1st Issue

EE DIGEST

CURRENT DEVELOPMENTS IN ELECTRICAL ENGINEERING AND SCIENCE

VOL. 1 NO. 1 | *Published by AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS FOR STUDENTS* | SEPTEMBER, 1959

Russians Show Electrical Engineering Advances

EE Starting Salaries at New High

Electrical engineering graduates continue to enjoy a great variety of career opportunities and to command impressive starting salaries.

According to a study completed by the Engineering Manpower Commission, 97% of the electrical engineering class (of close to 9,000) had completed post graduation plans some three weeks before they were expected to leave the campuses last June. The breakdown was as follows:

69.8% had accepted employment; 10.6% were considering job offers or other opportunities; 5.9% expected to enter military service; 10.5% were preparing for post-graduate studies. Only 3.2% had no employment offers or other plans at that time, compared with 5.7% for all engineering graduates.

Along with expanding opportunities in industry, government and educational institutions, the starting salaries for electrical engineers continue to climb. As might be expected, salaries vary considerably depending on the individual's qualifications, type of employment and other factors. In general, starting salaries for electrical engineers are among the highest of salaries offered to engineering graduates.

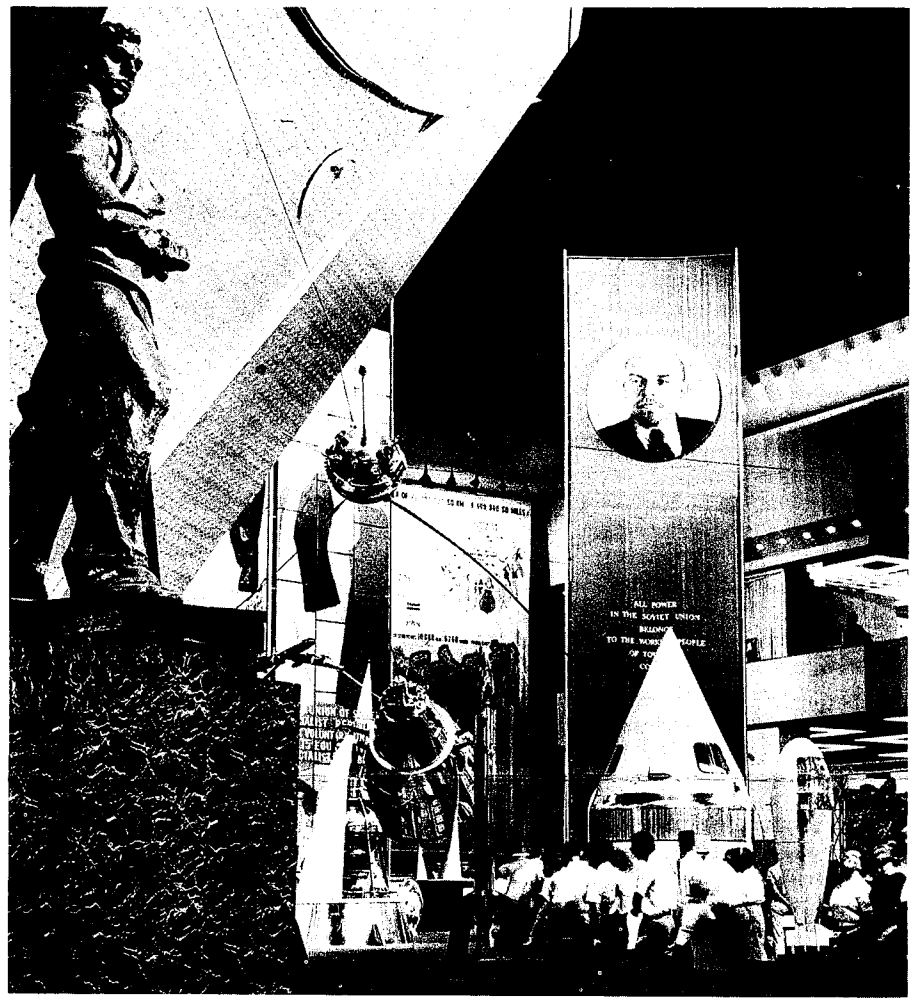
The Engineering Manpower Commission estimates that the median starting salary for electrical engineers, with bachelor degrees, in 1959 was $530 monthly. The lowest reported salary was $375 and the highest $750. Median salaries for graduates with master's degrees is close to $600 and $800 for those with Ph.D. or Sc.D. degrees.

Solar Energy Device For Space Ships Shown

A possible answer to the thorny problem of a power source for long-life satellites or space ships was recently discussed. The basis of the solution involves the energy in the sun's rays deployed through a parabolic reflector to heat a thermocouple and produce electric energy, and the use of a unique combination of older known thermal and electrical principles.

The attempt to convert an unlimited supply of solar energy to electric energy within the limiting factors of a space vehicle represents an engineering conversion problem of staggering magnitude. The new approach, outlined at the AIEE Seattle meeting in

(Continued on Page 3, Column 1)



A general view of the USSR satellite display, showing several models that were launched. The big white model is that of the cone of the satellite launched Jan. 2, 1959. It is believed still in orbit around the Sun.

EE Digest Makes Bow

With the publication of this issue of the EE DIGEST, the American institute of Electrical Engineers is inaugurating a new service to the student of engineering, to add to those it already makes available. The paper is published for electrical engineering students, but should also serve to interest students in the related fields of engineering and science.

It is planned to issue the Digest at intervals between September 1 and May 30 each year. In order that it may reach a maximum of those interested, bulk shipment to the electrical engineering departments of each school will be made, for distribution to students as each may see fit.

The EE DIGEST is intended primarily as a disseminator of technical electrical news, but should also furnish other news of specific interest, such as job opportunities, salaries, management of student organizations, and the like. It will follow the permanent policy of AIEE of covering all phases of electrical engineering. In fact, the EE DIGEST will be primarily interested in the news as it occurs and the future as experienced

(Continued on Page 8, Column 2)

Tunnel Diode May Outstrip Transistor

The newest "baby" in the fast-growing family of electronic devices — the "tunnel diode" — is coming of age.

The tunnel diode, first reported in 1958 by Japanese scientist Leo Esaki, is first cousin to a transistor, but operates on a different principle and offers advantages that the transistor does not. It should soon be used in high-speed computers, television sets, communication equipment, nuclear controls, satellites and space vehicles, Dr. Guy Suits, General Electric vice president and director of research, predicts.

The tunnel diode takes its name from the physical phenomenon that makes it possible: "quantum-mechanical tunneling." The term is used to describe the manner in which the electric charges move through the device. Such motion takes place with the speed of light, in contrast to the relatively slow motion of electric charge carriers in transistors.

The high speeds at which electric charges travel in the tunnel diode make it possible for the device to operate at

(Continued on Page 8, Column 3)

Satellites, TV Dominate Scene at N. Y. Coliseum

Powerful electrical equipment, which gave the visitor an impression of very advanced technology, indeed, were among the attractions which drew large crowds to the Soviet Exhibition of Science, Technology and Culture at the New York Coliseum.

As might be expected, satellites dominated the scene as the visitor rode up the escalators to the main floor of the exhibit hall.

A display called attention to a model representing the last stage of the big satellite launched on January 2, 1959. Even in the huge coliseum floor this object was not lost. (The Satellite is now assumed to be circling the sun in an orbit about that of the earth's). It is white, the size of an automobile, and is reported to weigh 3,250 pounds. Casual visitors gaped. Engineers tried, without much success, to see inside. Nearby were models of earlier smaller satellites and a mock-up of the cabin that carried Laika into space with her physiological parameters recorded for eternity. One satellite had an antennae which unrolled like a steel ruler.

SOVIET SYNCHROPHASOTRON

Nearby was an elaborately constructed cut-away model of the Soviet Synchrophasotron, the most powerful particle accelerator now in operation anywhere in the world. Physicists in this country doubt that the Synchrophasotron has yet achieved usable beams of protons for nuclear physics research at its full design power of ten Bev. However, it probably has exceeded in power the Berkeley Bevatron (6.2 Bev). The Synchrophasotron is designed to probe the secrets of nuclear structure with pulses of 10^9 protons acceleratd around a 36,000 ton circle of magnets twenty eight meters in radius.

A plastic colored light display showed past, present and planned status of the project for a complete electrification of the USSR in a single power grid. If finished, as planned in 1965, the tie-up will be the largest in the world. Connecting links between European Russia and Asian Russia are still to be made. The display board spanned nearly half the longitude in the world—from Poland to the Bering Straits—and included a lot of land on which to locate customers.

A model of the big Stalingrad hydroelectric station which will feed 2,530,000 KW into the grid (when it is finished) indicated that this station is about one-fifth finished. It will be the world's largest hydroelectric plant. Plans are to transmit 500,000 volts AC over a distance of 985 kilometers to Moscow and 800,000 volts DC to the Donets coal fields.

(Continued on Page 5, Column 1)

Student Prize Paper Winners Attend West Coast Meeting In Seattle

District Student Prize Paper Contest winners shown at the Summer and Pacific General Meeting of AIEE in Seattle where they were guests of the Institute. Students shown in the photo and titles of their winning papers are: Donald M. Davis, Clarkson College of Technology, "A Transistorized Pulse Monitor" (co-authored with Raymond L. Allen, also of Clarkson); Ivan E. Sutherland, Carnegie Institute of Technology, "Stability in Steering Control"; Robert C. Sommer, New York University, "A Narrow Band Peak Clipping Speech Amplifier"; William E. Montgomery, Duke University, "Design and Construction of a Solid State Video Pickup"; Robert G. Buus, University of North Dakota, "Rectifying PN Junction in Germanium"; Roger M. Goldwyn, Rice Institute, "The Bucking Bronco Motor as a Nonlinear Oscillator"; Francis A. Spelman, Stanford University, "A Voltage Comparator for Low Frequency Measurement"; Raymond W. Hall, University of Toledo, "Design of Apparatus to Remotely Handle Radioactive Material"; Joseph J. Panico, Northeastern University, "Thermal Resistance and Its Measurement"; William W. Clements, University of Alabama, "A Short-Range One-Way Communication System."

First prize winners who could not attend the Summer Meeting, were Robert Allington, University of Nebraska; "A Telemetering System for Stomach Pressure of Animals", and Gayle F. Miner, University of Utah, "A New Type Vacuum Tube Tester." Mr. Sommer was not present for the above photo.

STATIC CHARGES

Static charges built upon trucks as tires roll on the pavement may be discharged by choking the engine near the end of a trip. The dense black fumes resulting drain off accumulated negative electricity via the carbon they carry.

E E DIGEST

Volume 1, Sept. 1959, Number 1

PUBLISHED BY
AMERICAN INSTITUTE
of ELECTRICAL ENGINEERS
33 West 39th Street
New York 18, N. Y.

J. H. Foote—*President*
N. S. Hibshman—*Executive Secretary*
C. J. Grimm—*Acting Editor*
R. C. Mayer—*Production Manager*

CONSULTANTS
E. W. Boehne E. T. B. Gross
H. C. Bourne L. F. Hickernell
R. T. Weil

Printed In U.S.A.

Opening The Skies

Who says pioneering is dead? The age of exploration at an end? The last frontier crossed? So we've climbed Everest! Are crowding the Penguins in Antarctica! Aren't pushing the push-buttons on our missiles!

Space is ahead! Just waiting for the pioneer, the explorer, with problems dreamed and undreamed. What lies beyond space? More Space? A solid wall? Fluids? Is there a final frontier to cross?

Man has been gazing out there, wondering, fearing, theorizing, throughout all his short span of existence on earth. His first explorations were visual, and he probably climbed the hills to get closer. Later came the crude lens, the better lens, then the mechanical tracking system for his lens assembly—the telescope. The physicist and the mathematician moved in. Modern astronomy was born.

The electrical engineer entered the picture. The tracking system acquired a motor drive, automatic controls, vacuum tubes, transistors. Simultaneously came radio, radar, the radio telescope. The first mechanical fingers began tentatively to grope outwards. Space got a new definition—it became that area beyond the earth's atmosphere. Sputnik I, followed by Sputnik II, Explorer I, Vanguard I and others roared out to explore its nearest edge. Pioneers I and III took off for the moon area and, failing, nevertheless furnished much more knowledge before falling back to a fiery destruction on reentrance to earth's atmosphere.

Mechta roared out to oblivion and an apparent future as a new satellite of the Sun, but for the first quarter of a million miles the electrical engineer's radio stayed with it for more needed information. Pioneer IV followed Mechta into solar orbit and extended the contact range to over 400,000 miles before electronic signals failed. Others are waiting on the launching pads, in the production rooms, on the drawing boards, in fertile imaginations, for their brief period in the lead.

The military picture has been uppermost in the press to date. Civilian values are mentioned. But we wonder —isn't man's insatiable curiosity, his desire to explore the unknown, the drive to get there first, the deepest motivation of all?

And now for the student who wants facts—statistics—job information—history. All this was triggered by Francis Bello's "The Early Space Age" in the July 1959 issue of Fortune, which we recommend as "must" reading to every engineering and scientific student, dreamer and "practical man" alike.

Young Engineers Advised Not To Get Pants Shiny

The young engineer should strive to learn all he can while "low down on the totem pole," Philip I. Alger, a noted engineer, remarked upon receiving the AIEE Lamme Medal at the Summer and Pacific General Meeting of the Institute. He and Sterling Beckwith, of Lake Forest, Ill., were awarded the Medal jointly "In recognition of their contributions to the art and science of design and application of rotating electric machines."

Mr. Alger, who recently retired from the General Electric Company after a long and distinguished career, had this advice for the young engineer: ". . . the engineer, while young and low down on the totem pole, should strive to learn all he can, gaining in depth and also breadth of knowledge as he goes on. There is a very great deal of happiness to be gained in this process of learning and growing. The engineering art has so vast an extent, and is so rapidly developing, that there are unlimited opportunities to choose specific areas of knowledge, or types of work, that are to one's liking.

MEN AND MONEY

"Since, at the higher levels, engineers must deal with men and money, as well as material things, the young engineer with ability should not let the seat of his pants get shiny. He should speak at meetings, do a little teaching, read widely, and study economics, management and history as well as pure engineering. And he should cultivate able friends and assistants who can take over, or share in, his growing responsibilities as he rises in his profession. Many a good engineer has failed to win promotion because of his unwillingness to share his knowledge or to delegate responsibility to a younger man who might take his place. The man who is indispensable often is not promoted.

A RUTHLESS EXPOSÉ

"The experience of an engineer teaches honestly, since the laws of nature cannot be deceived, and ruthlessly expose the unfit. It also develops a cooperative spirit, since his large scale projects require many specialists to work in harmony. Nowadays when so many engineers are concerned with the development and operation of extensive systems, with problems of automatic control, stability and adjustment to meet varied conditions, they have every opportunity to become experts in the organizing and delegating arts."

Foreign Summer Jobs Attract Students

Summer training at paid jobs overseas? Yep! It's been done by almost 100 U.S. engineering and science students from 39 colleges this past summer under the program of the International Association for the Exchange of Students for Technical Experience which is sponsored by the Engineers Joint Council.

No giveaway deal this—students interested are required to pay a nominal registration fee to IAESTE, and also pay their own travel expenses to the job. While working, they earn a maintenance allowance which covers living expenses. The program is reciprocal, some 70 foreign students worked for 50 U.S. firms at the same time. Administrative expenses are paid by participating U.S. companies.

Twenty six member countries participate in the program. This past summer our students worked in Austria, Denmark, Finland, France, Germany, Great Britain, Israel, Italy, the Netherlands, Norway, Spain, Sweden, Switzerland and Turkey.

If you are interested in a foreign job for next summer, now is the time to start making inquiries of IAESTE, 33 West 39th St., New York 18, N. Y.

Ads Tell Engineers' Role

A series of public service advertisements designed to clarify the role of the engineer have been running in Editor & Publisher, the trade press magazine for the newspaper industry. They are sponsored by Engineers Joint Council, which represents 350,000 engineers. (AIEE included)

The ads titled "Let's Get Clear on What Engineers Do", "Just Who's Firing Those Missiles" and "Say Engineer When you Mean Engineer," are designed to help news writers and editors give the public a better picture of what the engineer does, and to clear up the existing confusion between the titles, scientist and engineer.

"The engineer's hand touches every material thing used by the consumer to make his life a happier one," says Enoch R. Needles, EJC president. "Our expanding economy is an engineering economy, and it is high time people realized their obligation to recognize the men and women who are making it possible."

Philip L. Alger and Sterling Beckwith, the Lamme Medal Winners Show Award to Robert G. Buus, (center) one of the Student Prize Paper Winners.

The thermoelectric generator pictured above demonstrated that it can convert solar energy of 2.5 watts, enough to operate a radio transmitter in space. Thus a possible competitor to the solar cell enters the space power source field.

Solar Energy Device

(Continued from Page 1, Column 1)

a paper by N. F. Schuh of the Westinghouse Electric Corp., and R. J. Tallent of the Boeing Airplane Co., is one of several undertaken by various researchers in efforts to develop better power systems, particularly for extended periods of time. The solar powered thermoelectric generator seems to present one system showing considerable merit. Solar power is abundant in space, and the system would require neither fuel nor shielding. In addition, the device is static and should have a fairly long life with good reliability.

The new device, which will require further study before it can become space-born was demonstrated during the meeting on the roof of the Olympic Hotel. It combines a parabolic reflector and a specially designed thermocouple in the thermoelectric generator. The reflector concentrates the sun's rays on the thermocouple — a closed circuit — and the resultant emf produces current. Shades of Seebeck, Peltier, and Thomson!

Simple, but the device developed only for experimental studies of the expected and unexpected design factors, has an output of 2.5 watts, enough to power some of the space vehicle transmitters now in use. Many problems of diverse nature already are aparent from use of this device. Just as an example, the power necessary to keep the experimental reflector turned toward the sun comes from a 110 volt motor having much greater input requirement than 2.5 watts!

The paper is absorbing reading for anyone interested directly in this very important current research problem, and equally so for anyone interested in the general problem of approach to research. AIEE's Transactions Paper No. 59-847 is one for the future-minded engineer.

GASSING UP

Nope — we haven't gotten mixed up with our internal combustion engine friends. We're talking about gas-filled transformers, the size of which is going up in KVA with almost every delivery from the manufacturers. A 10,000 KVA, 69 KV model held the record as this is being written, but even larger sizes are already coming thru the plants.

VENUS CONTACT CONFIRMED

The first successful radar contact of the planet Venus, which was made in February 1958 by the Lincoln Laboratories at MIT, has recently been confirmed. It took more than a year of equipment development and several weeks of computer analysis to prove, via magnetic tape recordings, that the contact had actually been made.

ENGINEERS URGED TO ENTER MANAGEMENT

An executive of a large aircraft firm has urged engineers to take a greater role in business management as well as fulfilling their obligations in technical fields.

Speaking at an AIEE 75th anniversary luncheon in Seattle during the Institute's Summer and Pacific General Meeting and Air Transportation Conference, Lysle A. Wood, director of pilotless aircraft at the Boeing Airplane Co., asserted that "the very rapid pace at which our technologies have advanced has in fact created a whole new set of management-type problems which demand the attention of today's engineers . . . I see no reason why engineers cannot be as skillful in working with people as any other group. Nor do I see that their technical and scientific knowledge need be in conflict with any real appreciation of time and cost . . . Let's have more engineers becoming competent managers."

A TREND HAS DEVELOPED

There is, in fact, said Mr. Wood, evidence that engineers are turning to business management in increasing numbers. This trend has developed, he said, " 'because it is easier to impart a general understanding of the fundamentals of management to an engineer than to convey to a non-engineer an adequate understanding of today's technically complex projects'. . ."

The engineer, he pointed out, can apply his special talents for analysis of problems, for planning, for orderly thinking, to the problems of general business management. In the area of taking long-range looks into the future —an activity which becomes increasingly necessary as industry and products become more complex—the engineer can make his greatest contribution, Mr. Wood said. The engineer, he indicated, would be better able to "predict the obsolescence of systems which have not yet reached production and to plan for their orderly replacement."

As examples, he cited today's air transportation and tomorrow's aero space systems in which "it is not unusual to have several years elapse between original design and production. Investments are correspondingly large. The result is a great and increasing need for 'cradle to grave' managements of our modern projects whether they be civilian or military." It is the engineer who can best offer this management, he said.

A "CONTINUING CHALLENGE"

Speaking further of the aircraft industry, Mr. Wood said that it offers "a great and continuing challenge to engineers." He observed that while originally there were few electronic instruments in planes, "today . . . an aero space transportation system consists of a vehicle largely filled with electronic components and greatly dependent upon ground based electronic components, all of which must work if the system is to perform its function.

"The manner in which the demands of air transportation have spurred the engineer to greater achievements and the rapidity with each new development in aerodynamics, in metallurgy, in structures, in propulsion has been seized upon to make a better product is without precedent . . ."

The Census Bureau will collect data on electrical and electronic technicians and all types of engineers in its 1960 census taking. This will cover age, sex, eduation, income and work experience.

HIGHLIGHTS

From the September Issue of "ELECTRICAL ENGINEERING."

by T. F. COFER

HOT AMPLIFIERS

Today's range of possible ambient environment requires operation in more than Kelvin temperatures.

World conditions being as they are, the electronic engineers have come to feel that while man himself may have to "fry", there is no reason why his electronic aids should not continue to function in the presence of severe nuclear radiation. Tests of components under such conditions indicate that some apparatus, properly designed, can tolerate much more than the human operators, thus making possible, if nothing else, the successful broadcast of last minute instructions or warnings, like the use of field telephones by bomb-demolition squads.

RELIABLE TRANSFORMERS

Along with this illuminating exposé on super construction, another article describing how to make reliable transformers indicates that even though the design correctly calls for the proper materials and assembly, the reliability of the complete unit is very largely dependent upon the skill and workmanship of the production personnel, in spite of the best possible inspection procedures. Thus, although our technology has progressed far beyond the farrier's art we are still subject to the same kind of failures as those described in the ancient ditty "and all for the want of a horseshoe nail".

BANDS ACROSS THE SEA

Cables go down to the sea in ships and end up on the bottom!

The hundred-year-old dream of connecting all the continents on Earth by wire communications is rapidly coming true as more and more of the best materials the electronic and dielectric engineers can devise are being taken out to sea and given the "deep six". Wide-band transmission handling multiple telephone conversations, literally hundreds of telegraph channels, or even moderate-speed pictures, are already available in both large oceans, with much more to come. In a series of articles, Bern Dibner, a well-known scientific raconteur, tells the story of the Atlantic Cables from their disheartening beginning to their latest losing brush with the international fishing fleet.

GROPING TRIALS

Another story describes the extreme care taken by modern cable manufacturers to ensure the capability of their product. These efforts, compared to the early groping trials of the initial Atlantic Cable suppliers, indicate why our present-day technology is succeeding. Careful research, bold development, and conservative applications make possible the dependable equipment available to industry everywhere.

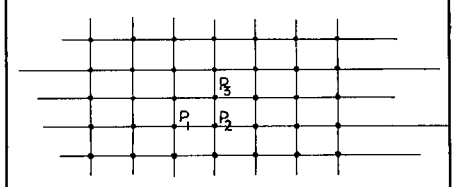
(Continued on Page 7, Column 2)

2 WRONGS=RIGHT

Residents of Springfield, Mass., have been paying for the same water twice each month for 27 years, and are happy to keep right on doing so! Two basically uneconomical single systems, designed and built far back in 1929-32, still stand as an example of farsightedness—and they have made money from the start. All they do is conduct the spent water from the water wheels used in the generation of electric power (the customer pays for KWH) into the storage reservoir for the water plant (the customer pays for gallons). Just a case where two wrongs make a right. The City's water problem is solved until the 1970 s, too.

STAR GAZER PUZZLE

Ever been out on a starry evening strolling with your girl, holding hands, gazing at the sky? Didn't know what to do? Here's a little quizzer you can mull over to pass the time. Keep holding hands. No paper work required. Answer given in next month's issue.



STATEMENT OF PROBLEM

A uniform two dimensional grid is constructed of one ohm resistors and is infinite in extent in all directions. All intersections are nodes.

REQUIRED

Determine the resistance between two adjacent nodes P_1 and P_2. Hint: remember symmetry, linearity, and superposition.

CHALLENGE

Determine the resistance between two diagonally opposite nodes P_1 and P_3.

1984

(To mark the 75th anniversary of AIEE, several top engineers peered into the future and told what they believed the profession would be like 25 years from now — 1984. Their predictions appeared in the Diamond Anniversary of Electrical Engineering, published last May. Here are some of the highlights of their crystal ball gazing.)

Walter L. Cisler, president of Detroit Edison Co.: Although conventional fuel will last into the foreseeable future, "in the long run high energy civilization will find nuclear power indispensable." There is no royal road that can be followed to the most effective and economic form of nuclear power, but "We will serve national interest if we proceed step by step, searching as we go, with the openness of mind that benefits a scientific age, fully aware that we are responsible for the optimum development of one of the greatest discoveries in the history of the human race."

W. H. Pickering, director of California Institute of Technology's Jet Propulsion Laboratory: Scientific and engineering achievements will not be governed entirely by our technical capabilities but will also be controlled to a significant extent by other factors. The complexity and cost of modern science and engineering require that very large sums of money be available to support experimental programs. particularly those of exploration of space. It is difficult to see how this support can come from any source other than the governments of the major powers of the world."

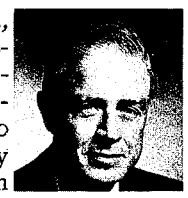
Dr. C. Guy Suits, vice president and director of the General Electric Research Laboratory: "... the question of the final outcome of a (scientific) research investigation is becoming more and more subordinate to the practical questions of probable cost, time required, and the availability of required scientific skills to accomplish the research. This will probably be true to a progressively greater extent in the future. Scientists will plan to make discoveries in areas of greater opportunity and need, and the powerful tools and skills of modern research will implement the planning." Scientists "to an increasing extent . . . will determine what discoveries need to be made and then plan to make them."

E. L. Harder, director of the Analytical Department of Westinghouse Electric Corp.: "The next 25 years should see the fulfillment of the dream of automation that is in but its earliest stage today." Far from displacing man from employment, automation, "will elevate him to a world of greater effectiveness and opportunity.

It is the computer, together with all the associated equipment for the process of information, which constitutes a large part of automation as it is known today. Automation through the use of the computer "holds tremendous challenge and opportunity."

The computer, "is to the machine what education is to man. We now have the tools to educate our machines. Engineers have accepted this challenge and in the last 10 years have made tremendous progress. . . . Computer intelligence should by then be applied wisely throughout industry to handle all of those types of tasks better handled by machine."

H. I. Romnes, president of Western Electric Co.: Within 25 years we should be able to speak to anyone anywhere in the world just by dialing or pushing a button on the telephone. "Direct dialing will grow into worldwide universal dialing. Push-buttons will take the place of dials. Many calls will be made using only one or two digits or completely automatically." There will be transoceanic television, visual communication in telephone calls, incredibly fast and brainy switching systems and earth satellite relay stations.



Thomas Watson, Jr., president of International Business Machines: Thinking machines — computers to the engineer — may make cash and even checks obsolete. "A bank account and bank checks are nothing more than devices which are used to store and transmit financial information. The same end, conceivably, could be accomplished through the use of an integrated data-processing network." A paymaster, instead of giving an employee cash or a check, would start a "chain reaction" by instructing a computer housed in a bank to credit an employee's earnings to a bank account. The accounts of the employee's company would automatically be debited by the amount of the paycheck. When the employee stops at a store to make a purchase, the sales clerk, upon receiving proper identification, would instruct the computer in the bank to debit the employee's account by the amount of the purchase and credit the store's account. Collateral information on the sale would also go to the store's computer for processing with sales, financial and inventory data. At the end of periodic intervals, the customer would get a statement on his deposits and all computer transactions.

Quicker Than You Can Say...

Ultra-high-speed, radically advanced electronic computer elements have been developed that can perform 10 million computer operations in the time it takes to say their name.

Known as BIAX, the new Aeronautic computer elements are small rectangular bars of ferrite magnetic material so tiny that more than 310,000 will fit into a quart milk carton. More than 5,000 can be held in the palm of your hand.

BIAX can operate at a wide temperature range — from 260° Fahrenheit, to Arctic temperatures well below the freezing point of water—in carrying out ultra-high-speed computing operations at millionths of a second.

BIAX computing equipment will result in much lower cost computers, because the tiny, relatively inexpensive elements will replace expensive semiconductor devices such as transistors and diodes.

TASI WILL DOUBLE THE CAPACITY OF SUBMARINE TELEPHONE CABLE

A new system which will increase the number of telephone conversations carried by underseas telephone cables —perhaps by as much as two times—is under development. The system is called TASI, which stands for Time Assignment Speech Interpolation.

In a normal two-way telephone conversation, one person on the average will be speaking only half the time, and even while he is speaking, there will be significant gaps and pauses in his speech. Thus, if the two directions of transmission are separated, each transmission path is idle, on the average, more than half the time. If two conversations are interlaced to take advantage of these gaps, greater use can be made of existing transmission facilities, according to Bell Telephone Laboratories. It is this interlacing process which leads to the designation Time Assignment Speech Interpolation.

In practice, the system would not work with only two talkers on one line since they would frequently be speaking at the same time. However, where a larger number of channels is available, such as a submarine telephone cable, an averaging effect occurs so that at any instant there is a greater probability of sufficient "free time" being available to accommodate the larger number of conversations. Increasing the capacity of a 36-channel system to 72 channels is more feasible with TASI than doubling the capacity of a 5-channel system.

TASI is essentially a group of high-speed switches. If, for example, 36 cable channels were available, 72 talkers could be connected. When there are more talkers than channels, the equipment will connect talkers who become active by disconnecting talkers who are silent at that moment. In turn, this disconnected talker will be assigned another momentarily inactive channel when he starts to speak again. A talker will be disconnected only when he is silent.

When a talker starts talking, his voice actuates a speech detector. The speech detectors are scanned by a control circuit similar to a modern digital computer. When a talker becomes "active" this control circuit initiates a coded tone burst consisting of a group of four audio tones which precedes the voice over an available cable channel. After the tone burst, which lasts only 10 milliseconds, the control circuit connects the talker to the same channel. The coded tones operate switches to connect the talker to the proper line at the receiving end. The tones are not heard since the listener is not connected while they are being transmitted. When a talker is not "active" and his channel is needed, another coded tone burst is transmitted over a separate signaling channel and severs the connection.

Switching of talkspurts from one channel to another is accomplished in a few milliseconds by a time-division switch. Speech is sampled for about two microseconds and the resulting pulses steered to the appropriate idle channel during the sampling by the selective operation of transistor "gates" in each channel. This short interval of sampling makes it possible to sample all active talkers 8000 times a second and then reconstruct the speech from the samples before it is transmitted over the undersea cable.

The signaling system in TASI keeps the receiving end informed of the connections that the transmitting end has established. Four groups of audio tones are employed for signaling purposes — four tones in each of three groups and three in the fourth group. Each signal comprises one and only one tone from each group — if more or less are present, an error is indicated and appropriate steps taken to correct it. "Connect" signals which precede the voice signal at the beginning of the speaker's talkspurt are sent over the same channel as the speech. Disconnect and connection checking signals are sent over a separate channel used only for this purpose.

All of the circuits for TASI are completely transistorized. Terminals for doubling the capacity of the transatlantic cable will require several thousand transistors of four different types, and tens of thousands of semiconductor diodes and passive components.

EE s Simulate Radio Signals Of The Sun

A team of engineers has reproduced in the laboratory one of the ways in which the sun generates and amplifies radio signals powerful enough to carry across millions of miles of space.

They are investigating the possibilities of using the mechanism as a probe in the study of how nuclear fusion processes work and as a technique to generate microwaves and open up new bands of radio frequencies higher than heretofore possible.

The research is being done by a group of electrical engineers from California Institute of Technology with the support of the Office of Naval Research and the Army Signal Corps.

In their Caltech laboratory, the engineers simulated certain features of the sun's outer atmosphere, or corona, and were able to amplify radio signals 100 to 1,000 fold. Their success verified a long-held theory as to one of the ways in which the sun produces the roaring hiss which has been picked up by radio telescopes. Previous attempts to substantiate this theory had failed.

The engineers began their research three years ago by developing vacuum tubes containing a plasma which was at a lower temperature but of equivalent density to the corona "atmosphere." Temperature of the corona, several million miles above the sun's surface, is estimated to be 1,000,000 degrees Fahrenheit.

It was believed that one of the key mechanisms for producing the sun's radio signals came from outbursts of particles from the solar surface and that these caused radio noise signals to be amplified as they went through the corona en route to outer space.

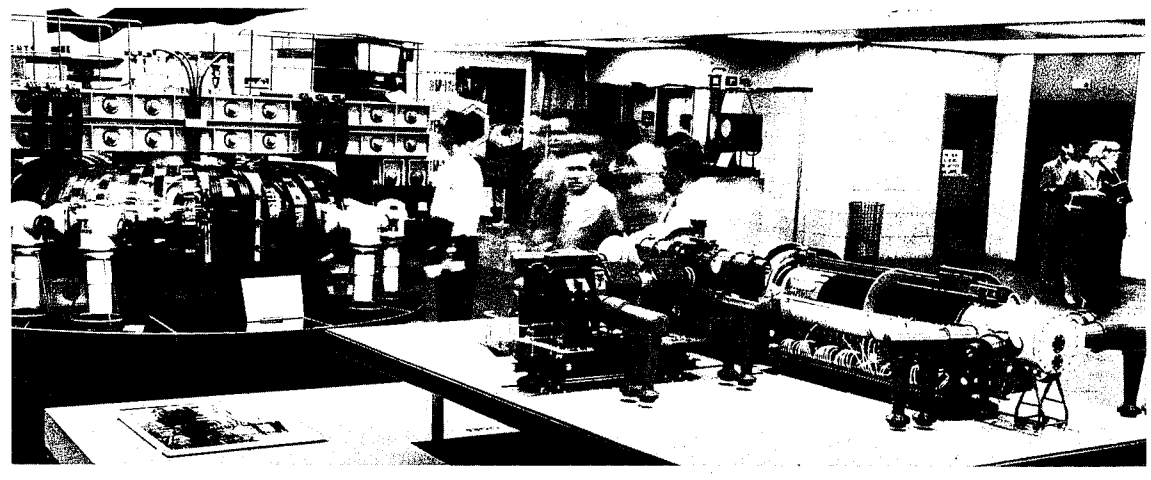
The engineers decided it was not necessary to attempt to duplicate the corona's high temperature to produce the amplification process.

(Continued on Page 7, Column 2)

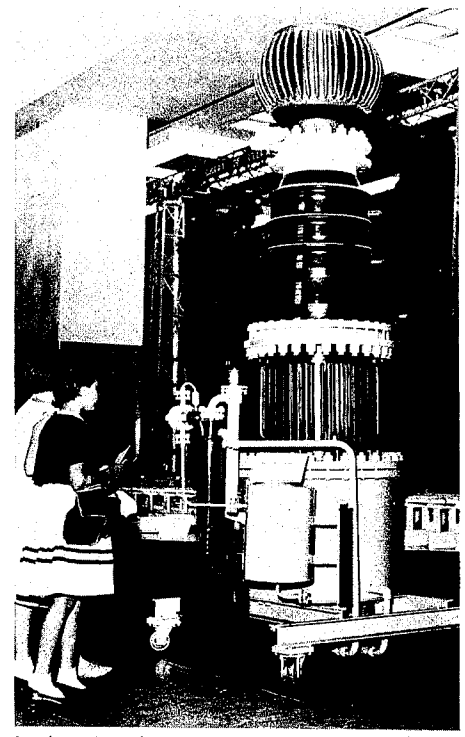
HIGH-FLYING ON HIGHER FREQUENCIES

400 cycle missile alternators in common use on today's guided supersonic destroyers pack too much heft. Studies on higher frequency systems indicated significant advance is possible in overall efficiencies. Basic redesign of all components of such a system is underway—anybody got any unused 900 cycle ideas lying around unpatented?

SATELLITES, POWER EQUIPMENT, TV SETS MAIN ATTRACTION AT USSR EXHIBITS



(Left) A model of the nose cone of the big Russian satellite that was launched Jan. 2, 1959. It's as big as an automobile and is said to weigh 3,250 pounds. Above is shown OGRA in the front and ALPHA in the rear. These are two experimental thermonuclear machine models with neon lights and full color to simulate contained plasma. Thermonuclear research has been going on in Russia since 1951.



This huge rectifier (right) is said to be for use on an 800,000 volt transmission line. It is believed to be based on a German mercury rectifier designer. It is designed to rectify alternating current at 130,000 volts.

Russian Show

(Continued from Page 1, Column 4)

Beside the hydroelectric model — and the grid with colored and confusing lights — was a very real piece of hardware indeed, a rectifier said to be in production for the 800,000 volt transmission line. Experts believe it may be based on German mercury rectifier design. It towered over engineers who inspected it. The identifying label said:

"This rectifier is designed for rectifying alternating current into direct current at a voltage of 130 KV and at an average current of 300 amperes."

The ratings claimed on this piece of equipment are doubtful, although the Russians are known to be forging steadily ahead on this project.

No such equipment is beyond the test stage in this country. Our cascaded rectifiers handle a few thousand volts at a lower output. Apparently, the availability of hydroelectric power at Stalingrad on the Volga River, and in other big installations, makes it feasible to stand the line losses involved in supervoltage transmission over very long distances.

MILLION DOLLAR MODELS

Several engineers at the exhibit were found admiring another example of model-making ("it must have cost a million dollars for these models alone") in a standard design for a steam power plant. The plant, it is believed, is designed for mass production, producing 1,200,000 KW. Six boilers operate at 570°C; six turbines at 565°C; six generators each put out 235,000 KVA.

"We have all this, of course," an electrical engineer said. "But this standardized plant, designed to fit a flat site, would seem to me to present many advantages." The number of plants of the represented design in actual operation could not be learned.

AUTOMATION DISPLAYED

What appeared to be rather crude applications of automation in machine tools flanked the big rectifier and the electrical grid display. One machine was a sorting device. An electrical erosion, copying-broaching machine, and a "universal ultrasonic machine" which uses 18.3 kcps to cut 320 cubic millimeters per minute of fragile materials, were shown in operation.

The known Russian penchant for gadgetry was given full rein in a model of a fully-automatic train control system demonstrated by Russian model trains. A placard read:

"Relay route type interlocking is an up-to-date system of switch points and signals. It facilitates the setting up of routes, increases capacity of station switch zones, promotes safety of train operation and eases mental strain of the station staff."

A Russian exhibitor assured visitors that the system is used in the Moscow subway. Trains between Leningrad, Moscow and Kiev, also use some aspects of the automatic control system demonstrated with model, the exhibitor said. Relays on the model set-up had more side-wipe motion (built in to reduce pitting and corroding) than do standard American relays which might be used in comparable demonstrations, it was said.

TV, RADIO, TAPE

Major effort in the display of consumer goods at the exhibit apparently was concentrated on television, radio and tape and disk sound reproduction systems. A color TV for installation over a surgical operating table in teaching institutions had a picture little more than six inches square. The color wheels occupied most of the cabinet space in the color TV set. Nearby, a projection color TV set-up was found to be not working on four separate visits.

The picture in a number of black and white TV sets on display was said by a professional to be of "studio quality". A model of a portable TV camera for journalistic use was displayed.

The TV sets could be recognized from their cabinets as alien to the United States. Hardwood veneer, covered with thick plastic, faced the cabinets. One set had a screen which swung up from a chess table like an old-fashioned sewing machine. Chess and TV might be considered an unlikely combination outside the USSR.

A remote control for one TV set was attached to the set with a long cable. But it appeared to have more control switches than usual American remote control devices. Russian TV uses a scanning frequency of 625. Sets are designed to operate on 127 or 220 volts at 50 cycles.

RUSSIAN HI-FI

An engineer who was peering into the sets reported that they had what seemed to be good layouts, printed circuits and were designs that could be mass produced. Russian hi-fi had plenty of volume. Stereophonic tape and disk combinations — complete with radio and in one case with TV— were shown. Standard American speeds of 78, 45, and 33 were marked on the phonograph controls. A radio set with six speakers and printed circuits looked a great deal like a Telefunken set. Missing from the TV and radio exhibits were prices or production rates. Automobile and portable radios, with transistors were shown. A scientific display hailed the contributions of A. S. Popov to radio on May 7, 189I and the contributions of P. L. Shilling in 1832 to telegraph.

PUZZLING AIRFIELD

An automatically controlled airfield, including 12 cabinets with simulated radar presentations, was presented in another model. The model appeared to puzzle many visitors, excepting small boys who enjoyed watching model airplanes travel along wires representing landing and take-off paths.

No digital computers were shown, although a photograph of the big Strela computer was hung over a row of cabinets with analogue devices. One analogue computer shown was said to be capable of solving a sixteenth order differential equation. Other computers were shown in mock-ups of industrial testing and control devices.

Of a long row of Russian testing equipment, an observer said: "This has had damned good people working on it." Signal generators, voltmeters, high speed oscillographs, and spectrum analyzers, were said to look like top-notch items, and as though they had been produced in quantity. All dials were clearly marked as has been German practice. One black box had a label on it which said: "IPPT-1 instrument for measuring parameters of junction-type transistor triodes."

An engineer familiar with American testing equipment said that it is impossible to know the accuracy, reliability and stability of the devices shown. A similar reservation was made of a display of silicon and germanium power transistors with ten to one hundred watts power dissipation. Transistors for radio frequency and for 400 megacycles were exhibited as components which could be mass produced.

A display of illuminating equipment (complete with sealed-beam headlights for automobiles) had two unusual items. One was a fluorescent globe, using 1,000 watts, about eight inches in diameter and sixteen inches high. It had a screw base. Another big globe was said by the Russian exhibitors to be a fishing lamp, whose 1,000 watt underwater output attracts fish. The exhibitor said he did not know what kind of fish it would attract, pleading innocence of the fishing art.

"LENIN" ICEBREAKER

Models of the atomic icebreaker "Lenin" and a big uranium-graphite power reactor evidenced model-making skill at work. Radiation detection equipment appeared to be much like that in use here. An electronically controlled telescope, with computer feed-in to track satellites, was shown as part of the Russian participation in the International Geophysical Year.

Perhaps the most colorful and impressive of the displays of Soviet science and technology was an exhibit which bore a large photograph of ocean water and the caption: "The problem of achieving thermonuclear power is one of the most majestic and noble problems challenging scientists."

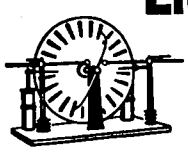
Models of the OGRA and Alpha experimental thermonuclear machines with neon lights and full color simulations of contained plasma gave the impression that this problem is near solution. This view is not widely held here. A voice points out in a recording that missile materials, and oil and coal will be exhausted.

Thermonuclear research, says the voice, started in Russia in 1951 and was first brought into the open by the USSR. Extracting by fusion machines the energy in heavy hydrogen which can make a gallon of seawater the equivalent of several hundred gallons of gasoline, according to the Russian recorded voice, is "the premier problem of contemporary physics."

The exhibit opened on June 30. It ran through August 10.

DIGESTS

DIGESTS OF PAPERS FROM THE AIEE SUMMER GENERAL MEETING, SEATTLE



Electrostatic Generation In Space

Electrostatic generation, earliest known method of creating electricity (Otto Von Guericke 1660) may have a definite place in the Space Age, Lt. Onezime Phillip Breaux, Wright Paterson Air Force Base, Dayton, Ohio, observed in a paper, Electrostatic Power Generation for Space Propulsion. These generators are considered as low power machines with poor power to weight ratios on the earth's surface, but in the weightlessness and vacuum of space, the picture changes, he said, "and the generators may have power/mass ratios more favorable than that of electromagnetic equipment of equal output power."

Rotating plate electrostatic machines "possess several inherent advantages over electromagnetic units," he said. Space consists of very high vacuum which may be utilized as a dielectric, therefore very little insulating material will be required for generators in space vehicles. Such devices would weigh less as bulky iron and copper coils would not be needed. The generators also would be very efficient.

"The actual potentialities of vacuum operating rotating electrostatic generators have not been fully explored in spite of their inherent low losses and simplicity. These devices have several characteristics which are advantageous for ion propulsion, operation in a vacuum, generation of power at high voltage, and high efficiency. Further development could make the vacuum electrostatic generator competitive with electromagnetic machines for ion rocket systems."

A generation ago, J. G. Trump experimented with a rotating electrostatic generator and "obtained an efficiency of 99% at full load."

AIEE Paper CP59-914

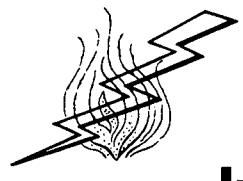
20,000 lb. Space Ship Predicted

A 20,000 pound space vehicle, possibly ion propelled, could be launched within five years, it was predicted by A. E. Lennert, of the Martin Co., Baltimore, Md. In a paper, Practical Considerations of an Ion Propulsion System, he said: "We may logically assume that within five years it will be possible to project into orbit a 20,000-lb. vehicle — five times as heavy as the largest satellite now in orbit. This payload capability is a necessary intermediate step in the long range program leading to manned space flights."

Today's space vehicles cannot maneuver, and until the recently announced SNAP III device (a nuclear generator), could not carry on uninterrupted communications for a great length of time. Control and communications are the two main obstacles to space travel, other than for exploratory and academic purposes.

"The ion rocket is a reasonable system which has the inherent growth potential to power a space vehicle on extended journeys," he said. "An ion system may be justified mainly by the requirements of future space vehicles, such as extreme liability, development time cost, power source, specific power generation, specific impulse, payload capability, and many others too numerous to mention."

The ion system is among those that meet the major requirements for space propulsion—high specific impulse and low weight. AIEE Paper 59-833



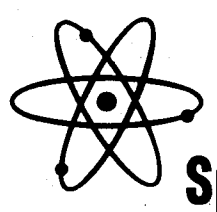
Thermo Electric Power Improved

The generation of thermoelectric power for space vehicles was the subject of several papers. New semiconductor materials "have multiplied thermoelectric heat conversion efficiencies by a factor of 10, approximately, compared with metal thermocouples," E. W. Bollmeir, Minnesota Mining and Manufacturing Co., St. Paul, observed in a paper, An Elementary Design Discussion of Thermoelectric Generation. "This remarkable increase has brought thermoelectric conversion to a point of potential competition with electro-mechanical or other conversion for some applications. However, large scale economic competition remains dependent on significantly higher materials efficiency attainment. At today's state of the art, the uses to which thermoelectric generating devices are suited are those which value some feature more highly than maximum economy or which utilize very low cost heat."

Nuclear heat is of "inherent practicality" for thermoelectric generation, because of the long life content per unit weight, among other things. Its advantages are cost and availability.

"Yet for those uses demanding maximum watt hours per pound or which cannot be periodically refueled, they are indispensable."

A good example of practical thermoelectric generation is the SNAP III Nuclear Fueled Generator. It was designed to demonstrate the feasibility of thermoelectric power supply for space vehicles. AIEE Paper 59-867



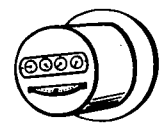
Nuclear Powered Space Ship

A space vehicle, using thermoelectric power generated by a nuclear reactor, was described by J. E. Cobb, G. B. Shook and W. E. Cutler, Lockheed Aircraft Corp. The vehicle would be launched by conventional means from a satellite in orbit and would be propelled by an ion motor during its journey to other planets, they explained in a paper, Nuclear-Ionic System for Space Flight.

The nuclear power plant, which could be started remotely, or after flight had begun, would be unshielded to reduce its weight, and its radiation would be dispelled into space.

The critical fuel mass would be 200 kilograms of fully enriched uranium. Three hundred kilograms of zirconium carbide would be required as core internal structure material and binder, and 1360 kilograms of graphite would be used as core internal material and reflector. An additional 200 kilograms of zirconium carbide would be required as core external structure.

"This type of control employed allows an excess reactivity of about 6 per cent to 8 per cent $\triangle K/K$ hot. This amount of excess reactivity will allow a total burnup of about 3 kilograms of U_{235} for this configuration. This total burnup allows about one year of full power operation. Fission gases are allowed to diffuse into space. The reactor system may be started after launching." AIEE Paper CP59-834



Hall Effect Wattmeter

The Hall Effect, known for 80 years, is being utilized in a new wattmeter. (The Hall Effect: When a thin rectangular sheet of metal carrying an electric current in the direction of its length is subjected to a magnetic field normal to the sheet, an electromotive force is developed which is at right angles both to the direction of the current and to the magnetic field).

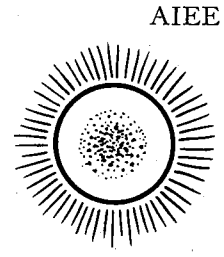
The utilization of this well known principle in a wattmeter was described by T. Barabutes and W. J. Schmidt, Westinghouse Electric Corp., in a paper, Principles and Consideration in the Design of a Hall Multiplier. Newly developed very high mobility semiconductors, such as indium-arsenide and indium-antimonides, make possible the practical application of the Hall Effect, they said.

"The inherent advantages of the Hall multiplier make it universally applicable to any device requiring an output proportional to the product of two electrical quantities. Since the measurement of a-c power is based on a product equation, the transducer self-contained wattmeter was chosen to illustrate one ideal application of the Hall multiplier.

"To put the Hall Effect to work, the Westinghouse type 803 Hall Generator has been fabricated. It consists of a thin wafer of InAs and is essentially a solid state multiplying element which provides an input voltage proportional to the product of two electric quantities:—the current passing through it and the field perpendicular to it. . . ."

In the past, watts have been measured by three basic multiplying devices, the electrodynamometer mechanism, the induction-disc mechanism and the thermal converter circuit.

AIEE Paper CP59-875



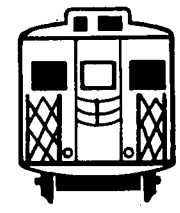
Silicon Solar Cell

Silicon solar cells "for the immediate future will probably become the work horse power source" for satellites and space craft, it was predicted in a paper, Thermionic Power Supply Using Solar Heat for Space Applications. The authors were E. F. Casey and G. Street, Jr. of General Electric Co. The solar cells may fill the "critical need" for long life secondary power for space craft.

Several sources of power including silicon solar cells have been used successfully. Battery technology "is approaching inherent limitations" and batteries are impractical for extended duty in satellites because of weight. "Electric energy converters using solar energy or nuclear heat sources permit the generation of continuous power with fixed weight, regardless of the time duration required."

A space power generating system will include a solar collector to concentrate the sun's energy, a thermionic converter to transform thermal energy into electricity, a radiator, intermediate heat transfer loops, control devices and a storage means for accumulation of thermal or electrical energy for use when the space vehicle operates in the earth's shadow.

AIEE Paper CP59-904



Transit To Use Silicon Rectifier

The silicon rectifier is a comparative newcomer in the transit field, but it may help solve the commuter problem, Virden E. Staff, of DeLeum Cather & Co., Chicago, and S. Blair Lent, power superintendent of the Boston Metropolitan Transit Authority, said. "The silicon rectifier has many practical and economical applications for railway electrical traction power and holds forth great promise for future use," in the growing problem of providing adequate transportation for commuters, they observed in a paper, Semi-Conductor Rectifiers for Traction Power on Electric Railways. Principle advantages of the silicon rectifier are simplification, reduction in initial cost, and reduction in operating cost compared with a conventional mercury arc rectifier.

Many schemes have been proposed for improving commuter service, with many of them based on the use of electric power. Existing rapid transit operations in general use 600-volt direct current at the third rail. Electrification of a railroad right of way outside the city would utilize a 600-volt direct current overhead system up to 10 or 12 miles and from there to as much as 30 miles further use 12,000-volt alternating current, which would be stepped down and rectified to direct current.

Cars would be of the multiple unit type. Each car would be equipped with self-contained silicon rectifier, transformer, associated controls, 600-volt direct current motors, pick-up shoes and pantograph. Each car would also have dual controls for operation on third rail within the urban area and overhead catenary for the collection of direct current and alternating current in the suburban area."

AIEE Paper 59-799

An Electrical Engineer in Industry

by
H. R. Huntley,*
chief engineer,
American Telephone
& Telegraph Company

"The career opportunities awaiting today's electrical engineering graduates are more varied and exciting than ever before. Because the field is growing so rapidly and in so many directions, however, young engineers should not be surprised to find that more often than not they are being asked to ply their talents in rather distinct areas of specialization.

While some specialization is a good and a necessary thing, it does impose increasingly tougher demands upon electrical engineers in several ways. A.I.E.E. has provided means, however, for making these problems easier to cope with.

First, the E.E. graduate with numerous opportunities to choose from will find that the problem is alike in some ways to deciding what to order from the dinner menu in a swank restaurant. Unless he has learned a smattering of several languages and knows something of the reputation and specialties of the house, he may find that what he hoped would be "his dish" is really an elaborate and expensive disappointment.

The point is that through membership in A.I.E.E., access to Institute active in a variety of fields, facts and opinions become available which can increase the likelihood of an engineer getting his career launched in a reasonably sensible direction.

Once at work in a particular specialty, from time to time he may be surprised (but I hope not embarrassed) to learn of progress in related areas which has a distinct bearing upon how he approaches his present assignment. Being successful as a specialist, like driving on the thruway, requires constant alertness for changes in speed, direction and conditions of things about him. The progress and decisions of others, unless noticed and allowed for, can often have unexpected effects upon his chances of arriving at his destination in good shape (or at all).

A.I.E.E. meets this need with technical sessions and publications covering current developments in a wide variety of specialties, with technical committee activities in important areas, and with opportunities for engineers to meet and compare experiences with many folks whose problems are similar or related to their own.

There is another requirement, not as "automatic" as the previous two, which is determined in individual measure by each engineer's ambitions for reward and recognition. One who is content only to do the same kind of job as well tomorrow as he did today will have to work at keeping abreast of progress in his field. If he aspires to greater responsibilities and rewards, he must strive not only for improved stature and performance in his specialty, but he must also increase and broaden his inventory of useful knowledge and skills in areas in which he may not actually be working at the moment.

A.I.E.E. through its program of publications and activities provides effective vehicles for self development and broadening in technical and professional knowledge and skills. Branch, Section and District administration and committee work also afford the young engineer with many practical opportunities for learning and practicing leadership."

Mr. Huntley was graduated from the University of Wisconsin in 1921 with a bachelor of science degree. He has been with A. T. & T. since 1930. He was named chief engineer in 1957. He recently was named to the Board of Trustees of the Electrical Historical Foundation and to the Board of Directors of the American Standards Assn.

SIMULATE SUN

(Continued from Page 4, Column 4)

They introduced into the vacuum tube mercury gas and put an electric current through it. This formed the gas into a plasma, similar to the sun's corona. A plasma is formed when the temperature of a gas is raised to the point at which its atoms start coming apart. The first symptom of formation is when electrons break loose from their atoms and dart about freely in the gas.

The vacuum tubes are designed so that a continuous beam of electrons can be fired through them. Some previous researchers also had fired beams through the plasma in hopes of generating radio waves.

They had failed because they did not send the electron beam through the plasma in high frequency bunches. The Caltech group did this in two different ways and achieved success with both methods. They put the high frequency energy on the beam and also on the plasma. In both instances, the plasma jiggled with jelly-like oscillations as the electron beam was shot through it.

In passing through the jiggling two inches of plasma, the high frequency waves were amplified up to 1,000 times. In effect, the jiggles intensified the waves of electrons in the beam.

—HIGHLIGHTS

(Continued from Page 3, Column 4)

WATTS COOKING...

or from fuel to electricity without B. T. U.'s

Falling water may lose its pre-eminence as a relatively heatless generator.

Although the modern steam power plant is gaining in thermal efficiency, it is doing so by the use of higher and higher temperatures and pressures. The end of such efforts to gain advantage by utilizing the upper part of the Kelvin scale is now in sight. Meanwhile a continuous search for means of producing electricity directly from chemical processes not requiring intense heat is beginning to pay off. By the time the present nuclear power plants are commonplace, there may be a serious competitor in one or more of the gaseous generators. These devices now suffer from low natural voltages and from their inability to produce anything but direct current. Perhaps our whole way of utilizing power may be in for a change; for instance, batteries charged in parallel may be used in series.

ALARMINGLY COMPLEX

Just in case such a fantastic arrangement does come along, a study of storage batteries also has been made. It turns out that a simple thing like measuring the resistance of a battery is quite alarmingly complex. The next time your automobile starter just grunts instead of spinning you may wish you had read this paper, although you will still need a push or a booster.

AROUND THE WORLD IN 18 DIGITS

The possibilities of human error in dialing wrong numbers may become boundless.

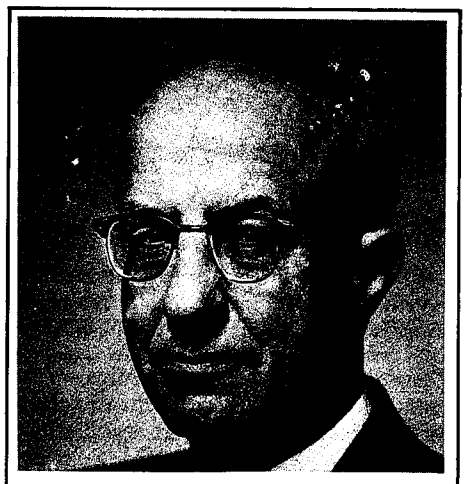
There is a supplier making small locks to fit telephone dials for those subscribers who have found their small children happily talking to total strangers in distant communities by means of automatic machine accounting and customer toll dialing. (So far no way of locking the new push-button "dials" has been proposed.) With the imminent advent of global connections to our telephone plant, the average householder can but hope that only "person-to-person" calls will be accepted, and these through human operators.

The worldwide communication network now makes use of a great deal of radio, both normal frequency and "over the rainbow" microwave, but as pointed out elsewhere more and more undersea cables are going into this service. The latter provide noise-free links with better spectrum efficiency than the radio can furnish, hence these cables can be expected to be extended to all important cities before long.

CIRCUIT OVERLOADED

As has happened many times before, as soon as a new communication service has been established, the available circuits are over-loaded almost at once. (One can only speculate how the information was interchanged before the service was started.) Anyway, the engineers have determined that enough of the conversation is one-way so that it is not necessary to furnish two-way channels all the time. By means of special terminal devices, only one channel will be connected as required by the talkers, and without the necessity of saying "over to you" like a "push-and-talk" radio circuit. The gimmick sounds pretty good, except for the "yeah, yeah" listeners, who might defeat the purpose by keeping a return channel open for nothing.

One awful thought comes to mind, though. What do you do when you get a wrong number in a foreign language? Maybe everyone will really need to learn Esperanto now!



J. H. FOOTE

of Jackson, Mich., was elected 1959-60 president of the American Institute of Electrical Engineers. Mr. Foote, is chief engineer of Commonwealth Associates and vice president and director of engineering for Commonwealth Services, Inc. He attended Michigan State University, '14 and received D.Sc. '58 from Wayne State University.

UEC BREAKS GROUND

Ground-breaking ceremonies are scheduled October 1, 1959 for the long-awaited new United Engineering Center on United Nations Plaza in New York City. Many Student Branches of AIEE, as well as student organizations of other engineering societies, have made contributions toward its construction. The beautiful, modern and spacious building will be ready for occupancy in mid-1961. The general contractor promises plenty of windows for sidewalk superintendents!

The building will literally become a world headquarters for the engineering profession, as well as serving as American headquarters for many of the North American professional socities including ASCE, AIME, ASME, AIEE, AIChE, AICE, AIIE, ASHRAE, AWS, IES, and SWE. Also there will be the joint bodies ECPD, EJC, Engineering Foundation, Engineering Index, Engineering Services Library, Welding Research Council and UET, Inc. The Municipal Engineers of the City of New York completes the list.

NEW UNITED ENGINEERING CENTER

Communication Theory

by
W. W. Peterson, University of Florida, Gainesville, Florida
R. L. Shuey, General Electric Research Laboratory, Schenectady, N. Y.

(This bibliography is the first of a proposed series for the Institute. Others may be included in EE DIGEST as they become available, if sufficient reader interest is indicated.)

Statistical communication theory[1-5] deals with the design of point to point communication systems. It is inherent in the theory that the system designer can determine the properties of both transmitter and receiver. In general, this means that the transmitter must properly *code* the message to be transmitted, and the receiver *decode* what is received.

In the past, the main contribution of communication theory has been in providing a better understanding of communication systems. Thus, such systems as pulse code modulation, pulse position modulation and amplitude modulation are thoroughly understood and accurately evaluated. Today there are a host of practical problems being analyzed by communication theory.[6-11] We are rapidly obtaining a better understanding of such things as multiplexing, coding, detection, and signal processing. This understanding is permitting the development of much more complex systems. These systems often require components not readily available. The influence of theory in specifying needed component and technique development is often not adequately appreciated. Today's new systems contain components designed to such specifications.

The rapid development a decade ago of communication theory by Shannon and others was due largely to the demands of the communication industry. Since that time, those techniques have been extended and applied to many other problems.[9-12] Man communicates, observes and processes information. The study of these operations constitutes modern information theory, a much broader field than that embraced by Shannon's original work.

Perhaps the most exciting branch of the study of information is research in information processing methods of a non-routine nature. The goal of such work is the development of systems capable of reaching good decisions, and obtaining good solutions to problems without detailed instructions as to how this is to be done.[13-16] A system of this type must have the ability to organize itself to perform the assigned task and might thus be called a self-organizing system.[17] Self-organizing systems will find great applicability in the communication, control, and information processing fields.

One of the keys to communication theory is the quantitative measure of information based on probability and statistical theory. While statistical methods are becoming an extremely valuable tool for every engineer, for the communication theorist a thorough knowledge of statistical theory is essential. Not only conventional electrical engineering and applied methematics, but also logic, number theory, and various areas of modern mathematics find useful application in the wide range of communication and information problems.

While speculation on what can be done with communication theory is fascinating, we need sound basic research and study by men thoroughly trained in electrical engineering and mathematics. This field of new concepts and ideas presents a real challenge.

REFERENCES

*1) Bello, Francis, "The Information Theory," Fortune, December 1953, p. 136.
**2) Shannon, C. E., "A Mathematical Theory of Communications," BSTJ 27, 379 (July-October 1948) (See also Univ. of Ill. Press, 1949)
**3) Feinstein, Amiel, "Foundations of Information Theory," McGraw Hill, 1958.
**4) Khinchin, A. I., "Mathematical Foundations of Information Theory," Dover 1957.
5) Goldman, Stanford, "Information Theory," Prentice Hall, 1953.
6) Black, H. S., "Modulation Theory," D. Van Nostrand, 1953.
7) Woodward, P. M., "Probability and Information Theory with Applications to Radar, Fergamon Press, 1953.
8) Brillouin, Leon, "Science and Information Theory," Academic Press, 1956.
9) Symposium on Information Theory, London, England, Sept. 1950, PGIT-1, Institute of Radio Engineers, 1953.
10) Jackson, Willis, "Communication Theory," papers read at Applications of Communication Theory, London, Sept. 1952, Butterworth, 1953.
11) Cherry, E. C., "Information Theory" paper read at London Symposium, Sept. 1955, Butterworth, 1956.
12) Quastler, Henry, "Information Theory in Psychology," Free Press, 1955.
13) Boehm, G. A. W., "The New World of Math," 1959, Chapter III: The Next Generation of Computers
14) Von Neuman, John, "The Computer and the Brain," Yale University Press.
15) Shannon, C. E. and McCarthy, J., "Automata Studies," Princeton Univ. Press, 1956.
16) "Mechanization of Thought Processes," papers presented at Teddington, England Symposium, Nov. 1958. To be published by H. M. Stationery Office.
17) Bellman, Richard, "Dynamic Programming," Princeton, 1957.

* A good non-technical description of information theory.
** These references require knowledge of statistics.

EE Digest

(Continued from Page 1, Column 2)

forecasters prophesy. We hope even to have a few day-dreams of the future from some of our less experienced readers — past history has at times proved them the best prognosticators of all!

The format in this issue, and in fact for future issues, is not final, nor will it be static. The DIGEST is indebted to many friends from the technical and general press for assistance and advice in getting their publication off the ground. With such continued help, as well as that of our readers, the publication will certainly stay on course.

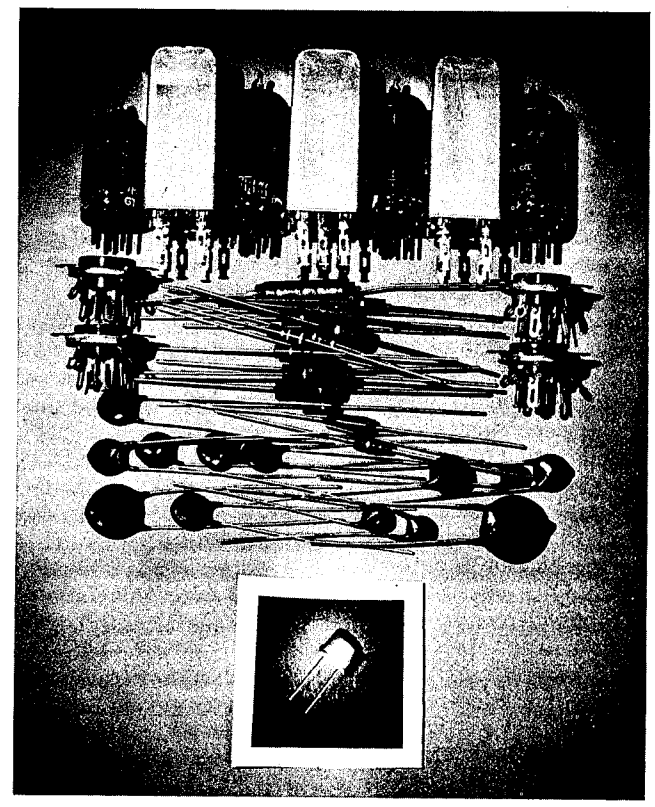
Thorium To Replace Uranium?

The Atomic Energy Commission has announced that it will attempt to derive nuclear power from thorium—an element estimated to be three times more abundant than uranium. Involved is a long range program designed to create a new type of nuclear furnace known as a "thermal breeder reactor" which would change thorium into a material that can be used for atomic fission.

Success of the program would provide a major breakthrough in attempts to add substantially to the world reserve of potential atomic fuel. At present uranium is the only natural material available for nuclear fuel and weapons.

A drawback to the program, however, is that while the earth's crust is three times richer in thorium than uranium, the known deposits of thorium that can be exploited for commercial use are not so great as those of uranium. Thorium usually comes only in low concentrations The best sources are in monasite sand deposits of India and Brazil and vein deposits of South Africa. Some deposits can also be found in the U.S.

TUNNEL DIODE (in can, at bottom of photo) can perform simultaneously the following functions that are necessary in an FM receiver: amplification, oscillation, conversion, limiting, detection, and automatic frequency control. If an FM receiver were rebuilt using a tunnel diode, all of the conventional components shown in the photo could be omitted, although with some sacrifices in performance. Such performance limitations reflect the present state of the art and not in the inherent capabilities of the tunnel diode.



Tunnel Diode

(Continued from Page 1, Column 3)

extremely high frequencies. Oscillation frquencies higher than 2000 megacycles have already been obtained, matching advanced transistor performance, and frequencies of more than 10,000 megacycles are expected in the near future.

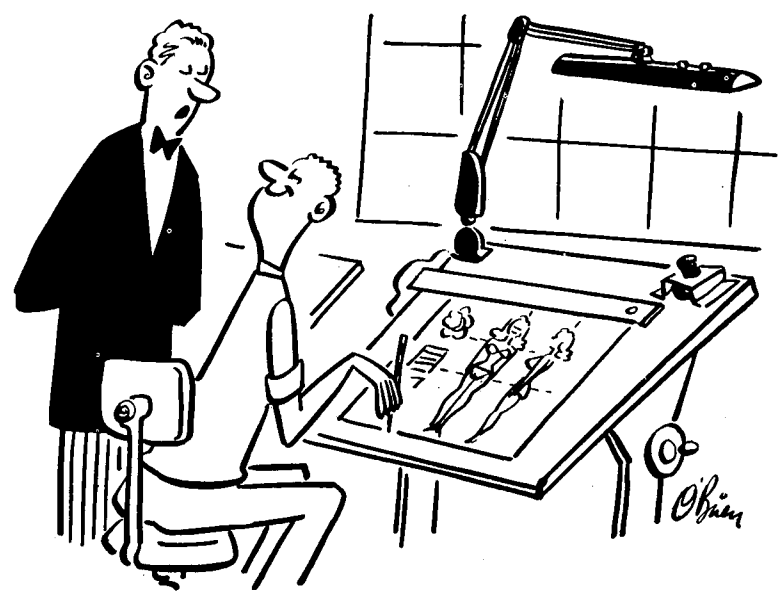
The device's high-speed response also suggested applications in computers. When used as switches, tunnel diodes have functioned in a fraction of a milli-microsecond—from 10 to 100 times as fast as the fastest transistor.

The device also resists the damaging effects of nuclear radiation. Because it is less dependent on the structural perfection of its crystal than is the transistor, it is much less affected by the damage that radiation can do to such crystal structures. In this respect it outranks transistors by more than 1000 to 1. Semiconductors that have been used by GE scientists for making tunnel diodes include silicon, germanium, gallium arsenide, gallium antimonide and indium antimonide.

The tunnel diode is smaller than a transistor and, because of a simpler structure, ultimately will be a small fraction of its present size. It also is little affected by environmental conditions. Silicon tunnel diodes made by General Electric work at temperatures as high as 650°F; conventional silicon diodes will not operate above 400°F.

As an electrical circuit element, the tunnel diode exhibits a unique combination of electrical properties including "negative resistance" over part of its operating voltage range. These characteristics allow it to be used in a wide variety of applications, such as an amplifier, a generator of radio-frequency power, and a switching device. The simplicity of this device makes possible the development of "integrated circuits," in which entire circuits for some applications may be formed on a single semiconductor structure. It is superior to vacuum tubes and transistors for applications in low-noise amplifiers and mixers for high frequencies. Many parametric amplifier jobs, for example, could be performed more easily by tunnel diodes.

Several studies on the tunnel diode have been launched in the U.S. and papers resulting from these studies are beginning to appear in technical meetings and publications.



Very interesting, James, this is your impression of a structural engineering problem?