Dan Johnson has a flair for making things.

Just ask his family in Marrakeck, Morocco. A solar cooker he helped develop is now making life a little easier for them—in an area where electricity is practically unheard of.

The project was part of Dan's work with VITA (Volunteers for International Technical Assistance) which he helped found.

Dan's ideas have not always been so practical. Like the candle-powered boat he built at age 10.

But when Dan graduated as an electrical engineer from Cornell in 1955, it wasn't the future of candle-powered boats that brought him to General Electric. It was the variety of opportunity. He saw opportunities in more than 130 "small businesses" that make up General Electric. Together they make more than 200,000 different products.

At GE, Dan is working on the design for a remote control system for gas turbine powerplants. Some day it may enable his Moroccan friends to scrap their solar cooker.

Like Dan Johnson, you'll find opportunities at General Electric in R&D, design, production and technical marketing that match your qualifications and interests. Talk to our man when he visits your campus. Or write for career information to: General Electric Company, Room 801Z, 570 Lexington Avenue, New York, N. Y. 10022.

GENERAL ELECTRIC
AN EQUAL OPPORTUNITY EMPLOYER (M/F)
Through the ages...

TELESCOPES

Galileo Galilei, the Italian astronomer, used a two-inch-wide telescope to first study the heavens in 1609. Using an improved telescope on January 7, 1610, he saw four satellites of Jupiter, viewed craters on the moon, and made the observation that the Milky Way was an enormous cluster of stars. Drawing of Galileo by Chrysler Corp.

The easiest way to do it is with mirrors—a new no-lens, wide-view-field telescope from a manned orbital lab above the earth's atmosphere used to fingerprint the stars.

A much earlier idea—a refracting telescope invented in 1608 by Hans Lipperhey, a Dutch spectacle-maker—gave way a year later to the first complete astronomical telescope constructed by the Italian astronomer Galileo. As originally devised, the telescope used a monocular optical glass, composed of a convex and a concave lens fitted at opposite ends of a tube. Years after Galileo, telescopes still used a simple converging lens for an objective, but these telescopes produced very poor images and were far from satisfactory. In attempting to get a better picture, some of the early telescopes with objectives only four inches in diameter were made as long as 200 feet. It's a wonder that early astronomers saw as much as they did, considering the quality of their telescopes.

More than 200 years ago, men discovered that various kinds of glass refract the different colors of light unequally. The invention of achromatic lenses, effectively realized by John Dolland, brought forth the modern refracting telescope, considered unrivaled for exact astronomy. The comparatively long focal length of achromatic objectives produces a rather large scale image, but this automatically reduces the area of the sky that can be observed at any one time.

In 1672, Newton came on the scene, replaced the objective lens of a refracting telescope with a concave mirror, and the reflecting telescope was created. This type of telescope uses a parabolic mirror to gather as much light as possible from the region being observed. With very large reflectors, this region may not be larger than the area of the sky covered by a pea held at arm's length.

We have come a long way from Newton's first reflecting telescope of one-inch aperture and six-inch focal length to the giant reflector on Mount Palomar, California, whose mirror is 200 inches wide. The Russians may go even farther. Noted in a recent article in the "New York Times" was an announcement of a Soviet telescope produced with a mirror 236 inches in diameter.

Significantly, the Space Division of Chrysler Corporation, in developing a no-lens, wide-view-field telescope, may (Continued on Page 20)

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RCA in Aerospace and Defense

The most significant benefit to mankind from meteorological satellites has been the dramatic improvement in the everyday observation of the earth's weather systems. With earth-orbiting satellites, the weather over the entire earth is viewed daily. The more than 30 spacecraft and major systems built by RCA have accumulated a total of nearly 20 years in outer space. You will find in this one area alone—Aerospace and Defense—RCA has set standards of engineering excellence that are second to none.

We are looking for EE, ME and IE graduates for positions in the Corporate Programs including Design and Development, Manufacturing, Purchasing, Operations Research, Finance, and Management Information Systems.

We welcome the opportunity to review your personal interests and career objectives, and show you how RCA can further your individual development and growth in many fields, such as: Home Entertainment Products, Communications, Solid-State Devices, Computers, Control Systems, Radar, Weather and Communications Satellites, Broadcast Studio Equipment, Conversion, Receiver and Power Tubes, Laser and Electro-Optic Devices, Microwave Systems, Medical Electronics, Graphic Systems, etc. See your college placement director, or write to College Relations, RCA, Cherry Hill, New Jersey 08031. We are an Equal Opportunity Employer.
My subject is engineering—a very broad subject, but one which I have been thinking about and actively working with, in various capacities and in various places, for a long time. I wish to preface my remarks by noting that I write as an individual, not as a representative of any organized group—neither an engineering society, nor university, nor industry, nor any other.

An early father of the Christian church, Tertullian, coined in about the year 200 A.D. the word “ingeniarius,” that is, invention or product of genius. A thousand years later the word “ingeniary,” that is, engineer, came into use.

Early in the nineteenth century the British architect Thomas Tredgold defined engineering as “the art of directing the great sources of power in nature for the use and convenience of man.” Nicholas Murray Butler, building upon Tredgold’s definition, added, “engineering is the link, the bridge between man and nature; a bridge over which man passes to get into nature to control it, guide it, to understand it, and a bridge over which nature and its forces pass to get into man’s field of interest and service.” Butler went on to say that “the splendid careers of the two outstanding engineers in America are the two learned professions of medicine and engineering. Medicine concerns itself with the protection and care of the health of the race; and the other, Engineering, concerns itself with giving it new command over the forces of nature and bringing these forces more completely into human service.”

These are vital definitions, because they establish two key ideas: first “invention”; and then “human service,” or “use and convenience of man.” Thus the nature of engineering — its basic characteristic — is that it deals in physical entities, and these entities must serve the needs and wants of people.

The history of our civilization is replete with the influence of engineers. Engineers have responded to the great needs and wants of the many cultures contributing to the development of our civilization, and the increased complexity of man’s existence is a reflection of the cumulative impact of engineering.

This cumulative impact is, of course, made up of a multitude of contributions, from the few and simple in ancient times to the many and complex today: engines to take the burden of work from the backs of men and animals and to transport men and goods; machinery to simplify and speed the processes by which the necessities of food, shelter and clothing are made available; products to make a more convenient and fuller life possible to man — anyone can easily list them out of his own daily experience.

Because these familiar results of engineering are so multi-faceted, it is natural to expect engineering work to be similarly multi-faceted. And indeed it is. But it is very important to remember that every contribution of engineering rests on three foundation stones common to all engineering:

The materials found in nature.

The energies found in nature.

Information techniques by which man can sense, communicate, record, retrieve, and process information and use it to control natural phenomena for his own benefit.

Looking at engineering in this way illustrates some very important relationships. Engineering is closely related, through the foundation stones on which its aspects rest, to the classical physical sciences. Engineering is equally closely related, through its human service aspects, to the life sciences and the behavioral sciences. Engineering neglects either of these, and I think neglect and misunderstanding have here indeed brought the engineering community into grave difficulties today.

Specifically, we have seen explosive developments of resources in the funds of knowledge and understanding through the sciences — not only in the physical ones, but very importantly in the life and behavioral sciences as well. Yet there is a vacuum at the interface between engineering and these new resources. If nature abhors a vacuum, modern society does so even more and will rush in somehow to fill one when it exists. Scientists are doing precisely that — moving into the vacuum at the interface between themselves and engineering. Engineers stand aloof, puzzled and dismayed when engineering work is undertaken by those educated and trained and normally engaged in scientific pursuits.

If both scientists and engineers are to make their best contributions, we need to remind ourselves continually of both their common and their differing characteristics. Science, as we know it today — the search for knowledge and understanding of nature, and the codification of the information thus generated — came into being with the Renaissance. Engineering is concerned with the practical application for the benefit of mankind of the funds of knowledge and understanding in science and technology. Science moves from the specific to the general, and engineering from the general to the specific.

Ancient cultures probed rather gently at the edges of science. The Greeks were especially interested, though their interest was one of philosophical speculation, a mental exercise. Experiments to confirm their speculations were frowned upon. Archimedes apologized for his interest in invention and discovery, claiming them to be only pursuits for his own diversion and amusement. Science and engineering were strangers. Almost two thousand years elapsed before the influence of the Greek culture was modified; engineers walked most of the long roads to our culture alone. What world history and our society might have been, had the Greeks wedded science and engineering!

Much of today’s engineering still drives its roots deeply into the technology generated by our forebears. Today all engineering is benefited by the availability and the flow of knowledge and understanding from science, though in some of the traditional disciplines of engineering, this flow and resulting benefit are at a low ebb. Some engineering came into being and grew out of scientific discovery. The physical, life, and behavioral sciences have been increasing and shattering impact on engineering.

The resource interface problems are of great number. Each interface results in difficulty of communication, understanding and cooperation, whether it be the interface between the physical, the life and the behavioral sciences; between the disciplines of each of these classical sciences; between science and technology; or between the traditional disciplines of engineering.

Individual scientists are judged within the scientific community by their contributions to the funds of knowledge and understanding in science and to the scientific literature. Judgment of the individual engineer by the engineering community is much more complex. The identification spectrums of each discipline, of subject in product or service, and of functional role are wide; for example:

Engineering in a field with dynamic change in technology contrasted with a field not yet caught in the sweep of technological change.

Self employment as contrasted with institutional employment.

Objectives related to defense and space contrasted with objectives related to civilian competitive enterprise.

Subject matter ranging from a minute electronic device to a national transportation system.

Functional roles encompassing research, development, design, production, operation, management, and education.

We can define and identify rather precisely the activities engaged in and the results of these activities in science and engineering, but many persons nominally classified as scientists or engineers find they are working in both fields. World War II was a war of science and technology. Much was demanded of and much was contributed by both the scientific and engineering communities to the war effort to the extent that there was some thrust into practical application of the latest in the basic sciences was accomplished by a movement into engineering.

(Continued on next page)
UNDER...neering fields of men educated in science and previously occupied with the pursuit of scientific objectives. This movement has continued as the requirement for the defense, nuclear, and space programs have confronted the scientific and engineering community with an endless series of problems at the cutting edge of science and technology. In reality the individual scientist and the scientific community work under a compelling economic and political need constantly to contribute information supporting the technology of our society. In this framework of economic and political compulsion, few scientists can afford projecting their interests into the field of application. Much of the output of the scientific community is not immediately relevant to the wants and needs of our society.

In a like manner, though the total engineering community is sharply divided by the traditional disciplines, there is abundant evidence that the majority of presently employed engineers are not well within the disciplines in which they majored during their formal educational experience. And the continued shift in the percentage of engineers institutionally employed as compared with those self-employed. More over, the last generation has seen a change in the pattern of work in the engineering community, from employment as an individual generalist to work as a member of a team of specialists.

In recent years our technological society has demonstrated the strong movement of persons from the scientific and engineering communities into positions of leadership and responsible management in government and in industry. As a result of all this, the image of the engineer has blurred, even within the scientific community. An individual engineer no longer fits into a simple and neat pattern.

Government has become a mighty force in giving direction to the best of our intellectual resources in science and in engineering, both in the academic world and in industry. The United States is engaged in world-wide competition for industrial, political, and social leadership, a competition in which science and engineering play a dominant role. Our research and development activities, quite apart from the economic and social benefits derived from this competition, are of considerable importance to the world's economic and political security.

Our nation is a nation of workers, and the men and women who work in the fields of science and engineering are a significant segment of the work force. The number of scientists and engineers working in the United States has increased from 30,000 in 1940 to 500,000 in 1960. A large number of these workers are involved in basic research, but an even larger number are engaged in application of scientific knowledge to the solution of specific technical problems. The scientific community is not a monolithic group, but rather a diverse body of specialists.

The scientific community is composed of many different types of scientists, each with his own interests and research objectives. The scientific community is a complex body of scientists, each with his own interests and research objectives. The scientific community is not a monolithic group, but rather a diverse body of specialists.

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New Eminent Member...

GEORGE H. BROWN

Dr. George H. Brown, Executive Vice President of the Radio Corporation of America, was inducted into Eminent Membership in Eta Kappa Nu, in Boston, Massachusetts on November 2, 1967. The Boston Alumni Chapter was in charge of the arrangements, and the program was held in conjunction with the Northeast Electronic Research Engineering Meeting (NEREM).

Dr. Brown, who was born in North Milwaukee, Wisconsin, was graduated in 1930 from the University of Wisconsin with a B.S. degree in electrical engineering. In 1931, he received his M.S. from the University of Wisconsin. He received his Ph.D. from Wisconsin in 1933 and the Professional E.E. degree in 1942. In May 1962, Dr. Brown was honored by the University of Wisconsin with a Distinguished Service Citation for leadership in industry and engineering.

In 1933, Dr. Brown joined the Radio Corporation of America. Prior to World War II, he developed the Turnstile antenna, which has become a standard broadcast antenna for television. During World War II, Dr. Brown was responsible for important advances in antenna development, for the development of radio-frequency heating techniques, and he and his associates also developed a method for speeding the production of penicillin. At the end of the war, Dr. Brown received a war department certificate of appreciation, "for his outstanding work in the research, design, and development of radio and radar antennas during World War II." Since World War II, Dr. Brown has held various positions in RCA, including: Director of Systems Engineering; Chief Engineer of the Commercial Electronic Products Division; Chief Engineer, RCA Industrial Electronics Products; and, in 1959, he was appointed Vice President, Engineering. In 1961, Dr. Brown was appointed Vice President, Research and Engineering, and in 1965, he was appointed to his present position.

He has made outstanding technical contributions to electronic communication and to modern television, particularly in antenna development and system design. Dr. Brown is the author of numerous articles and holds 79 U.S. patents.

Dr. Brown is a member of the Board of Directors of RCA and of RCA Communications, Inc. He is a Fellow of the Institute of Electrical and Electronics Engineers and the American Association for the Advancement of Science; a member of Sigma Xi, the Franklin Institute, and the National Academy of Engineering.

In May 1965, Dr. Brown received a citation for his contributions to international television at the Fourth International Television Symposium, and in 1967, he was awarded the Edison Medal by the Institute of Electrical and Electronics Engineers.

The induction team with Dr. Brown: L to r. Mr. John A. Tucker, Past National Director, HKN, Administrative Officer, E.E. Dept., M.I.T. — Dr. Charles Hutchinson, National Director, HKN, Professor of E.E., University of Mass. — Dr. George Brown — Bruce Welsh, Past President, Boston Alumni Chapter, HKN, Professor of E.E., M.I.T.
Resume of HKN Regional Visitation

O. M. Salati
Past National Director

The group leaders for the roundtable discussions were: O. M. Salati, H. H. Sheppard, and T. W. Williams. The following topics were discussed:

1. Candidate Selection
   There was considerable discussion on this subject. The constitutional requirement is that the candidate shall be in the upper quarter of his Junior class or the upper third of his Senior class at the start of the respective terms. It was felt by some of the chapters that this rule is too restrictive since a student may have failed one or more courses in his freshman or sophomore year and have done excellent work in his junior year. Thus, an excellent engineer is effectively barred from HKN.

2. Initiation
   Three chapters, Univ. of Penn., Drexel and Villanova hold a joint initiation. Other chapters have held joint dinners with other honor societies, but the initiation was separate. Joint initiations and dinners or dances with other HKN chapters or other honor societies is recommended since they may cut down on the total number of student obligations and their may promote fellowship among more students.

3. Program Planning
   It appears that optimum times for initiations, dinners, picnics, etc. differ among the schools. Each school has its own optimum time.

The question of the best time for a Regional Visitation was not really explored. It is quite apparent, however, that it should be after the football season but before examination periods. The Fall of the year is probably better than the Spring, especially for students on the co-op plan.

4. Campus Prestige
   This appears to be a problem for most of the schools since all too frequently campus "newspapers" refuse to carry campus news. Possible solutions are:
   a. Have a member of the staff of the newspaper or other campus news media. This is a very effective way of getting publicity.
   b. Send news items to the hometown newspaper of the student being honored.
   c. Start own newspaper or newsletter.
   d. Display the Bridge of HKN in appropriate places.

5. Relations with HKN Headquarters
   The only problem mentioned was that of late arrival of keys for new initiates.

6. Relations with Faculty
   A few schools appear to have problems concerning with recognition of HKN and its potential value to the school. A few suggestions for improving faculty-HKN relations are:
   a. Publicity, picnics or other student-faculty get togethers.
   b. Assist in maintenance of student lounge or laboratories.
   c. Aid to electrical engineering department during registration.
   d. In cooperation with other E.E. student societies, participate in evaluations of faculty members and courses. Give this information to the director of the school.
   e. Give an award for the outstanding faculty member.
   f. Provide a trust fund for a portrait of a prominent faculty member. Alumni will frequently assist in this project.
   g. Exhibit photographs of all faculty members.

7. Relations with Alumns
   Not all of the schools were near HKN Alumns Chapters. Those that are should attend Alumni Chapter meetings when possible. They are always welcome. The Philadelphia Alumni Chapter meets on the first Wednesday of the month, October through May at The Engineers Club in Philadelphia, 1317 Spruce Street, for luncheon (12 noon). The Alumni are always willing to assist the students by lectures, tours of industrial plants and laboratories and job selection guidance.

8. Chapter Finances
   All of the chapters are solvent. Some of them supplement their treasuries by modest dues in addition to part of the initiation fee.

9. Student Aid
   A few chapters indicated that they are not getting prospective members because the pledges cannot afford the initiation fee. Two chapters are presently waiving the cost; they expect to be repaid. A suggestion was made that a trustee fund may be set up for this purpose. Contributions to the fund may be solicited from students, alumni and possibly the E.E. department. This item will be brought to the attention of HKN headquarters.

10. Chapter Projects
    The following is a listing of projects that were reported on by the various schools:
    a. Lectures to aid in the development of well informed engineers.
    b. Prize to outstanding Sophomore or Pre-Junior E.E. student.
    c. Table or cabinet display of HKN key, emblem, certificate and the latest copy of the Bridge.
    d. Pledge projects: polish HKN casting and mount on plaque, interview all HKN brothers and staff members, essay.
    e. Athletic events with other societies.
    f. Construct and exhibit projects for E.E. open house.
    g. Act as campus guides.
    h. Outstanding Senior Award.
    i. Award for best pledge plaque.
    j. Tutoring programs, slide-rule classes.
    k. Digest of top 40 graduate schools.
    l. Write to former students presently in graduate school to get non-catalog information.
    m. Summer job information service.
    n. Lectures to stimulate Freshmen interest in Electrical Engineering.

Successfully executed projects are one of the best ways to publicize HKN.
Take Harry Sauls, of Miami Beach: a mature man, of perhaps 70-ish, who designed and built kites to fly on steel cables from the stern of our transatlantic voyages, to protect them from German dive-bombers and the large barrage kites to protect London during the WW-II blitz. Or take Domina Jalbert of Boca Raton: The last time I was at his laboratory — where he is working on certain unannounced projects — he was flying two kites, on nylon rope, from a two-handled geared winch on 2" x 2" single iron A-frame, in turn tied to his car. Others have designed trailers, with geared gasoline engines, to launch and haul in their kites. Even Santa Claus — Walter H. Scott, of Columbus, Ohio and Briny Breezes, Florida — my mentor and chief proponent — flies his kite from an 8" stainless steel winch, wound by a "V"-shaped electric drill on a specially designed table, using 80# woven nylon line.

SIMPLE KITES

Let's look at a few simple kites even you and I can make — and fly:

We can all remember the standard 2-sticker of our childhood. Usually diamond shaped; sometimes square or rectangular; always requiring a tail to stabilize it; the transverse spar could be bowed back, or upward. It is a simple kite to make and with a little experimenting with the amount of tail, easy to fly. It comes in all sizes, and is the usual kite sold in the five-and-dime stores, for from 29 to 49 cents.

The next is the conventional 3-sticker. This is only slightly more difficult to build; it usually has more "pull" than the 2-sticker, due to larger area. It is still a flat-face like the 2-sticker, and requires a tail for stability. It has the appearance of a larger kite, although the spars may be the same length as the 2-sticker.

Both of these, and their various variations can be made of dowel rods, bordered with tight string, and covered with tissue paper, kraft paper, or light windproof cloth, and may be decorated to the builder's taste. Better than string is nylon monofilament fishing line.

Lately, plastic sticks have become available for most of the commercial small boys' kites; they are strong, flexible and usually straight. Bamboo is often recommended for spars: it has great cylindrical strength, but is difficult to fasten, and is seldom straight, especially in smaller sizes. Personally, I prefer straight grained western white pine for spars, ripped to dimension in my own shop. It is light, strong and supple, and quite universally available at the lumber yard or cabinet shop, often as scrap trimming.

Covering material may be almost anything, light and strong, and easy to sew or glue. For a simple glue, there is nothing cheaper than flour and water. Elmer's white glue is ideal for cloth, paper, and porous substances; it is worthless for non-porous coverings like plastic bags from the cleaners or laundry. Kraft paper is cheap, strong covering easily worked, and can be made taut with a little care. Nylon cloth is more colorful, harder to get, and more difficult to work, but is light, strong, and with care to avoid "pocketing." may be sewed or glued. It has the advantage of being water-proof, to a large degree.

in the wind. Its disadvantage is that it collapses and dives when the wind moderates. To avoid this collapse in the air, it has been found desirable to add a cross stiffener — not too stiff — along the leading edge. A "V" of vent of prescribed proportions, forward from the trailing edge allows escape of air, and gives the sled a built-in "tail." Thus, we have the first and simplest of the "tailless" kites. The Scott Sled will fly in a whisper, it will fly high overhead; it can be launched with a whip of a fly rod. I have built successful Scott Sleds 24", standard 36" and 48" long; they all fly. When asked how I dimensioned them, I said I proportioned them by forcing the top panel into the form of the upper surface of an airplane wing. This kite, too will fly in a whisper; perhaps it is the basis of motorless gliders. It can be made in almost any size, but the larger sizes require two or more men to launch and control them. I have seen two Jaqit Airfoils mounted on either side of a 2-foot triangular box kite that required two men merely to hold it, and I am told required 4 men to get it down out of the skies.

A "professional" recommended to me that I stock with "small" kites. They are easier to build; cost less; can if necessary be launched and handled by one man (I sometimes question this), and will give all the fun — and frustrations — of the larger kites. Using 30# monofilament, or 36# woven nylon line, it is absolutely essential to wear leather gloves, to prevent bad skin burns, and cuts, from the flying lines. A substantial fishing reel, designed to reel in real sporting fish, will NOT reach a 36" or a 48" kite, pulling in a good breeze.

From these simple (and small) kites described, it is possible, if you are so inclined, to go into larger and more exotic forms, designs and sizes. Perhaps, as engineers, you can calculate the performance of a kite — with all the variations of wind velocity, air pressure, weight of line, load and lifting power. Perhaps, on the other hand, you may find this fascinating, experimentation — and frustration — of just "flying a kite."

When I was a small boy in New California, I was too young to make my own kites. During my 39 years with the General Electric Company, I never had time to go fly my kite. Now, in my retirement years, I am having fun. I wish you the same.
LETTERS from Ellery

In our Country

Dear Friends,

In considering conditions during the years soon following the Revolution, as I have been doing in the letters to the Family the story would be very incomplete without thinking of CANALS. This method of transportation goes back to most ancient times. The Romans built quite a system of canals in England and their virtue was well known in many parts of the world. In our country Washington had determined a canal to the west up the Potomac was needed before the Revolution began. Then too in the early 1700's a canal to connect Albany and Lake Erie was proposed.

The first canals actually to be constructed in this country were two short ones in Massachusetts to let boats pass two falls of the Connecticut River and one 60 or more miles long in South Carolina. These were built in the 1790's. One of the short ones went around Turner's Falls to Monticello and the other short one went around the falls at South Hadley. The name Monticarlo first came to my attention as I saw it was the name of a locomotive of New London Northern R. R. As you know I was completely fascinated by locomotives, especially the ones on N.L.N. R. R. which were all of them named. Montigue was different from all others I saw and the reason was that it had "Inside cylinders" hence did not carry the connecting rod so conspicuous to the front driving wheels and shining brass. To me it was a real wonder. And quickly I learned to identify it either by its puff, or bell, or whistle if it should pass in the middle of the night when I couldn't see. It was named from the town where that first canal was built.

I think it is interesting that the canal in South Carolina to make possible for boats to pass from the Santee River to Charleston was built by a man who came to this country with the Hessian hired to fight by the English. This man was captured by the Colonial Army at the surrender of Saratoga. He as prisoner then aided the Colonials by doing engineering work in the south. And it was he who surveyed and designed the canal which cost over a million dollars.

As soon as the war was over the matter of building canals became a chief issue. The point was that it costs much less to move a given weight a certain distance if it floats in water than to carry it in the heavy wheeled wagons of that age. In England at the same time they were building canals too. They got at the construction of Railroads earlier than we did in this country and in England the object of the railroads was to bring goods to be transported down to the canals. It was not thought of then that in a few decades railroads would then take over the transportation from the canals.

The next canal in New England was to connect Chelmsford (later called Lowell) with Boston about 28 miles. This was built during the 1790's. With the rage to get "Turnspikes" for stages there was also a craze to get "Canals". Washington was trying to get the Chesapeake & Ohio to open Washington to the west. It went very slowly and actually it was not in operation until the mid 1800's and never went beyond Cumberland and financially was a failure.

The ERIE CANAL

The big boom for canals came on the actual completion of the Erie putting Buffalo in direct connection with Lake Erie. The effect of this canal in opening the country to the west was quite marvellous and quickly paid for its cost. Then it was enlarged by being made both wider and deeper and that canal was still in active operation when I went to live in Schenectady. I was then filled with interest to learn the details of such operation as I had been when younger by learning about the wonders of Railroads. The difference was that I looked on the canal as something of the past. It was a way to me "History" rather than something like "Electricity", the thing which I believed had a great future.

In general it was the canals that were the agents to open the great new west. The success of the Erie led to dozens of schemes for canals where there was the prospect of settlement.

PHILADELPHIA

To me in a way the most interesting of the canal developments was the one to connect Philadelphia with the Ohio River at Pittsburgh. The Erie Canal in a manner put Pennsylvania in the background as compared with New York. Pennsylvania must do something to catch up. The canal was made by the west.

And it was built over the mountains, an engineering feat vastly more difficult than to put the Erie across the relatively level route. The job was done and the canal was operating when Dickens visited our country in 1842 to get material for American Notes and his novel that brings scenes in U.S. Dickens records the trip as unusual and delightful. And I am certain it was interesting to say the least.

To make that canal trip one stepped into a boat in mid Philadelphia and in due time he would step off in Pittsburgh. The first movement was on an incline. A stationary steam engine pulled the boat mounted on a wheeled car and then for some 90 miles it was pulled on land by horses to Columbus on the Susquehanna River. From that point to Hollidaysburg some 180 miles the boat was pulled up the Susquehanna and Juniata rivers by horses or mules. Then to Johnstown on exciting part of the trip. The boat was pulled up five steep inclines over the crest of the Allegheny Moun and then dropped down five inclines to be put in the water again. From that point to Pittsburgh was by canal with many "Locks". So that route to the west was open but this canal has not lasted as has the Erie because the mountains could be crossed cheaper by rail than by boat which needed so much land travel for the boat.

Another canal which quickly paid for itself and produced a marked change was the Michigan Illinois Canal that opened what now is Chicago to the Mississippi and so to the Gulf of Mexico. At the time of the Revolution but one white man lived in what we know as Chicago and in 1830 it was a very small village with no prospect of ever being of any account. I have mentioned the relative of Bryant the Poet who gave up his farm which was where now is the center of Chicago and moved to the place not far from Urbana (Bemen) for he wanted to live in a place which has a future." (His house still stands and in it Lincoln and Douglas made plans for their debates). In 1832 Lincoln in the Illinois Legislature helped pass a bill to authorize the Illinois-Michigan Canal. In due time the canal was opened and Chicago grew like the proverbial mushroom. The canal was what really made Chicago. This canal financially was a success but in time with railroads went out of service until a half century ago the new "Barge Canal" along the same route was opened. I used to take our senior students to inspect the works near Joliet and I used to explain to the students "This canal lock before being rebuilt to take larger boats and craft moved by engines instead of by horses and mules. I supposed the people in New York were on the wrong track to think it worth the great public cost of rebuilding their canal. I supported the notion of the tremendous value to the state rendered by the original Erie Canal made them believe their future prosperity depended on keeping their canal "Modern", was not true.

Many of the early canals were allowed to go out of service. Some of the boats were washed away by floods such as the disastrous one which did so much damage in the Dayton, Ohio region about 1913. To tell how wrong my idea of canals was I will say that today we have over 20,000 miles of canals in operation in our country. Some 10,000 miles of these are not over 9 feet deep so can be used only by the smaller boats. But you doubtless realize that now we are having a new interest in small motor driven boats and these smaller canals are quite adequate for such craft. You probably have noticed that in such papers as the Sunday Times maps of the canals which may be used by the boat fans are published. I have been interested to see from these maps what possibilities are open for a return of the canals up towards Canada look funny. And in the winter the many possibilities.

(Continued on Next Page)
ELLERY... to go south and explore Florida look attractive. I used to go on river boats when I lived in Florida but long ago those days gave up. They could not compete with the modern auto and bus travel. But the old river boats are still open and in use especially for the family boats.

But it is a mistake to think the heavy traffic of freight traffic has vanished. Quite the reverse as is indicated by the fact that the number of tons per mile was 8.6 Billion Ton-Miles we now have well over 100 Billion Tons per mile.

At present there are nearly 10,000 miles of canals in service with depth from 9 to 14 feet and 2000 miles of canals with depth over 14 feet so that we can land a boat of any size that is large enough to travel on the river.

We can understand the great interest in canals when we realize that in the early days by horse-drawn heavy wagons it cost about $52 to transport a ton 100 miles but the cost when the first canals were opened dropped to $1.00. With the modern boats of today it costs about 10 cents per mile.

When I was a boy Father took lumber to Webster by the old "Horse-Wagon" instead.

The Turnpike was about 20 miles and that was a real feat of engineering with three horses. You could only travel by night and then you would have to take a rest day for the horses.

The trip to Alabama would be made by using the canals and by boat through the eastern part of the state. As the canal boats could not be tied together, we would go only as far as the boat would go and then have to make the journey by land.

The canal boats could only go as far as the water, so we would have to travel by land from one boat to the next.

We would have to travel by train from one state to another and then by boat again. It would be a long and difficult journey, but it would be worth it to see the beauty of the land.

After the Revolutionary War, the world changed greatly with the introduction of power labor saving devices and new methods of transportation. The new transporta-
tion methods made possible great improvements in the railroad system. But the old horse-drawn canal boats were not forgotten. They were still in use in the 19th century. The boats were still in use until the early 20th century. The boats were still in use until the early 20th century. The boats were still in use until the early 20th century. The boats were still in use until the early 20th century. The boats were still in use until the early 20th century.
and I have discovered bread and tinned salmon which I have confectioned without qualms.

While we have been to Jebel Sheriff Hank has lost all of his steel traps for fox and laryx. The loss is put to curious children who have doubled in the number of the stick jambs and stone teeth of their forefathers. A plea to the Mutsherif is limited to sympathy, but whatever efforts he makes to recover the traps are unfruitful. We have stayed overnight in Kufra and traps or no traps we must leave by dawn. Hank is depressed and we all feel for him.

24TH MARCH

TEA AND SHREDDED WHEAT AND BULLY BEEF FOR BREAKFAST AT SIXTY. EVERYTHING WASHED UP AND PACKED UP AND READY TO LEAVE BY SEVEN-TENTY-FIVE. WE'RE FILLED THE AIRSHIP'S THERMOELECTRIC HEATERS WITH TEA BUT HAVE NO POTS OR EATING-IRONS TO SPARE SO CANNOT LEAVE THEM OTHER FOOD. IN ANY CASE THEY WILL BE IN TOP AMERICA FOR LUNCH, SO MUCH THE BETTER. WE ARE THREE-HALVES AND TWO-FIVE MILES TO THE SOUTH-SOUTH-EAST, AND ALMOST ON THE LIBYAN-EGYPTIAN-SUDANESE BORDER. UWONEAT IS AN ISOLATED MOUNTAIN RANGE WHERE THERE ARE SAID TO BE SOME VERY FINE PRIMITIVE ROCK-PAINTINGS. THE MORNING RAIN IS MAGNIFICENT. WE DO A HUNDRED MILES IN ABOUT FOUR HOURS, STOP FOR LUNCH UNDER A BOILING SUN, WITH SHADE A TWO-BY-FOUR SQUARE DIRECTLY BEHIND THE CAR. DESERT TRAVEL BEING WHAT IT IS, WE DON'T THINK WE WILL EVER BE ABLE TO RE-READ THIS DOCUMENT. HER normally NEAR HAND-WRITING has DEVELOPED THE ARCHITECTURAL LOOK OF CUNEIFORM. WINSLOE, WHO HITS THE WATER FOR THE LADY IS OUR GUIDE TO THE THREE CROOKED MOUNTAINS. AS PRACTICAL EXPERIENCE OF THE NEW DEVICE, WE USED TO TEST OUT THE CORE WATER USED THROUGHOUT THE TRIP, TUCKS ME IN WITH RANDOLPH'S AND CONTRIBUTES HIS OWN TO RECLAIM CATHTERINE'S CRACKED HOE. MY ARMS IS OUT OF THE COLD MOST OF THE TIME THESE DAYS AND NOT BOTHERING ME, BUT I'M GLAD OF THE BOTTLE FOR MY TOES.

The success of your project will depend upon your thoughtful investigation and advance planning. The right choice of country and educational institution is of great importance. And that means research and consultation. You should seek your own faculty advisor about your proposed study plan, or you might consult the leading clearinghouse of information in the field of educational and cultural exchange, the Institute of International Education.

The Institute's counseling division answers your questions on study opportunities in foreign countries through correspondence and personal interviews.
TELESCOPES…

offset Soviet gains. In 1930, Bernard Schmidt of the Hamburg Observatory revolutionized astronomical research with the invention of telephoto telescopes. The Schmidt Telescope, a prototype of it—with a 48 inch correcting plate and 72-inch mirror—is a companion to the reflecting telescope on Mount Palomar. Now, the newest advances in astronomy—you might say—are made by the All-Reflecting Schmidt Telescope.

“The new instrument will make possible surveys of the universe in the far ultraviolet spectrum. Lens-type telescopes filter out the high intensity ultraviolet ray.”

When adapted for use on the Manned Orbiting Research Laboratory, the Schmidt telescope will consist of two mirrors (one 15 inches in diameter and the other 30 inches) mounted at each end into a 7-foot-long metal cone, with a sighter or view finder affixed along-side the cone.

Project scientist Lewis C. Epstein, principal developer of the revolutionary telescope, points out that the Chrysalis telescope acts as its own camera. “It will be designed to operate as a very slow movie camera recording each exposure taking at least 30 minutes”.

Telescopes in outer space may also bolster the advances made by the radio telescope on earth. In 1931, Karl G. Jansky of the Bell Telephone Laboratory detected radio static which originated somewhere from bodies in outer space far removed from earth. The “radio stars” soon were located and studied by the radio telescope, a type of radio receiver equipped with large antennas that act as direction finders. Their one advantage is that they can work day and night and penetrate the Milky Way’s vast clouds of interstellar dust that are absolutely opaque to visual light.

In effect, then—with the turbulent, dusty atmosphere surrounding the earth finally removed—the clarity of photographs taken from telescopes in outer space should be spectacular and discovery-laden.

Another American first!

BEING SWTATED by the engineering community in efforts to overcome the academic difficulties of adapting to the demanding realities of the present and of the world to come in science and engineering, Sensitive, creative and courageous response and action by educators who recognize the new relations between science and technology, the increasing importance to engineering of the life and behavioral sciences, the new focal points of interest in engineering and the lack of relevance of the traditional disciplines to today’s engineering—these have been and still are being challenged by strident voices in the engineering community.

An important key to the eventual passing of the class in engineering thus may lie in vigorous leadership by the academic community. It is interesting to see an increasing impact resulting from the assumption of this leadership by some colleges and universities. An influential and growing leader in this respect is the engineering community understands and applauds this favorable evidence.

About two thousand years ago Vir- tuvian, the Roman engineer, observed that the engineer “should be a man of letters, a skillful draftsman, a mathematician, familiar with historical studies, a diligent student of philosophy, acquainted with music, not ignorant of medicine, learned in the opinions of lawyers, familiar with astronomy and astronomical calculations. He should be fair-minded, loyal and, what is more important, without avarice, for no work can be done truly, done without motive and clean hands. Let the engineer not be greedy, nor have his mind burdened with acquiring gold, but let him with seriousness guard his dignity by keeping a good name.”

To be sure, it may well be unrealistic in the modern world to expect every engineer to develop all the qualifications Virgil laid down, yet his perceptions of centuries ago still speaks urgently to the community of engineers, the new focal points of interest of the individual then, society demands of the engineering community today.
What is there left for you to discover?

Cyrus the Great, King of Persia, built a communications system across his empire some six centuries before the Christian Era. On each of a series of towers he posted a strong-voiced man with a megaphone. By the 17th century, even a giant megaphone built for England’s King Charles II could project a man’s voice no further than two miles. This same king granted Pennsylvania to Admiral William Penn as a reward for developing a fast, comprehensive communications system—ship-to-ship by signal flags.

We waited for the combined theories of Maxwell, Hertz, Marconi and Morse before men could transmit their thoughts by wireless, though only in code. Only after Bell patented his telephone and DeForest designed his audion tube could men actually talk with each other over long-distances. Today nations speak face-to-face via satellite. Laser-beam transmission is just around the corner. Yet man still needs better ways to communicate across international boundaries.

In a world that has conquered distance, in a world whose destiny could hinge on seconds, man is totally dependent on the means which carry his voice and thought. It is this means that we in Western Electric, indeed the entire Bell System, have worked on together since 1882.

Our specialty at Western Electric is the manufacture and installation of dependable, low-cost communications systems for both today and tomorrow. And to meet tomorrow’s needs, we will need fresh new ideas. Your ideas. There’s still much for you to discover right here at Western Electric.

CHAPTER DIRECTORY

(Continued on Page 24)

SENIORS

Opportunities are available for students interested in M.S. and Ph.D. level study and research in Electrical Engineering. Areas of specialization are Circuits, Communication, Computers, Control, Electric Power and Energy Conversion, Electromagnetic Fields and Waves, and Physical Electronics. Financial Assistance is available for qualified M.S. and Ph.D. level students. Write Chairman, Electrical Engineering Department, University of Missouri at Rolla, Missouri 65401.

(Continued on Page 24)
Delta Delta University of Denver, P. D. Smith 1960
Delta Epsilon Ohio University, W. Fakay 1960
Delta Zeta Washington University, R. J. Koeppen 1960
Delta Eta University of Massachusetts, F. Fitzgerald 1960
Delta Theta Pratt Institute, A. Siegelman 1961
Delta Iota Louisiana State University, R. T. Nethken 1961
Delta Kappa University of Maine, W. V. Turner 1961
Delta Lambda University of Kentucky, E. Kandall 1961
Delta Mu Villanova University, J. L. Hicks 1961
Delta Nu State University of Iowa 1962
Delta Xi Air Force Inst. of Tech., R. A. Hansen 1962
Delta Omicron Pennsylvania State University, J. L. Stanesby 1962
Delta Pi Colorado State University, R. M. Wainwright 1962
Delta Phi Augustana College, M. E. Olson 1962
Delta Phi Delphi College, M. S. W. 1962
Delta Sigma University of Notre Dame, L. Staader 1962
Delta Tau University of Southwestern Louisiana, W. H. Hall 1962
Delta Upsilon Bradley University, J. H. Haffner 1962
Delta Phi University of South Carolina, H. Noland 1962
Delta Chi University of W. Va. 1962
Delta Pi Saint Louis University, G. E. Dreidel 1963
Delta Omega University of Hawaii, S. G. Stringer 1963
Epsilon Alpha Cleveland State University, E. A. Klinghiser 1963
Epsilon Beta Arizona State University, A. V. Doerr 1963
Epsilon Gamma University of Toledo, G. Muckendorf 1963
Epsilon Delta Tufts University, G. Godfrey 1963
Epsilon Eta University of Houston, T. N. Whitaker 1964
Epsilon Zeta Lowell Institute of Tech., J. E. Powers 1964
Epsilon Eta Rose Polytechnic Institute, C. A. Rogers 1965
Epsilon Theta California State, Long Beach, C. E. Williams 1965
Epsilon Iota San Jose State University, C. Glover 1965
Epsilon Kappa University of Miami, W. C. Knopf 1965
Epsilon Lambda Vanderbilt University, R. Bourne 1966
Epsilon Mu Adelphi University, C. W. Jiles 1966
Epsilon Nu California State, Los Angeles, P. Paye, Jr. 1966
Epsilon Xi Wichita State University, C. H. Dunn 1966
Epsilon Omicron University of Delaware, M. G. Young 1967
Epsilon Pi Princeton University, L. P. Davison 1967
Epsilon Sigma University of Florida, J. R. Smith 1967

Jobs that just might change the world

Move people through rush hours to work. Westinghouse built the experimental transit expressway in Pittsburgh. And we are building the computerized controls for the San Francisco mass transit system that will be the model for others throughout America. We're looking for people to help us build equipment for a new kind of service, as they've never been moved before.

Desalt the world's oceans

Westinghouse has 13 water-desalting units operating or on order around the world. And we need you to help us design and build facilities that can desalt 150 million gallons a day—and solve some of the toughest water-supply problems we've ever tackled.

Build a city from scratch—the way a real city grows. Westinghouse has just purchased an embro city. We're looking for people to help us rebuild many of the existing cities in America. We can do it—Westinghouse now provides more products, systems and services for construction than any other single company.

Paper Company. These furnishings consisted of eight handsewn swivel chairs, one conference table, a combination desk and bookcase rack.

Present plans consist of completing the acquisition of the various mass production articles to complete the furnishings in the lounge and helping to install better faculty-student relations in the Electrical Engineering Department at the University of Arkansas at Fayetteville, Arkansas. Activities for the spring semester include a banquet and a social outing.

GAMMA TAU, North Dakota State University—Gamma Tau chapter of HKN initiated 21 new members on December 12, 1967. Four of the new members are on the faculty of NDST.

Following the initiation, a banquet was held at the M & J Steak House. The number attending included many faculty members and wives and guests.

Phil Heltland of the Physics Dept. was the guest speaker, and he gave a thoughtful talk on the emptiness of the life of the average modern man today.

The chapter is holding information sessions once a week for students struggling through sophomore physics. Turnouts at these sessions have been good, with up to 20 in attendance.

An effort is being made in the form of initiation projects to find the names and addresses of all graduates of the Electrical Engineering department of NSU. Much progress is being made in this project by the enthusiastic students involved.

Another project under active investigation is the development of new exhibits for St. Paul, the annual NDSU open house, which lasts a weekend and attracts many parents and alumni from a wide area. New exhibits are expected in the fields of electronics, power systems, and computer applications.

DELTA NU, University of Alabama—The activities of Delta Nu chapter were centered around a new project to promote interest for prospective members and to perform a useful service for the E.E. department. Among ideas discussed were "help sessions" and plans for participation in the Engineer's Day activities in the spring.

On December 13, 1967, Delta Nu initiated seven new undergraduate members. Following the initiation was an informal supper at the home of Dr. R. E. Lucy, our chapter's faculty advisor. New officers were elected for the following semester.

EPSILON TETTA, California State, Long Beach—The fall semester was very successful for the Epsilon Theta chapter. The chapter's tutoring service continued to expand in both the number of classes and number of students tutored. The chapter initiated ten members this semester. Following the initiation ceremonies a banquet was held at the Jolly Roger Inn across from Disneyland.

The pledge projects included the formation of a job file of the local industries and a fund on grade schools.

The semester's activities were highlighted with a very successful Christmas-NeW Years party.

NEW YORK ALUMNI CHAPTER—The New York Alumni Association of HKN met on December 13, 1967 at Newark (N.J.) College of Engineering in order to discuss the activities of the chapter in the New York Alumni Chapter, Professor Fred Rudniak, representing the Alumni. We're looking for people to help us build equipment for a new kind of service, as they've never been moved before.

Several very practical suggestions were made and one of these—a theatre party—is being planned for early in 1968. It was suggested that, if successful, this event could in the future support our HKN scholarship fund. Other suggestions included a dinner party to produce the theatre event, a welcoming social for new classes and a metropolitan chapter get-together. The undergraduates of the numerous NY alumni chapters are to be invited to meet at NCE Alumni House during the fall, and the graduates to meet in New York City in April.

Larry Dewey pointed out one reason for the diminished activity in New York. The chapter, he felt, suffered particularly because the Bell Telephone Laboratories had moved from New York to New Jersey. He therefore suggested two separate groups under New York Alumni guidance, a New York group and a metropolitan New Jersey group. The New York chapter, he said, was at one time recognized as a most active chapter and service organization, and could again rise to the forefront. He cited some of the successes of the chapter. The national organ, "The BRIDGE", was founded in NY, as were also the Engineering Member Award, the Outstanding Young Electrical Engineer Award and the Outstanding Young Electrical Engineer Award. In addition, during the depression, the New York chapter ran a very successful employment exchange.

The Council meeting was attended by past and present officers of NCE Alumni. New York Alumni Chapter including brothers Bob Dwyer, Larry Dewey, Jim Elinson, Bill B. Groth, Al Lefkov, Ben Lewis, Lou Nock, Hal Pefio, Fred Russell, Roger Wilkinson and Bert Sheffield.

FROM THE MAIL BAG

Dear Sirs:

I received your current copy of The Bridge today. I especially enjoyed the article "Cyclists and Bells", and the advertisement from Westinghouse. I found the article on "Investments in Enlightening" very good.

Gary David Gray
Santa Ana, California

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