In This Issue

COMMENTARY FOR NEOPHYTIC ENGINEERS
FRESH WATER FROM THE SEA
OBSERVATIONS OF SUCCESS—DESIGN ENGINEERING
S
ome
time
within
the
next
everal
years,
the
first
American
will
soar
into
orbit
around
the
earth.
He
will
be
sealed
in
a
small,
cone-shaped
space
capsule
mounted
atop
an
Atlas
missile.
The
missile
will
climb
100
miles
in
less
than
six
minutes,
where
the
capsule
will
disengage
and
go
into
orbit.
The
man
will
be
alone
in
space.

The
vehicle
for
this
historic
voyage
is
already
in
production
under
the
auspices
of
the
National
Aeronautics
and
Space
Administration's
"Project
Mercury."
One
of
the
methods
of
heat
protection
is
a
beryl-
lum
heat
sink,
forged
on
two
giant
steel
dies.
Both
dies
are
USS
Quality
Steel
Forgings.
The
top
die
(shown
being
rough-
machined
on
one
of
our
vertical
boring
mills)
will
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20
inches
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will
weigh
26,520
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The
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concave
and
18
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thick,
weighs
27,700
pounds.
Both
are
92
inches
in
diameter.

Steel
is
the
starting
gun
in
the
race
to
outer
space.
Space
ships
and
missiles
couldn't
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off
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ground
without
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And
Steel
dep-
pends
on
men
like
you.
Send
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coupon
if
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out
about
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many
engineering
financial
analysis
or
sales
career
op-
portunities
at
U.
S.
Steel.

This
mark
tells
you
a
product
is
made
of
modern,
dependable
Steel.
A phenomenon of modern America is the so-called "think company." It owns no factories, manufactures no products and makes no shipments, but just "thinks" about problems—and brilliant ways to solve them.

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NASA program-highlights

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60,000 lbs.
40,000 lbs.
20,000 lbs.

1960 1963 1967

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NASA Langley Research Center • Hampton, Virginia
NASA Lewis Research Center • Cleveland 35, Ohio
NASA Marshall Space Flight Center • Huntsville, Alabama
NASA Wallops Station • Wallops Island, Virginia

National Aeronautics and Space Administration
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Cover Note

"Turbine rotor on dynamic balancing machine—special photographic impression." Reproduced through the courtesy of Worthington Corporation, Wellesville, New York.

Our apologies to Bell Aerosystems Company, Buffalo 5, N. Y., for omitting a cover acknowledgment in our February issue. The cover on that issue, "Bell's All-Weather Automatic Landing System—symbolized" was made available to us by that company.

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Dear Editor:

I read your editorial in the January issue of the Rose Technic and feel obliged to express my views concerning some of the questions you raised in that article.

You asked two questions which are always foremost in an engineer's mind.

1. Is this project worth the effort and money spent on it, and
2. Is there a cheaper and/or better way to accomplish the desired results?

From an engineering viewpoint, the first question must be answered first. As is so often the case, the values of a project are intangible and cannot be expressed in dollars and cents, but these values are nevertheless real and must be expressed. This is the point where an engineer turns salesman for an indefinite period; this period depending primarily on his ability as a salesman. He must sell the intangible but real values to his superiors before he will gain authorization to continue with his project.

At this point I would like to give a very brief summary of intangible values gained from Rose homecoming decorations in their present or closely related forms. School spirit is built upon tradition, and the most important asset of any privately endowed school is a high degree of school spirit both in its student body and its alumni. Alumni will long remember their social and fraternal activities at Rose, but soon forget the long hours of hard study. They will also remain active in Rose affairs and contribute to its welfare in direct proportion to those memories. Since tradition is a definite building block of school spirit, traditions must be maintained or school spirit will crumble. Several traditions have already been eliminated at Rose. School spirit is sagging in the middle and may collapse without further help. Your efforts should be directed to returning these misplaced traditions to their important and rightful spot in the structure of school spirit, not in tearing down the remaining traditions.

When I return to Rose for homecoming each year, one of the things which I and my family look forward to is a tour of the Homecoming Decorations and the Bonfire on the campus. It is a visual return to my college days, a pleasant journey into the past memories. These decorations are probably the only contact many Terre Haute residents have with Rose, but it might kindle a spark which would result in a closer association. Rose has a duty to the Terre Haute community to be active in community endeavors. Rose students are citizens of the community also. The stature of Rose will not increase in the eyes of the community if you embark on a course of 100% business and 0% pleasure.

A final argument for the homecoming decorations, which you mention briefly, has considerable merit. Fraternity spirit in itself may be of limited value, but this spirit is developed through working together for common goals. The experience gained from fraternity life is very valuable in that aspect and will be called upon many times during each engineer's career. Building a homecoming decoration is only a small segment of fraternity life, but it is certainly not a wasted segment. One suggestion for improvement of the present system would be for the independent student organization on campus to also participate in the homecoming decoration activity.

The second question which you proposed is, I believe, easier to answer than the first. It is a question which must be answered by the "engineer on the job", however, and I can only offer some general comments.

When an engineer is confronted by insufficient capital he does not immediately dump the project at hand and seek a new project which may appear more attractive on the surface. He first evaluates the current methods and looks for a cheaper way of obtaining the same result. You mention a figure of $200 as the cost of a current homecoming display. A good engineer would figure out how to build the same display for $50 and have enough money left to take his wife out for dinner. Here is a real opportunity for you to display your abilities as future engineers. It is part of your training. I, as an alumni, expect it of you! Set a limit on the amount of money which can be spent by each fraternity. Require an exact accounting of all expenditures and submit this account to the homecoming display judges. Judge the displays on the present basis plus considerable weight given to the best job for the least money.

When you leave Rose your success as an engineer will depend primarily on your ability to attain that common goal, "the best job for the least money". Start developing this ability by building the Spirit of Rose to its highest level through the use of brainpower, ingenuity, and cents instead of dollars.

Yours truly,

Roy L. England
Class of '54
Energy conversion is our business

Earth's attraction for an apple?
Free fall in relativistic space?
A complex meson field?
Built-in return power for project Mercury?
How is it related to binding energy?

Gravity is both a bane and a boon to man's efforts—and a thorough understanding of it is of great significance in the completion of Allison's energy conversion mission.
Gravity conditions our thinking on advanced assignments. For example, in outer space there is a disorientation of conventional design. The fact that large accelerations can be obtained with low thrust forces has taken us into the new field of electrical propulsion, ion and magnetohydrodynamic rockets.

In our inquiries, we supplement our own resources by calling on many talents and capabilities: General Motors Corporation, its Divisions, other individuals and organizations. By applying this systems engineering concept to new projects, we increase the effectiveness with which we accomplish our mission—exploring the needs of advanced propulsion and weapons systems.
ROSE POLYTECHNIC INSTITUTE
Terre Haute, Indiana

HIGH SCHOOL GRADUATES OF 1961

You are cordially invited to visit Rose Polytechnic Institute where you can earn a degree in:

- Chemical Engineering
- Electrical Engineering
- Mechanical Engineering
- Civil Engineering
- Mathematics
- Physics
- Chemistry

Office of Admissions
ROSE POLYTECHNIC INSTITUTE
TERRE HAUTE, INDIANA
The engineering student is well aware of the value of his technical education, and he is often reminded of the potential dollars-and-cents value of supplementing his technical training with liberal education. However, there is another motive, less tangible but more important, for possessing a wider knowledge than the engineering curriculum can provide.

What is a liberal education? Carried to a superlative degree, it might be defined as a comprehension of all there is to know. Naturally, that is quite impossible, but there is a practical level of broad learning which, if everyone could attain it, would transform a harried, confused world into a peaceful, pleasant place in which to live.

Philosophers say that differences arise among people because of their varied perceptions of the universe through their senses. Like the blind men of Hindustan who went to see what an elephant was like, we can all sense an object or condition, but we do not by any means agree in our interpretations. If the blind men had been guided so that each gained a comprehension of the elephant as a whole instead of simply a tusk or an ear, then all their ideas about the elephant would have been more nearly the same. If people were educated to interpret and evaluate their surroundings correctly and to be guided accordingly, rather than by rumors, prejudices, and gossip, their serious disagreements would disappear with the enlightenment like ghosts at the break of day.

We are living in a democracy in which we, the citizens, elect officials to carry out our wishes. If the officials are unsatisfactory we have the right to replace them by election. But how are we to judge an official’s ability in dealing with other nations in the search for a peaceful world, if we know little or nothing about the people of those nations? How are we to settle our differences with those peoples if our knowledge of them consists of little more than a name like Arab or Manchurian, a few scattered ideas about them, and a hazy notion about what part of the earth they occupy? Then one of the requirements of an education is an understanding of other peoples through knowledge of their histories, culture, religions, and literature. We are inclined to associate a dull, dry, feeling with such knowledge, but this need not be so. What is more interesting than people? How often have we heard a person standing apart from a crowd remark that he enjoyed just watching people. The dryness lies in the manner in which these studies have been presented to us, not in the material itself.

Education is more than a wealth of information, technical or general. Studies such as Philosophy and Psychology furnish training in interpreting facts, in distinguishing truth from propaganda, in seeing through the blustering confusion of arguments, and in understanding people. Skill in these abilities is then an important requirement of a good education.

Orville Stone.
There are many likely reasons. Perhaps the best one is the sum total of them all:

At DuPont, there are no dead-end streets for able, ambitious people.

For example, DuPont is growing constantly, and growth means more jobs. Every year we spend $90 million in research alone, to develop new products that create challenging new opportunities.

In addition, DuPont invests an average of $33,000 in each employee to provide the most modern equipment, the finest facilities, the best supporting services—factors of special significance to the technical man.

Whatever the reasons, a recent survey of ten large companies showed that DuPont’s turnover rate among technical personnel is within a fraction of one per cent of being the absolute lowest! Moreover, after five years of service, the majority of DuPont engineers and scientists remain for the rest of their careers.

We think there’s food for serious thought in these facts for new engineers, chemists, mathematicians and physicists who are determined to succeed. For more information about opportunities here, ask your Placement Officer for literature. Or write: E. I. du Pont de Nemours & Co. (Inc.), 2419-3 Nemours Building, Wilmington 98, Delaware.

Better Things for Better Living . . . through Chemistry
St. Pat may or may not have been the patron saint of the engineer but tradition has it that on, or about, the 17th of March, Rose graduates get together to reminisce, renew old acquaintances and reaffirm their faith in the future of Rose. This is one of the Rose traditions worthy of encouragement.

This year I had the privilege of extending St. Patrick’s Day for three successive nights with the New York Rose Tech Club, with the Chicago Rose Tech Club and with the Baltimore-Washington Rose Tech Club. During that same week other Rose Tech Clubs were visited by Professor John Bloxsome in Detroit, Pittsburgh and Philadelphia. Professor Gordon Haist helped to bring a little bit of Rose to Louisville for their meeting.

While many other Rose Tech Clubs had their meetings during the same week, it was not possible to visit all of them personally. Since THE TECHNIC goes to each Rose alumnus whether or not he lives in a territory where there is an active Rose Tech Club, I would like to take this means of greeting each one. I shall try to meet as soon as possible with each Rose Tech Club wherever it is. Let us continue our tradition of remembrance on St. Pat’s Day. Let it be a time to think of your classmates and remember the fine times that you had while getting your education at Rose. We are trying to continue this tradition. We count on your help and guidance for the future.

The present student body continued the St. Pat’s tradition by having a successful dance on Saturday night, March 18th. The usual prizes were awarded for the most colorful beards. Next year each member of the Senior class will continue the tradition by attending a Rose Tech Club meeting in whatever part of the country he happens to be. These are the kinds of occasions which keep alive the strong attraction which each Rose alumnus has for his alma mater.
“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 Design will be Production and Teaching.

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 current, the most broad, and the most highly authoritative opinion available on any college campus of activities emanating from Engineering.

This article is intended to present the phases of the Design Engineering Field as determined by the writer’s experiences, the observations of the experiences of others in the field and by the philosophical impressions formed by the problems inherent in this type of engineering work. It is not possible to cover all details in a short writing, but the outstanding general features, concerning chiefly mechanical design, will be discussed. Because these general features are probably similar in other types of design work, they will apply substantially to the design field as a whole.

Both the advantages and disadvantages of design work are presented in the hope that the reader—especially the engineering student—will become fully informed. In this light, there will possibly be some students who will be discouraged in choosing this field for their career. But, on the other hand, there will be others who will accept the challenges of this work and will have their choice in the design field confirmed. In either case, the individual involved will perform better in his ultimate choice of work and will have a better career than if he made a wrong choice; and the design field in general will be improved by having participating engineers who like their work and will make real contributions to the field.

Nature of Work

The primary objective of the Design Engineer is to perform the detailed design of a useable product. Many times, the design field takes up where the research field leaves off. The results of new processes or improved materials can form the very foundation of new products; however, it is an everyday occurrence for improved materials to improve a product by an evolutionary process.

In product design, the engineer must assure that the product performs its functions satisfactorily and safely. These points are his responsibility and they must always be kept in mind during all steps of the design phase.

The final product must fulfill a need and be produced at a price which prospective customers will pay. The price need not always be low, but it must be competitive with the value received and must be competitive with equipment which can perform the customer’s need in another manner.

The routine of design work follows the engineering course as taught in school, in that design calculations, layout drawings, and final detail and assembly drawings are prepared by the designer and assisting draftsmen. Additional functions which the designer must perform are to co-ordinate with sales groups to determine the product features and customer’s requirements, to co-ordinate various design ideas and schemes with manufacturing groups to determine the best overall design from both performance and production cost standpoints, to co-ordinate with outside vendors on purchased components and to prove out by test before incorporation in the design, any components the performance of which may be doubtful. There are many loose ends to tie together, and it is the designer’s task to bridge the gaps among almost unlimited conflicting values along the way, and to arrive at the specific product which meets the overall requirements with the least compromise.

The proof of the prototype and the evaluation of its performance and limitations usually fall on the designer. It is at this time that the designer’s skill and the success of his work come to light.

The build-up and successful test of a model is very gratifying to the designer. Inner pride is quite real to him as the model shows physically the accomplishments of his work. A brief reflection can be made at this time, starting with the origin of various ideas, the sorting of these ideas and working out the best ones for the final product. Also, the design can be reviewed in the flesh, and ideas for future improvements which come to mind can be filed away mentally for future use.

The designer’s work is not free of set-backs, because negative results are nearly always present in a product. (The only perfect design is one which remains on paper and is never produced in hardware.) There are many things which can go wrong, such as too much compromise in design—possibility for possible cost reduction or other reasons—which did not work out, hidden flaws in fabrication or “bugs” which were not fully considered in the original design. If shortcomings are present in a product, they will always show up, because the actual performance will follow fixed physical laws which cannot be violated or sneaked past.

(Continued on page 32)
A HOPELESS SOCIETY?

A COMMENTARY FOR

Unless the unexpected — but by no means improbable — should happen in the meantime, there will be a most critical increase in the human race in the next few decades. It is not possible to give this fact too much serious attention as it is, by far, more relevant to the various problems of our time than has yet been generally realized. Attending this fact — even newer and more momentous — is the fact that minds have become more exposed than ever before . . . And this exposure too is undergoing an explosive increase. Mental and moral communications, within each culture and between cultures, have suddenly expanded beyond anyone's power to foresee the consequences. The agencies at work . . . are mass education, with its stress on nominal literacy, motion pictures, radio, television, modern advertising and . . . modern scholarship. (1)

Superimposed on all of this, there is the thesis being presently most seriously and strenuously advanced by Sir Charles Percy Snow, British novelist and scientist, who was in charge of Britain's scientific research recruitment in World War II. In the Rede Invitational Lecture, he made the statement that the intellectual life of the whole of western society is increasingly being split into two polar groups . . . . At one pole, we have the literary intellectual . . . at the other, scientists . . . Between the two a gulf of mutual incomprehension — sometimes . . . hostility and dislike, but most of all lack of understanding. (2)

He elaborates that . . . between the two, as one moves through intellectual society from the physicists to the literary intellectuals, there are all kinds of tones of feeling on the way. But . . . the pole of total incomprehension of science radiates its influence on all the rest. That total incomprehension gives, much more pervasively than we realize, living in it, an unscientific flavor to the whole 'traditional' culture, and that unscientific flavor is often, much more than we admit, on the point of turning anti-scientific. The feelings of one pole become the anti-feelings of the other.

He concludes that “this polarization is sheer loss to us all. To us as people and to our society.” (3)

According to I. A. Richards, philosopher and critic and now teaching at Harvard, a very gloomy prospect looms up — deriving radically both from the decay of the humanities and from the exuberant vitality of the applied sciences for the rise of “generations of dehumanized social animals in place of self-controlled, self-judging, self-ruling men and women.” (4)

It has been said that “growing up consists in learning how to behave and learning how to behave means acquiring the proper responses to the batteries of social stimuli which compose our social order.” (5) Richards takes exception to this. He believes that “learning to behave” should mean learning the what’s and why’s of human good — what man’s duties and responsibilities and his right relations to his fellows are, and learning how to stick to them under the terrible pressures of pleasure and pain . . . which forever try to force us from them. (6)

He says that — right now — just at a time when the humanities are more than ever needed and at a decisive turn of human fate, they are becoming through multifarious distractions — ranging from the movies up to graduate school — inoperative and ineffective. (7)

He warns that we are at a crisis — “a convergence of different principles into one event;” that we are experiencing a meeting — head on — of “two unreconciled ways of con-

(3) Ibid., p. 11-12.
(7) Ibid., p. 387.
NEOPHYTEC ENGINNEERS

by Mr. John G. Biel
Humanities Dept.

ceiving man and his good and how to pursue it. Both wish him well, but they differ radically as to how he can be helped." (9)

We live in this country, today, in a mixed economic system — neither entirely capitalistic nor entirely socialistic — which, perhaps surprisingly, is a very workable and sensible accommodation to our needs as free men. In this system, there appear private sectors and public sectors — in the statistics of the economist — but as a practical and real matter, there can be equally as much public concern over the conduct of private business as over the conduct of any public agency. One public agency — the Pentagon — contributes more than $41 million to our economy in a year. This is equalled, easily, by the net sales of nine of our private corporations. So it becomes properly shocking when a public official fails to meet his responsibilities — either through his own misconduct or his failure to control his subordinates. In these times, when the private sector is more than three times larger than all government expenditure, it is equally shocking when private corporate officials fail to control their large enterprises. (9)

In a "planned" economy an absolute central authority dictates the allocation of both human and material resources. That central authority is as Hitler was in Germany and as Pharoh was in Egypt; he is a despot; his word is law — and there is no appeal. In a free-enterprise economy, the responsibility for allocation decisions is left in the hands of the individual members of that economy. These individuals are free, as producers and consumers, to make their own decisions — choices — as to what shall be produced, to whom factors of production or goods shall be sold, how the resulting income shall be used and — above all — price is allowed to operate freely to bring about an exchange of goods and services in the market. It is assumed that each member of society will act according to his own interest — subject, of course, to the prevailing legal and moral codes — and that in so doing he will maximize the social interest. (10)

The responsibility is unmistakable but — implicitly and stated as an equation — responsibility equals accountability. Now, just what has happened to that "responsibility/accountability" factor and just what has happened to "the prevailing . . . moral code?"

Can it be that the humanities have failed — or have been permitted to fail — and we are in that era Richards predicted of "generations of dehumanize[ed] social animals in place of self-controlled, self-judging, self-ruling men and women?" (11) Can it be that in our educational processes we have not learned how to behave ourselves in society?

Snow says that all arrows point the same way. Closing the gap between our cultures is a necessity in the most abstract intellectual sense, as well as in the most practical. When those two senses have grown apart, then no society is going to be able to think with wisdom. For the sake of the intellectual life, for the sake of this country's special danger, for the sake of western society . . . it is obligatory . . . to look at our education with fresh eyes . . . We have very little time. So little that I dare not guess it. (12)

The exact and precise way human beings think and feel shapes the structure of society. During the four centuries of Western intellectual activity when the world was being transformed from medieval to modern, the central problem was to find a coherent relation between science and the humanities . . . to give the future scientist an abiding sense of the value of literature and the arts; and at the same time . . . to give to those whose preoccupation lies with the liberal arts a glimpse of the methods, the depth and the inspiration of science. (13)

Dr. Max Lerner, Professor of (Continued on page 34)

(8) Ibid., p. 387.
(12) Snow, Two Cultures, p. 53-54.
WATER PURIFICATION

FRESH WATER

One of man's oldest problems is securing a supply of good fresh water. Many places on our earth are barren due to the lack of this precious liquid. The largest single concentration of water on the earth is the ocean. Yet we cannot use seawater directly as it has many harmful effects. Many processes have been proposed throughout the ages, but there are only a few in actual use. One of the most fantastic was the idea of towing icebergs from the Arctic regions to temperate regions and let them melt in dry docks. Generally today there are only five processes that are considered practical. They are (1) forced circulation, multiple-effect evaporation, (2) multi-stage flash evaporation, (3) electrodialysis, (4) vapor-compression distillation, and (5) a freezing process.

At the present time the evaporation and distillation processes are the most important and most extensive. In all these processes heat must be applied. This is usually done as steam. The unpure water is either directly evaporated at a constant temperature by submerging heating tubes in the boiling liquid or the energy can be stored in the liquid by allowing its temperature to rise while the pressure is maintained high enough to prevent its boiling. Then upon suddenly lowering the pressure, a small fraction of the liquid is suddenly vaporized. This is known as "Flash Evaporation."

In flash evaporation the same general principles apply and more than one stage is essential for economy. In a single stage, the flashing occurs at the lowest possible temperature and no recovery of the heat of vaporization is possible. By flashing in several stages, each at a lower pressure and hence lower temperature than the preceding one, the heat of vaporization of each stage of flashed vapor can be utilized to preheat the feed system. Live steam is used only to give the final boost to the sea water feed before it enters the first flash stage.

A considerable number of multi-stage flash units are either in operation, in the construction stage, or in the planning stage. The largest in actual operation is the two and one-half million gallon per day, four stage unit in the sheikdom of Kuwait on the Persian Gulf. This type of evaporation appears to offer a number of advantages, two of the most important being, the relative ease of scaling up to very large units and the minimization of the scale formation problem as a result of the fact that the evaporation does not occur at the heating surface. Engineering design for cost estimating purposes has been carried out on a very large plant with fifty-two flash stages, a capacity of fifty million gallons per day, and a nuclear reactor furnishing the steam. The estimated cost of the fresh water was forty-two cents per thousand gallons.

The electrodialysis process has been developed rapidly in the past several years and is now the most practical and most widely used one for the treatment of brackish water. This process operates on a very ingenious yet simple principle. The apparatus is an assemblage of parallel compartments separated by thin membranes, which are alternately cation and anion permeable. The cation permeable membranes contain negatively charged ionic groups as in anion exchange resins, and hence tend to repel the anions but allow cations to permeate through them. Conversely, the anion permeable membranes have positively charged ionic groups which repel the cations. When an electromotive force is imposed across the assembly by electrodes submerged in the liquid, all the anions move toward the anode and all the cations move toward the cathode but the movement is impeded by the membranes in the following manner. All the anions move until they reach a membrane through which they cannot pass. The same thing occurs to the cations. Since the membranes are alternately arranged, alternate compartments are filled either with a very dilute solution or a concentrated brine solution.

In an actual unit, several hundred of these thin membranes are separ-
rated by spacers of a plastic material and the whole assembly placed in a press to hold the membranes in a fixed position. Suitable electrodes for introducing the electric current and channels for the flow of sea water feed, fresh water, and concentrated brine are provided.

The heart of the process is the membrane, and considerable research has been done and is being done to improve the quality of it. Desirable properties of membranes for application to large scale demineralization of sea water include high electrical conductivity, low permeability to the passage of water high selectivity to either anions or cations, and good mechanical strength. Of course, it is almost impossible to achieve all of these in any one substance. The first ion selective membranes were the naturally occurring ones of plant and animal origin. A great variety of membranes of different characteristics has been developed since then.

From the extensive data now available from actual operating plants, of which there are more than twenty throughout the world ranging in size from small two thousand gallons per day units up to two and four tenths million gallons per day, it appears possible to produce fresh water from brackish waters in large plants at a cost ranging from sixty cents to a dollar per thousand gallons depending upon various local factors. Membrane replacement is an important item of cost of the electrodialysis process. Another problem in connection with this, or any other process operating away from the seacoast is the disposal of the concentrated brine.

Another well known method, that uses the heat of vaporization, is vapor compression or thermo-compression evaporation. The principle is very simple. The water vaporized from the brine solution is compressed, desuperheated, and sent to the tubes of the evaporator where it condenses and gives up its heat of vaporization. The advantages of this system is that only one evaporation is necessary for good economy as compared to six or more in the multiple effect system but this is partly offset by the need for a compressor.

The disadvantage of the vapor compression process as compared to multi-stage evaporation is the need for electric energy or for high pressure steam for use in a turbine exhausting to a higher pressure. The power generated is used to operate a vapor compression evaporator, but the advantage of this system over either one taken separate is not very apparent.

Fundamentally, the conversion of sea water to fresh water by freezing involves the formation of purified water by the application of suitable heat transfer processes. Ice formed by freezing remains in intimate contact with the sea water. Apart from the difficult problem of separating ice from brine and the disadvantages of handling a solid, the freezing method offers advantages which are worthy of consideration. First, freezing has the natural advantages of an inherently low energy requirement; secondly, it may be accomplished at or near atmospheric pressure, and at low temperatures which cut scale and corrosion to a minimum; and finally the process is basically simple.

One of the major problems associated with the development of the freezing method is the separation of ice from the brine. Because the brine is strongly held within the spaces between the ice crystals, considerable washing is required to effect separation. Although much progress has been made, further development of the technology of freezing remains to be accomplished. To date, no large scale fresh water production operations have been put into operation. However, increasing interest in the process is reflected in reports from abroad.

The development of processes for the recovery of fresh water from sea water on a wide front throughout the world is on the go. The problem is now one of engineering research with the goal of reducing the cost. It seems reasonable to predict that fresh water will be made in the near future from sea water in large plants at a cost ranging from forty to seventy cents per thousand gallons. With some of the distillation processes the production of electric power as a by-product may materially effect the cost of the water. Chemical by-products from the purification of sea water are not to be expected, as none of the processes carries the concentration far enough to yield any solid products of value.
In this issue we shall discuss some of the phenomena of the distant objects in the skies — the stars. Although to many the stars look as near as the planets, they actually are many, many times the distance away from us that the planets are. We shall therefore talk about the distances of the stars, their motions, stellar spectra, magnitudes of the stars, their luminosities, and some of the more prominent constellations.

**DISTANCES OF THE STARS**

While the earth is revolving around the sun, a nearer star seems to be describing a little orbit with respect to more distant stars. This apparent orbit has almost the same aberration orbit of a star; it varies from nearly a circle for a star at the ecliptic pole to a straight line for a star at the ecliptic. It is much smaller than the aberration orbit even for the nearer stars and shrinks to invisible size for the more distant ones.

The Heliocentric Parallax of a star is half the major axis of the parallax orbit, with slight correction for the eccentricity of the earth’s orbit. It is otherwise the greatest difference between the directions of a star as seen from the earth and the sun during the year. Figure 1 shows the geometric relationship that relates parallax and distance. The radius of a circle laid off along the circumference subtends an angle, the radian, equal to 206,265". From the two sectors we have the proportion:

\[
\frac{D_s}{r_e} = \frac{206,265''}{\rho},
\]

where: \(D_s\) = distance of the star, \(r_e\) = radius of earth’s orbit, \(\rho\) = parallax

When the star’s parallax, \(\rho\), has been measured, its distance is found by the relation:

\[
D_s = \frac{206,265''}{\rho}.
\]

The distance, \(D_s\), is in astronomical units and since 1 astronomical unit, the earth’s mean distance from the sun, equals 149,500,000km, or 93,000,000 miles, we have that the distance to a Star is:

\[
D_s (\text{km}) = 1.495 \times 10^8 \left(\frac{206,265''}{\rho}\right)
\]

\[
D_s (\text{mi}) = 9.290 \times 10^7 \left(\frac{206,265''}{\rho}\right)
\]

This distance is an inconveniently large number, so we shall use either the parsec or the light year, after we define them.

The Parsec is the distance at which a star would have a parallax of 1 second of arc. This distance by the above relationship is 206,265 astronomical units. Therefore;

\[
D_p (\text{parsecs}) = 1''/\rho''.
\]

The light year is the distance traversed by light in one year. One parsec equals 3.26 light years, thus;

\[
D_l (\text{light years}) = 3.26/\rho'',
\]

or 3.26 x distance in parsecs.

**MOTIONS OF THE STARS**

There are two projections of a star’s motion:

1. **Proper motion** is the rate of change in the star’s direction, or apparent place on the celestial sphere; this angular rate decreases as the star's distance is greater.

2. **Radial velocity** is the star’s speed of approach or recession; this linear rate is independent of the distance and is often the only projection of the motion that can be measured.

Both of these concepts are shown in Figure 2. Due to the Doppler effect, the wavelengths are shortened if the star is approaching us and are lengthened if the star is receding; and the amount of the change is...
PART V: The Stars

By Francis J. Hirt, senior, math.

proportional to the radial velocity in the following relationship:

\[ V_r = \frac{\Delta \lambda \times V}{\lambda} \]

where:
- \( \Delta \lambda \) = change of wavelength
- \( \lambda \) = wavelength
- \( V_r \) = radial velocity
- \( V \) = velocity of light

STELLAR SPECTRA

Photographs of the Stellar Spectra are made in two different ways. One method employs a complete spectroscope with its slit at the focus of the telescope objective. Reflective prisms over the ends of the slit bring in the light of a laboratory source on either side of the beam of starlight. These two comparisons can be used for measuring wavelengths and Doppler shifts.

Stellar Spectra are classified in the following method: Each star has a letter and number classification, the latter ranging from 0 to 9. The letter classifications are

CLASS O. The lines of ionized helium, oxygen, and nitrogen appear along with those of hydrogen.

CLASS B. Lines of neutral helium are most intense at B2 and then fade, until at B9 they have practically disappeared; hydrogen lines increase in intensity.

CLASS A. Hydrogen lines attain maximum intensity at A2.

CLASS F. Hydrogen lines are declining; lines of metals are increasing in intensity.

CLASS G. Lines of metals are prominent; these are yellow stars. Our sun is a G2 star.

CLASS K. Lines of metals now surpass the hydrogen lines in strength.

CLASS M. Bands of titanium oxide become increasingly prominent up to their maximum at M7.

CLASSES R and N show bands of carbon and carbon compounds, CLASS S or zirconium oxide and lanthanum oxide.

MAGNITUDES OF THE STARS

The grading of the naked-eye stars in early times into six magnitudes was intended primarily to assist in identifying the stars. However, in the early 19th century, it was concluded that a geometrical progression in the apparent brightness of the stars is associated with the arithmetical progression of their magnitudes. The problem was then to find a constant ratio of brightness corresponding to a difference of 1 magnitude that would best represent the magnitudes already assigned to the lucid stars. Pogson proposed the adoption of the ratio having the logarithm 0.4, a convenient value nearly equal to the average ratio derived from his observations.

Fechner's Law, \( S = c \log R \), where \( S \) is the intensity of a sensation, \( R \) is the stimulus producing the sensation, and \( c \) is a constant, gave Pogson a basis to evaluate the constant in the corresponding relation:

\[ m - n = c \log \left( \frac{l_n}{l_m} \right) \]

where \( l_m \) and \( l_n \) are the apparent brightnesses of two stars having magnitudes \( m \) and \( n \), respectively. The constant is \( 1/\log 2.512 \), i.e., if the difference, \( m - n \), is 1 magnitude, \( l_n/l_m = 2.512 \).

The apparent magnitude of a star relates to its brightness, and this depends on the star's luminosity, or brightness at a specified distance, and on its actual distance. The absolute magnitude of a star is the apparent magnitude it would have at the distance of 10 parsecs.

When the parallax, \( p'' \), is known and the apparent magnitude, \( m \), has been determined by observation, the absolute magnitude, \( M \), can be calculated by:

\[ M = m + 5 + 5\log(p) = m + 5 - 5\log(r) \]

where \( r \) is the distance in parsecs.

(Continued on page 36)
The young lady gracing the pages of this month’s TECHNIC is Miss Andrea Whitehead. Andrea is a freshman at—of all places—Indiana State College and is majoring in art. She is a pledge of Delta Gamma sorority, and hails from the fair city of Terre Haute, Indiana. She is active at State in extra-curricular work—being among other things—a member of the yearbook staff and the Student Union Board.

Vital statistics are: Five feet seven inches in altitude, .955\pi \times .700\pi \times .955\pi in circumference, and 54,400 gm. in weight.

Art major Andrea Whitehead has the TECHNIC staff’s vote as a choice art study for March.

Andrea doesn’t believe in seasonal swimming, she feels March is as good a time as any for a short dip.
EFFECTS OF RADIATION EXPOSURE

By George Bentley, soph., physics

Unlike fire, which produces at once pain, blister, char, or other immediately discernible injuries, radiation may antedate by weeks or even years, its biological effects. It has been observed that some degree of repair follows radiation damage to somatic cells. Thus, it can be said that a dose of radiation that would be lethal if given at one time will produce little change in body tissues if it is spread over a protracted period, but the genetic effect appears to be independent of rate. The lessened effect of protraction of the dose is of much beneficial use in the clinical treatment of certain cancers; for normal tissues can often repair themselves to a greater extent than can the cancerous tissues.

In recent years the natural background radiation, which is contributed by traces of radium and related elements in our own intrinsic radioactive potassium isotope, and by cosmic rays has been energetically supplanted by man, with medical, industrial, and experimental sources of various types of radiation, including weapons testing.

In those countries which are most advanced in the field of medicine, the largest single contributing source of radiation received by man has been the inclusion of radiation useful in the clinical treatment of certain cancers; for normal tissues can often repair themselves to a greater extent than can the cancerous tissues.

A number of recent studies indicate that the development of leukemia in man seems to be one of the more delicate means of determining exposure to radiation. While some individuals can receive relatively large amounts of radiation without developing leukemia, in others radiation seems to be a constructive mechanism in the development of the disease. There appears to be statistical evidence bearing out this increase in the occurrence of leukemia with radiation exposure. The greater prevalence of leukemia in radiologists has long been known; furthermore it has been established that there occurred a distinct increase in the incidence of leukemia in survivors of the atomic bomb explosions in Japan.

There also appears to be evidence that radiation exposure causes premature aging. It has been recorded that one who has received up to one thousand roentgens of radiation exposure may expect a 10% decrease in his life span.

In addition, death from heart disease and arteriosclerosis comes at an earlier age among those who have been exposed to excessive radiation.

Much research and discussion has, and is now going on in balancing the preventive good in the use of radiation against the potential harm incurred. Leaders in many fields are currently endeavoring to come up with more specific answers to this question of benefits versus harmful effects.

Changes brought about in the germ plasm are in general harmful and cumulative, for there is very little repair of damage. In general, the only repair seen in germinant cells is that brought about by recombination of chromosome breaks. While in some plants and animals where rigorous selection can be carried out, increased mutability is of benefit, most mutations encountered in man probably must be considered as disadvantageous to the race.

Total body radiation is much more harmful than radiation of a localized part, as, for example, in the treatment of skin cancer. In the former instance 1/10 or less of the dose used in the latter instance may prove fatal.

The several body tissues vary greatly in the response to radiation. Lymphoid, blood forming, and germinal cells are very sensitive, showing acute evidence of damage after irradiation with 100 roentgens or less. Striated muscle tissue is one of the more resistant tissues, withstanding several thousand roentgens. The reaction to radiation varies with tissues and dosage intensity.

Except in large doses, the changes induced by radiation may be long delayed, appearing months or years after either acute or chronic exposure.

In conclusion, it should be noted that according to statistics radiologists succumbed at an earlier average age to practically every type of disease, indicating that the damage done to the body is widespread in its influence.

As yet, so few people have worked with radiation in sufficient quantities to determine the possible hereditary effect inherent in radiation exposure. At this time it is definitely not going to effect the entire population.

This problem, and its effects will have to be dealt with by many future genetecists.
Even before Ron Spetrino received his engineering degree from Case he had good job offers from six companies.

He joined The Ohio Bell Telephone Company—his reason: "I was convinced an engineer could go further here—if he was willing to work for it."

As soon as Ron got his feet on the ground in telephone engineering, he was tapped for a tough assignment. The job—to engineer switching equipment modifications needed to prepare Cleveland for nationwide customer dialing of long distance calls.

Ron wrapped it up in five months, and found he had earned a shot at another tough assignment. In this job Ron helped engineer a completely new long distance switching center connected Cleveland with the nationwide customer dialing network. It was about a year later that Ron put the finishing touches on the specs for this $1,600,000 project.

Today, as a Supervising Engineer, Ron heads a staff of five engineers and is responsible for telephone switching in much of the greater Cleveland area.

He supervises the design and purchase of $3 million worth of equipment a year. And even more important, he is charged with developing the technical and managerial skills of his staff.

Ron knows what he’s talking about when he says, "In this business you have to do more than a good job. We expect a man to be a self-developer. We expect him to take responsibility from his first day on the job and think for himself. You don't get ahead around here by just doing time."

"If you want a job in which you're given every chance to prove yourself, and real responsibility right from the start—you'll want to see your Placement Office for further information."

“Our number one aim is to have in all management jobs the most vital, intelligent, positive and imaginative men we can possibly find.”

FREDERICK R. KAPPEL, President
American Telephone & Telegraph Co.

BELL TELEPHONE COMPANIES

MARCH, 1961
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.
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.
A library has evocative power. Merely to sit within view of good books draws out the goodness in one. A library has driving power, too: it challenges us to convey meanings and feelings as famous writers did.

from The Royal Bank of Canada Monthly Letter

Periodicals and journals are especially useful sources for answering contemporary questions, and have certain advantages over books as sources of information, for they are more up to date than books. Also, articles that appear in periodicals and journals contain the major source materials for research, and have the advantage of brevity.

We thought we should list some of the newer journals that we will be receiving in the coming weeks. Subscriptions to these which are chiefly foreign, were made possible by funds from the Lilly Endowment Incorporated.

Acta Crystallographica. monthly
Annalen der Physik.
British Chemical Digest.
Canadian Journal of Physics. monthly
Chemical Society, London. Journal. monthly
Contains original contributions to pure chemistry and special lectures delivered before the Society.
Transactions of the Faraday Society.
Journal of Inorganic and Nuclear Chemistry. London.
Contains original work in the field of inorganic and nuclear chemistry.
Journal of Scientific Instruments. monthly
Philips Research Reports. Netherlands. bimonthly

A publication containing papers on research work carried out in the various Philips Laboratories.
Philips Technical Review. Netherlands. monthly

A publication dealing with technical problems relating to the products, processes and investigations of the Philips industries.
Philosophical Magazine. London. monthly
A journal of science which in recent years “a considerable portion of its papers have dealt with the structure of the atom and the ultimate constitution of matter.”
Royal Society: Philosophical Transactions. London.
Physica. Netherlands. monthly
Reports on the Progress of Applied Chemistry.
Soviet Physics — Acoustics. quarterly
Contains reports of current Soviet research in acoustics as contained in the Journal of Acoustics of the Academy of Sciences of the USSR.
Soviet Physics - Crystallography. bimonthly
Contains reports of current Soviet research in crystallography.
Soviet Physics — Doklady. bimonthly
Contains reports of current Soviet research in physics as contained in the “Physics” section of the Proceedings of the Academy of Sciences of the USSR.
Soviet Physics — Technical Physics. monthly
Contains reports of current Soviet research in physics as contained in the Journal of Technical Physics, of the Academy of Sciences of the USSR.

Soviet Physics - Uspekhi. bimonthly
Contains translations of original Russian articles currently published in Uspekhi Fizicheskikh Nauk (Advances in Physical Sciences).
Soviet Physics - JETP. monthly
Contains complete translations of the Journal of Experimental and Theoretical Physics of the Academy of Sciences of USSR.

NEW BOOKS
Out on a Limerick.
by Bennet Cerf
The limerick packs laughs anatomical
Into space that is quite economical.
But the good ones I’ve seen So seldom are clean,
And the clean ones so seldom are comical
... includes a collection of over 300 of the world’s best limericks.
“Here is a feast of puns, alliterations, trick spellings, odd happenings, capsuled wisdom of food and drink, on history, girls, famous men, sport, love, marriage — the whole range of human activity.”

Our Incredible Civil War
by Burke Davis
“A wonderfully entertaining new look at the personalities and changes of an entire epoch.”
The author provides us with fresh insights into the mind of Robert E. Lee, and the curious world of Stonewall Jackson and an exciting new concept of the Civil War.

Shadows on the Grass
by Isak Dinesen
Isak Dinesen a distinguished Danish writer who lived in Africa for many years recalls again the African land.

(Continued on page 41)
How do you design a precision instrument that will "see" 38 billion light years into space? This problem was answered by the engineers working on this revolutionary, new radio telescope.

But these engineers faced another challenging problem—How do you actually build it? How do you build a telescope as tall as a 66-story building with a reflector so big it could hold six football fields?

How do you build a rotating mechanism that can swing this giant up or down, or sideways, to aim at any spot in the Universe with pin-point accuracy? Just the tiniest amount of wear or distortion in this mechanism could throw the telescope millions of miles off target in the far reaches of space!

Where could they get construction materials tough and strong enough? Nickel gave them the answer! Nickel in steel gave these engineers a material tough enough to maintain precision in the rotating mechanism even under the anticipated 20,000-ton load.

And Nickel, to be used in the steel members, gave them the high strength at minimum weight needed to support the giant reflector.

The radio telescope is one of the many developments in which Nickel has solved important problems. Most probably you, yourself, in the near future, will be faced with problems just as difficult. When you are, you can count on Nickel—and the cooperation of Inco—to help get the job done... and done right!

If you'd like to get acquainted with Nickel steels, write us for a copy of, "Nickel Alloy Steels and Other Nickel Alloys in Engineering Construction Machinery." Educational Services, The International Nickel Company, Inc., New York 5, N. Y.

**Inco Nickel helps give engineers the solution to metal problems in new radio telescope**

**International Nickel**

I would first like to congratulate all the freshmen pledging fraternities. You men will find that your fraternity will affect you in every respect, in both your undergraduate and alumni days. Congratulations to all new Greeks!

The brothers of Theta Kappa have elected their new officers: Steve Ban, president; Max Goodwin, vice-president; Bill Nicewanger, secretary; Jerry Hahn, treasurer; Jack Hobbs, rush chairman; Andy Hrezo, pledge trainer; Jerry Badger, ritualist, Dave Dumford, social chairman; Bill Barone, villa manager; Ken Miller, steward; Dave Randolph, assistant treasurer; and Al Story, assistant ritualist. Good luck in the busy year ahead!

I would like to thank the “old” officers for a job well done. Congratulations go to Jack Hobbs who in a return match lost his pin to Miss Marsha Skorjanc of Plainfield, Ind. Don Robinson fell into the same trap with Miss Donna Buchanan of Indiana State.

Rush weekend was followed by mixers with St. Mary of the Woods and the Delta Gammas of I.S.C. (by proclamation of the Grand High Dragon or something they have dropped the “T”). A fine time was had by all (except Al Johnson, he just sat in a corner with his shirt inside out, his shades adjusted, and mumbled poems).

And last (because of their sticky fingers lately) I would like to announce the 1961 spring pledge class: Bill Bergstrand, Brookfield, Ill.; Bob Dice, Whitehaven, Tenn.; Tom Fenoglio, Terre Haute, Ind.; Bob Gordon, Elwood, Ind.; Tom Holmes, Evansville, Ind.; Jon Hunt, Anderson, Ind.; Bruce Kopf, Oaklawn, Ill.; Bill Kovacs, Lagrange, Ill.; Bob Leonard, Speedway, Ind.; Vaughn Love, Brazil, Ind.; Larry MacDonald, Brazil, Ind.; Don Miller, Seymour, Ind.; Carl Moffett, Terre Haute, Ind.; Hal Reilly, Darien, Conn.; John Rohr, Hinsdale, Ill.; John Stockton, Terre Haute, Ind.; Wilford Stratten, Creston, Ind., Bill Templin, Danville, Ill.; Tom Terry, Kewanee, Ill.; Mike Thomas, Brazil, Ind.; Bob Valle, Terre Haute, Ind.; and Steve Woolley, Kokomo, Ind. Look out actives, they’re a bunch.

Dick Mills

SIGMA NU

Well, the “BIG” weekend is over and we are proud to say that 22 men joined the ranks of Sigma Nu. These men are:

- Larry Bond, Sullivan, Ind.
- Robert Bonson, Palestine, Ill.
- James Brown, Memphis, Ind.
- Peter Canilia, Chicago, Ill.
- Steven Charlton, New Castle, Ind.

Larry Clemons, Trenton, Mich.
Edward Downey, Rosiclare, Ill.
Robert Forster, Indianapolis, Ind.
Paul Goss, Indianapolis, Ind.
Joseph Griffen, Speedway, Ind.
Larry B. Hall, Indianapolis, Ind.
Stephen Hoffman, Ft. Wayne, Ind.
Peter Petrowsky, Terre Haute, Ind.

David Holobaugh, Tipp City, Ohio
Alfred Ratz, Indianapolis, Ind.
John Sauser, Centerville, Ind.
Jeff Skjordahl, Glen Ellyn, Ill.
Richard Swan, Lakeville, Ind.
Joseph Thurston, Richmond, Ind.
James York, Fairfield, Ill.
Edward Zaenglein, Indianapolis, Ind.

Gerald Zinngerabe, Evergreen Park, Ill.

We would once again like to congratulate these men and also extend our congratulations to the other fraternities and their pledges.

In I-F basketball we finished second by defeating Alpha Tau Omega in a play-off. Having won the football trophy we are now in the lead in the race for the all-sports trophy. In anticipation of the softball season many of the brothers have been seen warming up the ole’ pitching arm.

Quite extensive remodeling took place at the house over semesters.

(Continued on page 37)
Is your future up in the air?

As the communications needs of our nation become steadily greater and more complex, the Bell Telephone System is continuing its pioneer work in microwave by "taking to the air" more and more to get the word across.

To this end, Western Electric — the manufacturing arm of the Bell System — has the monumental task of producing a large part of the microwave transmission equipment that knits our country together by shrinking thousands of miles into mere seconds.

In spite of its great technological strides, the science of radio relay is a rapidly-changing one. And new breakthroughs and advances are common occurrences. A case in point: our Bell System "TH" Microwave Radio Relay. This newest development in long-distance telephone transmission will eventually triple the present message-carrying capacity of existing long-haul radio relay installations. A full-scale system of 6 working and 2 protection channels can handle 11,000 telephone messages at the same time.

To make microwave work takes a host of special equipment and components: relay towers, antennae, waveguides, traveling wavetubes, transistors, etc. But just as important, it takes top-caliber people to help us broaden our horizons into such exciting new areas as communication by satellites!

And microwave is only part of Western Electric's opportunity story. We have—right now—hundreds of challenging and rewarding positions in virtually all areas of telephony, as well as in development and building of defense communications and missile guidance systems for the Government.

So, if your future is "up in the air," you owe it to your career to see "what's up" for you at Western Electric.

Opportunities exist for electrical, mechanical, industrial, civil and chemical engineers, as well as physical science, liberal arts, and business majors. For more information, get your copy of "Western Electric and Your Career" from your Placement Officer. Or write College Relations, Room 6105, Western Electric Company, 195 Broadway, New York 7, N. Y. And be sure to arrange for a Western Electric interview when the Bell System recruiting team visits your campus.

SUB-MINIATURE PRECISION DIFFERENTIALS

A complete line of sub-miniature precision differentials, for highly critical applications in computer assemblies and control instruments, has been announced by Instru-Lec Corporation.

Developed for fire control, navigation, missile, space, aircraft, and similar strategic installations, the Instru-Lec two-spider-gear design features a ½ inch diameter swing (clearance circle) which permits extreme miniaturization.

Made entirely of stainless steel, each differential employs six miniature ball bearings which conform to ABEC 7 tolerance requirements. Backlash is held to 8 minutes or less, break-away torque to 0.02 ounce-inches, and balance is maintained at all times.

Instru-Lec sub-miniature differentials are available with either 0.0779 or 0.0935 inch diameter shafts with overall lengths up to 3 inches. Pitch and number of teeth on end gears can be selected from a wide range. End gears are made from flat blanks that are parallel within 0.0002 inch.

ANALOG DRIVING SIMULATOR

To study interaction of driver and vehicle control characteristics, General Motors Research Laboratories has developed an analog driving simulator as part of a human factors research program. The five horizontal bars on the oscilloscope screen in front of the driver are a simplified perspective of the road ahead, providing the same visual stimulus a driver would receive on a full scale highway.

Beneath the five horizontal bars are two short vertical bars representing a vehicle’s front wheels. The five bars shift horizontally, giving the illusion of bends and turns in the road, and the driver manipulates the steering wheel to follow the road curvature.

The synthetic car is in its proper lane so long as the two vertical bars representing the front wheels stay within the outer limits of the lowest of the five horizontal bars. When the driver accelerates, the horizontal shifting of the bars speeds up, simulating increased car speed. The shifting slows down when the brake pedal is applied. This is one of a series of devices, which include a variable stability car and analog vehicle simulator, the GM Research Laboratories has developed to study car handling motion and driver performance.

THE GREAT STALACPIPE ORGAN

The touch of a 20th Century steel development is improving tonal power of ageless stalactites in the Caverns of Luray, Virginia, where man has found how to get music as well as visual beauty from nature’s ancient underground artistry.

The musical stalactites were selected and tuned by Leland W.
Sprinkle, Sr., inventor of "The Great Stalacpipe Organ" of Luray.
The threaded rods used are of Allegheny Ludlum Steel Corporation's AL-4750 alloy, .245 inches in diameter and range from one to five inches in length.
Small wire wrapped magnets are placed near the ends of the rods.
When an electronically controlled hammer strikes a stalactite, the combination of rod and wire-wrapped magnet becomes a tone hammer whose impulses pass into a powerful amplifying system. The amplifier releases the musical tone for listening audiences. This eliminates microphones.

In selecting a metal for the bars, corrosion-resistance was a prime factor because of the dampness of the underground cavern. A material which would rust would expand, causing the stalactites to crack or snap off.
There was also concern that the striking force of the hammers would crack some of the formations. With the AL-4750 inserts as the heart of the magnetic system, tones can be produced by a gentle tap. Three acres of stalactites are now utilized with plans of expansion to 64 acres envisioned.

**Solenoid Valve**
Production of a compact, high pressure solenoid valve for use in fluid (liquid and gas) control has been announced by General Magnetics, Inc. This compact, straight through flow solenoid valve meets, according to the manufacturer, the need for many applications where space is at a premium and low power consumption is desirable.
Available in six to 64 volt D.C., 6, 12, and 110-120 volt, 60 cycle A.C. and 110 volt, 400 cycle A.C. models, this valve operates in any position with a maximum rate of 1000 cycles per minute at 100 p.s.i. It is also available in waterproof and fungus proof models.

Using one to three watts of power, the unit, according to the manufacturer, will serve under pressures up to 200 p.s.i. in temperatures ranging from a minus 65 degrees F. to a plus 350 degrees F.
Weighing only five ounces, the inlet connection is ½ inch NPT with an outlet connection of ½ inch NPT. Overall length is 2 5/8 inches with a diameter of 1⅛ inches. Self-supporting, in-line mounting is a feature of this model.

A specially designed synthetic rubber needle valve is self-aligning and provides positive close-off at any pressure. All important parts of the unit are stainless steel and are silver brazed for rigidity. No gaskets are used in the valve.

"The Great Stalacpipe Organ"
During the early 1800's settlers in the Old Northwest found themselves in the unique position of farming some of the nation's richest land, reaping enviable crops but living as paupers. The crux of their problems was the poor transportation available.

The National Road was the east-west transportation system. North-south transportation was on the Wabash River and the Michigan Road from Madison to Michigan City via Indianapolis, Logansport and South Bend. Wags went so far as to suggest building a towpath beside this route and using it as a canal.

The completion of the Erie Canal and the Ohio canals, and the great prosperity enjoyed in the remainder of the country whetted the "Hoosier appetite" for canals and other transportation improvements.

Two major projects came up for consideration. The most populous area of the state had the loudest voice in the fray. This section of southeastern Indiana felt the need for ready access to the Ohio River. In 1827 a corporation was chartered to build a canal along the White Water River from the Ohio River to Fort Wayne. This company failed to actually plot a route beyond the White Water River, and did not specify the many villages it was to serve. The area did not abandon its hopes, however, and through political maneuvering gained its canal in later years.

Also in 1827 the Congress granted Indiana a strip of land consisting of every alternate section equal to five miles in width along its route, for construction of a canal to link the Maumee and Wabash Rivers. This followed authorization in 1824 for Indiana to survey the route. These measures required construction to commence by 1832, if the state was to receive the land grants.

Early travelers in the Fort Wayne area reported that in times of high water, a canal effectively existed. Traders were observed pushing their laden canoes across the marshes and backwaters of the portage. The Army did preliminary survey work for this canal which was estimated to be not more than six miles long. Had this canal, rather than the 452-mile Wabash and Erie Canal been constructed, Indiana history would have read differently.

In the winter of 1826-27 a board of canal commissioners was appointed to determine the route and sources of water supply. The commissioners retained an engineer, John Smythe of Miamisburg, Ohio, to gauge the Saint Mary's, Saint Joseph, and Wabash Rivers. He was taken ill and left the commissioners to shift for themselves as best they could, using their own estimates and those of Colonel Moore, who had conducted the previous surveys down the Maumee and Wabash Rivers. The commissioners had located the route and feeders and planted them by January, 1829.

Late in 1830 land offices at Logansport, Lafayette, and Fort Wayne opened to sell the canal lands granted by the government. Returns were disappointing and the project was in financial trouble even before it started.

In the process of the survey, the Hoosiers came to the rude awakening that the canal could not be constructed entirely within Indiana. The Maumee was not navigable from Fort Wayne to the rapids, so canal bed and locks would have to be constructed in Ohio.

The Ohio Legislature was fearful that the new Wabash and Erie Canal would drain business from their own Miami and Erie Canal and postponed ratification of the agreement until 1836. Construction did not start until after Indiana built a landlocked canal. Ohio's Maumee and Erie Canal was constructed sixty feet wide by six feet deep while the Wabash and Erie was forty feet by four feet, west of Fort Wayne.

A canal fund was established and placed in the charge of three commissioners as a result of legislation in 1832. The commissioners borrowed at six per cent offering land, tolls, and the faith of Indiana as collateral. Original estimates of the
cost ranged from $800,000 unofficially to $1,081,970 by Surveyor Joseph Ridgeway.

On Washington's birthday in 1832 the canal commissioners met at Fort Wayne to turn the first spades of earth with proper ceremonies. By 1834 a thousand men were working on the Wabash and Erie west of Fort Wayne. A large majority were Irish, equally divided between "Corkers" and Ulstermen or "Way Downers" from Kerry. To commemorate the Battle of the Boyne in 1835 these groups armed and the Corkers were marching to battle near Lagro when 400 hastily summoned militia arrived to quell the party. The Irish protested loud and long that they felt America should allow them to fight in peace. Following the Irish War there were no serious conflicts.

The year 1835 saw boats plying the waterway from Huntington to Fort Wayne. Indications of financial difficulties to come also sprang up during the summer. Tolls were not enough to cover maintenance on the short segment opened to traffic. Wooden aqueducts were already decaying and $100,000 would be needed to extend the canal to Lafayette. When the legislature met in 1834 to frame a bill for general internal improvements, the session turned into a political see-saw. Each section was willing to vote for the White Water canal if they received due consideration also.

Governor Noble signed the Mammoth Internal Improvement Bill on January 27, 1836. An enlarged canal board was to oversee the construction of the following works: (1) The seventy-six mile White Water Canal from Cambridge City to Lawrenceburg for which $1,400,000 was appropriated. (2) The Central Canal commencing on the Wabash and Erie between Fort Wayne and Logansport, via Muncie and Indianapolis to Evansville. For this $3,500,000 was appropriated. (3) An extension of the Wabash and Erie Canal from Lafayette to Terre Haute and construction of the Cross Cut of "Eel River Cutoff" to the Central Canal. The appropriation was $1,300,000. (4) $1,300,000 was set aside from the empty coffers to construct a railroad from Madison through Columbus and Indianapolis to Lafayette. (5) A New Albany-Vincennes turnpike was to cost $1,150,000. (6) Jeffersonville, New Albany, Salem, Bedford, Bloomington, Greencastle, and Crawfordsville were to be linked with a railroad or macadamized road for which $1,300,000 was appropriated. (7) Fifty thousand dollars was set aside for removing obstructions in the Wabash River. (8) A canal or railroad from Fort Wayne to Michigan City, via Goshen, South Bend, and Laporte was to be started within ten years.

A fund consisting of money from loans, grants, profits, tolls, rents, and state bonds was set up to cover this gigantic undertaking.

Celebrations were held throughout the state, a bonfire on every street corner seemed the rule of the day. Predictions followed freely that revenues from the transportation network would pay for the projects in short order and soon eliminate state taxation. The entire nation praised the enterprise of the young state.

The commissioners met March 7, 1836, and decided on a course of action. They planned to institute the program by building the White Water from Lawrenceburg to Brookville, the first twenty-two miles of the Madison Railroad, the Wabash and Erie to Lafayette, and the Cross Cut Canal. Also projected for immediate attention was twenty miles of the Jeffersonville and Crawfordsville road, bridges and grading on the Vincennes-New Albany turnpike, and work on short segments of the Central Canal outside Indianapolis and Evansville. This haphazard policy developed as a result of each commissioner's desire to keep political plums in his respective area.

Surveyors and engineers were scattered throughout the state, attempting to determine the feasibility of constructing the various modes of transportation along the proposed (Continued on page 39)
improve the background for their engineering education, which would lum concentrated too much on de-
formance of his product from what he had planned for it; because it in-
dicates his own error, and the ten-
dency is to overlook real problems when they are first observed. Sec-
ond, the revision of an existing de-
sign is very difficult, because the restrictions are much more severe than in the original design, where there was complete freedom to make any change desired. Courage, very clear and objective thinking, as well as hard and persevering work, are especially necessary at this stage of design work. It is in this area of correcting deficiencies that a latent opportunity exists for an individual — especially a young designer who is first assigned to a project at this stage — to prove his ability as a de-
signer, to gain an accelerated amount of design knowledge and experience, and to be a real contributor to his employer.

College Training Important to Work

The technical training which is taught in the engineering schools is very necessary, and it is used ex-
tensively in design work. The college technical courses form an ex-
cellent foundation for a design career. In fact, criticism has been voiced by graduates who were inter-
ested in other fields, such as sales work, that the engineering curricu-
num concentrated too much on de-
sign and prevented a broad general engineering education, which would improve the background for their type of work. It is emphasized that technical know-how is important to a successful design career.

The logical thinking process de-
veloped in college is a requirement for a successful designer. This type of thinking is a great asset in any field, but it is especially needed in the designers work where many de-
cisions must be made in situations where conflicting pressures, such as low cost yet good performance, are always present.

The ability to communicate with others is also important in the de-
sign field. Good verbal communica-
tion is not as critical for the design-
er as it is for the salesman; how-
ever, the designer does have a great need to be able to get his thoughts transmitted to others. Many times he must sell his ideas and plans to others, or else they will die. The ability to write good letters and re-
ports is a requirement for the de-
signer, because there is a great deal of specific information associated with design work. This information must be transferred to others whose knowledge of the subject is more limited than the designer's, and in such cases it is difficult to write so that complete information is trans-
mitted without misunderstanding by the reader. The engineering gradu-
ate will usually find himself weak in this area, so it behooves the engi-
neering student to make the most of this part of his education while in college.

Personal Traits Important
to Work

There are many personal traits such as intelligence, initiative, enthu-
iasm, willingness to continue learn-
ing, willingness to work and ability to get along with others, which are great assets in making a success of any chosen career. These traits are also important in the de-
sign field; however, other particular personal abilities help a designer to be outstanding in his work. Invent-
iveness, or the ability to originate ideas, is very necessary to a good designer. Somewhat along the line of inventiveness is the natural ability to have many thoughts about many different subjects, both on and off the job. Good ideas represent a very small proportion of the total number of ideas that an individual originates by thought. If the output of thinking is limited by a person, his output of good and useable ideas will generally also be limited.

The ability to evaluate ideas as to their complete consequences is a must requirement for a good de-
signer. There are far too many ideas which are born from the mind for all of them to be proven physically. An idea which can be originated in a few seconds may take hundreds, or possibly thousands, of hours of labor to determine if physically feasible. This same idea represents additional economic and human con-
sequences which would require in-
creased time and treasure for proof. Economics dictates that ideas must be sorted in the mental and paper states so that only the very best are risked in pursuing to the physical state.

Natural curiosity of a designer, which permits him to be interested in inquiring into and finding out the basic reasons why his physical sur-
roundings perform as they do, is a great assistance to him in his work. The reasons why a physical function follows a particular behavior pattern are many times hidden, and it is the designer's job to uncover these reasons so they can be correctly ap-
plied. Curiosity enables the designer to actively pursue seeking the truth in any situation, and gives him an advantage in approaching the real truth.

Summary

Engineering design forms a very important link in the technical revo-
lution in which we are now involved. Each phase of industry cannot stand on its own as an entity, but it is interdepen-
dent on the others for its survival. Research discovers the basic laws and determines the physi-
cal means, design originates and proves the product, production with its facility and labor produce the hardware, sales determines the needs and market the goods and cus-
tomers, many of whom have con-
tributed in the industrial process, complete the cycle and keep it functioning. Side phases such as fi-
nance, personnel relations, service, advertising, etc., form the lubricant for smooth-running operation of the
INNOVATION IN LIGHTING

ELECTROLUMINESCENCE

By Fred Terry, jr., e.e.

The use of low illuminating light is sometimes desirable. Electroluminescent lighting provides a practical source for this type of light. A high level source for generating electroluminescent light is still in the research stage, but small scale applications of low illuminating light are numerous. Signboards, dial faces, information-storage and display, controlled light-amplification, and cool, flexible lighting demonstrate the utilization of low illuminating light.

This type of lighting offers many advantages. Lamps can be made as thin and rugged panels, be cut to almost any shape, and can be formed into flexible sheets. The theoretical efficiency is higher than for either incandescent or fluorescent lighting. Light is emitted from an area source rather than a point or line source. They do not fail abruptly like the conventional lamps, since luminescence is the emission of light by a crystal.

An electroluminescent lamp is a parallel-plate luminous capacitor. The prosphorescent crystals are suspended in a translucent dielectric between two conducting plates, one of which is also translucent. The three aspects of light emission by a phosphor are, (1) the absorption of the energy of a bombarding electron, (2) the transfer and storage of this energy, (3) the conversion of this energy to light.

The primary electron loses its energy by the excitation of electrons in the conduction band of the phosphor. An incident electron of a few thousand electron volts can set many such electrons free. The electrons and holes wander through the crystal unit until they are trapped in “luminescent centers.” An electron in a trap is held until it packs up enough energy from the lattice vibrations to reach the conduction band.

An electron is eventually trapped in an excited state of a luminescent center or activator, which is an imperfection added to the crystal. This activator contains a free hole, and recombination of the hole and electron occurs. If this electron returns to the ground state, a photon of light is emitted. The frequency of the emitted light is where \( E \) is the energy change of the electron from the excited to the ground state and \( h \) is Planck's constant. Some of the original energy of the electron may be transmitted to the lattice as vibration, so a band spectra is emitted. The energy change in going to the ground state is dependent on the energy levels of the impurities. Most efficient crystals are ZnS crystals with copper as an impurity. This combination emits a green glow.

To induce continuous emission, this capacitor is subjected to an alternating electric field. As the voltage is increased more electrons are raised to the conduction band, and so more electrons are able to be freed. When the frequency is increased, the electrons escape at a faster rate. In both cases, the intensity increases. However, as the frequency increases more wasteful collisions occur, so the efficiency decreases with increasing frequency of the field.

There are two approaches to lamp construction; glass-organic and metal-ceramic. Westinghouse starts with a sheet of window glass coated with a thin film of tin oxide, a translucent conductor. The phosphor-dielectric material is then sprayed on in several layers until the desired thickness is obtained, uniformly. This is then cured in an oven. The rear electrode is formed by vaporizing aluminum on the back. Sylvania begins from the back with a thin steel plate. It is then enameled with a white, highly reflective coating. A phosphor-glass mixture is then silk-screened on and fired in a furnace. A translucent electrode and insulator are then formed on top.

The glass-organic type is initially brighter since the phosphors are not affected by the lower temperatures of curing. The steel-ceramic construction is rugged and more moisture resistant. This increases life since the phosphores are damaged by moisture.

Flexible lamps are made by coating the phosphor layer on a conducting glass cloth or metal mesh. The second electrode is vaporized aluminum. Also lamps can be constructed to transmit light from both sides.

At present, most EL devices emit a soft, green glow. The maximum brightness at 60 cps is 20 footlamberts, while 2500 footlamberts have been obtained at 20,000 cps. This is compared with 2000 footlamberts for a 40-watt fluorescent lamp. The increase in intensity is due to increased field strength is limited by the ef-

(Continued on page 38)
A COMMENTARY FOR NEOPHYTE ENGINEERS

(Continued from page 13)
American Civilization at Brandeis University, indicts our civilization mercilessly. He states that what Americans are suffering from is not so much a moral breakdown as a moral interregnum. One king is dead and a new one has not yet been crowned, as with the moral interregnum at the time of the Roman Empire, when the pagan codes had broken down and the Christian codes had not yet been shaped. (14)

He goes even further and says that in every society forces are generated that are harmful to its functioning and in the end destroy. It would be strange if this were not happening in America as well. The principles by which American culture lives are those of freedom and acquisition, and where the two meet — the freedom of acquisition. There are always a number of people who feel themselves left out of the operation of these principles, or who are in too much of a hurry to wait, or who feel resentful because others seem to start with an unfair set of principles and who therefore seek some equalizer. Since they feel at a strategic disadvantage in the competition of life, they feel justified in ignoring the usual inhibitions and in tearing down the accepted cement of social relations. Because they use a distorted version of the cultural energies to destroy social bonds and rip apart the cohesiveness of the society, they in effect pit the culture against the society. America is too young a society to have developed the kind of inner discipline which can serve to inhibit the full sway of impulsion. (15)

He then concludes that the delinquencies and moral breakdowns which flow from the sense that only power counts and all American life is a racket are less dangerous than those which flow from the sense that nothing counts — not even the rackets... the disorganization which flows from the desensitizing of men, and from a lack of belief in any values, is a threat to the idea of social structure itself. (16)

Dr. Crane Brinton, Professor of History and Chairman of the Society of Fellows, at Harvard, exactly pinpoints the problem. He says that

the mere listing of [the] seven sins — pride, covetousness, lust, anger, gluttony, envy and sloth — should remind us that whatever it is in men that inclines them to such conduct has certainly not been overcome... Is it not possible that, in some way comparable to that in which the natural sciences have opened the way to the unquestionable progress the race has made in its ability to make use of the powers of nature to secure some of the things men want, the social sciences may open the way to progress in our ability to get what we want out of ourselves? (17)

He concludes, emphatically, that the record shows no moral progress comparable to our material progress... Measured against the known standards for conduct set by the ethical principles of the Western tradition, are we in fact conducting ourselves better, narrowing the gap between conduct and ethics?... Is human conduct... at least sufficiently good by standards that measure group achievement so that we may say that the West is not, in a cultural evolutionary sense, clearly in a retrogression?... the whole problem is, unfortunately, hardly to be lifted above the level of the bull session. It can be debated but there will not even be a sense of the meeting. (18)

We live in a vastly changed world — one entirely different from anything ever known before. In the first place, it has been changed by a rapid succession of nearly unbelievable scientific and political developments and, in the second place, by a threat to individual life and liberty, the like of which — and the extent of which — has never before appeared in history. Particularly, with the advent of "sputnikitis" as a dominant influence in our way of life, scientific education has been raised to the level and importance of a cult and the humanities, with their emphasis on a broad, liberal education have been relegated to the hinterlands. Thinking people do not belittle the role of the physical sciences in this atomic age but neither do they fail to recognize that without the humanities technological advances would be of little value. It is not nearly enough merely to know how to construct a better H-bomb; it is vitally necessary to know how to use the atom to save, rather than destroy, the world.

"Ultimately, our security and our freedom lie in an educational system that trains, energizes, and stretches young minds to the limits of their capacities." (19) Dr. Harold C. Case, President of Boston University, predicts for us "the best educational results in the world — more well-trained young men and women who have ample know-how, and even better, they will have a value system to which they are committed, and they will know why." (20)

That gap which is so apparent most certainly must be closed. The imbalance now existing between the sciences and the humanities must be corrected. The educated person, today and tomorrow, must have a real set of values and a definite code of morals and must — above all — know how to behave in the social order in which he finds himself.

(15) Ibid., p. 664-665.
(16) Ibid., p. 6 6.
(18) Ibid., p. 442-443.

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THE ROSE TECHNIC
IMPORTANT DEVELOPMENTS AT JPL...

PIONEERING IN SPACE RESEARCH

The Jet Propulsion Laboratory has been assigned responsibility for the Nation's program of unmanned lunar, planetary, and interplanetary exploration. The objectives of this program are to contribute to mankind's fundamental knowledge of space and the space environment and to contribute to the development of the technology of space exploration. For the next ten years, as larger booster vehicles become available, increasingly versatile spacecraft payloads will be developed.

JPL will conduct the missions, utilizing these spacecraft to orbit and land on the moon, to probe interplanetary space, and to orbit and land on the near and far planets. Earliest of these spacecraft will be the "Ranger" series now being designed, developed and tested at JPL. The mission of this particular series will include first, exploration of the environment and later the landing of instrumented capsules on the moon.

Never before has such a wide vista of opportunity, or a greater incentive been open to men trained in all fields of modern science and engineering. Every day at JPL new problems arise, new theories are advanced, new methods tested, new materials used and new principles discovered. This creates a stimulating work atmosphere for trained individuals and an unlimited field for constructive development of a long-range and rewarding career. Wouldn't you like to take part in it?

Illustrated is a "Ranger" proof-test model undergoing design verification testing in one of the laboratories at JPL. Here design features are tested and proved, operational procedures developed and handling experience gained for the actual construction of the initial flight spacecraft. These spacecraft will be among the earliest pioneers in the development of space science.

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Send professional resumé for our immediate consideration. Interviews may be arranged on Campus or at the Laboratory.

MARCH, 1961
ASTRONOMY
(Continued from page 17)

Now that we have some idea of what "makes the heavens tick," let us talk about some of the stars which are visible throughout the entire year. As the stars in their daily path apparently circle around the Pole star, it seems that there must be some which never rise nor set, but are always above the horizon. If we look towards the North, we shall find the constellation of the Great Bear. Perhaps it is low, near the horizon, maybe right overhead. But whatever its position, the imaginary line through the two Pointers and extended about five times, brings us to the Pole Star.

A line, from the Pole Star to the horizon directly below, cuts this in the North Point, and all stars which are not farther away from the Pole Star than is the North Point, can never disappear below the horizon: they are visible at all times of the year, and are called Circumpolar Stars.

All the stars of the Great Bear have been given names, and the sequence of the Greek letters used to designate them is not in the order of decreasing brightness, but follows the sequence of the stars in the constellation. The star alpha is called Dubhe, beta Merak, gamma Phecda, delta Megrez, epsilon, the brightest star of the constellation, is called Alioth, zeta Mizar, and eta is called Benesnasch.

The Pole Star belongs to the constellation Ursa Minor, the Little Bear, which has a shape similar to that of Ursa Major, but its stars are much fainter. Polaris is the brightest of the constellation, and has the letter alpha assigned to it.

Between the two bears, there is a number of rather faint stars which make up the constellation Draco, the Dragon. Its tail is between the Pointers and the Pole Star, and its string of stars almost circles the little bear. Half-way around, however, it turns back on itself, and finally reaches two somewhat brighter stars, representing the Dragon's Head. These and other circumpolar stars are shown in Figure 3.
FRATERNITY NOTES
(Continued from page 26)

Paint was splashed all over the house, concentrating on the study room walls, but some of the brothers are still extricating globs from their hair. We stopped Rich Carter and his runaway sander after he demolished two chairs and a table. On convincing him that the floor was the only thing that needed sanding, somehow the floors got varnished twice.

Sigma Nu is still ‘movin’ and gruin’ socially. Our annual state-day was held March 11, at the ISTA building in Indianapolis. After a stirring speech, by Vice-Regent Evans at a banquet, the brothers winked, dined, danced and made merry til dawn, thus ceasing our social activity for at least a week.

Bob Carter

THETA XI

Although each spring a young man’s fancy lightly turns to thoughts of love at the drive-in, no Theta XI’s have succumbed to the charms of women since last notice. At least no one has gotten pinned.

As a result of rush, the following men pledged Theta Xi: John Blanchard, Joe Byrd, Al Cleek, Bill Collins, Mel Izumi, Dave Lovelace, Barry Lucht, Jerry McGraw, Pat Pierson, Bob Shaw, Sam Swan, Bill Teeguarden, John Willman, Curt Yee, Jerry Hellman, and Chris Deisher. We are proud to have such a spirited bunch of pledges, although the members in the house think they are a bit too spirited, since we are tired of eating with our fingers.

For the fourth year in a row, the TX Tigers won the IF basketball crown. In spite of rumors to the contrary, we are not going to the NIT tournies.

We have recently been visited by our National Executive Secretary, H. P. Davison. For steady readers, Mr. Davison stayed at a motel, so our worries last issue were all for nothing.

Some of our readers have made comments about our articles which leads us to believe that you view our efforts with an air of levity. Brother McCardle and I believe our writings fulfill a very serious purpose - i.e., they fill space to enable us to meet the 300 word minimum. In addition, they usually cover important topics, like today’s subject - the water fountains at Rose.

I am not discussing the number or placement of the fountains, but the lack of uniformity of them. This may seem rather trivial to some, but those of you who, due to your activities on the night before, have had an extreme craving for water can understand my point.

One of the most obvious faults is the fact that the spouts are not all on the same side. It is well-known that when one has this urgent craving for water, one’s faculties (physical and mental, not school) are not too alert. While it may be a great awakener, it is a definite shock to the nervous system to be hit in the ear with a stream of cold water.

Another non-uniformity is the variation in the amount and placement of pressure on the food-pedal required to get a constant stream. The fountain in the Student Center is a very good example of this.

Since I have to meet a printer’s deadline, I cannot list any more faults. However, as always, I will take time to make suggestions. The ideal solution would be to have beautiful girls with jugs of ice-cold water. However, this is sure to be vetoed by the administration, since the increased water consumption would require increasing the size of the rest rooms. The second best solution is to have fountains similar to eye-wash fountains in industrial labs. There should be rails mounted so those who are really hurting can steady themselves. Some will consider this suggestion very appropriate since this is all eyewash anyway.

I have to sign off now since I have 45 minutes to get this to the printers. Have fun.

Don Niedringhaus

ALPHA TAU OMEGA

The biggest piece of news this month is our fine new pledge class. Congratulations are well in order for Brother Dick Cordill for doing an excellent job in handling this year’s rush program. Also Brother John Walden, house manager, deserves to be commended for his fine efforts in getting the house in shape for the event.

Alpha Tau Omega is proud to announce our new pledges which are listed as follows:

Dave Morgan—Terre Haute, Ind.
Don White—Palatine, Ill.
Don McNally—Hobart, Ind.
Dave Burrall—Terre Haute, Ind.
Ray Ward—Ramsey, New Jersey
Dale Rosewick—Cleveland, Ohio
Del Ellis—Vincennes, Ind.
Bob McNich—Zionsville, Ind.
Brons deSupinski—Parkersburg, W. Virginia
Bob Finney—Deerfield, Ill.
Ed Wright—Casey, Ill.
John Warnke—Hutsonville, Ill.
Dave Rice—Cleveland, Ohio
Chuck Rose—Washington, Ind.
Larry Arnold—Terre Haute, Ind.
Mike Scherer—Indianapolis, Ind.
Jim Austin—Bay Village, Ohio
Dick Jensen—Indianapolis, Ind.
Bill Stegemoller—Dugger, Ind.
Chuck Huppert—Indianapolis, Ind.
John Stewart—Crawfordsville, Ind.
Bill Allard—Pickford, Michigan

Socially the brothers of Gamma Gamma have been active in the past month. The Heart Fund Tag Day was held this year with the Gamma Phi sorority, February 18. The Sigma Kappa sorority honored us with a trade party March 10, the theme for the evening being the “Roaring 20’s.”

The annual State Day Convention was held again at Indiana University this year. Speaking at the evening banquet was our National Assistant Executive Secretary, Norm Ritchie. The banquet was then followed by a dance at the Tau house to cap off a fine weekend.

Congratulations to our new initiate Brent Robertson, who was initiated Sunday, March 5.

In IF basketball play Gamma Gamma finished the season with a 3 and 4 record. The Taus put to-

(Continued on page 41)
men of rose

remember that
special occasion

give her a corsage
by heinl's

heinl's flower shop
william c. "bill" becker
129 so. 7th st.
terre haute, ind.

electro luminescence
(continued from page 33)

fusers, which absorb light, are re-
cy of a light source is based on con-

version of all its electrical input in-
to a yellow-green light of a wave-
length most sensitive to the human
eye. This color would yield a maxi-
mum efficiency of nearly 700 lumens
per watt. However, the melting point
of the tungsten filament limits the
theoretical efficiency of the incan-
descent lamp to about 50 lumens
per watt. The fluorescent lamp ap-
pears to have maximum efficiency of
about 100 lumens per watt, because
of the ultraviolet-visible light con-
version losses.

While the high voltages and fre-
cuencies required seriously limits
the usefulness of EL for present il-
illumination purposes, it finds greater
immediate application in display sys-
tems. Solid-state display panels may
be classified into two types.

In the xy matrix type, the phos-
phor is placed between two fine
screen grids. One grid consists of
parallel conductors in the horizontal
direction with the other perpendicu-
lar to the first. Voltage is applied to
one x conductor and one y con-
ductor. At the point of overlap a
strong alternating field is set up.
This produces a dot of light in the
phosphor.

The three principle problems of
this system are crosstalk, stability,
and brightness. Stability and bright-
ness research is concerned with new
phosphors. Crosstalk is due to the
whole x or y line producing light.
This problem is being attacked in
two ways: (1) the modification of
the phosphor material to make its
brightness-voltage curve have a
steeper slope. (2) The use of non-
linear elements in series with the
phosphor so that the voltages across
it may be easily modified. The most
popular approach is the use of a
ferroelectric capacitor in series with
the display screen. The capacitor is
biased so that a varying portion of
the input will be dropped across it.
In this way the display panel may
be operated in the high contrast re-
gion of its curve.

Most xy panels are designed to be
used in conjunction with a storage
display. In these displays the writing
is accomplished by a light signal.

The light falls on a photo element,
which conducts when excited by
light. This turns the EL phosphor on
for a predetermined length of time.
The phosphor may be turned off by
a strong electric field.

The problems encountered in these
devices are spreading of the stored
images, crosstalk, and poor resolu-
tion. In order to reduce crosstalk,
and spreading, the pillars of photo-
conductor must be physically sepa-
rated. This reduces resolution. How-
ever, advances in materials and
techniques are expected to some-
what relieve this conflict.

Much research remains to be
done — on phosphors, panel design,
and base materials—before general
illumination and information display
panels are of practical value. Electro-
luminescence is now practically
used for small dial faces, with dis-
play systems in the advanced stages
of development. However, many ba-
sic materials problems must be
solved before EL may be used for
room lighting.

observations of success
(continued from page 32)
whole process.

The need for designers, and
especially good designers, will al-
ways be present. The future will no
doubt require an even higher pro-
portion of the population for this
field than at present, because of the
increased demand by the consumer
for more complicated goods than in
the past. New and better perform-
ing equipment is a never-ending
process, and the design engineer is
in the midst of influencing and con-
tributing to this process. There are
an infinite number of combinations
of elements for any one product, and
there are an infinite number of prod-
ucts possible; so the field of oppor-
tunity has unlimited horizons for the
designer.

A student who really likes the
engineering curriculum and is inter-
ested in design should enjoy and
perform well in design work. Engi-
neering design is one of the few
fields where an engineer can practice
in a truly engineering career.
routes. The success of the Erie Canal overshadowed the failures of many lesser canals in the east, and pro-canal public sentiment overruled the pro-railroad governor and turnpike factions in most cases.

A powerful group in the legislature, led by the White Water group, worked to limit the commissioners' activities to but one or two simultaneous projects. They held the correct conviction that this was the only way to really accomplish their goals. Sectional interests defeated agreement for this policy.

Seventy-five resident engineers and surveyors were scattered about the state drawing a payroll of $54,000 from the state for their efforts on the many far-flung projects. These men became popularly (and bitterly) known as the "Eating Brigade." The great majority of them, particularly the group working on the Michigan City-Fort Wayne route, accomplished absolutely nothing.

Governor Wallace struck the sobering note when he addressed the state legislature in December of 1838. State taxation revenues had been $45,000 that year. The interest due was $193,350 and over $1,693,000 had been expended that year. His gross under-statement was, "If this consideration does not startle us, it should at least awaken us."

The board was ordered to centralize on one project at a time. Remedial action had come too late, however, and all work stopped August 18, 1839.

The rapid chain of events ground to a halt and, as the dust settled, Indiana found herself in a bankrupt state of affairs. She had ditches and bridges scattered about the state accomplishing nothing but providing ammunition for cynics and worthless collateral for mortgage holders. The citizenry was aroused by the realization that rather than eliminate taxes, the projects were going to drastically increase them. The legislature was disturbed that it had nothing but the Wabash and Erie Canal to show for its bankruptcy, and inner government circles soon realized that irregularities had occurred in the financial system, somewhere.

Looking back, the people examined the progress which had been made. Superintendent Long was employing nine hundred and seventy-five men in constructing the White Water which had been opened to Brookville in June, 1839. Final estimates for the work on this waterway ran to two million dollars. The first six months of operation netted but $670 in tolls. This same period saw the Wabash and Erie grossing $4,284, enough to pay interest on about $70,000, but not sufficient for maintenance of the canal.

Eight miles of the Indianapolis-Muncie route were complete while sixteen miles were completed south of Indianapolis and 750 men were employed at the site. Nineteen miles had been constructed north of Evansville along Pigeon Creek. When this sector was finished, the creek to be used was dry and boats could not utilize this portion. No portions of the Cross Cut were yet ready for water to be turned in. These isolated and rather useless segments had cost the state $1,820-026. Even more useless was the wagon load of maps the state had in return for the $156,323 expended on the Fort Wayne Michigan City route. The expenditures on the New Albany-Crawfordsville route seem to have provided only four seasons of hunting and fishing for surveying crews. A landlocked canal running from Fort Wayne to Logansport and two short segments of railroad rounded out the state's depressing collection of "internal improvements."

The legislature opened an investigation of the economic affairs and became hopelessly entangled in an economic nightmare. The original funding commissioners had not kept books and had each gone his separate way selling bonds and often failing to report to the other members.

The state found itself in possession of stocks of scattered railroads, insurance companies, failing banks, a sperm and candle factory, mining stock, and second mortgages on land in Brooklyn, New York City and Poughkeepsie — everything short of the unconceived Brooklyn Bridge which New York state and environs had to offer. Most of these securities were as useful to the state as its own public works projects.

The legislature became lost in this "mirage-nightmare" and degenerated to a group of squabbling petty-politicians. Cass County petitioned the legislature to adjourn charging it could accomplish nothing other than spending more money.

An audit completed in 1842 showed that $15,000,000 in bonds had been sold with returns of $8,592,000 in cash, $4,000,000 in worthless securities and over $2,000,000 embezzled.

The White Water Canal was taken over by a private corporation formed in 1846. It was then completed and extended to Hagerstown the next year. From Harrison, branches were built to Lawrenceburg and Cincinnati. The seventy-six miles in Indiana averaged $15,000 a mile in construction cost. The Cincinnati branch cost $35,000 per mile. Its valleys were too steep and narrow contributing to $100,000 flood damage in 1847 and $80,000 the following year. The White Water continued in operation until a railroad which paralleled it cut off its business in 1865.

In 1859 the state sold the Central Canal to Shoup, Rairdan, and Newman for $2,421. The canal never traversed the Mississinewa Valley to Marion. Anderson, Peru, Muncie, and other cities had no traces of the Central Canal. It reached from Broad Ripple to Waverly and is owned today by the Indianapolis Water Company. Other scattered canal works were abandoned.

Ohio had now begun construction of her portion of the Wabash and Erie Canal. The Hoosiers felt an obligation to Ohio, under their agreement, to finish the canal to Evansville. It was further felt that completion of the canal would improve...
the economic picture and help the dilemma. Work resumed and the canal reached the Tippecanoe River in 1841.

The work was now paid for with scrip redeemable in canal lands. The scrip was redeemed by merchants miles ahead of the construction work at par value. As the canal reached these villages the scrip depreciated to forty cents on the dollar, ruining merchants.

Tuesday, July 4, 1843 was a great day for Fort Wayne. Ten to fifteen thousand citizens of Ohio, Indiana, and other states crowded the city of two thousand to celebrate the formal opening of the canal from Lake Erie to the Wabash. The city was selected for the opening since construction had started there and it was the summit of the canal, being 193 feet above Lake Erie.

The newspapers of the day took pride in noting that these lands now so highly developed had belonged to the Indians but seven years earlier. The man responsible for the treaties, General Lewis Cass of Michigan, was the Principal speaker for the day. Trying for the presidential nomination, he delivered an address praising the canal in all its glory and including everything the stereotype politician is supposed to acclaim on Independence Day. His speech was punctuated with shots from the cannon which had opened the festive day with a 26-gun salute.

In 1843 Ohio completed the eastern end of the canal and the fastest packet boats in the nation were running from Toledo to Lafayette in two days. Nevertheless, problems beset the canal. The cost for repair of damage from a flood in 1844 was more than the toll receipts. Water shortages occurred in 1841 and the Fort Wayne Times and People’s Press apologized in August by saying, “We regret . . . that it is very uncertain whether we will be able to issue more than an extra next week because the supply of paper by the first boat has not yet arrived.”

In 1847 the canal was in use to Cayuga, thirty-six miles above Terre Haute. The next year 1,780 men were working from Coal Creek to Patoka Summit. Tolls rose to $146,148 while construction cost of $342,000 and $33,000 was needed for repairs.

The year 1849 saw boats reaching Terre Haute. Otherwise it was a bad year. Floods caused extensive damage to the Eel River section and cholera and plague broke out along the route killing and demoralizing workers while epidemics raged at Toledo and Lafayette. Receipts dropped to $131,000.

Halfway into the Nineteenth Century, progress allowed boats to reach Washington and tolls reached a new high of $157,158. Cholera continued to rage, killing 150 workers and the workmen fled, spreading the disease throughout the countryside.

The next year floods closed the entire system but not until tolls jumped $22,000. The work into Evansville required 1,200 men, and it was completed to Newberry. In 1851, $59,000 were spent for repairs and $65,000 for bridges for the canal to cross rivers, and 150 bridges for roads to cross the canal.

The upper portions lasted through 1870 becoming stagnant pools when the Wabash Railroad waged a successful rate war. A law of February 14, 1873 allowed county commissioners to keep the “Appian Way of Indiana” in repair, but few temporary measures were taken.

The Rocky Mountain made the last run from Lodi to Toledo on October 26, 1872. In 1874 a boat was crossing the Deer Creek aqueduct east of Lafayette when the structure collapsed drowning the Negro driver and the mules. In November of 1875, a boat managed to complete the Lodi-Lafayette segment, but the canal had served its usefulness. It had introduced industry, shipping, and new emigrants to the Wabash and Maumee Valleys throughout the booming fifties.

As canals go, those of Indiana were miserable failures. They were built with rose colored glasses on every official face. But as an economic factor they were indispensable. The canal boats took out boatloads of agricultural products and returned with Swiss and German emigrants to settle the frontier lands. The emigrants had traversed the Erie canal to reach the midwest. Before the Wabash and Erie Canal opened, the emigrants settled around Chicago, Detroit, Cleveland, and other lake front cities. As these cities grew and the railroad became more popular, the need for connecting railroads between the larger cities was felt.

The Wabash and Erie having contributed to the growth of north central Indiana cities, also contributed to its own demise. Connecting railroads were forced to traverse Indiana, and these newly vitalized towns provided profitable routes for the railroads — and the doom of the canal. The canal simply became incapable of coping with the business upswing.

Indiana learned several lessons in the improvements of the 1830’s. One of the foremost of these was the folly of a large, uncontrolled state debt. An amendment to the State Constitution has provided that state projects must be paid for in cash.

Another lesson was the economic importance of the canal. Although the canals nearly ruined Indiana financially, they simultaneously set the stage for great economic growth. New settlers were brought in to settle the sparsely populated land. Citizens geared their economy to the outside world as products moved in and out.

The lesson learned was evidently that of the economic importance rather than failure of canals. Late in 1907 a Chicago, Fort Wayne, Toledo “Lake-to-Lake Canal” was proposed. Army engineers completed surveys for the route which was estimated to cost from thirty to forty million dollars. The Guide to Fort Wayne for 1914 stated, “ . . . events have given every assurance that the great project is to become a reality” but this “great project,” like many of its predecessors has failed to evolve successfully.
FRATERNITY NOTES
(Continued from page 37)

together a victory over Sigma Nu and two wins over Lambda Chi to finish in a tie for second place forcing a playoff. However, the playoff game found Sigma Nu on top by a score of 56 to 37.

Spring is getting nearer and, more men are beginning to throw their pins around. Brother Jay Hirt is at it again. Jay’s most recent pin girl is Miss Ruth Ann Link of Louisville, Kentucky. Others who have relinquished their pins include Brother Jerry Heiniger, who is pinned to Miss Loretta Dillard of Paoli, Indiana, and Brother Tom Keeling, who is pinned to Miss Mary Ellen Schwarz of Terre Haute.

Congratulations to Brother T. C. Copeland who is now engaged to be married. Miss Sharon Chenault is the lucky girl and Sharon is now attending the University of Kentucky. Oh yes, Jay Pullitt is going steady with Diane Roberts. Congratulations, Jay.

Scott Herrin

LIBRARY NOTES
(Continued from page 24)

Shadows on the Grass contains four stories:
Fairah, the storyteller describes a mistress-servant relationship.
Brua A Soldani (Letter from a King).
The Great Gesture, shows how generosity triumphs over superstition.
Echoes from the Hills, recollections of the past upon hearing news of the author’s friends in Africa.
In Place of Folly
by Norman Cousins
“Since the day the atomic bomb was dropped on Hiroshima, Norman Cousins has devoted his principal attention and energy to the full implication of the nuclear age.”

He brings together in a single book the essential facts concerning the present danger as well as a clear, specific statement of alternatives.

The ultimate folly, the author believes, can be averted — so long as “we do not crave the distinction of being the last generation of men on earth.”

Experience is a great teacher but . . .
you can learn more from books cheaper and faster

Order your books through
Rose Polytechnic Book Store

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March, 1961 Page 41
When Rodger got home from college last summer his mother insisted on unpacking his trunk. The second article she took out was a coat with a pawn shop tag on it.

“Rodger, what is this tag for?”

“Oh, I went to a dance and checked my coat,” replied Rodger.
The next item was a pair of trousers with the same tag on them.

“Rodger, just what kind of dance was that.”

“Are you still engaged to that girl with the wooden leg?”

“No, I got mad at her and broke it off.”

One of the delicate problems a father faces is telling his son what he knows about women without displaying his ignorance.

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

E.E.: “I know all about electricity. A politically minded ion hears that there is going to be an electron, so he goes to the poles and volts.”

Lectures are like steer horns—a point here, a point there, and a lot of bull between.

“Madame, may I see your daughter?”

“No, Get out and stay out.”

“But, Madame, see this badge? I’m a detective.”

“Oh, I’m sorry; come in. I thought it was a fraternity pin.”

Answer to a question on a Physics test: A meter is the distance between two bars in Paris.

Two junior size “cats” were loitering on a street corner, when one said to the other:

“How old is you?”

“Ahs five,” was the reply. “How old is you?”

“Ah don’t know,” said the first. “You don’t know how old you is?”

“Nope.”

“Does women botha’ you?”

“Nope.”

“Youse fo’.”

Confucius says: It is better to have failed your Wasserman test than to have never loved at all.

First Drunk: “We’re getting close to town.”

Second Drunk: “How do you know?”

First Drunk: “We’re hitting more people.”

Econ lesson for the day: Girls without principle draw considerable interest.

Ode to a Future Business Major

Here I sit in silent bliss,
Listening to my sliderule hiss,
While every now and then is heard,
The explosion of a profane word.

Thru murky smoke is dimly seen,
Del-div. A, Script D between Cross, dot products, tensors too,
Cripes, I’m confused, but that’s not new,

The prof gave some problems
To do at the pad—
Another night’s sleep gone,
But that’s just too damn bad.

When the test asked “What’s strain”
I thought it meant worry.
Another course tubed,
But who’s in a hurry.

We study in groups,
To solve problems not clear.
But always we goof,
So out for more beer.

Now engineers are great
With exacting equations,
But they seem to be lost
At all other occasions.

No doubt about it,
Engineers are not sane.
And if I don’t get HIP—I’ll be engineer on a TRAIN!
If your sights are set on space survival—

Scientist photographs the development of experimental “lunar” plant at the Republic Aviation Corporation’s “Lunar Garden.”

—you’ll find Photography at Work with you

Solving the problems of a human being living in outer space has become the task of scores of engineers, chemists and botanists. And serving them as a valuable working tool is photography. It records the growth of experimental plants and fungi that can well become the space voyager’s food supply. Through autoradiography it can show the absorption of cosmic radioactive material, trace its circulation within the organism.

There’s hardly a field on which you can set your sights where photography does not play a part in advancing work and simplifying routine. It saves time and expense in research, on the production line, in the engineering and sales departments, and in the office.

So in whatever you plan to do, take full advantage of all the ways photography can help.

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

* * *

If you are looking for such an interesting opportunity, write for information about careers with Kodak. Address: Business and Technical Personnel Department, Eastman Kodak Company, Rochester 4, N.Y.
Several surveys indicate that salary is not the primary contributor to job satisfaction. Nevertheless, salary considerations will certainly play a big part in your evaluation of career opportunities. Perhaps an insight into the salary policies of a large employer of engineers like General Electric will help you focus your personal salary objectives.

Salary—a most individual and personal aspect of your job—is difficult to discuss in general terms. While recognizing this, Mr. Case has tried answering as directly as possible some of your questions concerning salary:

Q Mr. Case, what starting salary does your company pay graduate engineers?
A Well, you know as well as I that graduates' starting salaries are greatly influenced by the current demand for engineering talent. This demand establishes a range of "going rates" for engineering graduates which is no doubt widely known on your campus. Because General Electric seeks outstanding men, G-E starting salaries for these candidates lie in the upper part of the range of "going rates." And within General Electric's range of starting salaries, each candidate's ability and potential are carefully evaluated to determine his individual starting salary.

Q How do you go about evaluating my ability and potential value to your company?
A We evaluate each individual in the light of information available to us: type of degree; demonstrated scholarship; extra-curricular contributions; work experience; and personal qualities as appraised by interviewers and faculty members. These considerations determine where within G.E.'s current salary range the engineer's starting salary will be established.

Q When could I expect my first salary increase from General Electric and how much would it be?
A Whether a man is recruited for a specific job or for one of the principal training programs for engineers—the Engineering and Science Program, the Manufacturing Training Program, or the Technical Marketing Program—his individual performance and salary are reviewed at least once a year.
For engineers one year out of college, our recent experience indicates a first-year salary increase between 6 and 15 percent. This percentage spread reflects the individual's job performance and his demonstrated capacity to do more difficult work. So you see, salary adjustments reflect individual performance even at the earliest stages of professional development. And this emphasis on performance increases as experience and general competence increase.

Q How much can I expect to be making after five years with General Electric?
A As I just mentioned, ability has a sharply increasing influence on your salary, so you have a great deal of personal control over the answer to your question.
It may be helpful to look at the current salaries of all General Electric technical-college graduates who received their bachelor's degrees in 1954 (and now have over 5 years experience). Their current median salary, reflecting both merit and economic changes, is about 70 percent above the 1954 median starting rate. Current salaries for outstanding engineers from this class are more than double the 1954 median starting rates and, in some cases, are three or four times as great.

Q What kinds of benefit programs does your company offer, Mr. Case?
A Since I must be brief, I shall merely outline the many General Electric employee benefit programs. These include a liberal pension plan, insurance plans, an emergency aid plan, employee discounts, and educational assistance programs.
The General Electric Insurance Plan has been widely hailed as a "pace setter" in American industry. In addition to helping employees and their families meet ordinary medical expenses, the Plan also affords protection against the expenses of "catastrophic" accidents and illnesses which can wipe out personal savings and put a family deeply in debt. Additional coverages include life insurance, accidental death insurance, and maternity benefits.

Our newest plan is the Savings and Security Program which permits employees to invest up to six percent of their earnings in U.S. Savings Bonds or in combinations of Bonds and General Electric stock. These savings are supplemented by a Company Proportionate Payment equal to 50 percent of the employee's investment, subject to a prescribed holding period.

If you would like a reprint of an informative article entitled, "How to Evaluate Job Offers" by Dr. L. E. Saline, write to Section 959-14, General Electric Co., Schenectady 5, New York.