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Rose Technic Staff
Rose-Hulman Institute of Technology

Rose Technic

November, 1960

In This Issue

ASTRONOMY—THE MOON
INNOVATION FROM DETROIT
VIEWS OF A POWER ENGINEER

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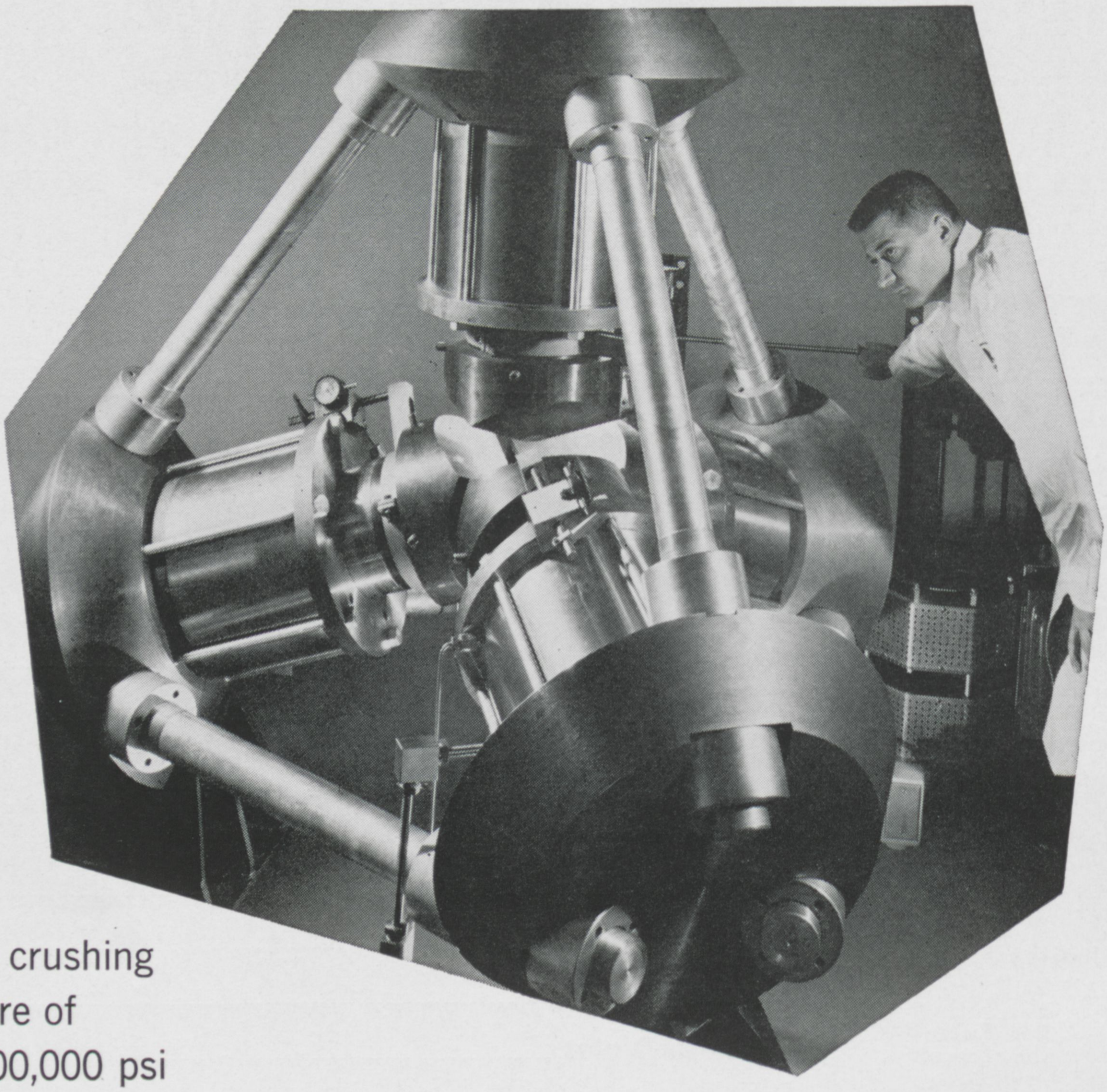

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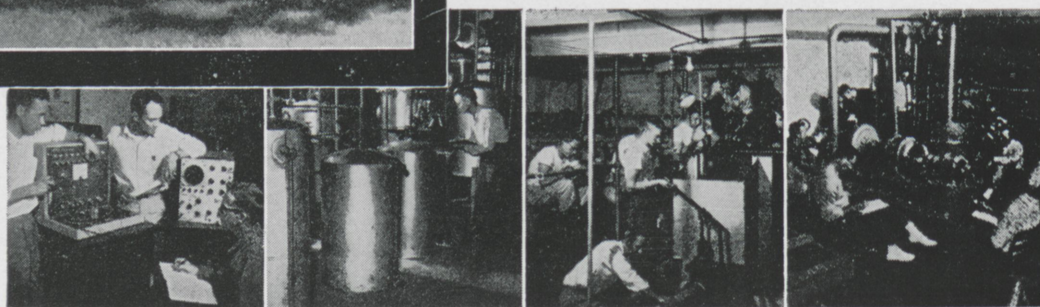

ROSE POLYTECHNIC INSTITUTE

TERRE HAUTE, INDIANA

HIGH SCHOOL GRADUATES OF 1961

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MECHANICAL ENGINEERING
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ROSE POLYTECHNIC
INSTITUTE
TERRE HAUTE, INDIANA

EDITORIAL

Student - Faculty Meeting

Thursday, November 17, a dinner attended by the heads of the campus student organizations and the heads of all the departments of the Institute was held at a downtown hotel. The purpose of the dinner was to better the communication among the student body, the faculty, and the administration. The student leaders were given the opoprtunity to ask any questions of anyone present and to state their own opinions on a variety of subjects without fear of reprisal. Your campus representatives were quite candid in bringing up such topics as future expansion of the Institute, the maintenance of our scholastic standards, the need of varsity football, the graduate program, hazing, traditions, fraternity drinking at Homecoming, and the movement of the fraternity houses to the campus.

Although no changes were definitely made at the meeting, the clarification of the division of responsbility among the responsible persons at Rose as stated by Dr. Morgen was extremely valuable. If you yourself have an objection to the manner in which something is being done, if you question the need of an activity, or if you have a suggestion as to how a given goal can be better achieved in any other area, go to the person or persons responsible for that activity or area. If your question is of an academic nature, see Dean Moench. If it has to do with development, solicitation of funds, or recruitment, see Mr. John Bloxsome. If it has to do with the business transactions of the Institute, Mr. George Moench is the man to see. If it concerns the course of a particular department, see the proper department head. If it concerns the government of the student body, or the allotment of funds to the studen organizaions, see the Student Council President. And finally, if you cannot obtain an answer from one of the above persons, as Dr. Morgen said at the meeting, his door is always open.

As a vehicle of communication, the meeting was extremely valuable. Such meetings will be held once at the beginning of each semester, followed up by smaller meetings of students and faculty interested in working out their particular problems.

J.W.F

From the

PRESIDENT'S DESK

As members of the student body and the alumni of Rose, you are believers in the contributions which independent, privately supported colleges make to the economy and the welfare of the United States. If this were not the case, you would not be a student or an alumnus of Rose. As citizens you should be aware that the Federal Government is committed by the campaign statements of President Elect Kennedy and by his opponent Vice President Nixon to the support of higher education with the use of Federal funds WHERE NECESSARY.

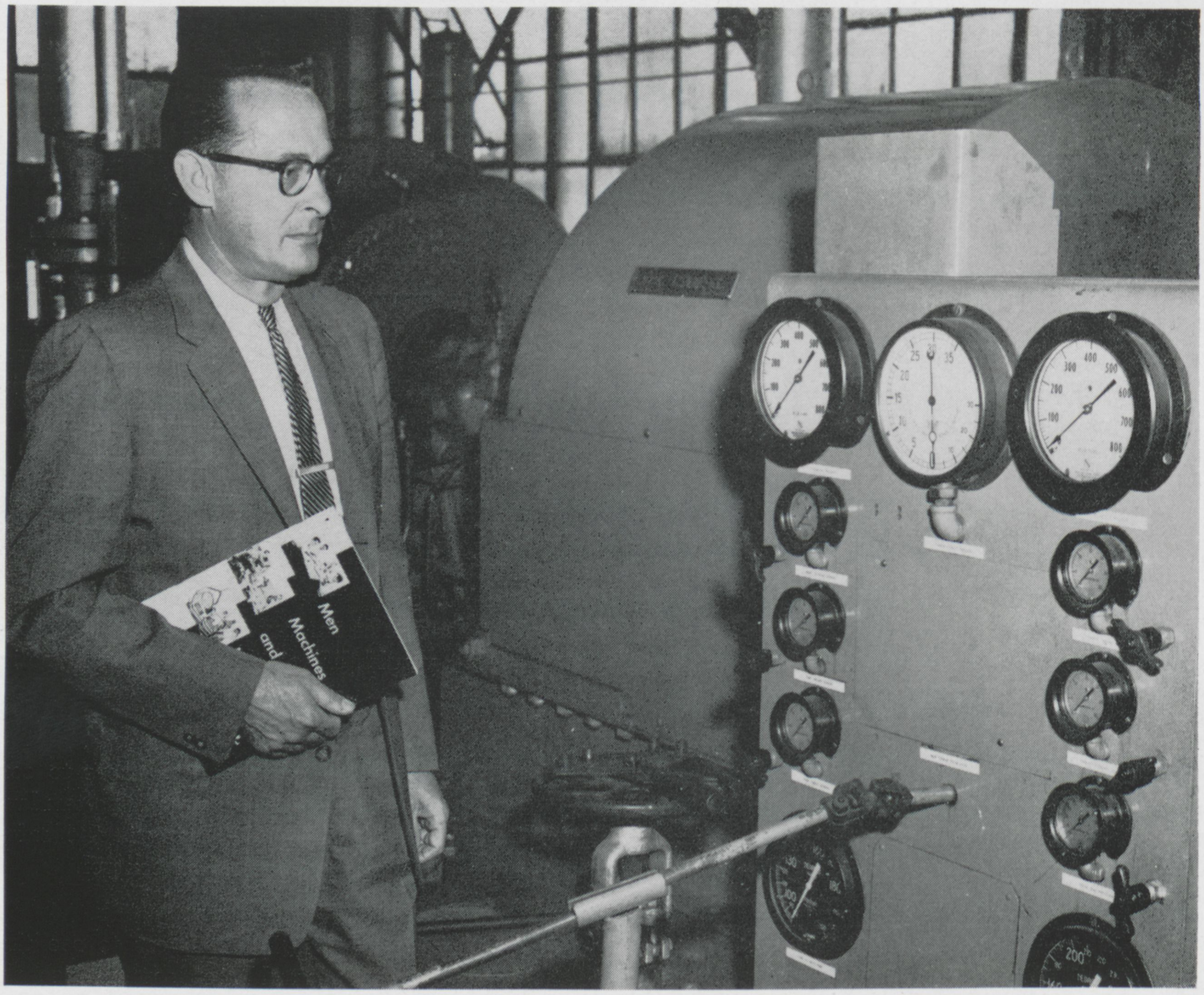
I believe that our diversified systems of higher education consisting of independent, church related and tax supported institutions has been an important factor in protecting the freedom of learning and has encouraged a healthy competiiton towards excellence. Therefore, any support which the Federal Government should give to higher education should be given in such a way as to strengthen the independent and church related colleges and universities as well as the tax supported institutions. Further, any funds so given should be free from strings which would affect the educational policy of any institutions receiving the funds.

Wise provisions in the tax laws have encouraged both individuals and corporate donors to contribute to education on a tax deductible basis from current income. Further revisions of the tax laws encouraging individuals to give to the support of the institution of their own choice is the safest way for the Federal Government to support higher education without any danger of control.

Each alumnus, each student, each parent of a student, should make it his business to see that any Federal Legistlation which is passed in support of higher education would not compromise the freedom of any independent or church related college or university. In this way Rose can maintain its freedom in the future.

R A Morgan

OBSERVATIONS Of SUCCESS



PART II: SALES ENGINEERING

by C. E. Cromwell
Manager, Commercial and Field Sales
DeLaval Steam Turbine

"OBSERVATIONS OF SUCCESS" is a series of eight articles written by outstanding alumni of Rose—men who are truly giants in their fields—to describe for you the nature of their particular field of engineering, the elements of their college training which were most helpful to them, and the traits of their personalities which were invaluable to their success. The fields of engineering to be discussed in later issues in addition to Executive Management will be Sales, Research, Design, Production, Personnel Relations, Teaching, and Purchasing.

Because ultimate job satisfaction cannot be obtained unless the philosophy of the man parallels that of the organization for which he works, it would be well to consider the values which these authors attach to things as evidenced in their writing in the thinking that precedes your selection of a field of engineering.

This momentous series will represent the most currnt, the most broad, and the most highly authoritative opinion available on any college campus of activities emanating from Engineering.

It was with real pleasure that I accepted an invitation from your editor to write an article about sales engineering. There are various fields of engineering which offer challenges to the individual. For many, the challenges offered in the practice of theoretical engineering, research and development, and design provide the realization of their ambitions. There is no question about the requirement for an ever increasing number of engineers with advanced knowledge to develop the needs of our continually improved standard of living, and our involvement in the nucleonics and space age.

The place for a sales engineer in this broad complex of technology is vital and presents one of the most challenging fields of engineering. In most cases, he is the main channel of communication between the design engineer and production engineer on the one hand and the customer's operating and process engineers on the other. He must be able to communicate in a technical and confident manner the engineering concepts of his company's products to customers and to keep the channel of communication open to properly interpret the customer's requirements for his company. His opportunities for creative engineering are many in that his company needs his continual search not only for new markets for both existing and new products, but also for suggestions for product improvement. The broad experince obtained in sales engineering is invaluable to an individual as he advances in his career.

I hope my observations of what characteristics contribute to the success of a sales engineer will be helpful to those who would embark on such a career.

The De Laval Steam Turbine Company established in 1901 had its headquarters and manfacturing facilities located at Trenton, N. J. Its products are sold through District Sales offices and representatives located in the principal cities of the United States and through representatives in foreign countries. De Laval products are centrifugal pumps, steam turbines, centrifugal blowers and comprssors, rotary screw pumps, worm gears, helical and planetary gears and turbochargers. They are sold to municipalities, electric and gas utilities, chemical plants, oil refineries, paper mills, steel plants, the transportation industry—both land and marine, educational, state and government institutions, and many other types of industries.

My position of Commercial and Field Sales Manager makes me responsible for the activities of the Commercial Sales Departments of Centrifugal Pumps, Steam Turbines and Centrifugal Compressors. I am also responsible for the administration of all domestic company district sales offices and for co-ordinating the sales activities of district offices and representatives for all of the company's products. In my work I have the additional responsibility for the selection and training of sales personnel, and I came to the conclusion quite some time ago, and I am probably prejudiced, that, while it is obvious that the character and ability of all of the people in any company determine its success, probably in no other group is this as immediately evident as it is in the sales group.

In gaining acceptance of a company's products, there are competitive factors of quality and performance, and price and time required for delivery. However, in many cases, the most important competitive factor becomes the sales engineer, and it is his personality, ingenuity and ability to minimize disadvantages and maximize advantages that results in success for him and his company. Certainly the image a customer has of a company will have considerable influence in the decision that is made, and except for the important factors of advertising and previous experience a customer has had in using a company's products, the image a customer obtains of the company's reliability and integrity many times rests squarely on the shoulders of a sales engineer. This is particularly true in the missionary work of seeking new customers.

In the case of most of our products, many of which are engineered to suit specific applications, it is required that our sales personnel be engineers. Most all of the people in the operating, engineering and purchasing departments of our customers are engineers, and it is only natural that a common bond of expression generally exists when engineers are speaking with each other.

To properly represent a company successfully and achieve success for himself, a sales engineer should have certain characteristics, many of which he develops while he is in college. Some of these characteristics are initiative, resourcefulness, creativity, self-discipline, industry, aggressiveness, and determination. Many of the subjects that an engineer studies while he is in college develop his mind to analyze and think clearly in solving difficult problems. The mathematics and physics courses are invaluable in conditioning a student's mind and are of great help to him in later years whether he applies this knowledge directly or indirectly, depending on the career he follows.

In the case of our company's products, a good knowledge of the fundamentals of applied mechanics, fluid mechanics and thermodynamics is important in helping to understand their application.

Since a sales engineer must have as complete a knowledge as possible of his company's products, the study habits he develops in college have a great deal to do with the ease and thoroughness with which he is able to study his company's products and their application. Also, the characteristics of alertness and enthusiasm are generated by a successful student during his college career, and in the field of sales these are very important characteristics, for he must be alert to a customer's needs and enthusiastically present his solution to meet these needs.

Obviously a sales engineer must like people and be able to work with people. This is evidenced in college by the way a student conducts himself with his fellow students in laboratory work and his activities outside the classroom. In selling, teamwork is so important not only in working with customers but also with headquarters and other sales offices, since many projects involve more than one sales territory.

In order to adequately represent his company and service customers, probably the most important characteristic of a good sales engineer is loyalty. This involves loyalty to his company and a conviction that he believes in his company and the goals it has set. This characteristic can be compared with the loyalty and the co-operation that exists between members of any successful team. It also involves loyalty to a customer, for when making sure that both the company and the customer's interests are well served is the climate maintained for a favorable relationship. The words reliable service probably best describe what people with these characteristics provide, and this is fundamental to assure success of an individual and his company.

It is important that a sales engineer have a personality which includes poise as well as a convincing and pleasing manner, all of which are needed to sell himself. This obviously is prerequisite to being able to sell his company.

In times past, it was believed that to be successful in the sales profession one had to think of high pressure tactics, have an ability to talk fast, and otherwise outguess his customer. In sales engineering, these are far from the desirable traits that are necessary, as sincerity, logical analysis, the desire to be of service, and the other qualities mentioned are what place an individual in the category of a successful sales engineer.

In looking through the Rose catalog to be reminded of important subjects, I noticed the English subject, Letters and Reports, and also the Economic subject, Legal Institutions and the Functions of Law. Sometimes in our intense interest of obtaining an engineering education, we feel that these English and Economic subjects are minor in their importance. However, as you proceed into your career, you may find that your ability to express yourself clearly with as few words as possible, so that there is no misunderstanding, can be one of the most important assets you have. This is particularly true in sales work. As a matter of fact, all of those subjects which relate to the business world are very important to Sales Engineers, as he is not only an engineer but is a business man as well.

If I have not mentioned all of the various subjects in a student's curriculum, it is not because they are of lessor importance in achieving success in your chosen career. The advantages of an engineering education are in all of the subjects in the curriculum, all of which have been designed to be helpful in any type of career.

In summary: If a student is well grounded in engineering fundamentals, has an ability to analyze problems and think clearly, wants to work with people, has a spirit of teamwork and loyalty, is alert, ingenious, creative, aggressive and determined—all of these qualities having an opportunity to be developed in college—then he has the necessary ingredients of a successful sales engineer. I am sure that the feeling of accomplishment is no more keenly felt in any other type work than it is in achieving success in selling. The contributions a successful sales engineer makes to the profession of engineering are very important indeed, and they may be measured by the degree of development of our modern highly engineered society. Certainly his efforts are required to seek out and provide his company the opportunities to develop and manufacture products for this society.

It is hoped that this article answers some of the questions you may have about sales engineering and that it will prove helpful to those of you who would like to contemplate a sales career.

THE ENGIN

When the young thoroughbred colts that playfully romp over the rolling Kentucky hills of succulent bluegrass are trained to be the champion runners so many of them turn out to be, they are ridden at ever increasing paces around a training track. The interesting twist to their training is that although every race in which these horses will run during their careers will be run counterclockwise around the track, when young, they are trained to run the track both clockwise and counterclockwise. If in the formative months of muscle growth they were to make only left turns while running, the muscle growth pattern would be unsymmetrical with the result that the horses would be unable to develop a full speed since a large portion of their muscles would not have grown.

Here at Rose, in our training to become engineers, we are being run in only one direction. We are being taught physical concepts, in the main. And the non-physical concepts of economics, history, and language which we are taught are not integrated with the engineering function, and worse, are not shown to be capable of being comprehended with a utilization of the concepts of physical principles. We are not being shown how we can apply the concept of physical laws to everyday associations with individuals and organizations. We don't have the flexibility to run in both directions—to translate the physical into the humanitarian—with the result that when the race is on after graduation, we will be less ably equipped to develop the momentum which we should latently be capable of developing.

To obtain an idea of what this flexibility, or ability to translate principle of engineering into other more humanistic areas, can consist, let us start by taking some simple physical cases. We will observe the processes of the engineering approach to one of these cases, define the state of the engineer's involvement with this problem, understand the physical principles involved in this case and others, and attempt to translate some principles or laws, giving them applicability, if possible, to entirely non-physical and slightly abstract situations.

Consider a wooden block resting on a horizontal plank of wood. One end of the plank is slowly raised so that the plank makes an ever increasing angle with the horizontal. As you observe this in your role as an engineering student, what are the most probable thoughts that will enter your mind? Probably you will visualize the forces acting upon the wooden block. You draw upon your knowledge of the principle of friction force behavior to predict that the maximum value of the friction force will be a constant of the surfaces in contact times the component of the weight normal to the plane. You will then reason deductively in applying the general principle generalized by scientists that in a static system the summation of all forces acting on the system will be zero. You will come to the conclusion that the block will remain stationary with respect to the plank until such time as the component of the weight of the block down the plane exceeds the maximum value of the friction force. Computation of the specific relationships involved will give you the approximate angle between the plank and the horizontal at which the block will start to slide.

Let's look at the type of thought processes used by the engineer in analyzing this simple problem. He started with a physical case. He then stated his problem, which in this case would have been to determine the angle. Surprisingly enough, in dealing with complex physical systems, one of the more difficult steps in arriving at a solution is quite often that of defining the problem. After defining his problem, he focused his attention on the critical factors influencing the behavior of his system by a process of isolation known

ERING MIND

By James W. Funk, senior, m.e.

in this case as "taking a free-body diagram". Having determined what the variables were, he then proceeds to see how they interact—in other words, he analyzes his system, combining his technical educational background with his reasoning ability. At this point, the engineer may simply analyze, or, if he is creative as a good engineer should be, he may first synthesize and then analyze. In this example, synthesis could have consisted of placing a liquid on the plank. After the final analysis has taken place, and the results have been stated, the engineer is in a position to reason inductively to generalize the results of his particular physical system to others in which the same variable interact in the same manner.

Now that we have observed the thought processes of an engineer as he performs his engineering function on a physcial system, let us analyze some of these process and, more specifically, the engineer's attitude toward them.

In a physical system governed by the universal laws of nature, the various probable actions of the elements of the system can be predicted within limits, assuming that the necessary amount of knowledge can be obtained. In our case of a sliding block, the knowledge that the friction force was proportional to the weight of the block normal to the plank was necessary before the problem could be solved. Our block had only two alternatives as the plank end was raised. Either it was to remain stationary, or it was to slide down the plane. As the engineer observed the apparatus he was aware of both of these possibilities. Notice please, that the engineer was not forced to ask himself such seemingly absurd questions as, "If the block doesn't like the plank will it still slide when the universal laws of nature state that it should?" or, "Did the plank have an argument with the wife last night and is therefore in no mood to permit the block to remain stationary upon it no matter what the angle?" It is obvious that non-living objects such as blocks and planks have neither emotions nor capacities for reasoning. This realization, though obvious, is far from being ridiculous. For these are the things with which an engineer is trained to deal. Let's extend this realization. The young engineering student is trained to spend a portion of his time synthesizing inputs for pieces of laboratory apparatus and predicting their output. When he leaves his laboratory, his desk, or his drawing board, it is likely that he will meet other physical objects like himself which, because of the particular thought process he has been trained to use, he may subconsciously regard as being pieces of laboratory apparatus. Whether he regards them as such or not, he will probably attempt to use his engineering thought processes in dealing with them, because, after all, this is the way he has been trained to think.

Herein lies the difficuly. The engineering student (it is hoped) will quickly realize that his scientific thought process and his attitude toward engineering situations should not be applied directly to a group of persons or even to a single individual without substantial modification.

For one thing, the alternatives are far more than either it will slide or it won't. Also, the variables involved are sometimes too myriad to enumerate. Later examples of other physical systems will point out other areas in which modifications should take place.

One sweeping generalization which can be made in a discussion of this topic is that all things which an engineer designs or analyzes must be useful economically. This aspect of engineering is not readily apparent when the field is surveyed from behind the rose-colored school win-

(*Continued on page* 45)

A FACULTY MEMBER'S PET PROJECT

DETERMINING EQUILIBRIA

Chemical equilibrium, in at least limited form, was observed by the ancients as they used plant pigments in mordant dying, made perfumes and obtained salt from the shores of the Dead Sea. The Alchemist of two to three centuries ago recognized equilibrium in the behavior of gases and in the phenomenon of osmosis. Students of chemistry during the last six or seven decades have been concerned with the Le Chatelier Principle, the Nernst Equation governing electrochemical reactions and the Laws of Thermodynamis, all of which pertain to various aspects of chemical equilibrium.

In 1850, Ludwig Wilhelmy worked out a mathematical expression for the velocity of inversion of sugars by acid and in 1862, M. P. E. Berthelot published a paper concerned with the velocity of esterification. He found that when an acid and an alcohol are brought into contact, the reaction between them never reaches completion but stops at a definite equilibrium point. From these early experiments to the present time, thousands of equilibria have been observed and their positions experimentally measured by the chemist.

With the knowledge of Michael Faraday's early experiments in electricity at hand, Svante Arrhenius, in 1887, promulgatetd his now famous theory of electrolytic dissociation. This is the basis of our present theory of ionic equilibria which is quite familiar to even the better informed of our high school students.

The behavior of weak acids or bases is illustrated by two hypothetical examples:

$$(1)\quad HA \rightleftharpoons H^{+} + A^{-}$$

$$(2)\quad B(OH)_2 \rightleftharpoons B^{++} + 2OH^{-}$$

The well prepared student is able to explain that these reactions do not proceed to completion, but rather attain an equilibrium position (more or less proportional to the length of the arrows) which may be described by an equilibrium constant, or more specifically in this case by an ionization constant:

$$(3)\quad K_a = [H^{+}][A^{-}] / [HA]^{*}$$

$$(4)\quad K_b = [B^{++}][OH^{-}]^{2} / [B(OH)_2]$$

*The brackets signify that concentrations of the various species present are expressed in morality or gram-moles per liter of solution.

Similar expressions are used to describe the solubility of slightly soluble substances, the decomposition of many gaseous molecules (where pressure is usually a more convenient concentration designation) and the formation or dissociation of complex ions. This paper will be largely concerned with the latter type of equilibrium.

Such important processes as purification by recrystallization, use of colored acid-base indicators, reliable water hardness determination and even jelly making are all governed by the principle of chemical equilibrium.

The work of Alfred Werner near the turn of the century lead to a Nobel prize for his development of an entirely original conception concerning the composition of the metal-ammonia complexes. As the father of coordination compounds, Werner opened the doors of both theory and practice for the chemists of the twentieth century. While Werner was largely concerned with complexes of chromium, the present day freshman is usually much more familiar with similar coordination compounds of copper, and in many instances will attest to the fact that a pale blue copper sulfate solution becomes deep blue in color upon addition of ammonium hydroxide to it. The chemistry of the copper-ammonia complex system is summarized by the equation:

$$(5)\quad \underset{\text{(PALE BLUE)}}{Cu^{++}} + 4NH_3 = \underset{\text{(DEEP BLUE)}}{Cu(NH_3)_4^{++}}$$

The extent to which this reaction occurs is described by the formation constant:

$$(6)\quad K_f = \frac{[Cu(NH_3)_4^{++}]}{[Cu^{++}][NH_3]^{4}} = 3.89 \times 10^{12}$$

Since the formation constant is quite large (almost four trillion) it is evident that this is quite a stable coordination componnd. The greater the concentration of ligand or chelating agent (ammonia, NH3, in this example) the greater will be the concentration of the complex ion and hence the darker the deep blue color of the solution.

CHEMICAL QUANTITATIVELY

By Frank Gutherie, Professor, Chemistry Department

Actually, this and many other complex ions are formed in a stepwise process and it is possible to mathematically evaluate a constant for each separate step:

The valves of k_1, k_2, k_3 and k_4 are respectively, 1.35×10^4, 3.01×10^3, 7.42×10^2, and 1.29×10^2, and their product equals the previously described k_1, 3.89×10^{12}.

(7)

$$Cu^{++} + NH_3 = Cu(NH_3)^{++}$$

$$K_1 = [Cu(NH_3)^{++}] / [Cu^{++}][NH_3]$$

$$Cu(NH_3)^{++} + NH_3 = Cu(NH_3)_2^{++},$$

$$K_2 = [Cu(NH_3)_2^{++}] / [Cu(NH_3)^{++}][NH_3]$$

$$Cu(NH_3)_2^{++} + NH_3 = Cu(NH_3)_3^{++}$$

$$K_3 = [Cu(NH_3)_3^{++}] / [Cu(NH_3)_2^{++}][NH_3]$$

$$Cu(NH_3)_3^{++} + NH_3 = Cu(NH_3)_4^{++}$$

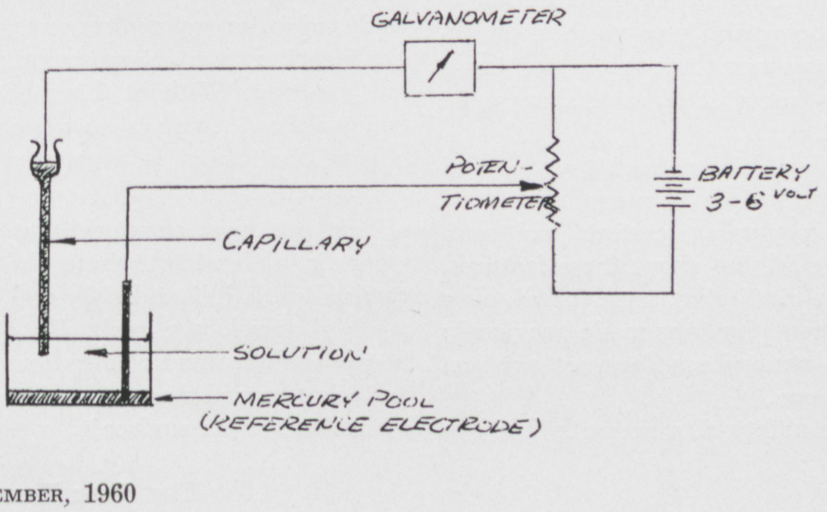
$$K_4 = [Cu(NH_3)_4^{++}] / [Cu(NH_3)_3^{++}][NH_3]$$

The actual experimental measurements of many of the consecutive formation constants have been reported in the chemical literature.

EXPERIMENTAL METHODS

Guido Bodlander, in 1902, carried out some of the earliest quantitative measurements of stability of coordination compounds using solubility data, a method which notes changes in solubility induced by complex formation. A second, and more modern, variation of the solubility method is based on the difference in solubility of the simple and complexed species in separate layers of immiscible liquids and is popularly called liquid-liquid extraction. A technique dating back more than a century, but only recently sky-rocketing in popularity, involves the use of ion-exchange resins in a manner very similar in principle to the other two solubility methods.

A number of electrochemical methods have been used over the years. Included are E.M.F. measurements from which non-complexed metal ion concentrations may be determined. For weak acids or bases to serve as chelating agents they must normally shed their H+ or OH- and the concentration of these ions is measured with a pH meter. A third electrochemical method is polarography ,the basis of current studies at Rose, by the author, and to be discussed in more detail later in this paper. Electrical conductivity of electrolytic solutions has also proven useful in some equilibrium studies.



The most common optical method is based upon the spectrophotometer and may employ ultraviolet or infrared radiation as well as the visible region of the spectrum. In these methods, usually changes in color or changes in the intensity of the color will be related to the concentration of cation or ligand involved in the complex.

The polarographic method was invented by Jaroslav Heyrovsky in 1922, and by the fall of 1959, when he was awarded the Nobel prize in chemistry for this work, in excess of 7,000 scientific papers had been published on different aspects of polarography.

The polarographic method is based upon an electrolysis (usually reduction) at a dropping mercury electrode. The essential components of the electrical system are shown in Figure 1. The method involves measurement of current flowing at many different applied potentials. Since the dropping mercury electrode grows in size, and is renewed every few seconds, as its name suggests, the polarogram has a saw-tooth appearance illustrated in Figure 2. It is obvious that little

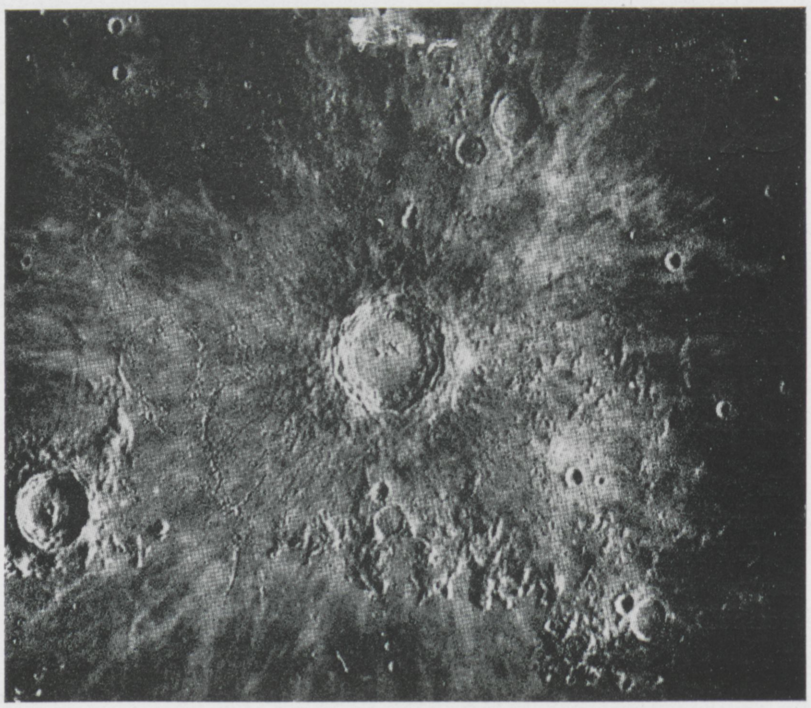
(*Continued on page* 34)

ASTRONOMY

PART II:

THE MOON

By Jay Hirt, senior math.



Right: The Crater Copernicus.

The earth is accompanied in its revolution around the sun by its single satellite, the moon, which is 2160 miles in diameter, or a little more than one fourth the earth's diameter. Although it ranks only sixth in size among the satellites of the solar system, the moon is larger and more massive in comparison with the earth than is any other satellite with respect to its primary. The earth-moon system has more nearly the characteristic of a double planet.

Possibly the first heavenly body that was of interest to the early astronomers was our nearest neighbor, the moon. Many things have been told about this neighboring spheroid that are myth alone, but there have been many factual things discovered about it, too.

The thing that comes to mind first is just what is the surface of the moon like? Of course, it is not "green cheese," but in reality it is composed of rocky surfaces such as are not known in size and grandeur on the earth. Most of the peaks on the moon are higher and the valleys deeper than those on earth. This little neighbor that circles our earth once a month is barren and waste. It has no evidence of water; no atmosphere; and no vegetation. It makes Death Valley seem like a lush wonderland in comparison.

Above, in Figure 1, is a photograph of some of the Lunar Landscape. Notice that, by the shadows, we can tell that the peaks and sides of these craters are very high since the photograph covers quite a considerable area. This particular photograph shows the crater of Copernicus, and is a Lick Observatory Photograph. The shadows in the left of the photograph give us the best definition since they are in the terminato (sunset line) and show more detail.

It should be noticed that most of the surface of the moon is studded with mountains, craters, and seas. Before talking about these features, let us first give some proof of a statement that was made previously — an atmosphere does not exist on the moon.

The ability of a heavenly body to retain an atmosphere depends solely on the velocity of escape from its surface. This velocity is the initial speed that an object must have in order to overcome the force of gravity of the body. Our own earth has a velocity of escape of about 7 miles per second, while that of the moon is only about 1.5 miles per second.

Thus, the velocity of escape on the moon is not enough to hold the molecules to it. The molecules of gas that compose an atmosphere have a velocity that exceeds the escape velocity, and the moon has not the power to hold them.

This also holds true for the molecules of water vapor; thus our nearest neighbor has no water present on its surface. Without this medium being present, there is no reason to believe that there is vegetation on the planet.

Thus we have the idea that the moon is a desolate sphere that is covered with hill and dale and sea —all of which are rock. But just how was this friend of ours formed, and what caused the craters that are so profuse on its surface?

At the present time, we have to admit that the origin of the earth remains somewhat of a mystery. Some say that it was formed from the sun, or from a second star associated with the sun. Others say that it was formed from a cloud of rarefied gas that surrounded the sun. Yet, we still do not know exactly how the earth was formed. Our knowledge of the moon takes on a similar light. There is no doubt that the moon was once very hot, because, like the earth and other large solid bodies in the solar system, it is more or less spherical; and unless it had once been molten, it could not possibly have taken on this form. However, the moon has since lost most of its internal heat. The earth has solidified to a great extent, but the moon has cooled down even more, simply because it is smaller.

In 1796, the French mathematician Laplace decided upon what was to become known as the Nebular Hypothesis. This stated that at one time the sun was surrounded by a vast cloud of tenuous gas, which contracted and split up into rings. Each ring finally condensed into a gaseous planet. The earth then contracted towards its own center of gravity and threw off a ring of its own, which condensed into the moon.

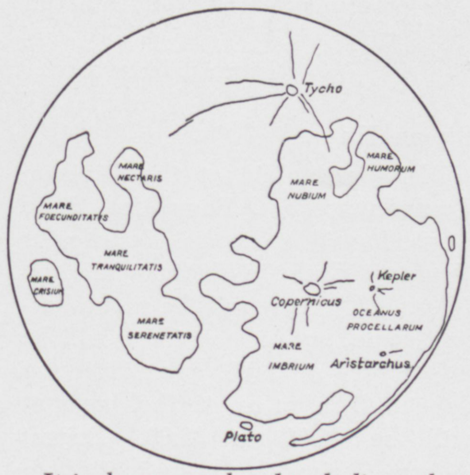
This theory, however, could not stand the test of time. Mathematics has shown that such a gas cloud would not form definite rings, and in any case such material in these rings would never condense into a definite mass.

In the 19th Century, G. H. Darwin came forth with his earth-moon theory. Starting with the earth and moon as being one, he said that the moon was thrown off as a compact fluid mass. This happened when the resonance of the sun tides and the vibrations of the earth's period reached an unstable equilibrium and the planet became pear shaped, then dumbbell shaped, and finally the moon, one of the dumbbells, broke off.

If we take a glance at the eastern coastline of the Americas and the western coastline of Europe and Africa, we see that with a little allowance made for washing by the sea, the two coastlines fit remarkably well together. Could, then, the Atlantic Ocean be the birthplace of the moon?

When one looks at the moon, the thing that seems to be of most interest is the crater effect. There have been many theories as to how these craters were formed. We shall list and discuss three of them here.

The first is the Volcanic Origin Theory. Since the surface is so obviously volcanic, it has been attempted to regard the craters as nothing more than extinct volcanoes. The English astronomers Nasmyth and Carpenter brought forth the theory that the central volcano erupted and showered material outward that built up the sides of the craters. As the volcano was dying out, it had only enough energy to lift material out of the vent, thus the central peaks were built up (see Figure 1). Craters without central peaks were explained by saying that the volcanic explosions ceased rapidly.



It is, however, hard to believe that a circular wall almost a hundred miles in diameter could be formed in such a haphazard fashion, and in any case, the inner slopes are far too gentle for such a formation. Also, the central peaks are always much more shallow than the edges, which does not hold up under the theory. The theory explained the rays (discussed later) as being lava that oozed out of cracks, but it has since been found that the rays are surface deposits.

Next in line is the Impact Origin Theory forwarded by Gruithuisen in 1824. It attributes the craters to being formed by meteoric bombardment. It was true that a meteor would cause such a crater, even if it hit at an angle, since it would explode like an artillery shell upon impact. The central peaks were written off as the rebounding of surface after the impact.

The fatal objection to this theory comes in the fact that the craters are not random in distribution. When one crater breaks into another, it is always the larger that is damaged; and although it is true that the larger meteors would in general have fallen first, there would be at least a few exceptions, but actually there are none.

The final theory to get attention was the Tidal Origin Theory of Boneff. He states that when the moon's crust had just solidified and the moon was much closer to the earth than it is now, the hot interior was much more affected by the earth's tidal pull and so with each revolution the molten lava surged upwards, breaking through weak points in the crust, and the craters were formed by the pump action. As the moon receded and its spin slowed down, the effects lessened and only small craters could be formed, and finally the crust became too solid and the action ceased altogether.

This theory may be torn apart in many ways. First, the central mountains cannot possibly be accounted for; next, the hilltop and wall craters are unaccounted for; and finally, the lunar landscape is far too hard and sharp to have been formed by this means. Thus this theory is disregarded.

It seems that parts of all of these theories are feasible and it also seems likely that these and other things took place on the moon. While some of the craters are volcanic, it is not at all impossible that some others could be of meteoric origin.

The moon rotates on its axis in the same period in which it revolves around the earth, namely, the sidereal month of $27\frac{1}{3}$ days. In consequence of the equality of the two periods the moon presents about the

(*Continued on page* 36)

Fraternity

Lambda Chi Alpha

Now that the summer of 1960 has come and gone, it is that time of year—autumn at Rose. Autumn time means study time and it also means Homecoming. Steve Ban is really building up steam on the Theta Kappa display. We all give Steve our grateful thanks for a "real movin'" display. The Brothers hope that this year's is a trophy winner.

Members Checkley, Dekker Michael, Ireland, Pike, Andel, Hrezo, Terry, Blahut and Randolph are representing Lambda Chi on the varsity football team this season. The Fly Boys, coached by "Able Joe" Andel, won their first and third I-F football matches. Sigma Nu was the trouble maker who downed Joe's boys. We can only hope that we end the season as well.

Jerry Hahn, Andy Hrezo, Don Dekker, and Bob Checkley attended the fraternity's General Assembly, August 21-24. Delegates from every chapter met in Cincinnati to discuss and make amendments. DLD's eyes lit up when he mentioned the banquet and dance the last two days of the convention. Bob, Andy, and Jerry also seemed to have enjoyed themselves.

Lambda Chi Alpha is proud to announce the pledging of Al Story, a junior from Danville. Al and sophomore Dan Little, a pledge of last semester, make up our fall pledge class.

Last summer was an overly active one for the lovers of 912 South Sixth. Bill Young married Miss Daryl Pifer of Danville last August 27, while Ron Klinect was becoming engaged to Miss Lorey Tieber from Cleveland. Brother Warren Griffith pinned Miss Deborah Smith, Bill Fenoglio lost his badge to Miss Becky Williams, Ed Blahut gave up to Miss Bonnie Vanata, and George Newman pinned Miss Patsy Pershing of Atlanta, Georgia—quite a drive for a Saturday night date! It has been rumored that Steve Ban has romantic entanglements in some city north-west of Chicago. We'll have to wait for more definite confirmation before we really put him on the spot.

Dennis Karwatka

Sigma Nu

Plans were laid at the Division Conference at DePauw for State Day. It will be at the Westchester Country Club in Indianapolis on March 11. There will be no basketball game, but instead there will be a banquet at 7:00, preceding the dance. The price of the banquet will be $5.00 to $6.00. Regent George Evans has been invited to speak at the banquet, so besides enjoying a wonderful dinner in the company of our Brothers in Sigma Nu, we should hear a very great Sigma Nu. We would like to invite all alumni who can possibly come to do so. This would be a good time to get together, besides the one time a year at Homecoming. The dance will be from 9:00 to 12:00. Brent Lower is on the committee in charge of the dance and banquet.

Brother Dick Fletcher, Executive Secretary, will be at Rose November 15 for a luncheon with all the brothers. Brother Fletcher will also speak and show slides on "The History of Sigma Nu." This event is being looked to with anticipation, for Brother Fletcher is very dynamic and inspiring in his role as the executive arm of the fraternity.

In the way of pinnings and engagements, we have had our share. Jim Kvasnica pinned Miss Sherrin Staley, a junior at Indiana State, Bill Yochum is now engaged to Miss Sue Jones, also from Indiana State, and Gilbert Robinson pinned Miss Sally Adams, a freshman from Indiana State.

The consensus is that the brothers enjoyed visiting with all the alumni who came back at Homecoming. We heard plenty of stories about "the good old days" and had a few hands of cards. We also would like to show our appreciation for the donations left.

After seeing the bonfire I think congratulations to the freshman class are in order, for that was about the hottest bonfire I've seen; however, I think that the freshmen should thank the faculty and the alumni, who had a great deal to do with the success of the bonfire.

Bob Carter

Theta Xi

Six more Theta Xi's, momentarily blinded by passion, have joined the beleaguered ranks of the pinned. The following presentations have been made: John Henke to Miss Dorothy Helming; Ron Andis to Miss Linda Sweeney; Dave Reese to Miss Nancy Elliot; Ralph Wardle to Miss Joanne Nero; Jim McClure to Miss Martha Singleton; and Dan

Notes

Pool to Miss Juledine Scherer.

On Saturday, November 12, Kappa Chapter will host Theta Chapter of Purdue University in an inter-fraternity touch football game. The Theta's, who have never played IF football, will be at a decided disadvantage. A trophy will be awarded to the winner—loser buys the casts.

As a three-year veteran of writing fraternity notes, I am patricularly aware of the stereotyped form which has previously bound this column. Last month's TX notes, which deviated somewhat from the standard, aroused a certain amount of comment. (Mostly derogatory.) It has since occurred to me that I am in the advantageous position (at least 'til the prexy cuts me down) of being able to attack, in a quasi-editorial manner, institutions that are above censure.

In this vein, I would like to offer a few comments about that hallowed objet d'art, the Rose Polytechnic Institute Seal. I would admire to see it changed. As a start I believe it would be prudent to abolish the arm and hammer, since the symbolism invariably reminds one of baking soda, baking soda reminds one of upset stomachs, and upset stomachs remind one of the morning after Homecoming. I suggest that the symbol be replaced with a more contemporary item, such as a computer.

I further suggest that the motto, "Labor et Scientia", be inscribed in Greek, not Latin, since Greek is the language in which most of our textbooks seem to be written. I also advise that the three gears be replaced with portraits of Shadrach, Meshach, and Abednego, in observance of the fact that most of us, upon matriculating to R.P.I., have found ourselves, in a scholastic viewpoint, out of the frying pan and into the fire.

As for the rest of the seal, it is sufficient. I can see no way to improve upon it (principally because I am nearing the minimum word requirement).

The foregoing commentary was not motivated by malice, but was merely written to please the editors, who insisted that TX have something in the November issue of Technic. I invite you all to write the Technic, vehemently criticizing this blatant editorialization in the Feature Department.

Bob McCardle

Alpha Tau Omega

At the Honor's Convocation held October 6 several Taus received honors. Brothers Joe Snyder and Dale Oexmann were tapped for Tau Beta Pi. Congratulations men and keep up the good work. The new Blue Key pledges included Brothers Dean Powell, Jim Godwin, T. C. Copeland, Joe Snyder, and Dale Oexmann. Also Brother Jon Stiles received Junior Class Honors; Brothers John Walden, Joe Snyder and Dale Oxemann received Sophomore Class Honors, and Brother Larry Schaffer received Class Honors during his Freshman year. Other Taus active in school organizations this year include Brother Andy Breece who was elected President of the Camera Club. Joe Snyder was elected Vice-President of the Student Council and Al Jannasch is the Secretary-Treasurer for the Class of '62.

Socially, the Taus at Gamma Gamma held a very successful hayride Saturday night, September 24, and the AOPi's were persuaded to lend their valuable assistance to the building of the homecoming display the week before homecoming.

"Cutter" Washburn has been elected new Pledge Trainer to replace Brother Bob Stark who is now attending Indiana University. We are happy to announce that Brent Robertson was pledged to Alpha Tau Omega Tuesday night, September 27. Brent is a Junior CE and hails from Cory, Indiana.

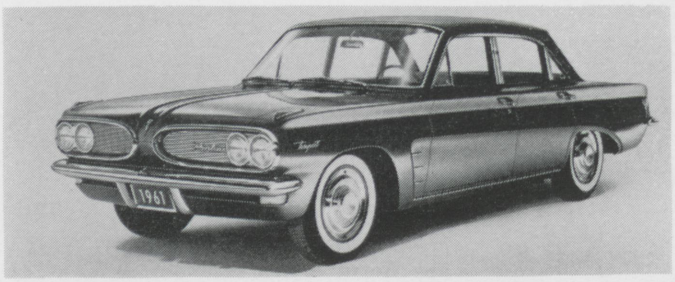
The "Terrible Tau" football squad got off to a good start with a 6 to 0 victory over Sigma Nu as we lost the services of Center Dave Trueb for the rest of the season when he left the game with a broken wrist. The following week Theta Xi evened up our record, ATO losing in a hard fought battle by the some of 12 to 9. The injury riddled Tau squad lost their next game, 20 to 6, to Lambda Chi Alpha as Brother Bill Volkers left the game with a broken arm.

During the month of October Brother John Modesitt presented his Badge of Honor to Miss Diana Gardner. Brother Dean Powell took the big step as he married Miss Janet Schell Friday night, October 14. Congratulations to both Dean and Jon.

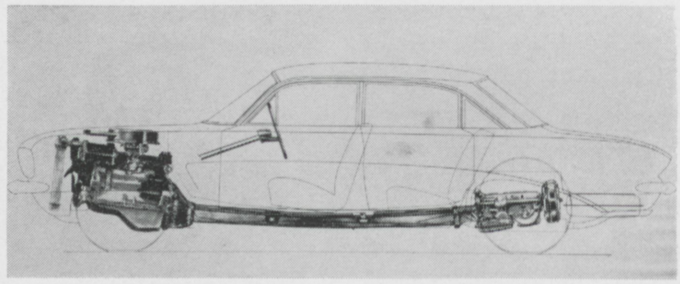
Scott Herrin

Innovation from Detroit

By Don Barnett, Senior, m.e.



Pontiac Tempest



Engine Transmission Relationship

The Pontiac's Tempest is the first American car to achieve the front engine-rear transmission arrangement so important to a perfectly balanced automobile. It is the first car in the world to employ an automatic transmission using this arrangement. The Tempest has inherited quality performance by adopting the regular Pontiac V-8 power plant (minus the left hand bank), resulting in four-cylinder reliability. Following Pontiac tradition, Tempest design features wide track wheels, independent four-wheel suspension and unit body construction. These inherent characteristics, brand the Tempest as a totally new design concept.

Standard power for the Tempest will be the 195 cubic inch, four-cylinder, regular fuel engine promising economical operation and top flight performance. This is the first four-cylinder engine to appear on a General Motors car since 1928. Pontiac produces the four-cylinders on special molds which enables the foundry to cast the right bank of the big Pontiac 389 cubic inch V-8 without the left bank. The engine is machined on the same production line used for the V-8, using the identical tools to drill the four-cylinder engine as are used to drill the right bank of the V-8. The fours and V-8's alternate on the production line and are handled automatically in any sequence. The four-cylinder engine displacing 195 cubic inches, uses the same cylinder heads, valves, pistons, connecting rods and exhaust manifold as the V-8. Only the crank and camshafts, intake manifold, water pump, fan and carburetor are different.

As can be seen from the chart, a premium fuel engine with a four-barrel carburetor will be offered in addition to the regular fuel, one-barrel carburetor engine. Compression ratios are 10.25 to 1 for premium fuel and 8.6 to 1 for regular fuel engines. During its development the Tempest engine tallied approximately one and one-quarter million miles on highway and dynamometer tests.

Design of the Tempest engine affords the best possible use of engine compartment space and provides easy serviceability. The exhaust

TEMPEST ENGINE & TRANSMISSION COMBINATIONS AVAILABLE

Valve In-Head, 194.5 Cubic Inch

4 cyl. In-Line Engine, 4-1/6″ Bore, 3-¾″ Stroke

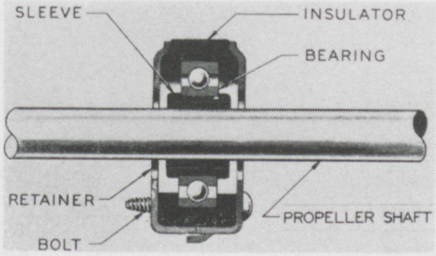
Std. or Optional	Transmission	Comp. Ratio	Carb.	BHP / Torque	Advertised Max.
Standard	Synchromesh	8.6:1	1 Bbl.	110 @ 3800	190 @ 2000
Optional	Automatic	8.6:1	1 Bbl.	130 @ 4400	195 @ 2200
Optional	Synchromesh	10.25:1	1 Bbl.	120 @ 3800	202 @ 2000
Optional	Automatic	10.25:1	1 Bbl.	140 @ 4400	207 @ 2200
Optional	Synchromesh or Automatic	10.25:1	4 Bbl.	155 @ 4800	215 @ 2800

215 Cubic Inch V-8 Regular Fuel Engine

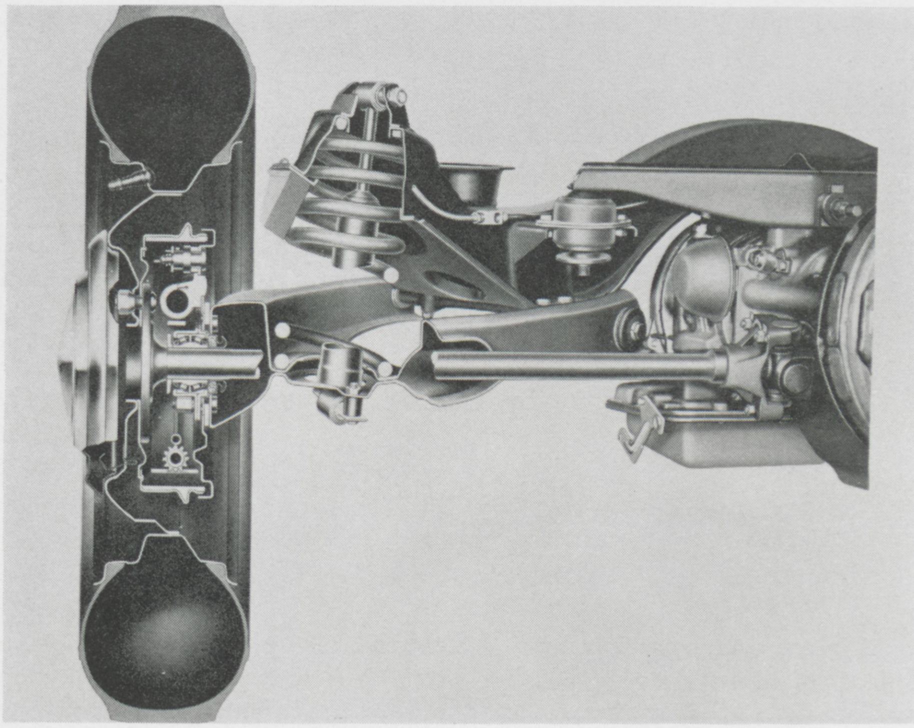
Bore 3.50″, Stroke 2.80″

Optional	Synchromesh or Automatic	8.8:1	2 Bbl.	155 @ 4600	220 @ 2400

Axle Ratios Available: Standard, 3.55:1; Economy, 3.31:1; Performance 3.73:1



Driveshaft noadal support


Transaxle, independent suspension diagram

pipe and manifold are on the right side of the engine, while the intake manifold, carburetor, fuel pump, 12-volt generator and starting motor are on the left side in the space normally used by the left bank. The cast iron cylinder block has three intermediate bearing bulkheads and five main bearings of three-inch diameter for the crankshaft.

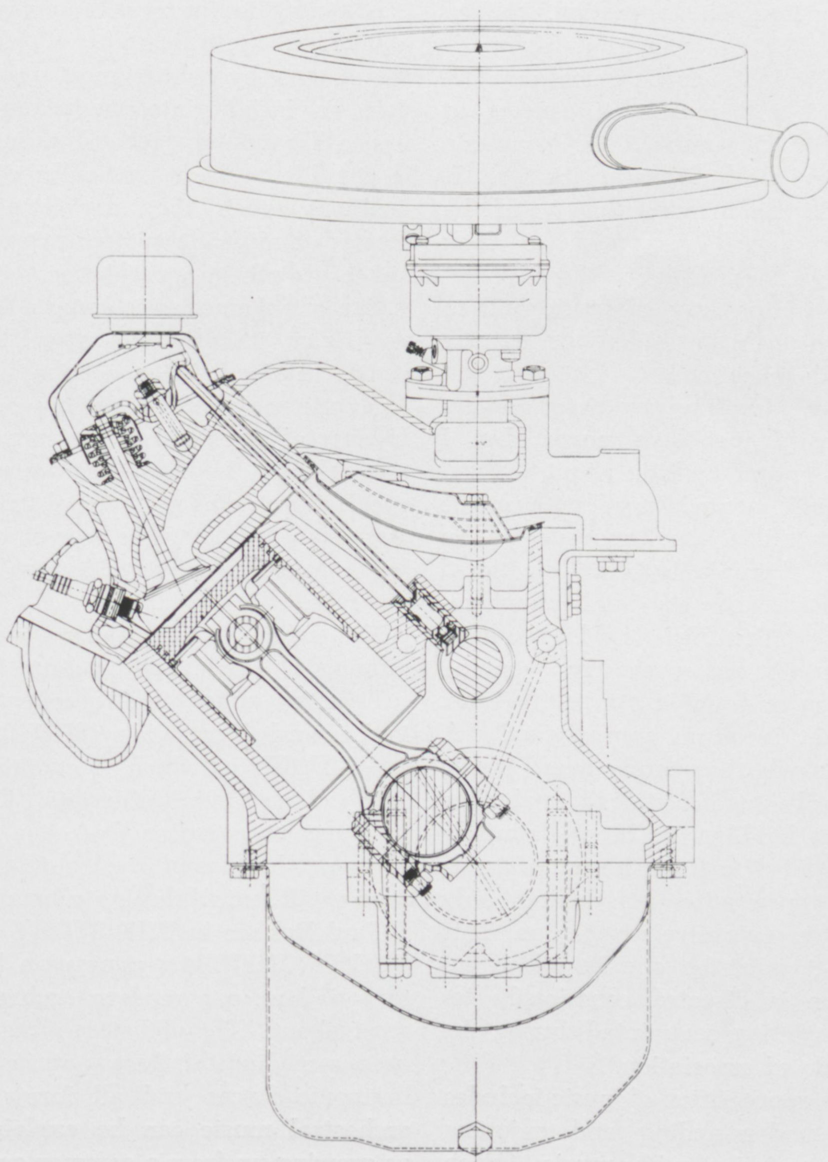
Unusual smoothness found in the new L-4 engine is achieved by balancing the pearlitic malleable iron crankshaft in assembly to .50-inch ounce with the crank rotating, and by the use of a harmonic balancer and four integrally cast counterweights that minimize crankshaft deflection.

The optional aluminum V-8 is of 215 cubic inch capacity and has an 8.8 to one compression ratio. It uses regular fuel through a dual-throat carburetor, and is reportedly in the 150-165 horsepower bracket. A latecomer on the V-8 scene, Pontiac will have to use the straight Buick version and won't be able to fit them in large quantities.

One of the most spectacular items in design is the drive shaft, a long, one-piece torsion bar bolted to the flywheel at the front and the transmission input shaft at the other. The shaft is a 5/8-inch diameter nickel-chrome-moly rod, shot-peened to reduce surface stress and coated to prevent corrosion. The engineering department wanted to keep the details of their new drive shaft quiet during its development. Sample parts were ordered in pairs and referred to as torsion bars, which gave rise to reports that Pontiac had torsion bar suspension under its compact.

The shaft is stressed so that it

(*Continued on page* 38)


Cross Section of Tempest Power Plant

Library Notes

By Carson Bennett and Winifred Kitaoka

A great symphony is a man-made Mississippi down which we irrisistibly flow from the instant of our leave-taking to a long foreseen destination.

Aaron Copland

The Indianapolis Symphony Orchestra will present a concert at Rose on December 7, 1960, as one of the Fall Convocation Series. It is with this in mind that we of the library were prompted to look through our collection for something in the way of music and to announce recent additions to our record collection.

How often have we heard the remark, "I just love music, but I don't know anything about it."

A real acquaintance with music results in a true appreciation in which there is both an emotional response and an intellectual response. Yes, there is a higher level of reaction to music than tapping rhythm or humming a pretty tune.

What is *music appreciation?* A person who has rarely heard music is hardly qualified to judge whether or not he likes it; he is definitely unqualified to think he understands it. Appreciation can result only after an extensive association. This contact must be one in which attention is directed consciously toward getting acquainted during the periods of association.

The appreciation of music includes both understanding and enjoying the association with music. Each experience with music or related activities makes its contribution toward appreciation whether it be positive or a negative contribution.

Listening to the music composed and brought into being by others is the means by which most people gain an insight into the realm of music. Fortunately, recordings make it possible to hear particular compositions when they are wanted. Recorded music is an indispensable aid to growth in appreciation.

The art of music has come a long way from its primitive stage; but it has retained its connection with the springs of human feeling, with accents of joy and sorrow, tension and release. In this sense we may speak of music as a universal language. Its vocabulary has been shaped by thousands of years of human experience.

We suggest these titles as a beginning to music appreciation:

Recently added to the collection is Lenaord Bernstein's THE JOY OF MUSIC, in which is contained seven of his *Omnibus* scripts. This has been prepared so that even the layman who cannot read a note of music will learn "the joy of music."

Paul Bekker in THE STORY OF THE ORCHESTRA gives us a history of how our modern orchestra came about. The orchestra has only been a medium of the exposition of harmonic forces and all forms of orchestral music can be explained as growing up from a common root: harmony. Yet, these forms are incessantly changing. Mr. Bekker discusses these changes in terms of the periods in music.

If you don't understand the opera, we have the BOOK OF OPERAS by Kehbiel, in which seventeen of the better known operas are discussed.

Frederick Crowest in his book THE STORY OF THE ART OF MUSIC tells us how the art of music has grown around us. He shows the step by step growth of the art in various countries concerned with music's foundation.

Want to be a well tempered listener? Well, we have Deems Taylor's, THE WELL TEMPERED LISTENER.

The Library subscribes to the following magazines:

Audio—the original magazine about high fidelity.

HiFi/Stereo Review.

High Fidelity—the magazine for music listeners.

Saturday Review—devotes a section to new records.

NEW RECORD SHELF

From THE BEST OF CARUSO, a Victor record which brings the great singing of Caruso at his best. A few of the selections that can be heard follows:

Celeste Aide from Aida

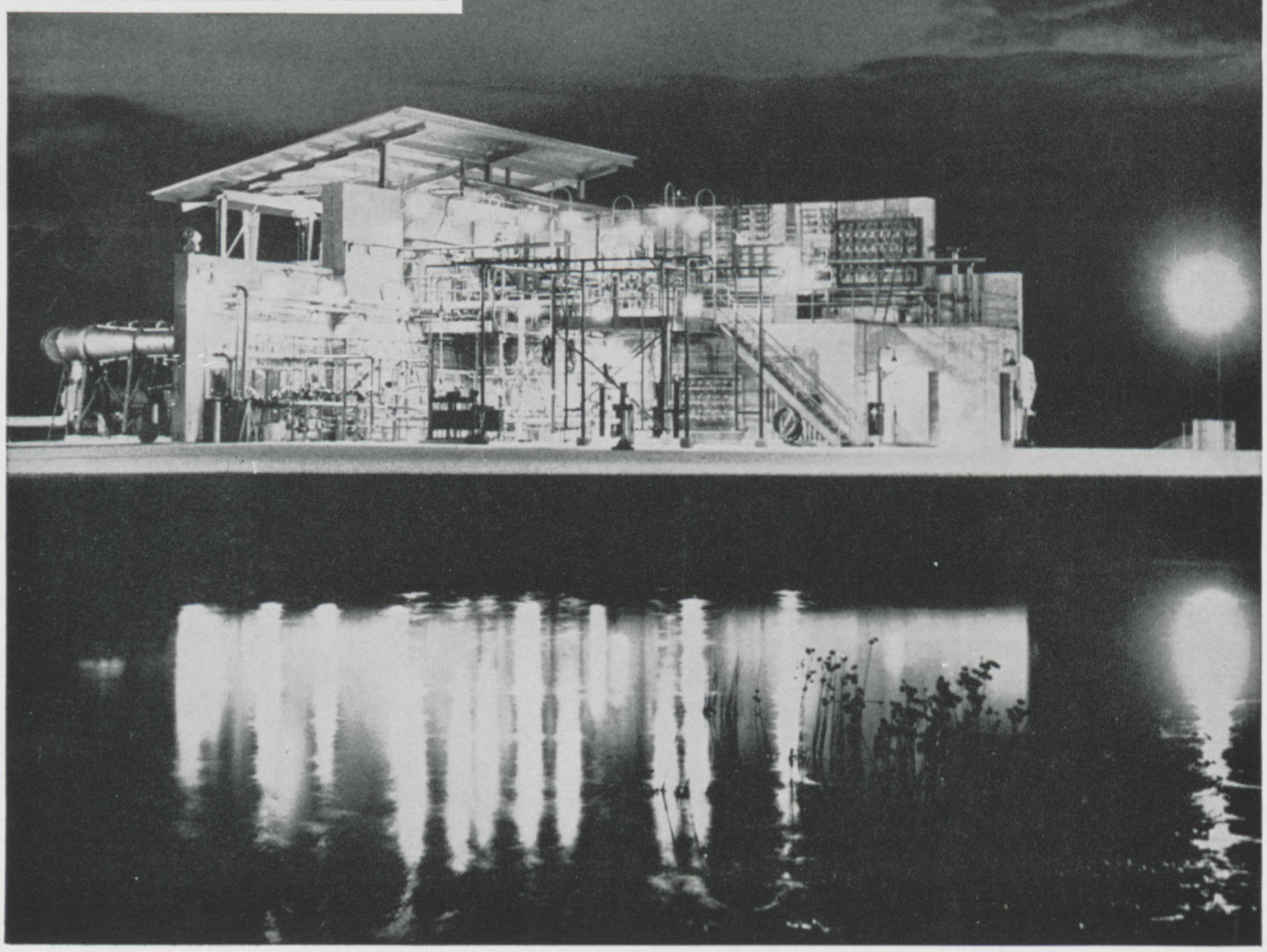
Che Gelida Manina from La Boheme

Recondita Armonia from Tosca

(*Continued on page* 40)

What would YOU do

as an engineer a



Development testing of liquid hydrogen-fueled rockets is carried out in specially built test stands like this at Pratt & Whitney Aircraft's Florida Research and Development Center. Every phase of an experimental engine test may be controlled by engineers from a remote blockhouse (inset), with closed-circuit television providing a means for visual observation.

Pratt & Whitney Aircraft?

Regardless of your specialty, you would work in a favorable engineering atmosphere.

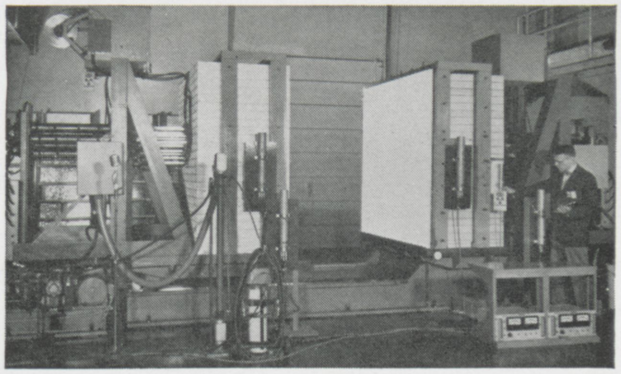
Back in 1925, when Pratt & Whitney Aircraft was designing and developing the first of its family of history-making powerplants, an attitude was born—a recognition that *engineering excellence* was the key to success.

That attitude, that recognition of the prime importance of technical superiority is still predominant at P&WA today.

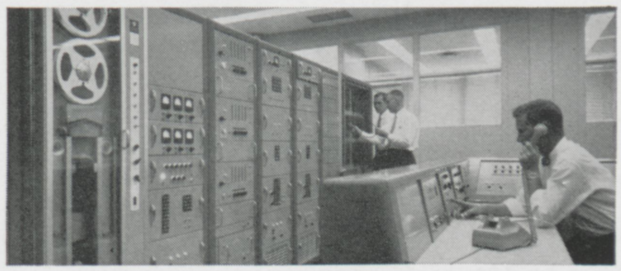
The field, of course, is broader now, the challenge greater. No longer are the company's requirements confined to graduates with degrees in mechanical and aeronautical engineering. Pratt & Whitney Aircraft today is concerned with the development of all forms of flight propulsion systems for the aerospace medium—air breathing, rocket, nuclear and other advanced types. Some are entirely new in concept. To carry out analytical, design, experimental or materials engineering assignments, men with degrees in mechanical, aeronautical, electrical, chemical and nuclear engineering are needed, along with those holding degrees in physics, chemistry and metallurgy.

Specifically, what would *you* do?—*your own engineering talent* provides the best answer. And Pratt & Whitney Aircraft provides the atmosphere in which that talent can flourish.

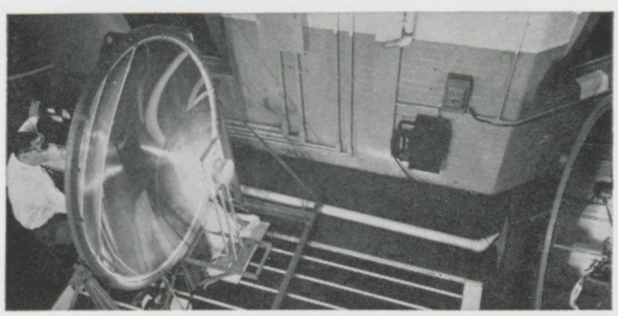
For further information regarding an engineering career at Pratt & Whitney Aircraft, consult your college placement officer or write to Mr. R. P. Azinger, Engineering Department, Pratt & Whitney Aircraft, East Hartford 8, Connecticut.



At P&WA's Connecticut Aircraft Nuclear Engine Laboratory (CANEL) many technical talents are focused on the development of nuclear propulsion systems for future air and space vehicles. With this live mock-up of a reactor, nuclear scientists and engineers can determine critical mass, material reactivity coefficients, control effectiveness and other reactor parameters.



Representative of electronic aids functioning for P&WA engineers is this on-site data recording center which can provide automatically recorded and computed data simultaneously with the testing of an engine. This equipment is capable of recording 1,200 different values per second.



Studies of solar energy collection and liquid and vapor power cycles typify P&WA's research in advanced space auxiliary power systems. Analytical and Experimental Engineers work together in such programs to establish and test basic concepts.

PRATT & WHITNEY AIRCRAFT

Division of United Aircraft Corporation

CONNECTICUT OPERATIONS — East Hartford

FLORIDA RESEARCH AND DEVELOPMENT CENTER — Palm Beach County, Florida

MISS TECHNIC of NOVEMBER

The Miss gracing the pages of this month's TECHNIC is Donna Schumpert, a 20-year old AOPi at Indiana State. Donna is a 5'6", 120 pound addition to the attractions of the I.S.T.C. campus. She is a junior, from our own city of Terre Haute, majoring in elementary education and was recently a candidate for State's Homecoming Queen. In her spare time, she enjoys such things as dancing, jazz, and other interests.

Aside from being able to tell you that she has brown hair and greenish-blue eyes,—well, you'll have to figure the rest out on your slide rule. (Or ask her yourself.)

This month's Miss Technic, Donna Schumpert, graciously demonstrates "How to Get a Flat Tire Changed by a Gallant Passing Motorist."

Research & Development

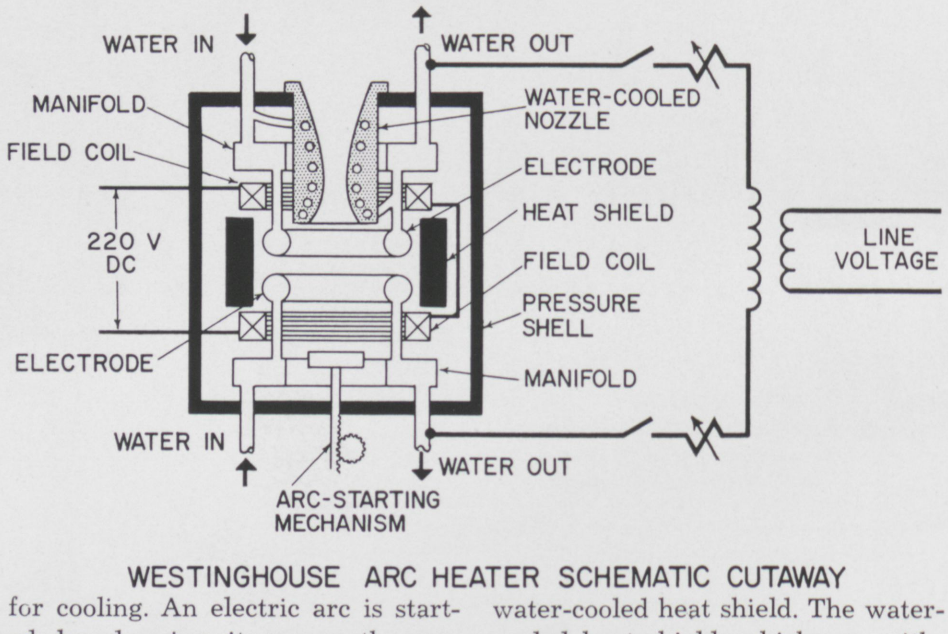
By Don Bonness, junior, e.e.

HIGH ENERGY ELECTRIC ARC HEATER

A high energy electric arc heater with the potential capability to supply a stream of gas at 20,000 degrees F. has been devised by the Westinghouse Electric Corporation. With the ability to operate for sustained periods of time, the heater has an extremely low level of contamination. Immediate application in wind tunnels as a synthesizer of extreme conditions met by missiles and other space craft has provided an extremely useful tool to the air craft industry. Also this machine shows promise as a chemical synthesizer and as a furnace for processing metals with ultra-high melting points.

Success in the latter two applications depends upon the very low contamination level credited to the machine. Comparable machines produce contamination levels of as much as 10% while this new heater has guaranteed a maximum contamination 0.2%.

A key to the performance of the new machine lies in the design of the two electrodes which are terminals for the arc. Each of these electrodes consists of a hollow donut-shaped ring placed horizontally, one directly above the other, with water being pumped through these rings for cooling. An electric arc is started by drawing it across the gap between the two rings; and then by means of a magnetic field from direct current coils, the arc is rotated around the gap at a high rate of speed. This rotation combined with water-cooling prevents the electrodes from heating past the point beyond the structural endurance of the electrode material.



WESTINGHOUSE ARC HEATER SCHEMATIC CUTAWAY

Repeated tests of this unit have left the electrodes undamaged indicating a lack of contamination from this source. Air, nitrogen, or some other such working fluid enters the arc through openings near a copper water-cooled heat shield. The water-cooled heat shield, which can withstand arc temperatures well above 10,000 degrees F. without eroding, protects the walls of the arc chamber. After leaving the arc, the fluid then passes through a water-cooled nozzle.

This arc heater is now available to the aircraft industry while advancement in arc-heater technology should make equipment available to metal, chemical, and petroleum industries in one or two years.

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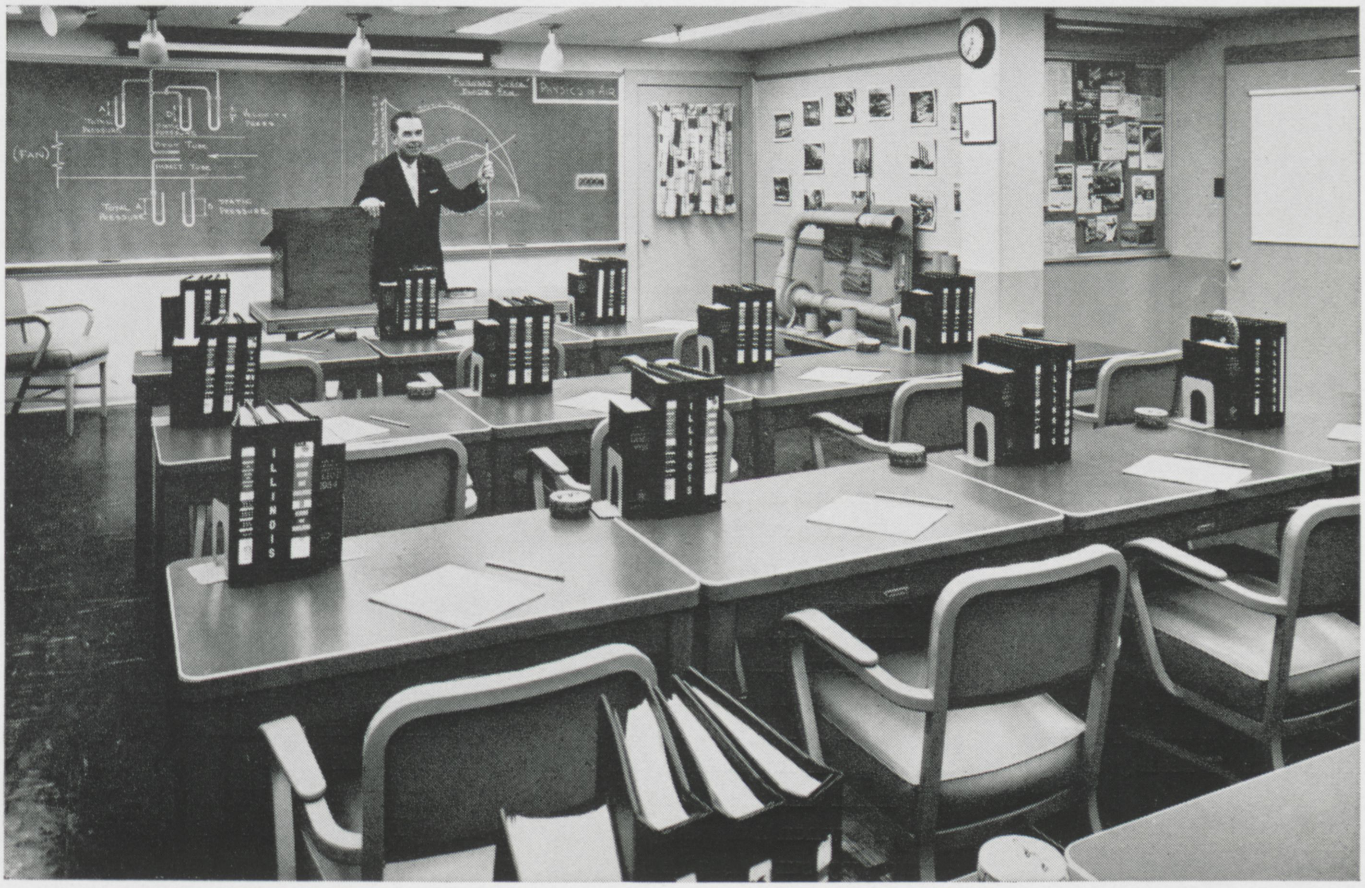

Engineers who qualify to fill these chairs...

are on the road to filling responsible jobs with a growing company in a growing industry

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VIEWS POWER

The terms space travel, magneto-hydrodynamics, fuel cells, atomic power, ballistic missles, high-speed computers, electronic subminiaturization characterize a few of the great technological advances we are hearing about today. By comparison my subject of electric power appears prosaic. But in reality is it? Ab-so-lute-ly not !

Where would technological progress be today without electric power? Water used to be the prime necessity for life; yet today millions of Americans would be without this necessity if electric service were interrupted. Similarly, technological progress itself would stop or be retarded considerably without electric power. We engineers associated directly or indirectly with utilities can be proud of the record of our service and acheivement.

Where does power stand in its use of the engineer now with electronics such an important factor? I feel confident in estimating that an often overlooked fact by students such as yourselves is that somewhere between 50 and 75 percent of the graduate Electrical Engineers in this country today earn their livelyhood at 60 cycles per second. This despite the tremendous notoriety being given to the requirements of the aircraft, communications and other electronics industries. Perhaps that this is unrealized is the result of the failure of the power industries to remove their light from under the bushel.

Now I would be among the first to agree that there is excitement to be found in the electronics field. I have stood inside the closed doors of a tracking radar van on a missle launching site and felt that excitement of launch creep through my feet from the floor at missle takeoff time and known the satisfaction of the knowledge that my efforts were to be an important part of the successful mission. Believe me, however, when I assure you that this in no way surpasses the thrill inherent in the satisfaction of being a part of the restoration of service to the home of an eight year old polio patient before the emergency resources to operate the iron lung upon which her life depends are exhausted. True, this is not a daily occurrence, and with God's help to our technical ability, I pray it is only a very rare crisis; every day though holds a responsibility equally as vital to the health, safety, and welfare of the community for the engineer in the public utility.

Permit me, if you will, to take a couple of moments and become somewhat philosophical. I should like to pose the question, "What is it we are really seeking out of life and our job?"

Certainly one thing is a day's pay for a day's work, and truthfully we won't discourage a rather sizeable paycheck at that. But let's be practical, each of you is studying to become an engineer and the chances are none of you, or your future families, will starve to death or even struggle too greatly to have a pretty comfortable standard of living. Naturally, some of you will earn much more in your lifetime than others of your classmates, but experience and statistics will bear out that the differences will depend far less on your choice of an industry than it will on your individual ability coupled with the right breaks at the right time. Then since this isn't the real goal we seek it must be something deeper.

I have given this subject a great deal of thought and, while I can't force you to agree with me, I offer to you my summation of the conclutions I have come to. We seek a sense of being needed (or important, if you want to be blunt). We want a feeling of accomplishment and a sense that that accomplishment contributes to the good of mankind much as a doctor feels he contributes to his fellowman. We must find a satisfaction at the end of a day's work in that our efforts have ended on the credit side of life's ledger, for without this feeling your family won't be able to live with you when you get home at night. This may seem rather far-fetched to you now, but the day is just around the corner when you will face it as altogether too true a reality.

The needs I have just outlined can be satisfied in many industries but I can assure you that none can surpass the electric power industry in fulfilling these necessities.

Well the question should logically arise at this point, "Just what is an Electrical Power Engineer and where can he be found?" Obviously the power engineer can be found in the electrical utility. Likewise he can be found in almost any type of

OF A ENGINEER

by Robert L. Royer
Class of '39
Asst. Supt. Electrical Distribution Dept.
Louisville Gas & Electric Co.

manufacturing industry you can name whether they manufacture products for the utility, consumer goods, defense products, or materials for use by other industries. Also a large number can be found in service industries such as consulting offices, construction firms, all types of utilities, government agencies and the transportation industry.

Well then what functions does he perform in these industries? His duties are similar to those of an engineer in almost any field. He is the key figure in operations, design, development, rsearch, supervision and consulting. In many types of products lines he is the most important member of the sales staff. Perhaps most significantly, he varies from engineers in many other industries, in that in many organizations in which he might be employed he is the management, for his knowledge, training, and ability are a most necessary component in the qualities needed for guiding an industry specializing in technical services.

Now you ask me, This is all well and good, but how does his pay stack up with the fabulous offers of some other fields" I'm not going to attempt to deceive you on this point, but I should like to call upon for a reference the report of the Engineer's Joint Council entitled Professional Income of Engineers 1958". By analyzing these tables and charts we find that it is true that his starting salary is slightly lower on the average—not much but slightly—than in some other fields, primarily those involving a higher degree of risk, notably those holding defense contracts. This glitter of gold looms large to the new graduate for him generally pay is synonymous with dollars. But looking further into these same charts, we find that if anything maybe his raises come along with a little more regularity and significance than others and perhaps he begins to start narrowing the gap.

Within his first ten years, dollars as a measure of pay will begin to take on a lessening importance. Most of you will be married by that time, be buying a house, raising a family, and incurring many types of debts and oblgations. Security will begin to take on a new and deeper meaning to you. Have you ever watched a man over 30 or 35 try to find a job at a supervisory level and noted his frustrations. Probably he wasn't fired because of any inadequacy in his qualifications; his employer simply was forced to lay him off along with hundreds of other engineers because a contract was cancelled and there just was no work available. Here is this man—not starving, nutritionly speaking—finding at every turn that the companies where he is applying are looking for younger men for these types of positions so that they can train them in their own manner. Now security has meaning.

To the married man at this point, he likewise is beginning to more fully appreciate his fringe benefits. The medical insurance, life nsurance, annuity programs; these are now real benefits upon which he can place his confidence of protection against financial disaster.

Sometime later in his career, perhaps between the 10th and 20th year we se a trend developing which begins to place the power engineer in an enviable position. This I think will be especially true of you men who are graduating in the next five years.

Historically, characteristically, and from a necessity created by the nature of this type of business, a higher percentage are becoming the managers and the executives in the power indsutry than in many industries with large design and research staffs. Let's face up to the facts. Today some of the most inviting opportuinties for future advancement are to be found in the power and utility fields. Don't misunderstand me, this is no guarantee; many won't make the grade. There will be a combination of reasons for this. Some won't measure up to the responsibilities, they just weren't cut cut for management. For some, the timing at which opoprtunties will open will be wrong for the particular man. For some, maybe the lack of foresight in training a replacement for himself will make the man indispensable in a lesser important job. I simply contend, that it is my belief, and the statistics seem to be on my side, a greater percentage will make it.

To tie together my portion of this evening's program, and to site some specific examples of an engineer's responsibility in the power industry,

(*Continued on page* 42)

CHEMICAL EQUILIBRIA

(*Continued from page* 17)

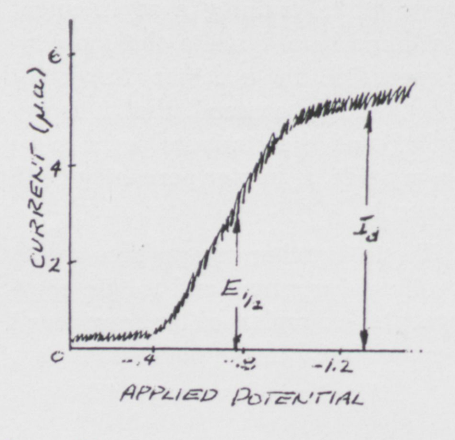
current is flowing in the early part of the polarogram where there is insufficient potential to cause any electrolysis reaction. Since the process is diffusion-controlled (i.e., there is no stirring which means that the only way the species to be reduced can reach the electrode is by diffusion), the maximum current flowing, i_d, is directly proportionale to the concentration of the species being reduced. This is the basis for quantitative analysis by the polarographic method.

The half-wave potential, $E_{1/2}$, is independent of concentration and is the basis of qualitative analysis. Each cation requires a specific voltage for its electrical reduction and experimental determination of this value is the route by which identification of the metal or metals present might be accomplished. The approximate value of the half-wave potential can be obtained by inspection of the polarogram whereas more exact values, often required in fundamental research, are obtained with somewhat greater difficulty. Both the I.B.M. 650 and the Bendix G-15 electronic computers have been used to advantage by the author to obtain reliable $E_{1/2}$ values from experimental data.

The fundamental equation describing a polarographic reduction wave is:

$$(8)\quad E = E_{1/2} + \frac{0.0591}{n} \log \frac{(i_d - i)}{(i)} = a + bx$$

where n is the number of electrons involved in the reduction of the cation and i_d represents the maximum current flow. E and i represent, respectively, the voltage and current at various points on the rising part of the polarogram. It should be obvious that Equation (8) is that of a straight line. From a plot of the log term vs. E (the computer calculates this by method of least-squares in a matter of seconds) one obtains the half-wave potential when $E = E_{1/2}$. This situation exists when it is exactly half of i_d (i.e., when the log term becomes zero). Often six or more E and i values are obtained from a given polarogram for this calculation. $E_{1/2}$ values thus obtained are usually reliable to about 1 millivolt, and with care can be determined with somewhat greater accuracy.



DETERMINATION OF CONSECUTIVE CONSTANTS

*Permissible ligants may be neutral molecules such as NH_3, $NH_2CH_2CH_2NH_2$, pyridine, etc., or negative ions such as chloride, syanide, hydroxide, thiocyanate, etc.

As one adds a complexing ligant* it becomes more difficult to reduce the metal due to complex formation. Thus, complex formation always results in a shift in the half-wave potential, usually toward a more negative potential (reduction more difficult) if the complex is reduced to the free metal. Usually transition metals are most favorable toward chelation than are other metals.

Recently the Nernst Equation (Equation 8 is a modified form of it) and the Ilkovic Equation (which describes the amount of current flowing during the reduction, in terms of concentration, diffusion coefficient and the characteristics of the dropping mercury electrode) were combined in such a manner that experimental data can be used to determine consecutive formation constants for various complexes. The combined equation is stated: where n has the same meaning as in Equation (8), and the subscripts "s" and "c" refer to the simple ion and the complexed ion, respectively. "I" has the same meaning as i_d except that it is for either the simple or complexed ion. Theoretically, these experimental data are related to the desired constants via a power series:

$$(9)\quad F_0(X) = \text{antilog}\left[\left(\frac{n}{0.0591}\right) \times \left([E_{1/2}]_s - [E_{1/2}]_c\right) + \log I_s/I_c\right]$$

Here [X] represents the molarity of the ligand and k_0 has a theoretical value of unity. If the highest complex species involves four ligand molecules or ions, as was the case with the previously mentioned copper-ammonia system, the highest constant obtainable with be k_4 and the plot of $F_0(X)$ vs. [X] will result in a quartic curve.

When k_0 is transposed, and both sides of the equation are divided by [X], the result yields the relationship:

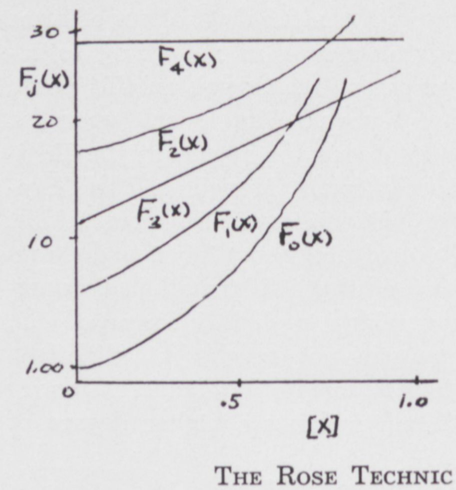
$$(10)\quad F_0(X) = k_0 + k_1[X] + k_2[X]^2 + k_3[X]^3 + \ldots$$

$$(11)\quad \frac{F_0(X) - k_0}{[X]} = k_1 + k_2[X] + k_3[X]^2 + \ldots$$

which is called $F_1(X)$ and which produces a cubic curve in the copper-ammonia system.

By repeating the process, values of all of the stepwise constants may be obtained, using graphical means as shown in Figure 3 or by calculation as the author has done using the I.B.M. 650 computer. In Figure 3, note that the value of the zero intercept for a given $F_j(X)$ curve is

(*Continued on page* 44)



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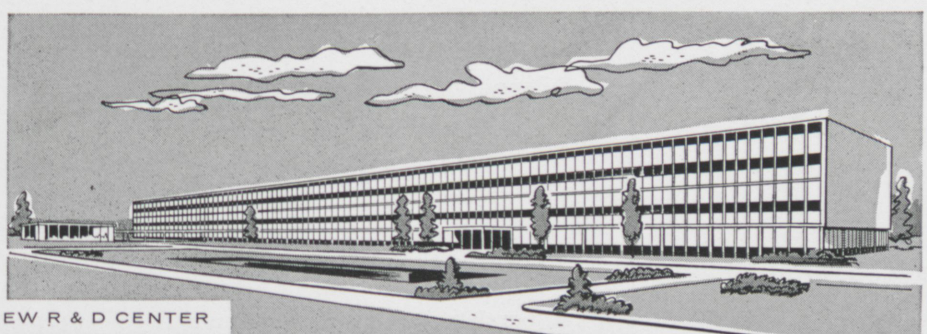

DELCO'S NEW R & D CENTER

Delco Radio Division of General Motors

Kokomo, Indiana

ASTRONOMY

(*Continued from page* 19)

same hemisphere toward the earth at all times. An examination of the surface shows that features near the edge are sometimes in view and sometimes out of sight. Thus, the moon seems to rock slightly; and these oscillations or librations arise mainly from three causes:

(1) The libration in latitude results from the inclination of about 6.5° between the moon's equator and the plane of its orbit.

(2) The libration in longitude is caused by the failure of the moon's rotation and revolution to keep exactly in step throughout the month, although they come out together at the end.

(3) The diurnal libration is a consequence of the earth's rotation.

The character of the moon's surface that we can see has been determined by many means. The surface temperature of the moon varies from more than 100° C when the sun is overhead to —50° C at sunset and is reduced to —150° C at midnight. These values were determined by Pettit and Nicholson at Mount Wilson Observatory, who also observed a drop of 110° C in the temperature in one hour during a lunar eclipse.

The albedo, or reflecting power, of the moon is only 7 percent, in contrast with the value of 40 percent for the earth; this refers to the ratio of the light reflected by the whole illuminated hemisphere of the moon to the light it receives from the sun.

Selenography, the study of the details of the lunar surface, dates from 1610, when Galileo made the first map of the moon as observed with the telescope. He had recognized the lunar mountains and had called the large dark areas "seas," a misnomer that persists in the current nomenclature. The principal features to be described in such lunar maps are the lunar seas, mountains, craters, rays, and rills. Such a map is shown in Figure 2.

The large dark areas that form the face of the "man in the moon," the profile of the "girl in the moon," and other products of the lively imagination are the lunar maria (seas), so called when they were thought to be such. They are also known as plains. These areas appear to be darker than the rest of the surface because they are more nearly smooth than the rest of the surface.

Among the few formations that have any resemblance to terrestrial mountain ranges are the three that form the western border of Mare Imbrium; they are the Apennines, Caucasus, and Alps. All of the mountains have a sharper slope on their seaward side, some of the peaks rising to nearly 20,000 feet above the plain.

The lunar rays are bright streaks 5 or 10 miles wide and up to 1500 miles long, which radiate from points near a few of the craters and pass over mountains and plains.

These phenomena are best seen when the sun is high above them, the rays being a very noticeable feature of the full moon. The most conspicuous and longest ray system radiates from Tycho near the south pole; another shorter system radiates from Copernicus (see Figure 1).

It is obvious that there are many things that we do not know about even our closest celestial neighbors. It also seems that the only way possible to find out exactly what causes these different characteristics on the moon is to go there. With the present development in rocketry and space technology it does not seem that such an exploration is too distant.

QUESTIONS ON THE MOON

(1) What are the three main crater-formation theories, and what are their faults?

(2) What is a Ray? What is the most prominant ray system and what crater does it generate from?

(3) Explain why there is no atmosphere on the moon.

(4) What was the Nebular Hypothesis? Who formed it?

(5) Explain Darwin's earth-moon theory.

NEXT MONTH: PART III—THE SOLAR SYSTEM

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INNOVATION FROM DETROIT

(*Continued from page* 23)

bends or bows downward some five degrees from the engine and upward to the transmission. The shaft, when bent into an arch, no longer obeys the laws of a beam and is not subject to the vibrations of a straight propeller shaft. Automotive engineers have always designed large drive shafts to cope with critical-speed vibrations, not because large tubes were needed to carry engine torque.

Bending the shaft into an arc eliminated critical vibration points, leaving only second-node vibrations to be controlled by two damper bearing blocks fitted inside the torque tube.

Nearly all test miles on the solid drive shaft were run in full-size cars with a large V-8 engine providing the twist. An advantage of the solid drive shaft is that it acts as a torsion bar to absorb engine torque throb. The shaft also acts as a constant-velocity power transfer device, there being no universal joints to shift velocity and disrupt the smooth flow of power.

Success of Tempest's solid drive line depends on the central backbone tube. It is a channel section about six inches deep that has been formed with a slight sag which drops the center about eight inches below the ends. The open side of the nearly six-foot-long channel is closed by a spot-welded steel plate. Bolted between the engine and transaxle assembly, it holds the damper bearings and protects the drive shaft, while keeping engine and transaxle so stiffly aligned that the chassis may be driven without a body. It's this skeleton chassis which makes it possible to assemble Tempests on conventional production lines where the body is "dropped" onto the chassis. Corvair can only be built on "special" assembly lines where suspension and engine are brought up from the bottom to be hung onto the body.

The transaxle includes an automatic or manual transmission between independently-sprung rear wheels. The latter are driven by open axles with universal joints next to the differential carrier. The manual transmission is a standard three-speed synchromesh unit forward of the differential, with which it shares a common lubricant. The box is driven through the front (clutch) gear which has an internal spline mating with the driveshaft. The floor-shift selector rod enters the left side of the case. Standard differential ratio is 3.55 to 1.

Designed in 1957, Tempest's air-cooled automatic (also with 3.55 to 1 axle ratio) is the first torque converter transmission employing the split-torque principle to reduce slippage. In high gear, drive power is split, with 60 percent of engine torque transmitted through the converter and 40 percent passing directly to the rear wheels by mechanical connection. The aluminum-cased three-element (gear case, differential, and torque converter) two-speed unit has an automatic upshift which depends on speed and throttle. Below 25 miles per hour it shifts to low, if the throttle is pushed about halfway down. An upshift is made at 35 to 40 miles per hour with half-throttle loading. For maximum acceleration a full-throttle downshift is possible below 45 miles per hour. A manual downshift, allowable below 50 miles per hour, is for overrun braking or mountain use. The dashmounted shift quadrant lists Reverse, Neutral, Drive and Low. Fluid level, 11 pints, is checked through a plate in the trunk floor.

Inside the Tempest automatic you'd find three hollow shafts connecting the torque converter, at the rear of the differential, with the gear case in front of the differential. The drive shaft is splined into the gear case to drive the smallest of the three concentric shafts, which turns the transmission gears and the torque converter pump. In Low there is no mechanical connection to the rear wheels, all power being multiplied and transmitted to the differential by the torque converter. This is accomplished by the converter's pump-driven turbine, which is rotating the hollow turbine shaft

(*Continued on page* 43)

LIFE OF A FROSH

By Dick Jensen, frosh.

I am a member of the class of '64, a freshman, and I'm proud to say it. Freshmen have a great advantage over upperclassmen. They can look the school over objectively, their memories not having been rotted by time, and appreciate the institution for all it is worth. We are the best freshman class Rose has ever had, so we are told. This makes me very proud until, however, a little investigation reveals that every freshman class had been the best freshman class that Rose had ever had. A simple conclusion can be drawn from this fact. The first freshman class must have consisted of cave men, and the class of '64 must be pretty near perfect.

Coming to college is not just a change in your place of living, but a change in your way of living. In a way, I think we all premised this before coming, and it affected our attitudes toward the approaching change very much. We were all looking forward to the magnificent freedom or to the long hours of studying that we were unaccustomed to. Our high school teachers naturally had us worried half to death about the work we would have. I remember having days when I could hardly wait to get here and other days when I would have given my eye teeth for another year of fun and frolic at good old North Central High School. Now that I am here, I can seriously say that I would not go back to that jail for all the sugar in Cuba.

Rose men as a whole certainly deserve mentioning. One day last year I was told that the students and faculty at Rose are one great big happy family. I didn't take the statement too seriously at the time, but I can now see what was meant. The size of the school and the type of people who go here make it possible for us to be one happy family, and this is one of the nicest things about Rose. The friendliness of Rose men is the main contribution to the never dying loyalty toward the school. Rose men are some of the greatest guys in the world.

The new freshman class was used as a guinea pig this year in an experiment with a week long orientation program. During the course of this week, we were subjected to three harrowing placement tests: one in English, one in Math, and one in Chemistry. We were then divided into groups for closer observation. I still haven't decided whether or not the purpose of the program was for us to get used to the school or for the school to get used to us. It was probably a combination of the two. I know that it did help us get into the swing of college before school actually began, and for this reason alone I feel that the program was a complete success. A complete success, that is, except for one thing, the military physical. We got several hours behind in that physical and missed a couple of important classes. How the planning committee ever expected that one lone doctor to check 171 boys in a four hour period I'll never quite understand. The poor guy only had ten fingers.

Of all the things I have noticed thus far, the thing that has made the deepest impression on me has been the Rose tradition. The men here at Rose are the backbone of the institution. The backbone of Rose men is the pride they take in the school, its accomplishments, and certainly its traditions. Therefore it is logical to assume that the Rose tradition is a major component of the backbone of the school without which the school would be an amporhous mass. It pains me no end to see this valuable tradition trod upon so wrecklessly. This school is not a large public institution where rules may be assigned by the ruling body and may God have mercy on those who disagree. The individual is the important component of a school of this type, and, without the full support of the individual, you have nothing.

The support of the individual depends upon his loyalty to the school, which in turn, as I have already pointed out, depends largely upon the tradition of the school. It seems foolhearty then to risk the loyalty we have for Rose for any reason.

The sophomores must be allowed to watch over the freshmen. Hazing has been a tradition for years in many colleges. I don't think that there is a freshman in the school who would, if asked, say that the amount of hazing caused us any undue heartache. The problem of lakings should have been brought up before the Student Council where a reasonable decision would certainly have been reached with no hard feelings on anyones part. When decisions are made for people, when they could have done as well for themselves, and would rather have, friction and heat result. I hope the traditions will be restored in full tact as soon as possible.

(*Continued on page* 44)

LIBRARY NOTES

(*Continued from page 24*)

La Donna E Mobile from Rigoletto

Along with Caruso, we have Mario Lanza SINGS CARUSO FAVORITES. Each number on this record seems to have a strong personal link with Caruso.

If you're a Wagner fan we have the WAGNER RECITAL which is also new, with the vocal by Kirsten Flagstad, who is celebrated as the greatest Wagnerian soprano of our time. The recital consists in part, of:

Elsa's Dream from Lohengrin
Der Engle (The Angel)
Stehe Still (Stand Still)
Im Triebhous (In the Conservatory)
Schmerzen (Pains)

For something in a lighter vein, we have Tony Lavelli, ALL AMERICAN ACCORDIONIST WITH ORCHESTRA. A new record with Will Glahe and his orchestra has been added which is entitled BEER GARDEN MUSIK. Here we have a mixture of Romberg, the polka, and Viennese Waltzes.

From Cole Porter's "Can-Can," we have the original soundtrack album of the movie CAN-CAN.

Also added to our collection are several ballets. We have two of Stravinsky's Ballets, one called PETRUCHKA and the other called LE SACRE DU PRINTEMPS (or The Rite of Spring). Khachaturian's Suite from the Ballet GAYNE is recorded with Kabalevsky's THE COMEDIANS on the reverse side.

If you prefer orchestration and instrumental music we have these new records:

Vaughn Williams' *Symphony No. 1 in D Minor*
Bartok's *Sonata for two Pianos and Percussion, and Music for Strings.*
Brahms' *Symphony No. 3 in F Major*
French Overtures.
For Strauss Lovers Only, a piano reverie with Otto Schulhof at the piano.
Haydn's *Symphony No. 100 "Military"* and *No. 101 "Clock."*

POWER ENGINEER

(*Continued from page 33*)

I should like to use as an example, the electric utility field, about which I feel the most qualified to talk. I think, too, that it covers such a broad range of responsibilities that it typifies the electrical engineer in the power industry. Actually within a single electric utility an engineer can find himself called upon to use every basic principle he has learned in college from basic English to Atomic Physics.

Industry, housing, commercial shopping centers, indeed every factor involved in the makeup of the city, is expanding at a phenominal rate today. The very pulse of our economy is timed by the ability of the electric utility to provide an ample supply of electricity at a reasonable rate. If the heart-beat of this force stops, in effect, so does our community. Even our rural areas are finding themselves increasingly dependent on this magnificant workhorse. The role of the engineer has been extremely important during this period of tremendous growth. In most already well developed areas, electric utilities are finding their loads doubling every ten years. Its engineers have been supplying the technical know-how to construct new facilities and improve the quelity and efficiency of its service to keep its rate rise far below the rise in the cost of living.

The electric utility industry isn't without its headline attractions either. Virtually every major utility in this country is actively participating in research and development of practical nuclear reactors for use in electric generating plants and while for many areas the economics of nuclear power are still sometime off, some areas are ready today and this research with its associated pilot plants is hastening its feasibility for the entire country. Along with this development comes the need for higher and higher transmission voltages with their associated seemingly insurmountable problems. Nevertheless, transmission facilities in the 500 kilovolt class today are nearing readiness for large scale use. Magnetohydrodynamics, a word originally associated with space flight, is being turned into a technological advancement for the benefit of every man on the street through the efforts of the privately owned electric utility. Imagine the revolution to be created by a generator with no moving parts except a flow of ionized gas. This is not a daydream; working models are now a reality and the time is now in focus when large full scale production units should be practical.

Along with these headline grabbers, however, and certainly no less important and in many ways more exciting, is the everday job of providing and improving economy and reliability of service with the tools of today in a community which is growing steadily more dependent on electric power. To perform this task, the Electrical Engineer must be extremely well-rounded in technical ability. In the course of a day he may handle a dozen or more entirely unrelated problems, some calling for engineering knowledge outside his own field. He must even gain a speaking acquaintance with accounting, regulatory routines, and perhaps the most complicated of all theories—human engineering. Also he must be a master at dealing with people for outside contacts are frequent and, peculiar to this business, the majority of the engineers in a utility are charged with superivsory or managerial responsibility at a very early point in their career. If you want to go into this field, you would be wise to study your professors closely too, for a little teaching ability can be a great asset.

Having chosen utility work as a profession, you might be assigned to Generation and Production where maintenance and operation of the plants and substations will be your responsibility. You must accurately forecast how much energy will be needed, where and when, and see that it is economically generated and dispatched. You must have in mind at all times how loads can be quickly shifted from one point to another in the event of the loss of any piece of the hundreds of major items of equipment under your superivsion. The necessity of a constant review of short-circuit availability on every point of an interconnected system will bring you into frequent contact with engineers from other utilities for conferences and network anaylsis board studies.

Perhaps you would be assigned to the Transmission and Distribution Engineering department. A true challenge would be presented to you here, for it would be your contribution to the system which would ultimately determine the quality of service with which the customer is to be supplied. Not only will you need to design adequacy and reliability into your system, provide for quick restoration of service in the event of storm damage, and insure that each piece of equipment meets the standards required by the system and for the protection of a lineman's life, you will be called upon to work closely with the developer, the customer and the Sales engineer to see that his needs are adequately met.

Another field in which you might find yourself would be Construction. If so, you would be extremely fortunate but you had better be mighty versatile for you will provide design, consulting, and testing services for almost every operating department in your company. Also you will supervise construction and test everything from microwave installations and remote superivsory control to gigantic steam-electric generating stations.

I could go on to elaborate on dozens of other tasks the utility engineer performs such as sales and customer consulting, data processing rate development, communications and electronic control supervision but I should like to sum it all up by saying that the frustrations and satisfactions you experience by the end of a day's work will leave you with a true sense of having made a real contribution to the health, safety, welfare, and happiness of your next door neighbor and the kids down the street.

INNOVATION FROM DETROIT

(*Continued from page* 38)

surrounding the inner converter pump drive shaft. The turbine shaft then runs forward into the gear case where torque is multiplied by differential gears to give Low-gear pulling power.

To provide the 60-40 split of power in Drive, the Tempest automatic has been set so that in Drive there is a direct, geared connection between the drive shaft and differential through the high-gear clutch, and the front sun gear and planet set. At the same time, the torque converter is also being turned at engine speed. But because the torque converter multiplies torque to a greater degree than the sun and planet gears of the gear case, it applies more twist to the rear wheels through the rear sun gear than do the transmission's front sun and planet gears.

The closest analogy to the split-torque principle is a railroad's use of locomotives at the front and rear of a long train. The front engine, acting as direct drive, supplies some 40 percent of the power needed to move the train. The rear, or pusher engine is the 60 percent torque converter. Its wheels are spinning as it works to produce just a little more push than the train can absorb. Tempest's split-torque converter works in somewhat the same way, as it too works a little harder than necessary to transmit maximum horsepower to the rear wheels. The 40 percent of direct gearing in the transmission provides a feeling of solidity not provided by most torque converters, and unusually good high-gear efficiency. In Tempest's automatic, the transmission and differential use different lubricants, with rifle-drilled shafts carrying transmission fluid from the converter through the differential to the gear case, and back again.

The front suspension is said to be a Pontiac original. Independently-sprung rubber-bushed lower wishbones have "compression struts" giving a progressive increase in rate to control body lean. One end of the compression strut is bolted to the lower wishbone, and the other end is about 18 inches back in a rubber socket in the frame. The compression struts take the place of a sway bar, acting to increase stiffness only on the outer, heavily-loaded front wheel in a corner.

At first glance Tempest rear suspension looks like that used under Corvair, but Pontiac engineers claim it has been completely redesigned for use in the Tempest. The rear cross-member attaches to the body at four points, while the transaxle is mounted in rubber to the cross-member. The independent action of rear wheels shows up best on high-speed turns when car weight transfer tilts the outside wheel inward at the top to improve cornering and tire adhesion.

Tempest may well be the hottest compact of 1961. The combination of a large four-cylinder engine — with high torque and rapid-acceleration potential — plus a light, unitized body and all-independent suspension makes it appear that Pontiac's baby is going to be the real fun car of the year.

CHEMICAL EQUILIBRIA

(*Continued from page* 34)

equal to the corresponding constant, k_j. Further, the slope of the curve at the zero intercept is an estimated value of the next higher constant.

Depending upon the concentration of the ligand, the coordinating ability of the cation and the stability of the coordination compound, it is often possible to identify and measure four or more consecutive constants. The last constant that can be obtained is identified by the F_j (X) vs. [X] plot resulting in a constant (i.e., a horizontal straight line).

It is the author's hope that this paper will provide its readers with a more adequate understanding of one area of current chemical research, active at Rose and throughout the academic world. It is further intended to show the interdependence of several scholastic fields often encountered before a research project reaches a successful conclusion.

LIFE OF A FROSH

(*Continued from page* 39)

The whole business of going to college is exciting. Every week has something new to offer. The first week we became acquainted with the campus and met all the new people. We went swimming in the lake; we hitch hiked into town to see what it had to offer; we generally adjusted to our new surroundings. Since then, we have started our new classes, met our first professors, worked our first brain-wracking Math assignments, and gotten our first grades. Even the disappointments, as we look upon them, are interesting.

The change in our lives has been a big one. We have left much in the past. There are many things we look back on with fond memories that will never be repeated in our lives. But it is senseless to live in the past. We have four years of college to look forward to, and those four years are supposed to be, so it is said, the best years of our lives. It will be great if we can make it through.

Advertising Index

THE ENGINEERING MIND

(*Continued from page* 15)

dows of theory and education. Because the engineer designs his machines and processes to require the least amount of the least expensive material fabricated and assembled with the least labor expense, day in and day out, he is, by virtue of dollar-bill designing, led into a philosophy of utilitarianism. The chemical engineer hears his company's management say, "If this proposed new plant won't pay out in two years, we won't build it". The engineer considers that if a machine won't pay for itself and the stockholder's dividend check, it must be thrown out. At the same time, he sees more and more human physical and even memory and decision functions being taken over by machines. And so, when the engineer sits in management's chair, it is easy for him to reason that the old engineer in his department is too technologically obsolescent to cope with 80% of the engineering problems the department is faced with, so why not turn him out to pasture with the other outmoded machines and replace him with a new man. This example is not so extreme as it may seem.

Here is the real lesson. The philosophy of engineering and science is cold and hard. Utilitarianism doesn't enfold its wings over the truly beautiful and sensitive human attributions of trust, of respect, or even of love. We should not only broaden ourselves by obtaining a tolerance of the methods of reasoning or lack of reasoning of other groups, be they professional or not. For more tolerance, after all, is only "putting up with those other idiots". In observing a material object such as an ocean, different professions or classes of people would have different thoughts. The artist would think of painting the strength, the fury of the breaking waves. The engineer would think of an economically feasible way to eliminate the salt to make the water usable in power plants. The lawyer would question who had legal rights to the use of the water, the poet would concentrate on its majestic beauty, and the athlete would anticipate the exhiliration of swimming in it. None are complete, mature, broad individuals unless they can not only grasp the reactions of the others, but can also appreciate the ocean in the various manners enjoyed by the others.

It should be realized that while principles of physical concepts can be translated and applied to situations of personalities and groups, so, too, it should be feasible that some of the principles of political science, history, and business administration have application to the physical world encountered by the engineer The avenue of translation of concept should be a two-way street. The terrible and ever-increasing problem of communication between the technical and non-technical worlds cannot be completely solved until such time as each can comprehend the basic concepts of the other, and not just have a cursory knowledge of the meaning of the jargon employed by the other world.

For the past eighty-six years, Rose has unquestionably produced engineering graduates with a high degree of technical proficiency. It is questionable, however, whether she has produced truly educated men other than by chance, for no particularized efforts have been made to instill in the men of Rose the flexibility with which to translate engineering concepts into organizational, political, and humanistic concepts.

Other examples can be used to emphasize more capably the translation process. Let's draw an analogy between an electronic feedback loop and a person conversing with an associate. In the feedback loop, a segment of the system current output is looped back to the system, where it is "analyzed". Information thus gained is used to modify the actions of the system upon the input so as to give the output which will best suit the conditions for which it is intended. When talking with an associate, an individual can study the reactions he receives to ideas he propose, using this as the information for his feedback loop. This brings us to an interesting question. In electronics, if the feedback current is strong, then the applied correction or change in output will be correspondingly strong. If there is a strong protest to a suggestion which you propose, does it necessarily follow that you have the best chance of convincing the other person by becoming stronger in your assertion?

Thermodynamics tells us there is a limit to the amount of energy in a system of particles which is available to do work. As the system expands without external work into the system, the quantity of available energy decreases. Isn't it true that it is impossible to obtain all of the energy in the form of useful work from a large group of indivduals which form an organization? And does the amount of unavailable energy per individual increase as the individuals are separated by distance? Does an individual's intensity or "temperature" decrease if he is isolated?

Newton's celebrated second Law of Mechanics tells us that for each force or action there is an equal and opposite force or reaction. If you become angry with an individual and scold him in loud terms, will he become just as angry and shout back just as loudly as you shouted at him? Isn't it true that his reaction, although possibly not expressed in shouting back, is probably just as intense as was your action? If you are warm and friendly with an individual, it is also likely that he will be friendly toward you. If you say hi to a stranger, he'll greet you in return. Here we see a possibility that we will have to alter the statement of a physical concept before applying it to a non-physical situation. Our experience teaches us that although the reactions we obtain with our personality thrusts are proportional to the thrusts, they are usually similar to the thrust, seldom diametrically opposed, as Newton's Second Law would indicate.

Faith of the Engineer

I AM AN ENGINEER. In my profession I take deep pride, but without vainglory; to it I owe solemn obligations that I am eager to fulfill.

As an Engineer, I will participate in none but honest enterprise. To him that has engaged my services, as employer or client, I will give the utmost of performance and fidelity.

When needed, my skill and knowledge shall be given without reservation for the public good. From special capacity springs the obligation to use it well in the service of humanity; and I accept the challenge that this implies.

Jealous of the high repute of my calling, I will strive to protect the interests and the good name of any engineer that I know to be deserving but I will not shrink, should duty dictate, from disclosing the truth regarding anyone that, by unscrupulous act, has shown himself unworthy of the profession.

Since the Age of Stone, human progress has been conditioned by the genius of my professional forbears. By them have been rendered usabl to mankind Natur's vast resources of material and energy. By them have been vitalized and turned to practical account the principles of science and the revelations of technology. Except for this heritage of accumulated experience, my efforts would be feeble. I dedicate myself to the dissemination of engineering knowledge, and, especially, to the instruction of younger members of my profession in all its arts and traditions.

To my fellows I pledge, in the same full measure I ask of them, integrity and fair dealing, tolerance and respect, and devotion to the standards and the dignity of our profession; with the consciouness, always, that our special expertness carries with it the obligation to serve humanity with complete sincerity.

RESEARCH AND DEVELOPMENT

(*Continued from page* 30)

SUPER GRAPHITE

One of the most promising high temperature rocket materials developed to date has been revealed with the disclosure of a series of high dentisty super graphites being produced by National Carbon Company, a division of Union Carbide Corporation.

In a revolutionary hot-working process, which is closer to metallurgical than ceramic technology, a recrystallized graphite is produced with about two or three times the high-temperature strength of conventional graphites. This unique structural material has useable strength at temperatures as high as 5500 degrees F. Both high strength and exceptionally low erosion rate are facilitated by the crystal alignment and internal grain structure of the recrystallized graphite. The polycrystalline nature of this material retains the advantages of machinability and thermal shock resistance, while attaining strengths and densities comparable to pyrolytic graphite.

In tests made at various laboratories engaged in military work, conditions of pressure, temperature, velocity and chemical composition of rocket exhaust gasses—all factors in the erosion rate of the nozzle insert—were varied. Nozzle inserts made of this new recrystallized graphite proved to be as good as, or better than, other high temperature materials such as tungsten and pyrolytic graphite.

Results to date have been so outstanding that details of the recrystallizing process have been classified by the Air Force, and all production earmarked for the military during the immediate future. There are reportedly no technological limitation to the size in which recrystallized graphite can be produced. Cylinders as large as eight inches in diameter and ten inches long have been produced with twelve to fourteen inch pieces anticipated soon. Such size is unprecedented for material with super graphite's structure and properties.

The recrystallization process achieves a more uniform and compact graphite structure. By close control of the process, grain orientation can be varied to produce a range of super graphite, each graphite having its own particular set of properties suited to a certain application. This line of super graphite fills a gap that other graphite materials had left void.

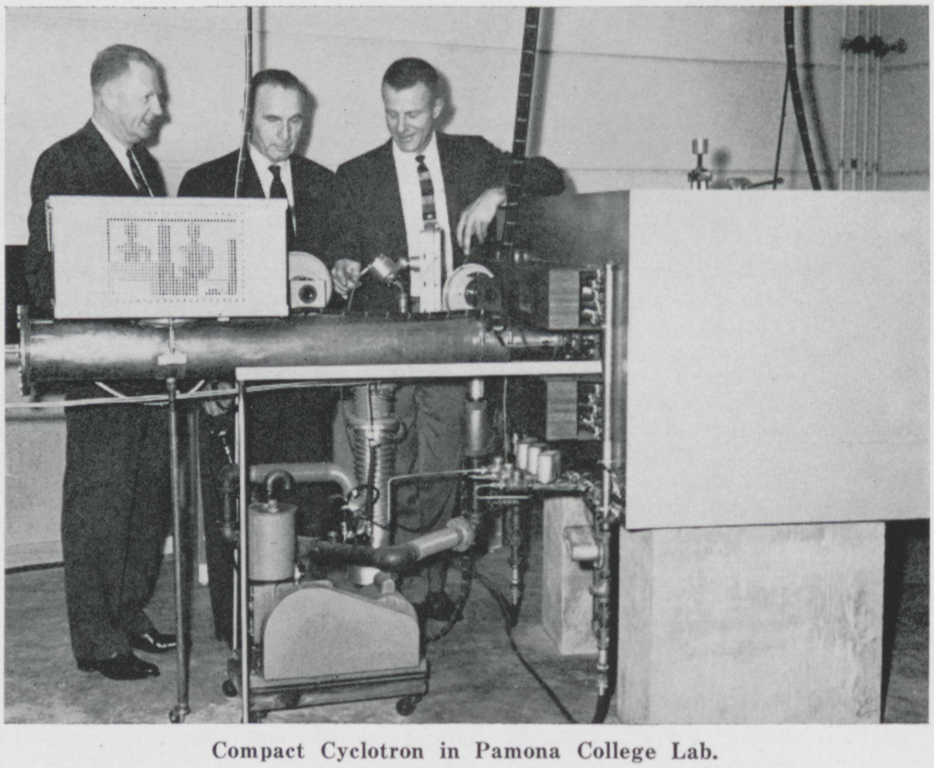
COMPACT CYCLOTRON

A compact cyclotron, no larger than an office desk, will be unveiled at Pomona College as part of the college's 73rd Founder's Day ceremonies. Built by Hughes Aircraft Company, this small "atom smasher" is the first cyclotron in the nation designed and maintained strictly for undergraduate instructional purposes.

As the backbone of the nuclear physics instruction of Pomona, the two million volt machine will eventually be available for individual work by every physics major. Despite its small size, the cyclotron is also applicable to major research projects. Designed by Dr. Byron Wright and Dr. Kenneth Mac Kenzie both of U.C.L.A. and former students of Ernest O. Lawrence inventor of the original cyclotron; this machine is practically foolproof from the standpoint of safety. Not only is this particular machine compact, 3 x 5 feet weighing seven tons; but it is unusually simple to operate.

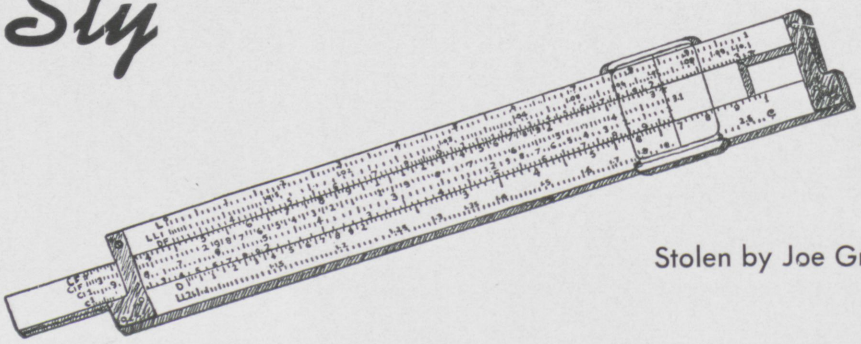
The Pomona College cyclotron is able to produce either protons of two million electron volts or deuterons of four million electron volts at a maximum current of 25 microamps. Using an ocillating radio frequency potential, positively charged particles are accelerated between two semi-circular electrodes. A large electro-magnet producing a field of nine Kilogauss constrains the particles to a circular path which increases in radius as the particles gain energy.

Targets are exposed to the cyclotron's proton beam by inserting them through a one-inch vacuum valve on the front of the vacuum tank. Having provisions for installing a deflection electrode to extract the beam from the vacuum tank, experiments with large targets can be conducted. The Pomona instrument is unique in that its electrical and electronic circuits are controlled by magnetic amplifiers.



Compact Cyclotron in Pamona College Lab.

Sly



Droolings

Stolen by Joe Grumme, Bob Lovell, Max Goodwin

Explorer: "We were surrounded by savages. They uttered awful cries and beat the ground with their clubs."

Bored listener: "Golfers, probably."

* * *

Juvenile delinquent: a youngster who has been given a free hand, but in the wrong place.

* * *

"I've been married since I saw you last."

"So I heard. In fact, I knew your wife before you married her."

"You're lucky — I didn't.

* * *

Employee (to tough boss): "I've been here for two years, doing the work of three men for one man's pay, and I want a raise."

Boss: "Well, I can't give it to you. But if you'll tell me the names of the other two men, I'll fire them."

* * *

Traffic Cop: "Use your noodle lady! Use your noodle!"

Lady driver: "My goodness! Where is it? I've pushed and pulled everything in the car."

* * *

"Well," remarked the undertaker as the coffin rolled off the truck, "We'll have to rehearse that again."

* * *

"I guess I'll cut in on this dance," said the surgeon, as he operated on the St. Vitus patient.

What they mean when they say:

See me after class—(It has slipped mind).

Pop quiz—(I forgot my lecture notes).

I will derive—(formula has slipped my mind).

Closed book quiz — (memorize everything, including the footnotes).

Open book quiz—(Oil your slide rules and wind your watch).

Honor system—(alternate seats).

Briefly explain—(not less than 1000 words).

* * *

A spy was being led to his execution by a squad of soldiers on a cold rainy morning.

"You soldiers are barbaric," the spy grumbled, "to make me march through this cold rain like this."

"Quit squawking," snapped one of the soldiers, "we've got to walk back."

* * *

Many of the girls you see at college are at the age where their voice is changing—from no to yes.

* * *

"How's your patient, Doctor?

"Coming along fine, thank you. This morning he took a turn for the nurse."

* * *

She: "I'm perfect."

He: "I'm practice."

Applicant: I'm Gladys Zell."

Personnel Manager: "I'm happy myself. Have a seat."

* * *

Him: "Why is it you have so many boyfriends?"

Her: "I give up."

* * *

Then there's the one about the mechanical engineer who started at the bottom and stayed there.

* * *

1st Korean Vet.: "And there we were on top of that shell torn hill, fighting for our very lives, odds 200 to one."

2nd Korean Vet.: "Boy that must have been rough."

1st Korean Vet.: "You said it. That was the meanest Chinaman I ever saw."

* * *

Little Johnny came home from school crying. "Hey, Ma, all the boys are picking on me. They say I have a big head."

"You don't have a big head, Johnny. Now run along and play."

The same thing happened the next day and the next, and each time Johnny's mother comforted him. The fourth day Johnny came home with the same story.

"For once and for all, Johnny, you don't have a big head. Now please go down town and get me ten pounds of potatoes."

"O. K., Ma, give me a sack."

"Sack? What do you need a sack for? Use your cap."

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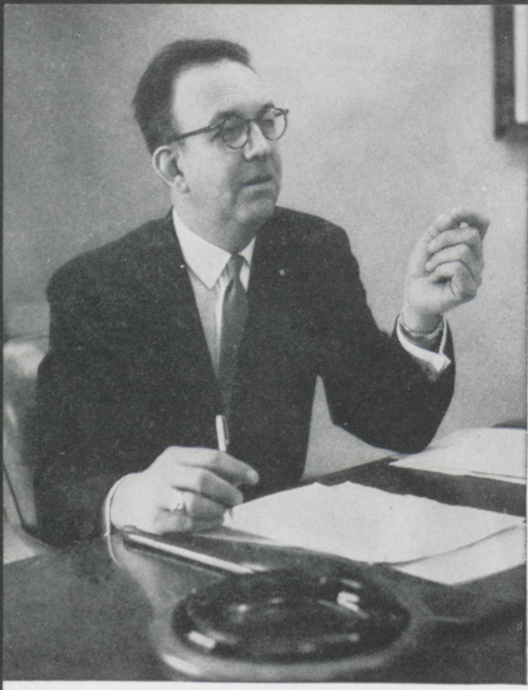

One of a series*

Interview with General Electric's Charles F. Savage Consultant—Engineering Professional Relations

How Professional Societies Help Develop Young Engineers

Q. Mr. Savage, should young engineers join professional engineering societies?

A. By all means. Once engineers have graduated from college they are immediately "on the outside looking in," so to speak, of a new social circle to which they must earn their right to belong. Joining a professional or technical society represents a good entree.

Q. How do these societies help young engineers?

A. The members of these societies —mature, knowledgeable men— have an obligation to instruct those who follow after them. Engineers and scientists—as professional people—are custodians of a specialized body or fund of knowledge to which they have three definite responsibilities. The first is to *generate* new knowledge and add to this total fund. The second is to *utilize* this fund of knowledge in service to society. The third is to *teach* this knowledge to others, including young engineers.

Q. Specifically, what benefits accrue from belonging to these groups?

A. There are many. For the young engineer, affiliation serves the practical purpose of exposing his work to appraisal by other scientists and engineers. Most important, however, technical societies enable young engineers to learn of work crucial to their own. These organizations are a prime source of ideas — meeting colleagues and talking with them, reading reports, attending meetings and lectures. And, for the young engineer, recognition of his accomplishments by associates and organizations generally heads the list of his aspirations. He derives satisfaction from knowing that he has been identified in his field.

Q. What contribution is the young engineer expected to make as an active member of technical and professional societies?

A. First of all, he should become active in helping promote the objectives of a society by preparing and presenting timely, well-conceived technical papers. He should also become active in organizational administration. This is self-development at work, for such efforts can enhance the personal stature and reputation of the individual. And, I might add that professional development is a continuous process, starting prior to entering college and progressing beyond retirement. Professional aspirations may change but learning covers a person's entire life span. And, of course, there are dues to be paid. The amount is graduated in terms of professional stature gained and should always be considered as a personal investment in his future.

Q. How do you go about joining professional groups?

A. While still in school, join student chapters of societies right on campus. Once an engineer is out working in industry, he should contact local chapters of technical and professional societies, or find out about them from fellow engineers.

Q. Does General Electric encourage participation in technical and professional societies?

A. It certainly does. General Electric progress is built upon creative ideas and innovations. The Company goes to great lengths to establish a climate and incentive to yield these results. One way to get ideas is to encourage employees to join professional societies. Why? Because General Electric shares in recognition accorded any of its individual employees, as well as the common pool of knowledge that these engineers build up. It can't help but profit by encouraging such association, which sparks and stimulates contributions.

Right now, sizeable numbers of General Electric employees, at all levels in the Company, belong to engineering societies, hold responsible offices, serve on working committees and handle important assignments. Many are recognized for their outstanding contributions by honor and medal awards.

These general observations emphasize that General Electric does encourage participation. In indication of the importance of this view, the Company usually defrays a portion of the expense accrued by the men involved in supporting the activities of these various organizations. Remember, our goal is to see every man advance to the full limit of his capabilities. Encouraging him to join Professional Societies is one way to help him do so.

Mr. Savage has copies of the booklet "Your First 5 Years" published by the Engineers' Council for Professional Development which you may have for the asking. Simply write to Mr. C. F. Savage, Section 959-12, General Electric Co., Schenectady 5, N. Y.

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