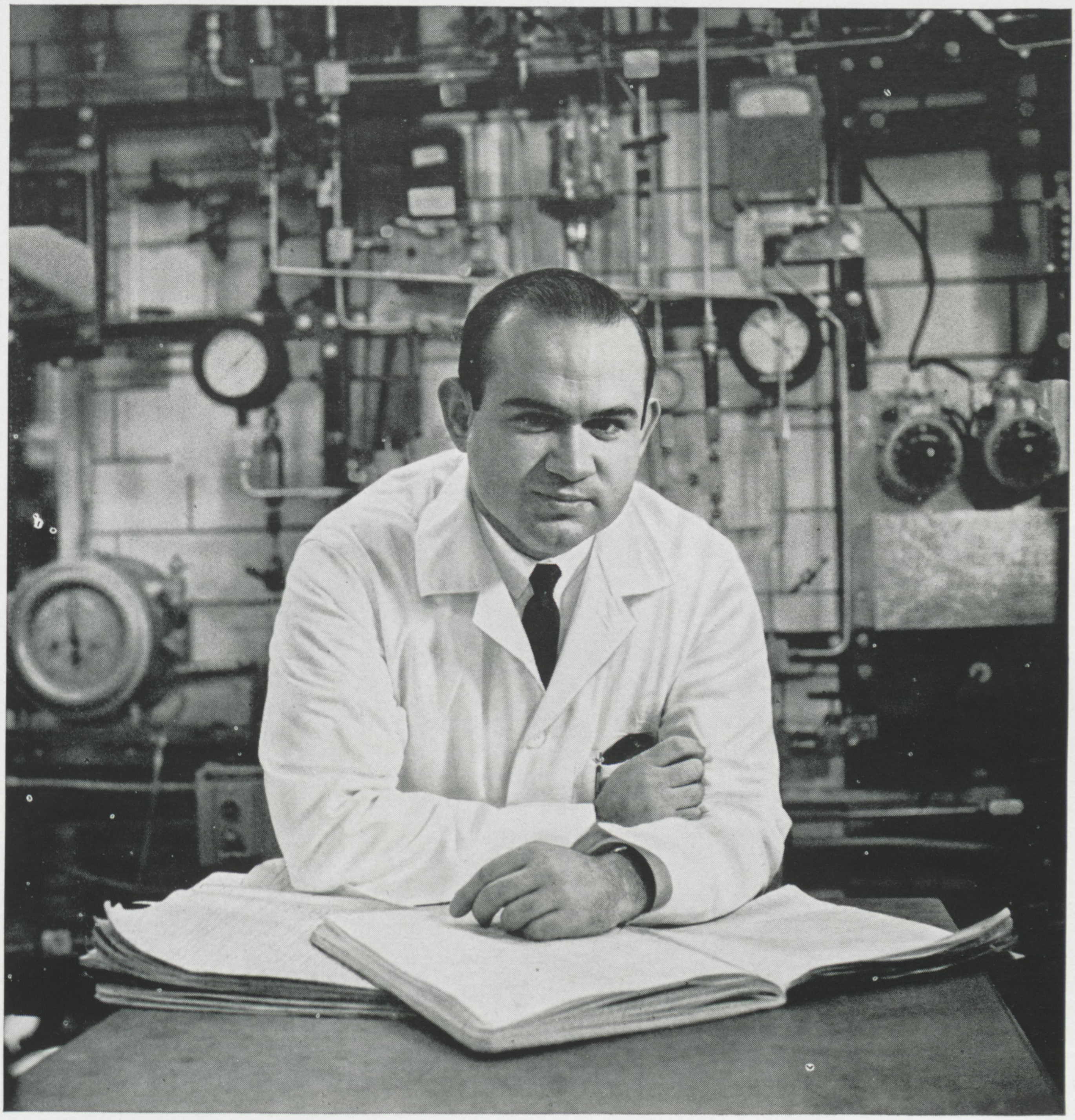
The nuclear-space age has come upon us so suddenly and so spectacularly that we sometimes fail to remember that it is not something entirely apart from the rest of history, but rather the product of all the ages that have proceeded it.

It has been said that "of all the scientists. engineers and technologists who have made significant con-

(*Continued on page* 27)

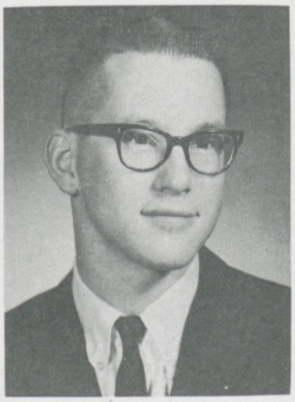
GOVERNOR GEORGE D. CLYDE

Gov. George D. Clyde of Utah is a former Dean of the School of Engineering at Utah State University. He holds a B.S. in Agricultural Engineering and an M.S. in Civil Engineering. He taught engineering at U.S.U. and served as Chief of Engineers for the Soil Conservation Service. He was elected Governor in 1956 in his first bid for elective office. He is recognized as one of the foremost authorities on reclamation and water resource development.



Don't Think - IMAGINE!

By Mars Gralia, II Math Dept.



Mars Gralia II graduated from Rose in 1964 with a degree in mathematics. He is now serving as a teaching assistant while doing graduate work. He is a member of the American Mathematical Society and is originally from Indianapolis.

This article is a story of evolution. It is concerned with the present plagiarism by man as he attempts to make electronic and mechanical copies of himself. It is the story of man causing his electronic mazes to evolve into better copies of himself. With science currently engaged in the area of "bio's" (biochemistry, bioelectronics, biophysics, etc.), this paper is interested mainly in the area known as cybernetics.

Cybernetics is the study of communications, approached from a mathematical viewpoint. But I would like to speak of more than just communications. Thus, this paper will point out differences and similarities between "computers" and the human equivalents: the mind, the eyes, the ears, the hands.

This paper was greatly influenced by von Neumann's book; to me, this is one of the most intriguing works I have ever happened across, for the development of computers mirrors the agility of the human brain. I am truly sorry that John von Neumann's untimely death left the work unfinished.

I feel this particular area of study is rather important, for it provides us with two simultaneous advances—(i) it advances computer technology, and, (ii) more importantly, this comparison permits us to answer many of the enigmas of psychology. The second advance is by far the more significant, for only by increasing self-knowledge can man survive the world he built: "man has the capacity to extinguish his species"—it must remain a theoretical and unproven fact. In the final analysis, this responsibility rests not on machines but on man, for he built the frankenstein and he must decide when and how to unleash it.

Before getting into the topic at hand, we must first cover some definitions and concepts which we shall later need, first covering the concepts of the computer and then the brain. We shall consider the terms "computing," "calculating," etc. to be associated only with "hardware"—i.e., with nuts and bolts, wires and transistors. However, the terms such as "thinking," "reasoning," etc. refer to processes carried out by humans. This is not to say the processes are necessarily different, but it is helpful to keep the two opposites clearly defined.

The most general division of the elements which compose a computer is that of analog and digital. An ana-

log elements represents quantities by general size, with the advantage that their quantities may be continuously variable. On the other hand, digital elements represent quantities by discrete amounts. For example, we can distinguish analog and digital ideas by comparing them to a ramp and a stairway. Both the ramp and the stairway accomplish the same job—that of going from one height to another; but with a stairway, one can be at only a certain number of elevations. On the ramp, however, one can be at *any* level between the two heights. If it is desirable to more closely approximate intermediate values, the number of individual steps may be increased, but, in general, there are only a limited number of values.

A second classification of computer hardware is parallel and series processing, with the division here based on how the computing elements are tied together, and hence how the solution is actually found. Parallel processing occurs whenever several parts of a solution are found simultaneously and later are brought together. Series processing is a sequential action in which each component part of the solution is found one at a time. In terms of an example, suppose we wish to count the number of eggs in a box in order to determine if there are actually twelve in it. A machine organized along parallel lines would have three fingers, one to count the eggs in each row. However, the series machine would have but one finger to count the dozen eggs. Thus, a parallel machine is faster than a similar series machine, but the parallel machine needs more computing elements.

In the case of series machines, it is evident that there must exist some method of recalling intermediate values which had been previously computed. This, then, is called the memory. Besides storing intermediate values, the memory is also useful in allowing computation to proceed at a faster rate merely because the information is more readily available from a memory than from outside sources. That is, it is faster for the machine to find a previous result in its own memory than it is for a human to look over printed results and to then tell the computer that result. One other rather important use of a memory is as a "buffer." Since, in practice, a computer can calculate much faster than it can disgorge results, machines are built with a buffer in them. This buffer is a short-term memory which can receive information at high rates from the computer itself, and then, much more slowly, send the information to output devices such as typewriters. This action is reversed to facilitate the entry of information to the computer. The advantage of a buffer is that it allows computation speed to proceed at the rate of the computing elements, rather than at the rate of the input-output devices.

There is only one vital part yet needed. This part is the decision element, and is the component which elevates computers above the class of office calculating machines. A decision element is like a fork in the road: it decides on which of two courses of action the computer will follow in the future. Decisions may be based on any number of conditions, the most common being the state of some number within the memory. Thus, the computer will follow plan (or "program") 'A' if some number is zero, and plan 'B' if that number is nonzero.

Considering the human nervous system, the primary element is called a neuron, or nerve cell, and its operation is more nearly digital than analog. Whenever stimulated, the neuron sends out a pulse. This pulse is picked up by a neighboring neuron, and the pulse jumps from one neuron to the next until, finally, it arrives in the brain. But neurons are also decision elements, for one neuron may be stimulated to produce an output pulse by, say, physical pressure, while the next neuron is stimulated only if it receives simultaneous pulses from two adjacent neurons, say a pressure neuron and a heat neuron. In the brain, this decision process becomes infinitely more complex due to the tremendous density of neurons in the brain. While in the skin perhaps three neurons may directly effect one decision neuron, in the brain, the number is more nearly three hundred.

As a general comparison of natural (biological) and artificial (manmade) computing components, von Neumann arrived at the following conclusions:

(i) The natural components can perform 10,000 more operations than the artificial components, based upon either volume or energy requirements.

(ii) The natural components individually behave more slowly, so that the human brain must be highly parallel, while artificial automata are usually serial.

(iii) There are some processes which cannot be carried out simultaneously and must be done serially. Hence, natural and artificial automata differ greatly in logical structure, for the natural structure must often change from serial to parallel operation, and vice versa.

While we have noted that the elementary component of the nervous system is the neuron, and the neurons emit pulses, we have failed to note how the neurons sense quantity—that is, we realize that the neurons send digital information, but how do the receiving neurons know the exact temperature detected (as opposed to knowing merely that there is a temperature difference)? Physiological research suggests that the rate at which pulses are emitted is a measure of the stimulus applied to a neuron. But the rate is only a measure and not a precise ratio. That is, the output of a neuron is more nearly of an analog nature in that its output is continuously variable. Thus, the nervous system is primarily a digital system, augmented by an analog method of measure; we call the nervous system a "mixed" logical system.

Considering the fact that response to a stimulus is analog in nature, we can expect that it would not be

very precise. Yet we know that people can compute results with a precision in the order of ten or twelve decimal places. This is rather fantastic, because there is no known computing machine which can operate reliably with a precision of two or three decimal places, the maximum of analog systems. But it should be noted that this low level of precision results in a high level of reliability, for if one pulse in a digital system is missing, the result may well be gobbled gook, but a difference of a few pulses will only slightly alter the rate of transmitted pulses, and hence, only slightly alter the meaning of the signal. Since our nervous system is limited to two or three decimal places, and yet we arrive at ten place solutions, we can only conclude that the nervous system is essentially statistical in its calculations. That is, the mind performs the same operation simultaneously through a number of paths. Then the final answers are compared, and the most common solution is considered to be final. This also increases reliability, for in the event that one path was incorrect, its effect on the sum total would be negligible.

This idea of statistical methods via parallel processing is of importance in present computer technology, for there is a recent experimental machine which was built for the military. This computer was to be an experiment for the systems employed in manned-space efforts, because reliability was of utmost importance. The computer consisted of three identical computing systems to be used in parallel. Whenever a problem was introduced, the three systems produced three independent solutions. The machine then compared the answers; if one answer did not agree with the other two, the machine prudently accepted the majority solution, and found a correction factor to force the incorrect solution to agree with the other two. From then on, the machine continued to correct the answers from the "wrong" system. Here, then, the military had developed a clear copy of the human brain in order to obtain greater reliability. The only difference is that the human brain uses many more than three separate systems to find an answer.

Another experimental computing system was developed from the early attempts to have a computer play chess. After many years of examination, programmers decided that in order to have a machine play anything but a merely acceptable game of chess, they would need a machine which could learn from its previous mistakes. This machine would play very poorly at the beginning, but, as it gained experience from many games, it would eventually become very expert, or so the programmers envisioned. In 1962, a team at M.I.T. achieved a first step toward this goal, for they built a machine which could learn. As expected, this operation was financed by the military, so the use of the machine has been oriented toward the military and not toward the apparently frivolous goal of a good

(*Continued on page* 23)

WE'VE INSTALLED DIGITAL AND ANALOG COMPUTERS FOR THE ECONOMIC GENERATION OF POWER . . .

WE'D LIKE TO TALK TO YOU ABOUT THE GENERATION OF IDEAS!

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THE POWER WITHIN THE ATOM

By Howard Alm

Throughout all of history there has never been so profound a change in man's way of life as that resulting from the discovery of the tremendous forces which are bound into one single atom of matter. The unearthing of the power in an atom is a complex story which, while having its beginnings in a bygone age, has mainly developed in the last century.

Nearly five hundred years before the birth of Christianity lived a Greek prophet with so clear a vision of the true atomic nature of matter that it was not to be matched again until two thousand years after his death. This prophet, Democritus, was the ancient Greek forerunner of the modern atomic scientist. To him came the idea that all matter is made of minute, finite particles, which were indivisible and the ultimate in matter. Democritus arrived at his atomic concept through purely inductive reasoning, many centuries before there were any means for gathering experimental corroboration for his ideas.

For nearly twenty centuries after Democritus made these predictions, the pseudo-scientific clan of the Dark Ages completely disregarded even pondering his ideas. The science of alchemy was founded and nurtured on the forlorn promise of untold riches inherent in Aristotelian matter. How easy it would be, it was thought, to transmute into gold the base metals lead, iron, and copper once the right additions or subtractions of Aristotle's "elements" of fire, water, and air were worked out. And in the meantime true science stagnated while the whole of scientific learning in the Middle Ages came to a standstill.

It was not until the Renaissance of learning in Europe came along that science gradually reared itself from its Aristotelian quagmire and began to look about for truth rather than accept dogma. And it was the turn of the nineteenth century before John Dalton, a mathematics professor at New College in England, gave the world its first concise description of the concept atom. Dalton said that his atoms were unsplittable into anything of a smaller nature.

Science immediately launched itself into an era of fact-finding, of an accumulation of vast amounts of experimental data, rather than of theorizing. These discoveries led to extremely accurate methods for determining both atomic and molecular weights.

In 1895 an obscure German professor, Wilhelm Konrad Roentgen, discovered an invisible ray which could pass through flesh and cast a sharp shadow of the bones on a photographic plate. Roentgen had been working with an evacuated Crookes tube in which were imbedded two electrodes attached to the opposite poles of an electrical generator. William Crookes, the inventor of this glass tube device, had earlier observed that a stream of electric particles would come shooting out of the negative pole or cathode toward the positive pole as the potential difference across the tube was brought to a sufficiently high level. Roentgen found that if these cathode rays were allowed to pass through the glass walls of the tube they would cause a flourescent screen to glow at a distance of several feet. Through further experimentation Roentgen found that these "x-rays" easily passed through all sorts of opaque materials but were completely stopped by thin lead plates.

In 1896 Henri Becquerel made the historic discovery that rays could emanate quite spontaneously from matter, as he found when he mistakenly developed an unexposed photographic plate on which he had placed a vial of uranium salts.

At about this same time the great English physicist, J. J. Thomson, found that he could physically shift the path of cathode rays in a Crookes tube through the external application of a magnetic field. In addition Thomson was able to deflect the beam with an external electric field and he found that the cathode rays veered toward the positive electric pole. By these experimental strokes Thomson revealed beyond dispute that cathode rays consisted of particles carrying negative electric charges.

In 1899 Becquerel applied a magnetic field to his uranium rays and found that they coud be deflected in the same direction as cathode rays. He then reasoned that negatively

charged particles were shooting forth with great speed from his uranium crystals. By bending the rays from his uranium sources in magnetic and electric fields and applying certain complicated motion equations, Becquerel concluded that his rays were exactly the same as cathode rays.

At the same time two sets of scientists, Marie and Pierre Curie, and Robert Owens and Ernest Rutherford, simultaneously observed that the rays which were emitted by thorium, one of a series of newly discovered radioactive elements, seemed to shift if there was a draft in the laboratory and caused nearby objects to acquire a radioactivity of their own. Rutherford further investigated this paradox of wind-blown rays and together with another of his co-workers, Frederick Soddy, figured out a plausible explanation. With one thory they explained both the atom-born negative electric particles discovered by Becquerel and the strange emanations first noted by Owens. They postulated that atoms were not indestructible and that the large radioactive atoms could break themselves down to form smaller ones. In plain and simple language they were saying that atoms were spliting up.

Soon the scientific world was in a turmoil trying to offer more proof for Rutherford's theory. Thomas drilled tiny holes in the cathode of a Crookes tube and found that there were rays which seemed to pass through these drillings and stream to the back of the tube. Through the application of electric and magnetic fields he noted that these rays were also charged particles but of a positive nature rather than negative like cathode rays. Thomson also remarked that these positive particles had a much greater charge-to-mass ratio than cathode ray particles. By 1909 Rutherford had found conclusive evidence that his alpha rays and positively charged helium atoms were one and the same thing. In 1911 Rutherford and H. Geiger performed an experiment in which they directed alpha ray particles at thin gold foil. The resultant wide scattering angle led them to theorize that an atom was made up of a concentrated postive core or nucleus surrounded by orbiting negative electrons.

C. T. R. Wilson's photographs of streaks of ionized vapor in his cloud chamber provided evidence of the existence of particles shooting from the hearts of atoms. Laue and Bragg produced photographs through x-ray diffraction techniques which left no doubt that the atom itself existed.

By placing hydrogen gas in a discharge tube and noting the effects of the cathode rays, Rutherford again astounded the scientific world when he stated that the hydrogen atom had somehow been stripped of its single orbiting electron leaving behind a unit positive charge which was christened the proton.

By 1932 James Chadwick had discovered the neutron which was the missing link for atomic scientists as it offered a "completed" concept of the atom's structure. (But it should also be noted that while the electron, proton, and neutron are the most well-known sub-atomic particles and the building blocks of the atom, science today has postulated some thirty-six other particles which make up the atom.)

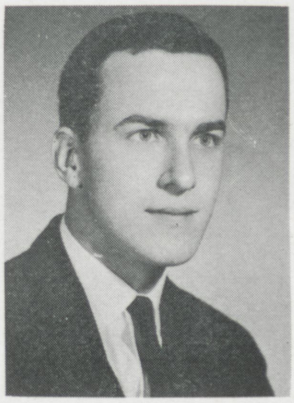
Digressing a bit to the year 1904, an English astronomer, Sir James Jeans proposed that the energy of the radioactive atom might be coming from positive and negative subatomic particles coming together, neutralizing each other, and both going up in a puff of energy. Here then is the first seed of the transformation of matter into energy.

But the powerful weapon which first actually smashed the atom was not a massive machine in a physics laboratory, but a puny pencil in the hands of a genius. The year was 1905 and the genius was Albert Einstein, then working as an examiner in a Swiss patent office.

While cogitating certain problems concerning the speed of light and the mass of a moving electron, Einstein wrote down the simple relationship, $E=mc^2$. With these symbols he was saying that neither matter nor energy was indestructible. Even more startling was the stupendous amount of energy which Einstein claimed would be released through the destruction of a minute amount of matter. Here was Einstein (like the early Greek prophet Democritus) with nothing but a pencil, paper, and his brain, years before anyone succeeded in smashing an atom and destroying matter, predicting that matter *could* be destroyed to produce vast quantities of energy. Einstein further suggested that the proving ground for his prediction might be found in the atoms of the radio-active elements.

The first announcement of induced disintegration of an atomic nucleus was made in Rutherford's laboratory in 1914 where he had been bombarding nitrogen gas with alpha particles. When these alpha particles smashed into the nucleus, Rutherford detected high-energy

Howard Alm is a senior in electrical engineering. He is a member of the I.E.E.E. and Lambda Chi Alpha fraternity. His home town is LaPorte, Indiana.



SPORTS
Unillustrated

By DENNY LIND
JR. MATH

The start of the new school year shows much improvement in the athletic facilities of our college. The biggest single improvement has been the purchase of a new portable basketball floor 104 feet by 100 feet. Since the new floor is twice the size of the original floor, it will allow two intramural games to be played at the same time and will also greatly aid varsity basketball practice. The new floor has necessitated the purchase of six new goals.

The inside of the gym has a new paint job, which greatly improves its look. On the east side of the field house new portable telescopic bleachers will be set up with a seating capacity of nearly five hundred and fifty. There are other improvements in and around the fieldhouse including the continued improvement of the facilities in the training room and in the equipment room. Also, two new tennis courts located near the old ones are now being completed.

The football team under the direction of new coach Dick Martin looks the best of any Rose team in recent years. Coach Martin has added new ideas, many learned on coaching jobs at Olathe High School and Yates Center High School. One of his ideas has been for a man on the second team to challenge a first team member for his job. They are matched against each other in these four categories: 1) sprints, 2) ball carrying, 3) blocking, and 4) tackling. Martin will also be head track coach and will assist Coach Mutchner with the basketball team.

The cross county team, with Jim Carr at the helm, is looking forward to another winning season. Coach Carr is promoting competition by seeing which team member has run the most miles at the end of the season. To show each member his total miles, a map is used with Terre Haute as the starting point and points west as the destination.

Prospects for the basketball team remain a question mark due to the presence of a very large freshmen class. Coach Mutchner did state however, that Rose probably has the best group of freshmen basketball players in several years. The prospects for a winning season will depend greatly on their development. Three games have been added to the schedule making a total of twenty. Also negotiations have been worked out to broadcast several of the home games over WTHI Radio. The team will also have new uniforms this season.

Due to considerable interest in weight lifting, the athletic department is in the process of organizing a weight lifting club. Club members will conduct classes on the proper method of lifting weight and the development of a good phyisque. Several new pieces of weight equipment have been purchased by the athletic department.

The athletic department has the administration fully behind them in their program to bring Rose and its students a good athletic program. It seems as though almost everyone associated with Rose has taken an increased interest in the sports schedule, both varsity and intramural. Says Coach Mutchner, "The overall philosophy of the athletic department is to provide a comprehensive, well-balanced program of physical activity, and intercollegiate sports designed to serve the best interest of all the students".

POWER WITHIN THE ATOM
(*Continued from page* 17)

protons being shot out of the test chamber. The feat that Rutherford accomplished, although of incalculable value for the advance of atomic knowledge, was an infinitesimal operation from the point of view of atom smashing. Out of every million alpha particles which he shot into his gas chamber, only three actually ever succeeded in knocking a proton out of the nitrogen nucleus.

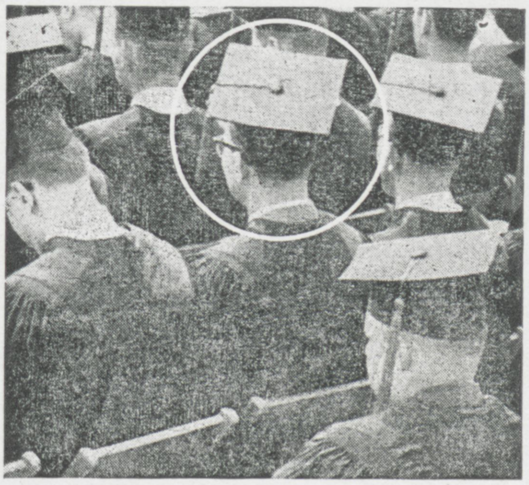
Soon, as the limit of atom smashing by the agency of naturally occurring particles was reached, the need for artificial particle accelerators was recognized. And in 1932 two of Rutherford's proteges succeeded in developing a machine which smashed atoms with artificially created and accelerated particles, thus sending the world hurtling in a mad race toward the realization of a long cherished dream: the release of energy from within the atom.

Early atom smashers were built under the assumption that only charged particles could actually do damage in bombarding the nucleus. But in 1935 a group of Italian workers led by Enrico Fermi discovered that the key to success was the neutron, which, since it was an uncharged particle, could move in close to the nucleus without undergoing strong electrical repulsion.

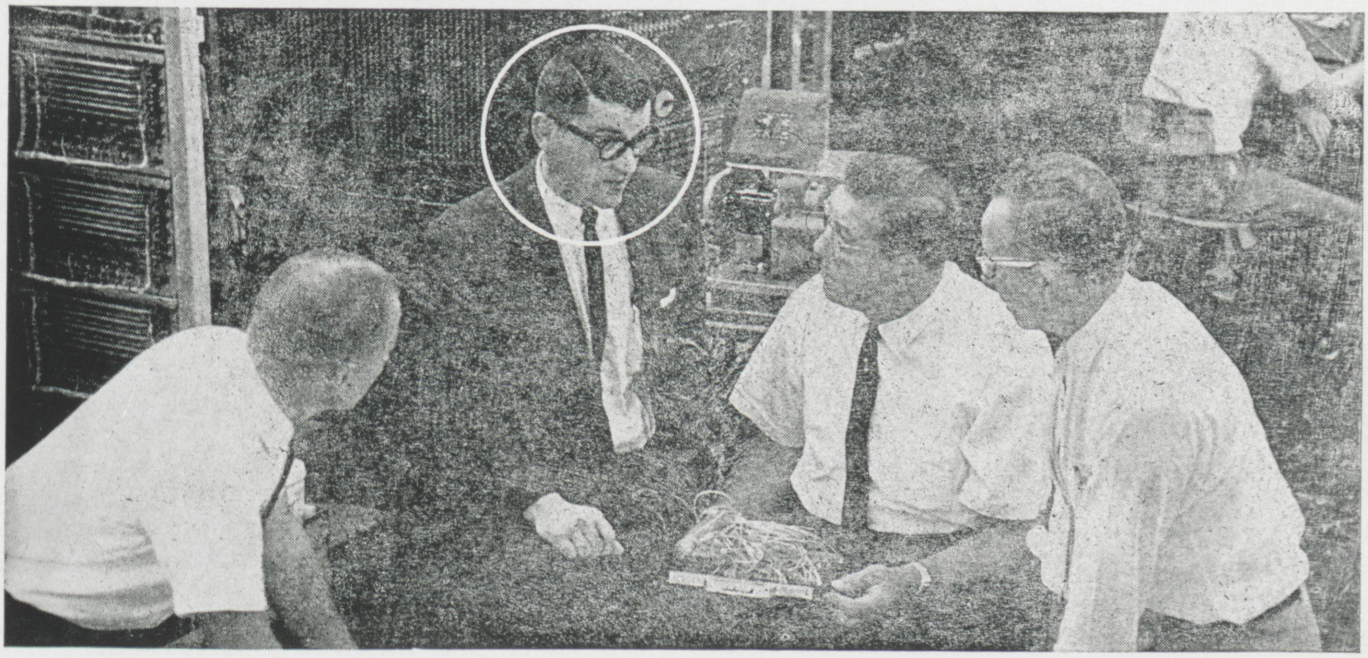
But the biggest technical problem was the essential element of a chain reaction. It was a process by which atom splitting would become contagious, in which one splitting atom would infect another—*two* or *three* others, by preference—with the urge to split. Without such a chain reaction the release of energy, atomic or otherwise, is a poor proposition.

Then in early 1939 the nucleus of an atom was split into approximately equal halves by a process now labeled as fission. Almost immediately dozens of laboratories around the world set out to duplicate the process. It was rapidly found that when uranium underwent fission it split into two lighter elements and produced a swarm of

(*Continued on page* 35)



Tom Thomsen wanted challenging work



He found it at Western Electric

T. R. Thomsen, B.S.M.E., University of Nebraska, '58, came to Western Electric for several reasons. Important to him was the fact that our young engineers play vital roles right from the start, working on exciting engineering projects in communications including: electronic switching, thin film circuitry, microwave systems and optical masers.

The wide variety of Western Electric's challenging assignments appealed to Tom, as did the idea of advanced study through full-time graduate engineering training, numerous management courses and a company-paid Tuition Refund Plan.

Tom knows, too, that we'll need several thousand experienced engineers for supervisory positions within the next few years. And he's getting the solid experience needed to qualify. Right now, Tom is developing new and improved inspection and process control techniques to reduce manufacturing costs of telephone switching equipment. Tom is sure that Western Electric is the right place for him. What about you?

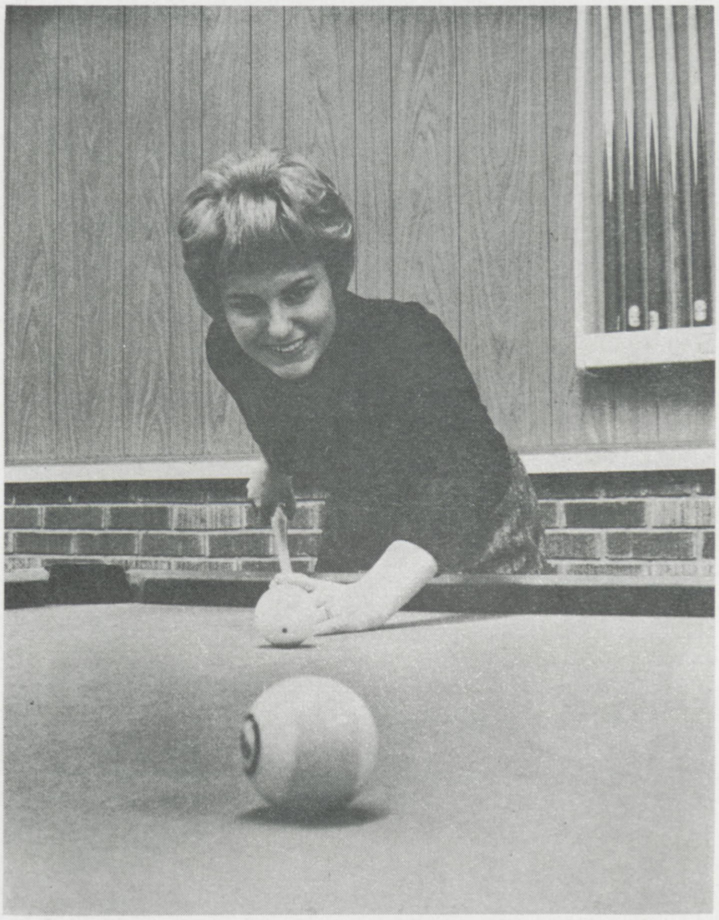
If you set the highest standards for yourself, enjoy a challenge, and have the qualifications we're looking for—we want to talk to you! Opportunities for fast-moving careers exist now for electrical, mechanical and industrial engineers, and also for physical science, liberal arts and business majors. For more detailed information, get your copy of the Western Electric Career Opportunities booklet from your Placement Officer. And be sure to arrange for an interview when the Bell System recruiting team visits your campus.

Western Electric MANUFACTURING AND SUPPLY UNIT OF THE BELL SYSTEM

AN EQUAL OPPORTUNITY EMPLOYER

Principal manufacturing locations in 13 cities ☐ Operating centers in many of these same cities plus 36 others throughout the U.S. Engineering Research Center, Princeton, N. J. ☐ Teletype Corp., Skokie, Ill., Little Rock, Ark. ☐ General Headquarters, New York City

Miss Technic for October

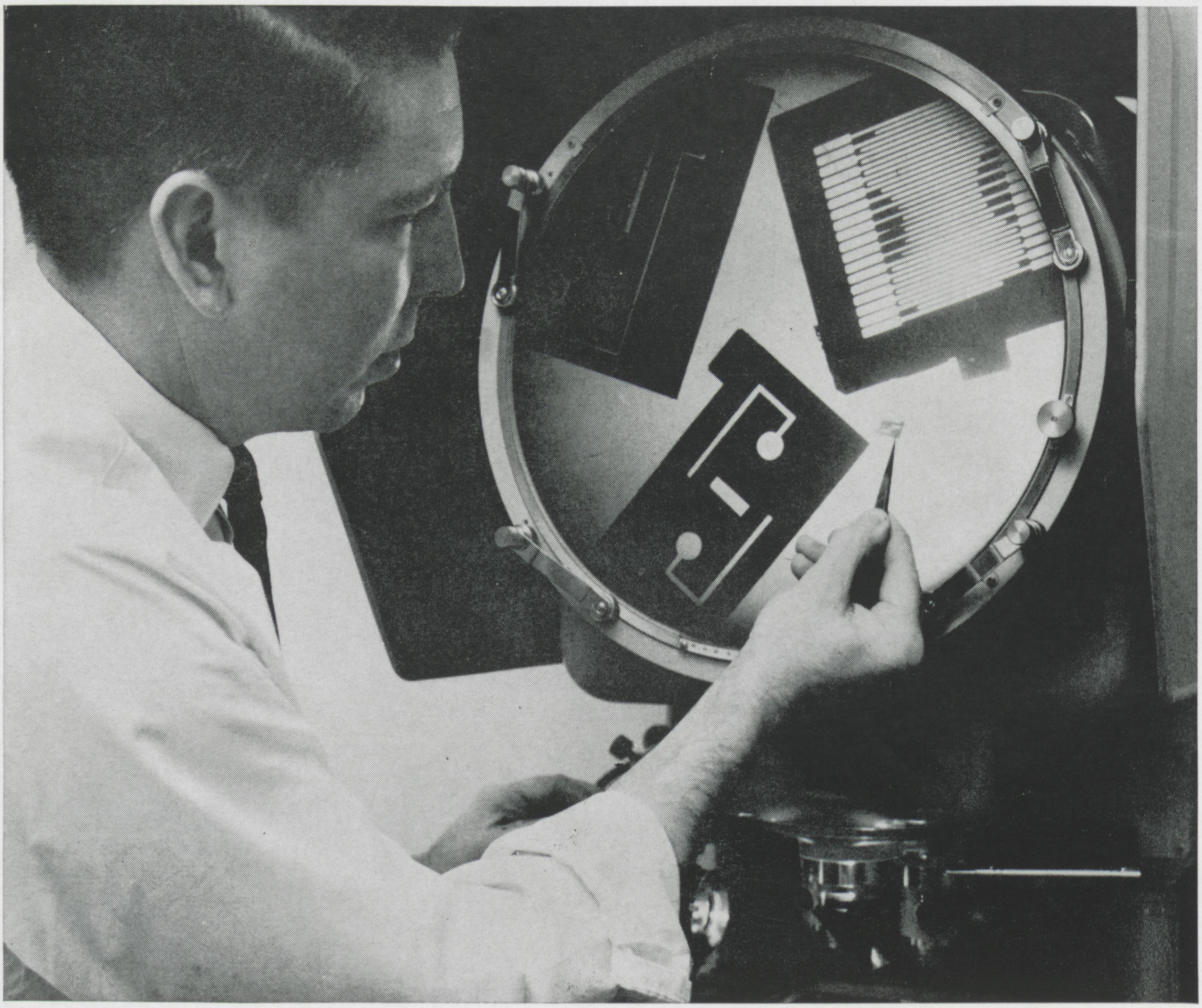


MISS DONNA FREEMAN

Miss Technic for October is Miss Donna Freeman. She is a freshman at Indiana State College where she is majoring in elementary education.

Donna hails from Columbus, Indiana, where she reigned as Junior Miss Beauty Queen during last year.

Her very special numbers are 35 - 23 - 35, making her BHW number a proud 3.041. She stands 5′ 1½″ and weighs a trim 112#, making her an extra special October date.



DON'T THINK—IMAGINE

(Continued from page 14)

chess game. Thus, the reported tests on the machine indicated that it had been equipped with tape recordings of undersea noise. Now undersea noises are rather important to the Navy, for this is the way they detect underwater objects, such as the bottom, mines, or even the ever-friendly, ever-present Soviet submarines. The old method of detecting submarines was to find some lucky submariner and have an "old-timer" try to teach him to distinguish between the sound of fish and that of submarines. But this is a rather difficult job, simply because often even the "old-timers" cannot tell what is beneath them. But then the "learning" computer was developed, with the result that the Navy thought perhaps a computer could tell a submarine from a whale when even the experienced sonar operators could not. After a few days of practice, lo and behold, the computer *could* distinguish between questionable noises.

While we have talked for the most part about the brain, engineers are copying more than just nervous systems. For instance, typewriters, with their "character-at-a-time" method of writing have yielded their jobs to machines known as line printers. These devices use the idea that if one typewriter is good, then two are better, with the result that the line printer is basically 132 typewriters, each one built to type but one character in a given line. To print, information is fed to the printer, and each "typewriter" is told what character it is to print on that line. Then, all at once, all the "typewriters" are told to type, and presently one complete line is typed in one blow. With this scheme, printers have been developed which will print 1500 lines per minute.

The most amazing device now being plagiarized is the eye. So far, the engineers have developed a workable, but very crude copy. The ultimate optical reader (as these

(Continued on page 32)

R & D

Edited by
Larry Buchanan, Frosh

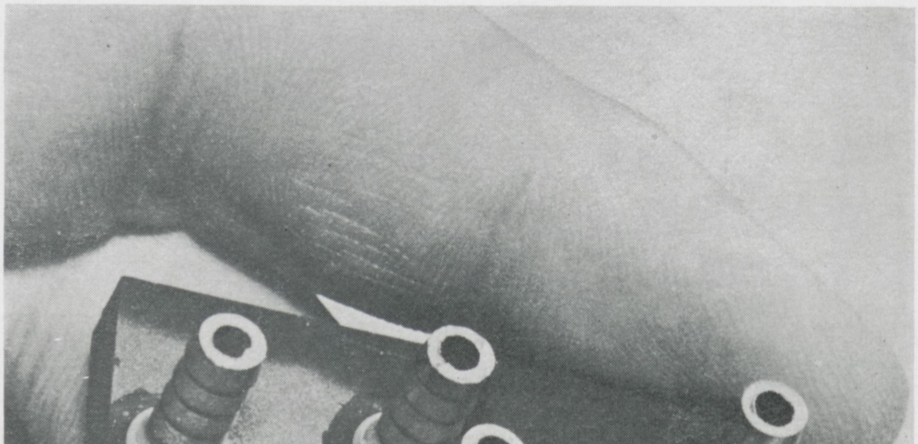
Corning Glass Works has introduced half a dozen fluid amplifier devices at the convention of the Instrument Society of America in New York City this October the twelfth through the fifteenth.

Fluid amplifiers are used primarily for logic and control functions. They utilize the flow of a fluid—such as air—in much the same way that electric current is used in electronic devices.

Glass fluid amplifiers are made by photographically imposing a desire pattern in flat layers of photosensitive glass, then etching away the image partially or completely to form fluid channels, chambers, and port. The glass is converted to glass-ceramic by heat treatment to make it stronger and temperature resistant up to 500°C. The layers are fused in whatever number is needed for a particular device, and fittings are attached to accept input and output tubing.

Because of the flexibility of this photo-etching technique, Corning makes many fluid amplifiers to custom design.

Only one of Corning's devices, the "clock" is not a pure fluid amplifier. In the "clock" or timer the pulse width and interval of the four-output clock are independently and continuously adjustable from one-half second to more than 20 seconds, giving a maximum clock rate of two cycles per second. Timing



A two-input active NOR gate for fluid amplifier systems, sold by Corning Glass Works for as little as $15, can be fanned out to four similar inputs, with no measurable feedback from control to control. The NOR gate requires a supply of five pounds per square inch gauge and an input signal of less than 0.6 psig. If fed to a closed chamber (dead-headed), output is two psig. If fanned out, output is more than 0.6 psig. In the photo, the device rests on its supply fitting. Tht output fittings are opposite the supply, and the input fittings are at right angles. The NOR gate costs $25 singly, or $15 each in lots of four or more.

accuracy is ± 20 per cent.

A nominal 20 pounds per square inch gauge pressure supply is required to operate the timer. Output pulses can be obtained as high as two psig.

Two of the clock's outputs must be dead-headed, Corning said—that is, fed to a piston or diaphragm, for example, or else plugged. The other two outputs are isolated upstream from the regulating chambers and can be either dead-headed or fed to a flow device. Corning supplies connections for both outputs.

The company has been using the 11-layered clock in its own fluid amplifier operation at Bradford, Pa., for several months, particularly for life testing other devices.

Overall size of the clock, including fittings, is approximately 2.5 x 3.25 x 1.5-inch. Price is $125.

Another of Corning's devices, the binary counter is load insensitive so is easily coupled. One of its best uses is in a binary to decimal converter. Corning noted that one output can be used for readout at the same time the other output is operating the next stage.

Nominal supply required for the counter stage is five psig. Input signal required is one psig. Output is more than 1.5 psig. Overall size is about 1 x 3 x 0.5-inch.

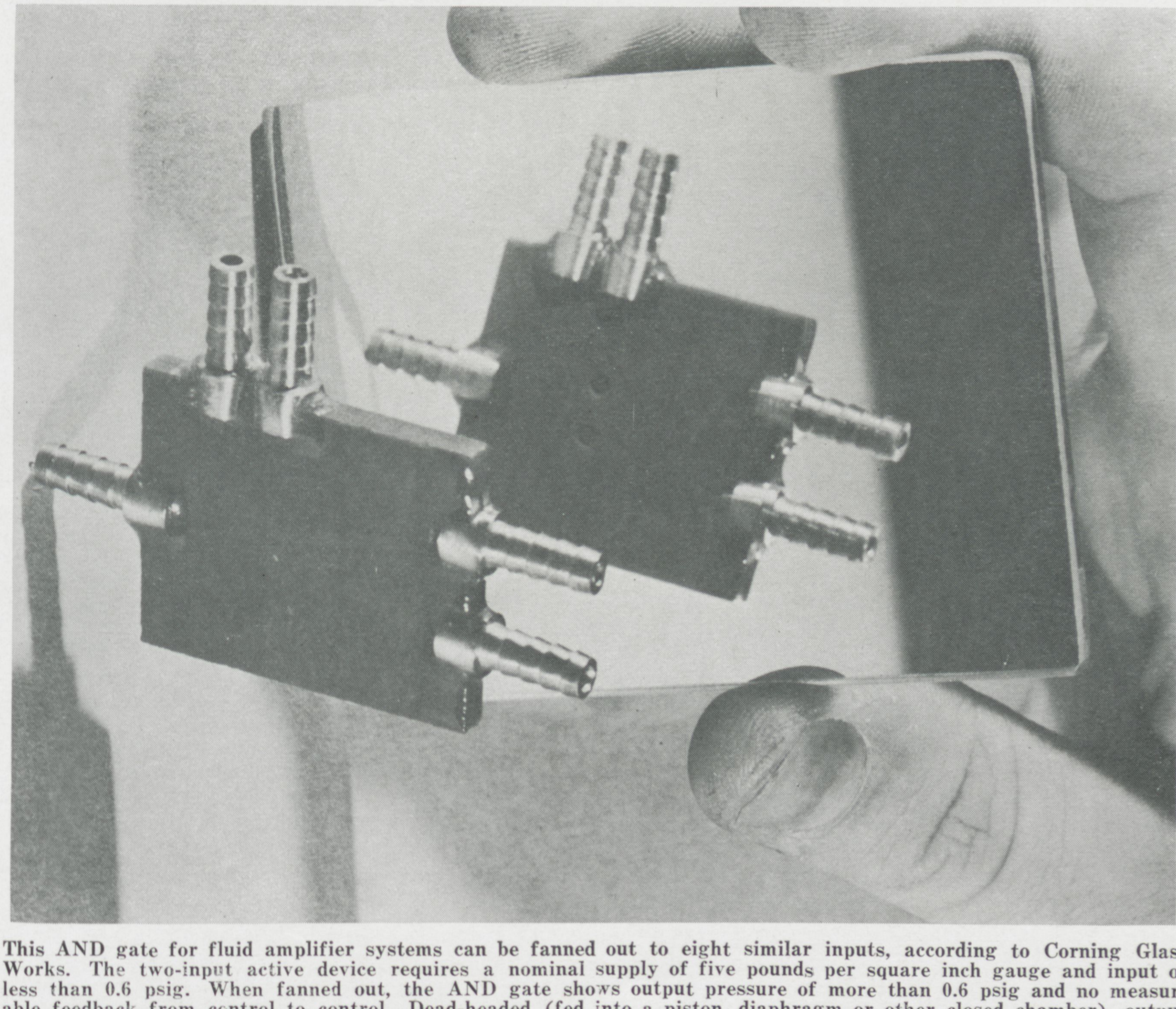
The third in Cornings list of fluid amplifiers is the AND gate. It is a two-input, active device, requiring a nominal supply of five psig and an input of less than 0.6 psig. It can be fanned out to eight similiar inputs.

When fanned out, the AND gate shows output pressure of more than 0.6 psig and no measurable feedback from control to control. Dead-headed, output is two psig, Corning said.

The NOR gate also is a two-input, active device which requires a five psig supply and an input signal of less than 0.6 psig. If dead-headed, it produces a two psig output. If fanned out to as many as four similar inputs, the NOR gate, like the AND gate, shows more than 0.6 psig output and no measurable feedback.

The new set of flow restrictors has values of .1, .2, .3, .4, .5, .7, and .9 million pounds force second per foot^5. The term is a measure of fluid resistance, representing pressure divided by flow (pounds per square feet divided by cubic feet per second, or lbf/ft^2 over ft^3/sec, which simplifies arithmetically to lbf sec/ft^5).

In the low ranges, especially, flow restrictors are useful to designers in breadboarding multi-staged fluid systems, Corning said.



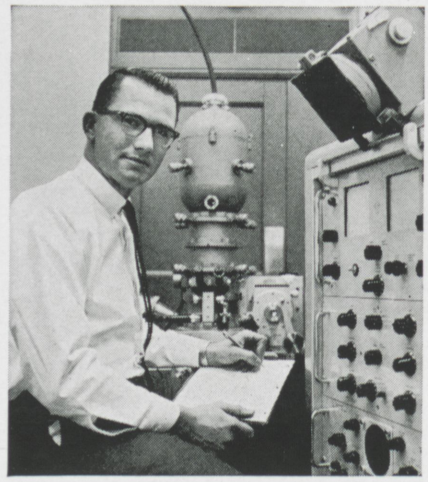
This AND gate for fluid amplifier systems can be fanned out to eight similar inputs, according to Corning Glass Works. The two-input active device requires a nominal supply of five pounds per square inch gauge and input of less than 0.6 psig. When fanned out, the AND gate shows output pressure of more than 0.6 psig and no measurable feedback from control to control. Dead-headed (fed into a piston, diaphragm or other closed chamber), output is two psig. In the photo, the two input fittings are in the middle, the supply nozzle is at one end and the two output fittings are at the other end. The AND gate costs $42.50, or $30 each in lots of four or more.

Men on the move at Bethlehem Steel

BETHLEHEM STEEL

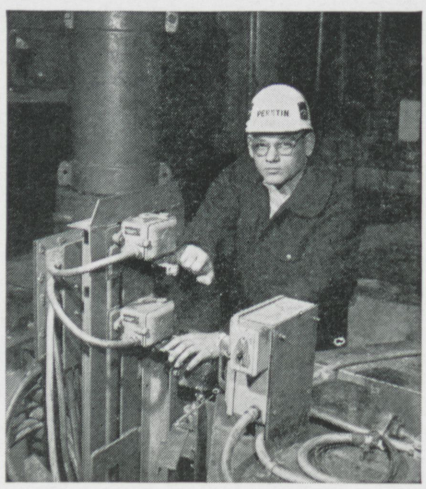
JIM DAVIS, CH.E., GEORGIA TECH '59 —Jim is a salesman in our Chicago District. His technical training has been a valuable asset in selling steel products.

LEON HARBOLD, MET.E., LEHIGH '59 —Leon's many assignments around the open hearths at our Sparrows Point, Md., Plant led to his latest promotion as Assistant to the Superintendent of #3 Open Hearth.

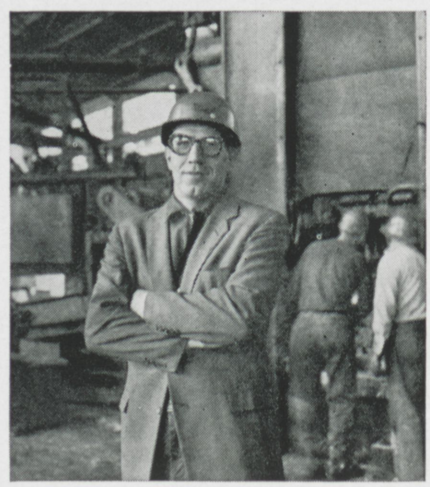


DENNIS WITMER, CH.E., MARYLAND '61 —An engineer at our research laboratories in Bethlehem, Pa., Dennis is shown using a microprobe to study corrosion-resistant coatings on sheet steel.

FRED EWING, C.E., CARNEGIE TECH '60 —Fred is a turn foreman, supervising a force of 130 men in the rod and wire mills at our Sparrows Point, Md., Plant, the nation's largest steel plant.



FRANK PERETIN, E.E., PITT '60 —As an engineer in the Johnstown, Pa., Plant Electrical Department, Frank's duties involve power generation and distribution, drive systems, and electronic controls.



BILL BALLEK, M.E., LAFAYETTE '62 —As turn foreman in the Bethlehem Plant forge shop, Bill supervises hammer forge and mechanical press operations. He also coordinates quality control for the entire shop.

These alert young men are a few of the many recent graduates who joined the Bethlehem Loop Course, one of industry's best-known management development programs. Want more information? We suggest you read our booklet, "Careers with Bethlehem Steel and the Loop Course." Pick up a copy at your Placement Office, or write to our Manager of Personnel, Bethlehem, Pa.

An equal opportunity employer

ENGINEER'S RESPONSIBILITY

(*Continued from page* 9)

tributions to the human race, 75 percent are alive and working today."

The United States in four generations has become the richest nation on earth — and most of this development has occurred in your lifetime and mine. In freedom, opportunity and prosperity, we its citizens, are on top of the world.

We have spread what in any other country would be a middle class across a great continent. We are making consumer goods on a scale that was unimaginable, even twenty years ago.

We can no longer eat all we raise or use all we can produce.

I am afraid the United States in the twentieth century has let accomplishments in science, engineering, technology and mass production go to its head. We as a free people have become stupefied by a kind of technological concept. It has made us sleepy, self-indulgent, complacent, dependent on government for protection against competition and I am afraid it is causing us to decline as a free people at an accelerating rate.

Too many of us feel that the present position of the United States is untouchable—that the constitution and our economic system alone will preserve it. That is not true. Our heritage and our current position are in jeopardy.

They cannot be preserved by continued excellence in science, engineering, technology and natural resources alone. These are relatively easy history records:

1. After the first industrial revolution Britain was a top nation for 100 years.
2. We in the United States followed the British. After a scientific revolution the British lost their position.

There is nothing heaven-sent or pre-ordained that makes it certain that we will not lose our position. Any spirited country, given the drive, dedication, manpower and resources, can carry out a technical revolution. The Russians and Japanese have proved it. The Chinese and Africans are proving it.

It took 1500 years to set the stage for the British—the Japanese set it in forty years.

Russia, China, Africa are becoming industrialized at a much more rapid rate than we became industrialized and by stepping off our shoulders in the technical field. They have great industrial potentials and when they become great industrial powers the whole political face of the world will change.

In your lifetime and mine (one generation) we have seen and in some cases participated in:

1. A revolution in education (methods, techniques & scope)
2. A scientific revolution (space - energy - matter)
3. A revolution in government (rise of communism)
4. A social revolution (search for security - cradle to grave)
5. A military revolution (nuclear bombs - missiles)
6. A revolution in human thought (new idealogies - rise of communism - welfare state)
7. A revolutionary drive for national independence. (under privileged nations - Africa - Latin America - Middle East)
8. An economic revolution (communications - transportation, industry, manufacturing, natural resource development and utilization)
9. A revolution in labor-management relations (shorter hours - marginal benefits - working conditions)
10. A revolution in world trade (tariffs - imports - free trade - common markets)
11. A revolution in philosophy of government (self reliance and free enterprise vs. governmental dependence) (strong central government vs. sovereign states) (rule by regulation vs. rule by law)

In 188 years the United States has become the richest nation on earth.

IT HAS BECOME THE ENVY OF ALL THE WORLD.

In less than four decades the face of the earth has been changed and we are now looking ambitiously toward the face of the moon and the planets. Our basic concept of the nature of matter and energy has been revolutionized, our whole way of life transformed. In some ways, that not-too-distant year of 1917 - 1930 - 1940 - 1950 lies in another age.

Our modern way of life is largely the product of science and engineering. Our great dams and power plants, our marvelous super-highways, our railroads, automobiles, airplanes and space-probing rockets, our myriad labor-saving devices and gadgets that have taken the drudgery from every day living — all these are products of scientific research and applied engineering. The contribution of the engineer to society is enormous and incontrovertible. His contribution to progress will surely continue and expand.

Yet, at the same time, the engineer owes a peculiar and special debt to society, which is too often neglected.

As prime architects of this age of science and material progress, are we not also at least partly responsible for the apparent lag in spiritual and moral growth which may make man the victim of his own creations? Have we, like Frankenstein, made a monster to destroy us?

The world stands in two armed camps, separated by an enormous chasm of ideological concept. Now this is nothing new, for each great civilization since the dawn of history has sometime been challenged.

What is new, and terribly frightening, is that man has built himself weapons capable of destroying, not only armies, but civilization itself. Both sides have the scientific knowledge and productive capacity to build bombs of such frightful destructive power that they could literally erase life from the face of the earth. We are faced with the dual problem of both keeping abreast of our potential enemies in the arms and missiles race, lest they over-power us, and also maintaining the mental, moral and spiritual

balance and stamina to control the incredible forces we have assembled and make sure the weapons of destruction are not used to destroy.

Within recent months, we have seen the Soviets successfully send the first man beyond the pull of gravity and bring him back alive. Since that time, we too have orbited men in outer space and returned them to earth. In spite of this accomplishment, we remain conscious of our serious national shortages of scientists and engineers. Our problem, however, is not merely to educate enough scientists and engineers, to design and produce better rockets and missiles, but also to keep up or again forge ahead in the entire technological race.

The other, and perhaps bigger, part of our problem is to preserve and strengthen the moral fibre which enabled our colonial ancestors to stand firm against one of the mighty nations of the earth and win our independence, and which has bolstered this nation through our history. We must have adequate weapons to prevent our being overpowered by an agressor, yes; but we must also have the strength of character, the will to survive, the determination to stand firm on righteous principle and not quail in the face of threatening danger if we hope to maintain peace in the world, or to survive if war should break out.

Engineers - scientists - and technicians will play a vital role in the preservation of our heritage but that role must not be confined to purely professional tasks. They must participate actively in government at all levels to insure that:

1. The dignity of man be respected.
2. The rights of the individual be recognized.
3. The free enterprise system be preserved.
4. There be freedom of worship.
5. Government always serves the people.

For without these, technical and scientific progress has no meaning.

Let us for a moment look back over our history and note the changes that have taken place—and the constant values which have not changed—in the comparatively brief time that we have been a nation.

The men and women who founded our first colonies were people of heroic courage. They set out to conquer a vast and often hostile wilderness with only the simplest tools and equipment. Their greatest power and their stoutest armor was their burning devotion to the cause of liberty. In that cause they were happily willing to endure physical hardships and suffering, to do without the comforts and conveniences they had known in Europe, and to undertake the tremendous job of carving a civilization out of the wilderness with little more than their bare hands to work with.

Their lack of adequate tools was not merely the result of their comparative poverty; power tools simply did not exist.

The early Americans had their crude muzzle-loading muskets and blunder-busses with which to seek game. They had the axe and the adze and a few simple tools of carpentry. They had shovels with which to move the earth, a veritable hand-

Homecoming Oct. 30 - 31

FRIDAY, OCTOBER 30

8:30 P.M.

BONFIRE

HOMECOMING QUEEN

PEP RALLY

SATURDAY, OCTOBER 31

2:00 P.M.

FOOTBALL GAME

HALFTIME

ROSE RIFLES

SALUTE TO HOMECOMING QUEEN

10:00 P.M. - 1:00 A.M.

Homecoming Dance

Terre Haute House

ful at a time, and simple plows to prepare the earth for planting. The only principles of mechanics they knew to help multiply their strength or that of their domestic animals were the few fundamentals that had been known for centuries: the wheel and axle, the lever, the pulley and the inclined plane.

The responsibility for building a home rested squarely on the broad shoulders and stout muscles of the home-owner-to-be—and no less on his courageous heart and his refusal to bow to discouragement or admit defeat. Usually, home building began with an assault on a tract of forest land, which had to be cleared of trees both to provide room for the house and the farm which would later sustain the family, and also to yield the basic materials from which the house would be built. And this assault was made without benefit of power saws or bulldozers, or any of the other machinery which we consider indispensable to attacking a task of comparable proportions today. Trees were felled laboriously by stroke of the axe, and the stumps usually had to be burned out of the ground. A man who cleared his land and built his rough home in the New World knew full well the meaning of the Biblical admonition that man should live by the sweat of his brow—and his perspiring labors often had to be performed under the threat of attack by hostile Indians. A home was a prize indeed in those days, and the prize was appreciated at its full worth.

Groceries did not come from the corner super market. Life-sustaining grains and fruits and vegetables had to be raised from soil that was sometimes thin and reluctant, always under threat of flood or drouth or attack by insect hordes—and there was no department of agriculture to step in with a cash payment if the crop failed. Hunting and fishing were not the recreation of leisure hours, but stern tasks whose success was vital to the feeding of the family. A season of game scarcity was as serious as a crop failure.

Travel and communications were of the most primitive, by inland and coastal waterways and over rough forest paths where passage was both difficult and dangerous.

How was it, then, that the men who performed the Heruclean tasks of subduing the wilderness and keeping themselves and their families alive also found time and inspiration to found a nation different from all other nations on the face of the earth, to fight and win a war of independence against a great military power, to conceive and set down on paper the greatest political document of all time: the Constitution of the United States?

Some say it was because of the very hardships under which those early Americans constantly labored. In the furnace of toil and adversity were forged the sinews of steel and unswervable determination that carried our forefathers through to final victory over every obstacle. But this is only a partial explanation of the glorious phenomenon of our early history.

Hardship and difficulty alone can

as easily lead to discouragement and defeat as to determination and victory, as witness the teeming misery of the slums of great cities. The rest of the answer to our national growth is to be found in the inner, spiritual fire that supplemented the rawhide endurance and whipcord muscular strength of those early Americans.

We were a hungry and ambitious nation, hungry and ambitious not merely for wealth and power and physical comforts—these were secondary considerations. We were hungry for liberty and equality of opportunity—things which had been denied our forebears in the old world they had left and which were made the cornerstones of the new nation they founded and laboriously built on this side of the Atlantic.

Through the formative years of the young nation, we grew and developed under the impetus of the same basic driving force, a fierce love of liberty, and an unyielding determination to succeed. Our material wealth increased as we developed the fabulous store of resources that lay in the new land, and before the nation was a century old, materialism was a force to be reckoned with. This new materialism came into sharp conflict with our fundamental principles as we approached and passed through our critical period of Civil War, just 100 years ago.

After the Civil War, the surging energy that has always been the hallmark of these United States, made itself manifest in the rapid building and re-building in the East and in the great western movement that carried covered wagons to every unoccupied corner of the rolling plains and towering mountains, clear out to the Pacific Ocean. This pioneering movement was a repetition of the colonization of the 16th and 17th centuries in only slightly different dress.

The pioneers of the mid-1800's carried virtually the same simple tools and weapons that had served the Americans of a century or two before. They had need of, and exhibited, the same spiritual strength, moral courage, and physical toughness that had characterized the Pilgrim Fathers, the Daniel Boones and the Davy Crocketts that had gone before. The western wilderness yielded to the advance of civilization no less stubbornly than had the rocky New England coasts or the pine forests of the Carolinas, and the heroic men and women who accomplished the tremendous task of subduing it emerged with the same stamp of self-reliant courage that had marked their ancestors.

While we were engaged in winning of the West, some notable engineering advances were made. Early in the 19th century the steam engine was developed to the point of practical commercial use, and within a few years the railroad and the steamboat became realities to change forever the picture of transportation. But the power of steam had not yet been extensively applied to such things as earth-moving equipment, and as recently as the beginning of the 20th century the tasks of the farmer and the road builder were about as arduous as they had been 50 or 100 years previously.

The advent of electricity — or, rather the harnessing of electricity to specific, controlled uses — in the early 1900's was a big milestone on the road toward our modern way of life. It was many years before the full potential of electricity began to be realized, but 1900 marks the beginning not only of the 20th century but of all the scientific wonder it has come to symbolize. It opened the modern age of experiment and scientific research, and when major advancements did come, they came with bewildering rapidity.

The internal combustion engine had been demonstrated some three centuries earlier by a scientifically-minded Dutchman who used gunpowder for fuel, but it was not until the early days of the 20th century that the gasoline engine was developed to the point of practical use. The diesel engine was already a reality, although it would not come into its own for a few more years. The second decade of the century was little more than underway when the Wright brothers thrilled the world by achieving sustained flight in a heavier-than-air machine. There was a feeling of excitement and wonder everywhere as the age of science dawned over the world, but life on the farm—and even life in the cities —was little changed from the pattern of the 19th century.

The real change in American life came right after World War I. Under the stimulus of wartime necessity, scientists and engineers had moved ahead by leaps and bounds and when the conflict was over they quickly set about adapting the machines of war to the purposes of peace.

The battlefield tank was transformed into the tractor and the bulldozer, and the new era of engineering progress was really under way. Tasks that had been difficult, if not actually impossible, in the days when horsepower came wrapped in horses were now astonishingly easy. Great canals could be dug in the time it used to take to run a tiny irrigation ditch a few hundred yards —and with a fraction of the effort. With the new tractors, power shovels, graders and other heavy equipment, engineers found once-impossible problems of road building comparatively easy to solve. The exhausting physical toil of pioneer days was gone forever from a large part of the American scene. With power tools at hand, a man had only to press a button or pull a lever, and what had been the hard labor of weeks was done for him in instants, as by Aladdin's Genii.

In the years between wars, scientific and engineering progress was steady and frequently exciting, but once again it was the spur of wartime necessity that produced really spectacular results. The developments that had awed and amazed us in the years before 1940 began to appear, in retrospect, as the fruits of a period of retarded development. The airplanes whose beauty and speed had seemed incredible a few years ago suddenly became antiquated junks, left shuddering in the wake of the new super-streamlined models that roared by at three or four times their speed. Feats of

(*Continued on page* 32)

engineering that had seemed destined to go down in history among the great wonders of the world were dwarfed by newer and bigger accomplishments. ,

Then came the climactic event, the release of nuclear energy. When the first "A" bomb shook the ground and lit the pre-dawn skies at Alamagordo, a new and frightening era began in the world. Man's standard of living had, from time immemorial, been determined by the amount of force he could develop and put to controlled use. When primitive man first learned to multiply his own strength through the use of a lever, life was made forever easier. When men learned to harness and direct the power of steam and electricity, the amount of work he could accomplish was multiplied many times and his reward was correspondingly increased. But now he had loosed a power so tremendous, so potentially destructive, that he threatened to destroy himself.

In the years since the end of World War II, the dizzy pace of scientific and material progress has been maintained and accelerated—quite possibly because the ever-present threat of nuclear weapons has made the cold war as urgent a time as a shooting war used to be. Engineers continue to surpass old records with a regularity and casualness that is disconcerting. Even the incredible power of nuclear fission has been relegated to a secondary position by the still more awesome power of thermonuclear fusion. Man-made satellites are circling the earth and probing outer space. Men have already gone into space and returned and it is only a question of time until they go to the moon and the planets.

Along with these fabulous developments have come the luxury automobiles, the washing machines, the television sets and countless other machines and devices that make every-day life easier, more pleasant and less effortful. *The disturbing thing is that progress in social and human relations appears not to have kept pace with our headlong material advancement.*

The contrast with our beginnings as a nation becomes greater by the day. Then, we were poor in material things but rich in spiritual values. Men might labor many days to dig a ditch or lay out a rough road. But they could produce a document that will stand forever as an inspiration to free men.

The scientists and engineers of this 20th century have given the nation a wealth of material comforts beyond the wildest dreams of our pioneer ancestors. But there are many today who wonder if the strength—physical, moral and spiritual—which sustained our forebears has been sapped by too-easy living and too much concern with material rewards.

I sincerely believe that the brains that created the world of technology and material wealth—the men of science, the engineers, the leaders of business and industry—should turn at least a part of their powers to social and spiritual problems and to the conduct of government. This is at least a part of the special debt which I earlier said the engineer owes to society.

I realize that there are many engineers connected with government activity, in their professional capacity and at staff level. I believe, however, that we should have some engineers at policy level in government, applying their special approach and training to the making of decisions instead of merely carrying them out.

Throughout our history, a large factor in the success of our democratic form of government has been the fact that our legislative and executive bodies have presented a fairly accurate cross section of our total population, with particular emphasis on the types of people who have led the way in private enterprise. In this day when the engineer and the scientist are playing so large a role in our way of life, it would be tragic if we failed to include them representatively in our circles of government, and so left all of the critical decisions to laymen who cannot fully understand the age in which they live.

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DON'T THINK—IMAGINE

(*Continued from page* 23)

electro-mechanical copies are called) would be able to read any and all characters, varying from the handwriting of a very old and palsied Russian peasant to the Liliputian script of an insurance form to the gigantic print of newspaper headlines. At the moment, however, reality has not quite caught up with fiction, for one only has to look at his checkbook to assure himself that the present devices can read only mutilated Arabic numerials.

To close this paper, the following quotation shows the evolutionary goal of the computer engineers, but one that they can never fulfill, for though inventions of man may be extraordinary in their ability to perform designated tasks, they can never be more extraordinary than those who conceived them.

Day and night, from childhood to old age, sick or well, men and women think. The brain works like the heart, ceaselessly pulsing. In its three pound's weight of tissue are recorded and stored billions upon billions of memories, habits, instincts, abilities, desires and hopes and fears, patterns and tinctures and sounds and inconceivably delicate calculations and brutishly crude urgencies, the sound of a whisper heard thirty years ago, the resolution impressed by daily practice for fifteen thousand days, the hatred cherished since childhood, the delight never experienced but incessantly imagined, the complex structure of stresses in a bridge, the exact pressure of a single finger on a single string, the development of ten thousand different games of chess, the precise curve of a lip, a hill, an equation, or a flying ball, tones and shades and glooms and raptures, the faces of countless strangers, the scent of one garden, prayers, inventions, crimes, poems, jokes, tunes, sums, problems unsolved, victories long past, the fear of Hell and the love of God, the vision of a blade of grass and the vision of the sky filled with stars.

library notes

> A "BOOK OUGHT TO BE LIKE A MAN OR A WOMAN, WITH SOME INDIVIDUAL CHARACTER IN IT, THOUGH ECCENTRIC, YET ITS OWN; WITH SOME BLOOD IN ITS VEINS AND SPECULATION IN ITS EYES AND A WAY AND A WILL OF ITS OWN."
>
> **John Mitchel, Jail Journal, 1854.**

by harry gilbert

librarian

WHEN THE CHEERING STOPPED: the last years of Woodrow Wilson, by Gene Smith. William Morrow and Co., 1964. There have been a number of interesting books received in the Library in the last month, but few have been both lauded and critized by reviewers like this one. This story of President Wilson begins with the final months of the ailing first Mrs. Wilson, the former Miss Elly Lou Axson of Rome, Georgia. At this point the happiest phrases of Woodrow Wilson's life, both personally and politically, are behind him. His first administration had achieved a legislative record destined to become an enduring strand in the national fabric. But this would soon change course because of the great war getting under way in Europe. Then Mrs. Wilson dies, and the President is distraught. The President's need of feminine devotion and attention lead him to an attraction for a 42 year old widow, Mrs. Edith Bolling Galt, a lady of an old Virginia family. Despite the apprehension of Democratic politicians that his early remarriage would adversely affect his campaign in 1916, they were married in December of 1915.

The President and the new First Lady weather the political storm, and the entry of the United States into World War I, together. She accompanies the President to Europe in December. 1918 to attend the Paris Peace Conference. A mild cerebral thrombosis causes a partial collapse of the overworked Chief Executive. His Congressional enemies at home, notably Senator Lodge, set traps designed to defeat the provision under the Treaty for the League of Nations.

In September of 1919, the President, his wife, his physician, and his secretary set out by private railroad car on a speaking crusade designed to persuade the American people that their country must join the League. Wilson, now past sixty, exhausted by a world war and months of wrangling over the treaty, goes out for the last time to meet his countrymen face to face. The doomed tour, and its aftermath, are the heart of this book. The reception at first is cool, but it warms as Wilson moves west. Suddenly the trip is cut short. Only his intimate friends know that the President has suffered a thrombosis. He returns to the White House a permanent invalid.

Thus begins the seventeen months when the President of the United States was completely isolated from the world by his wife and his doctor. Documents pile up, letters go unanswered, and the President's orders appear as notes scribbled in his wife's handwriting. It was a nightmarish situation, and yet it remains possible that it could happen again at any time and pose the same problems, because the law is not exact and satisfactory on just who is to determine "inability to discharge the powers and duties" of the Presidency.

During these months of Presidential inaction the Senate decreed that the U.S. would not enter the League. At the end of his term of office Wilson has sufficiently recovered to entertain a notion of a third term. Like his vision of the League, this too is defeated, and he retires a bitter and broken man. But the remaining three years of Wilson's life reveal an amazing climax. Retiring to a house in Washington's S Street he finds that he is not forgotten. Crowds flock there daily. Admiring letters warm him. This is the beginning of the adulation that has now placed Wilson among the truly great Presidents, and the dream for which he fought remains with us. Its home looms high above the East

River in New York City, and its name is now the United Nations.

Some other interesting acquisitions this past month have been:

Language and Faith, by John A. Hutchinson. Westminster Press, 1963.

Technology and Economic Development, by Scientific American. Knopf, 1963.

The Language of Computers, by Bernard A. Galler. McCraw-Hill, 1962.

Challenge to Affluence, by Gunnar Myrdal. Pantheon, 1963.

Linear Programming, by Robert W. Llewellyn. Hot, Rinehart, and Wilson, 1964.

The Flash of Genius, by Alfred B. Garrett, Van Nostrand, 1963.

Literary Opinion in America, by Morton D. Zabel. Harper. 1962.

Santayana: the Later Years, by Doniel Cory. Braziller, 1963.

Prelude to Yorktown, by M. F. Treacy. Univ. of North Carolina, 1963.

Shinran, by Hyakuzo Kurata. Tokyo. Cultural Interchange Institute for Buddist.

Epicurus my master, by Radin, Max. Univ. of North Carolina Press.

The great philosophers, by Radoslav Tsanoff. Harper, 1964.

Magic: its history and principal rites. Dutton, 1961.

Plato's theory of knowledge, by Norman Gulley, Barnes & Noble, 1962.

The Psalms for the common reader, by Mary Ellen Chase, 1962.

The Ancient Gods, by Edwin Oliver James. Putnam, 1960.

Adonis, Attis, Osiris; studies in the history of Orental religion. 1962.

The Boss and the Machine: a chronicle of the politicians and party organization.

Records:

Beethoven, Three Favorite Sonatas.

Brahms, Symphony No. 2 in D Major, Opus 73.

Dances for Orchestra.

Shakespeare, Julius Caesar.

Shostakovich, Violin Concerto, Opus 99.

POWER WITHIN THE ATOM

(*Continued from page* 18)

free neutrons. It was this discovery which was the necessary triggering chain reaction mechanism.

This was the situation when the Second World War came crashing down around the heads of the scientists and the rest of the human race. An intense, feverish race was on to construct an atomic bomb which would unleash energy never before witnessed by mankind. History has already named the winner, but it was a long six years from the discovery of atomic fission to the utilization of that discovery in an actual weapon. The story of what transpired behind the curtains of secrecy —hastily drawn across the atomic stage with the outbreak of the war —is a powerful saga of human achievement. For the discovery of atomic fission coupled with the making of a chain reaction did *not* solve the problem of atomic energy release. It merely raised the hope that such a release was possible—or, at least, not impossible.

ENGINEER'S RESPONSIBILITY

(*Continued from page* 32)

So, as I see it, we of the engineering profession today face a double challenge. One is professional, the challenge to meet and surpass the soviets in the conquest of space and the other great fields of scientific advancement. This is not a matter of today and tomorrow but of years to come, and we are concerned not only with our own efforts but also with developing qualified scientists and engineers to carry on in the future. It is not merely a matter of offering scholarships and other forms of assistance to engineering students, but of acting as missionaries to kindle the flame of interest in the breasts of talented young people while they are still in high school and even junior high school, and helping keep the flame alive until they have completed their preparation and become full-fledged professional engineers.

The other challenge is to meet our responsibility to the community, to the nation and to the cause of freedom, by taking an active part in the affairs of government and lending every assistance we can to the solution of the knotty problems which confront us.

My country made it possible for me to live as a free man—progress under a free enterprise system—establish an inheritance and worship as I please.

I owe my country at least a part of my experience, talent, and time.

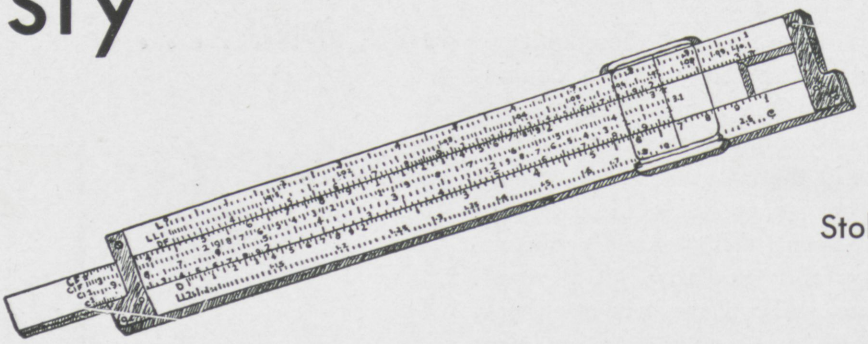
One way to pay that debt is to accept the responsibility of public office and apply such talents in honesty without fear or favor.

Remember what Edmund Burke said:

"All that is necessary for evil forces to win is for enough good men to do nothing."

And finally—I quote from an engineer you all know, Charles F. Kettering — "Making your country's progress your profession is an exciting and rewarding way to spend your life."

sly droolings



Stolen by Larry MacDonald, Sr. M.E.

Rumor has it that manufacturers of a certain feminine garment are currently making only three kinds: The Russian type, the Salvation Army type, and the American type. The function of the Russian type is to uplift the masses, the Salvation Army type to raise the fallen, and the American type to make mountains out of mole hills.

* * *

A girl who dresses like a million dollars shouldn't walk like loose change.

* * *

Some girls are like cigarettes: They come in packs, get lit up, make you puff, go out unexpectedly, leave a bad taste in your mouth and still they satisfy.

* * *

A wild goose is one that is an inch off dead center.

* * *

"What happened to you?"

"I was doing a rhumba with my girl when her deaf father walked in."

* * *

The guy was walking down the street dressed only in a barrel when a cop stopped him.

"Are you a poker player?" asked the law.

"Not me," replied the character, "but I just left a couple of guys who are."

* * *

How can you tell the difference between the boy and girl chromosomes?

Look at their genes.

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

* * *

"What kind of guy is your roommate?"

"Well, last night he stubbed his toe on a chair and said, 'Oh the perversity of inanimate objects.'"

* * *

Lecturer: "If I talk too long, it's because I forgot my watch and there's no clock in this hall."

Voice from the audience: "There's a calendar behind you."

* * *

Male: "Are you afraid of the big bad wolf?"

Female: "No, why?"

Male: "That's funny, the other two pigs were."

* * *

Then there was the CE who told his date he was primarily interested in the study of strap tension on shell structures.

* * *

Girl answering telephone: "Sorry, Betty is not here. This is her 114-pound, five-foot-three, blond, blue-eyed sister."

* * *

As the bra said to the hat, "You go on ahead, and I'll give these two things a lift."

* * *

Engineers are continually surprised to find that girls with the most streamlined shapes offer the most resistance.

Two men, neither very bright, were helping to build a house. One kept picking up nails, looking at them, keeping some and throwing others away.

"Why are you throwing away so many nails?" asked his companion.

"Because they are pointed the wrong way. They have the head on the wrong end."

"You fool. Those are for the other side of the house."

* * *

A Chinese scholar was lecturing when all the lights in the auditorium suddenly went out. Unperturbed, he asked the people in the audience to raise their hands. They did, and the lights immediately came on again. "Proves wisdom of old Chinese saying," he remarked. "Many hands make light work."

* * *

Preparing to give a small boy an aptitude test, a psychiatrist told his nurse to put a pitchfork, a wrench, and a hammer on the table. "If he grabs the wrench, he will be a mechanic. If he grabs the pitchfork, he will be a farmer. If he grabs the hammer, he will become a carpenter. The boy fooled everyone. Yes, he grabbed.

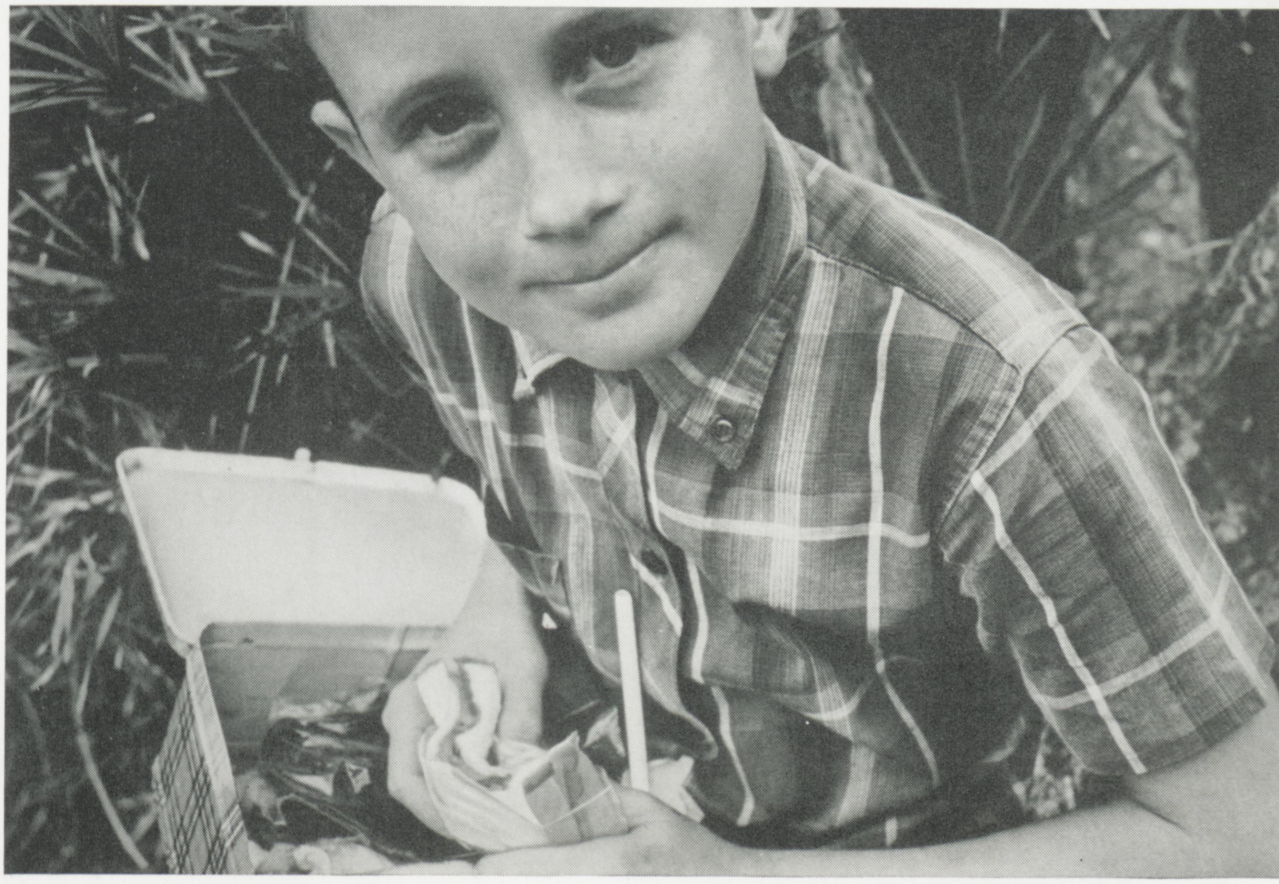
* * *

What's the difference between a sewing machine and a girl running to class?

A sewing machine only has one bobbin.

* * *

A bachelor is a man that didn't have a car when he was in college.



Is it possible that a leading maker of jet engine turbine blades had a hand in giving Pat Deegan a fresh sandwich today that was made last night?

It's perfectly logical to assume that the nation's leading producer of alloying metals like chromium, manganese, tungsten, and vanadium could become an expert on their use in new forms of steel. One result is the development of a new kind of stronger stainless steel.

Nor would it be surprising that the nation's pioneer and leading producer of plastic raw materials would be selling plastic food bags with a new kind of fold-lock top that locks in freshness. They're called "Glad" Bags, and they keep Pat Deegan's lunch fresh even though it was packed the night before.

But you'd have every reason to doubt that two such unlike activities could come from the same company. Provided you didn't know about Union Carbide.

In fact, you'll come across lots of diversifications at Union Carbide. It's one of the world's largest producers of chemicals, and it makes ingredients for textiles, paint, and urethane foam for cushioning. It is one of the most diversified private enterprises in the field of atomic energy. As a world authority in super-cold fluids, it produces tons of liquefied hydrogen, oxygen, and nitrogen for fueling space vehicles. It's a leader in carbon products and makes exhaust nozzle liners for rockets, brushes for electric motors, and electrodes for electric arc furnaces. And its consumer products include world-leading "Prestone" anti-freeze.

In fact, few other corporations are so deeply involved in so many different skills and activities that will affect the technical and production capabilities of our next century.

The next century starts with Pat Deegan's lunch.

UNION CARBIDE

UNION CARBIDE CORPORATION, 270 PARK AVENUE, NEW YORK, N. Y. 10017. IN CANADA: UNION CARBIDE CANADA LIMITED, TORONTO
Divisions: Carbon Products, Chemicals, Consumer Products, Food Products, International, Linde, Metals, Nuclear, Olefins, Ore, Plastics, Silicones and Stellite