THE BRIDGE

Eta Kappa Nu *Maytime '70*

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Eta Kappa Nu

Electrical Engineering Honor Society

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OUR COVER

Nuclear Power's expanding role in worldwide electrification is illustrated by Spain's Santa Maria de Garona plant, constructed by the General Electric Co. This lovely painting by Paul Calle, courtesy of G.E., introduces our special supplement on Electric Power. (page nine)

The BRIDGE is published by the Eta Kappa Nu Association, an electrical engineering honor society. Eta Kappa Nu was founded at the University of Illinois, Urbana, October 28, 1904, that those in the profession of electrical engineering, who, by their attainments in college or in practice, have manifested a deep interest and marked ability in their chosen life work, may be brought into closer union so as to foster a spirit of liberal culture in the engineering colleges and to mark in an outstanding manner those who, as students in electrical engineering, have conferred honor on their Alma Maters by distinguished scholarship activities, leadership and exemplary character and to help these students progress by association with alumni who have attained prominence.

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Welcome To Our New Chapter At Tuskegee Institute

Real and Imaginary

The history of....

PARTIES

Your drinking glasses, furniture, entertainment budget and delicacies simply won't do the job if you decide to entertain in the manner of Ahasuerus, Lucullus or Caligula.

To begin with, a feast given by King Ahasuerus would be a pretty rough act to follow—it lasted seven days! As told in the Bible, the highlight of each night was a royal wine served in solid gold vessels. And in keeping with the decor, the beds that the guests reclined on were gold and silver.

The seven-day bash of Ahasuerus paled when compared to the luxuries the Roman nobles lavished on their guests. According to researchers at Heublein, one wealthy Roman, Lucullus by name, spent as much as $5,000 on a single meal. What does one eat for five thousand dollars? Well, grasshoppers and nightingale tongues were regular entrees. For something more filling, Lucullus served whole boars.

However, in those days, an emperor could always be relied on to outdo a common patrician. The Emperor Caligula was said to have tossed pearls into his vinegar. Yet, even he was surpassed by that gentleman who had nothing better to do than fiddle away his time planning parties.

For if you were lucky enough to attend a party at Nero's "house" perfume sprinkled from the ceilings would rain on you and a massive jewel would be your prize if you had the lucky number.

We have to move ahead a few centuries till we match

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THE GAMES MACHINES PLAY

LEARN. THINK. Create. Conceive. Inspire. Dream. All words used to describe a very powerful and unique capacity of the human being—the power of the brain.

But is this so unique? Is the human being the only thing on the face of the earth with such capacity? In *2001: A Space Odyssey*, a 21st century computer named HAL almost succeeds in destroying a space ship and her crew. The last crewman was able to save himself and the ship by unplugging the higher-order memory cells of the computer, reducing it to a babbling moron capable only of singing "A Bicycle Built For Two."

Interesting science fiction, true. But is it really pure fiction? Is it conceivable that machines can "learn," can be "taught," can "improve" themselves through "experience," even to the point of becoming "smarter" than their creators?

Surprisingly (and perhaps somewhat frighteningly) the answer is yes.

Since the dawn of the era of the Princeton Machines in the early '50's, (forerunners of modern digital computers) Man has applied himself more and more toward constructing, developing, and orienting the computer along the lines of the free-thinking human brain. And with some marked successes.

To attempt to follow the rationale behind these efforts requires projection of oneself into the realm of abstract mathematics and philosophical thought—which engineers, by their very nature, are not predisposed to do. Nonetheless, it is interesting to attempt to apply scientific analysis to the human thought process in order to better grasp the potential the electronic computer has for "thinking."

The 13th century scholar St. Thomas Aquinas divided human intellect into three portions: a) Passive, b) Active, c) Will. The Passive Intellect interprets inputs from the senses and contains the memory or repository for learning. The Active Intellect controls and develops abstract concepts such as loyalty, God, beauty, creativity, and so forth. The Will provides motivation and inspiration for intellectual activity. Since the major portion of man's behavior is concerned with the Passive Intellect, it is this portion to which efforts have been made to develop machine simulations.

The analysis of games and gamesmanship lends itself nicely to developing learning procedures in machines. Problems taken from real life tend to become complicated by detail, while the details of game playing strategy can be controlled, defined, and developed in the machine.

Characteristics of games whose emphasis is on developing machine learning techniques are as follows:

1. The activity must not be deterministic (the outcome must not be predictable at the start). This is true of chess and checkers, but not true of tic-tac-toe, where the first person to move cannot lose.
2. A definite goal must exist—winning the game—along with intermediate goals which have a bearing on the final goal. For example, in checkers the goal is to deprive the opponent of the possibility of moving, and the dominant criterion is the number of pieces of each color on the board.
3. The rules of the activity must be definite and known. Unfortunately, many problems in daily life do not satisfy this requirement, while games do. However, the learning principles associated with games do have importance elsewhere.
4. A background of knowledge (experience) should exist, against which the learning process can be tested.
5. The activity should be understandable to a large number of people so that the program will be understandable. Playing games against human opponents provides convincing demonstrations that machines really can learn.

First developments of game-playing machines were centered on games of definable and precise strategy, where the machine would never lose.

An electrical machine to play tic-tac-toe was developed in 1950 using telephone switches. All possible games were built-in, in prewired form, using the symmetry of the tic-tac-toe matrix to cut down the amount of actual circuitry involved. A unique twist was that the machine did not produce stereotyped games easily recognized by human opponents. After noting the first human move, symmetry operators were applied in a random fashion to its own standard replies, and an unpredictable variety was thus obtained.

The digital computer provided an impetus to the development of games-playing devices, and programs for tic-tac-toe and another game simply called NIM

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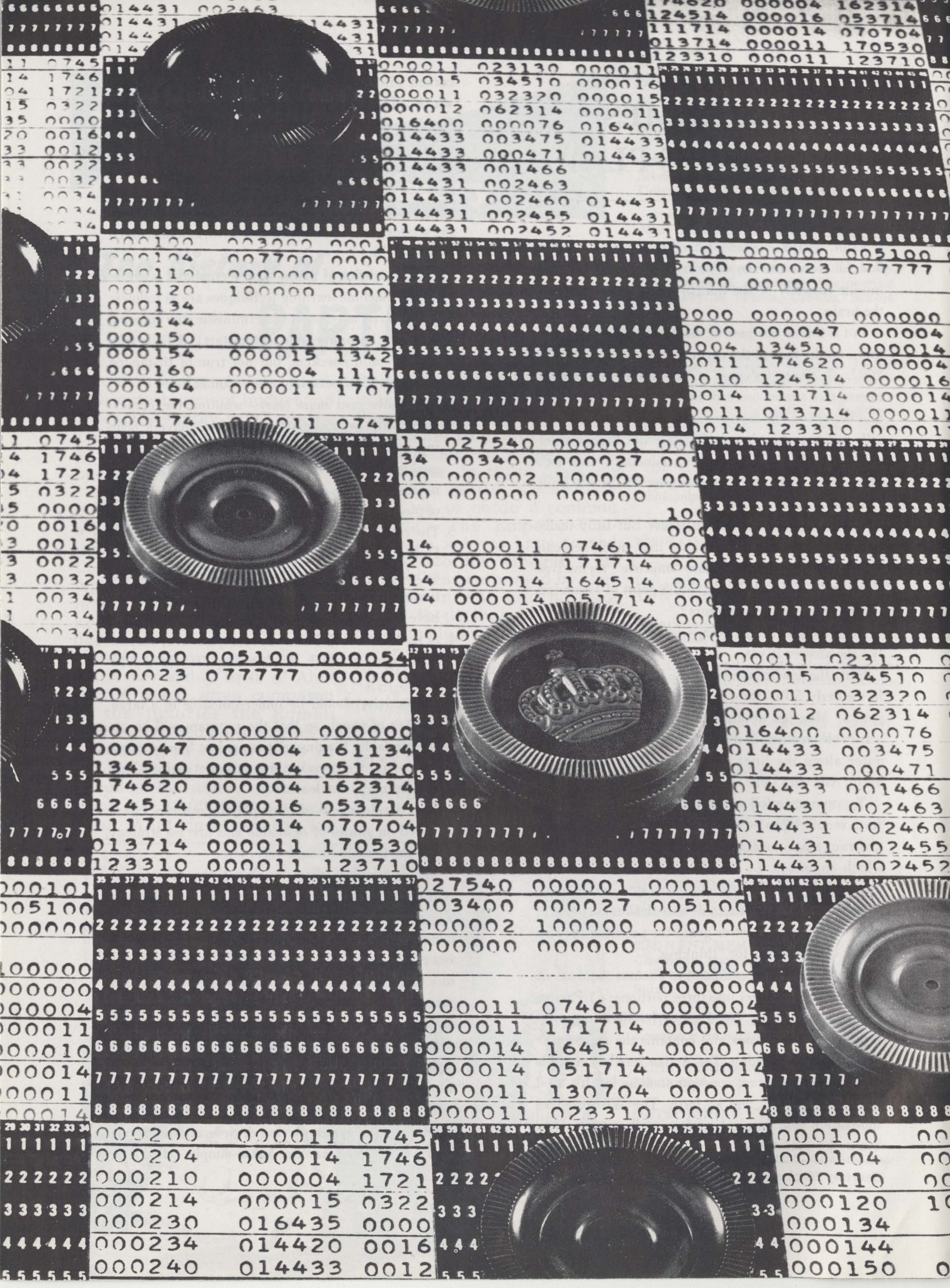
Courtesy Hughes Aircraft Vectors



were speedily developed, many of which used schemes to produce randomness (or apparent randomness) to the machines responses.

All such efforts, however, are of only limited interest because precise strategy is available and the person who moves first cannot lose (except through error).

Of far more interest are games where no precise strategy is known because of their complexity. Chess and checkers are two such games, both of which require the following basic steps: 1) A program to make legal move, 2) a means for evaluating the strength of any position, 3) A means of keeping track of some past history of the game.

Listing and storing all possible games (as was done for tic-tac-toe) is virtually impossible for chess or checkers. For a typical chess game, listing all possible moves would take 10^{90} years. For checkers, something like 10^{23} years, even when 3000 choices are considered per microsecond.

An alternative is to investigate all possible moves to an arbitrary depth, say three or four, and then evaluate the choices through a numeric assignment to the relative strengths and weaknesses. A chess program was developed circa 1950 that investigates moves to a depth of four and plays respectable chess, taking about 12 minutes per move. The following relative strength assignments were used:

Pawn=1	Rook=5
Knight=3	Queen=10
Bishop=3½	Checkmate=100

From a machine learning standpoint, however, less complex games such as checkers lend themselves to more emphasis on learning and less on development of a formal game playing program.

An outstanding development in this area came in 1959 with two checker playing programs that allowed an IBM 704 to learn to play a better game than the programmer, in the remarkably short time of 30 to 40 games (8 to 10 hours machine time). The machine was given only the rules of the game, a sense of direction, and a redundant and incomplete list of parameters which were used by the machine to assess numerically its relative "smartness."

The technique of relative numeric strength and assignments was used, keeping a score of board positions and their relative values, in numbers called *scoring polynomials* and *evaluation polynomials*.

As games were played and experience gained, appropriate coefficients in the polynomials were modified, and thus the "learning" procedure improved the game.

To improve this learning rate, the program was modified to act as two separate players, Alpha and Beta. Alpha was allowed to generalize on its experience after each move, adjusting evaluation polynomial coefficients while Beta's polynomial was held fixed.

After several games, if Alpha has been the predominant winner, (as compared by a neutral portion of the program) Alpha's polynomial was given to Beta. If Beta won, a black mark was given to Alpha. A total of three such black marks meant Alpha was on the wrong track and a radical change should be made in its scoring polynomial. This capability was tested by periodically playing book games between Alpha and a human opponent. Alpha's performance was then correlated against the recommendations of master players.

The second learning technique — rote learning — was also applied. In this technique, all board positions during a game are saved along with computed scores. Reference is then made in subsequent games to this memory, to a depth of 3 or 4 moves, in an effort to improve subsequent play.

Some interesting comparisons can be made between the former learning-by-generalization method and the latter rote-learning method. The rote method soon learned to imitate master play during opening moves, played poorly during the middle game, but easily learned how to avoid obvious traps during end-game play, generally winning if left with a piece advantage.

The generalization method never learned to play in a conventional manner, its opening usually weak. However, it soon learned to play a good middle game and, with a piece advantage, could easily defeat human opponents in end-game play. Interestingly, after 28 games it still had not learned how to win with two kings against one in a double corner.

Many conclusions were reached through the machine-learning techniques of this outstanding program. Both generalizations and rote techniques have advantages, and attempts are now being made to combine them, with further emphasis placed on refinement of the evaluation polynomial.

Efforts to develop intelligence in machines have resulted in programs that do have rudimentary parallels to the human learning process, progress being somewhat slowed because of our own lack of knowledge about the human process. Animal-like neural networks have been developed from random switching networks; however, the greatest potential lies in the digital computer. The great effort in software development began in the late 1950's, and if the rate of such development continues, we may well see HAL, the computer of the 21st century within the 20th century.

HONORS AT THE GOLDEN GATE

by

CARL KOERNER
Assistant Editor—BRIDGE

The awarding of Eta Kappa Nu's highest honors at both student and professional levels took place in the City of the Golden Gate—San Francisco, California on August 20, 1969.

On this day, Thomas L. Niemeyer, graduating Senior at Ohio State University was honored as Outstanding Electrical Engineering Student, for 1969. Recognized with him were Honorable Mentions Bertrum S. Baray, University of Florida, Jimmy K. Cox, University of Texas and Dennis R. Kertz, University of Missouri.

Patrick E. Haggerty, Chairman of the Board of Texas Instruments, also on this day joined the ranks of Electrical Engineering's most honored as he was inducted as the 52nd Eminent Member of Eta Kappa Nu.

The awards were presented by National President John C. Hancock at a luncheon held at the San Francisco Hilton Hotel. Bob Macmillan, President of the Los Angeles Alumni Chapter, as Toastmaster introduced the honored and distinguished guests. Larry Hamilton, Chairman of the Student Award Committee gave the story of the selection of the winners. Others who contributed to the success of the program were Marc Dodson, Alumni Chapter Vice President; John Holtrichter, Chapter Secretary and Ed Wagner and Archie MacMillen, Chapter Past Presidents.

For five years Eta Kappa Nu National has sponsored this Awards event, designating the Los Angeles Alumni Chapter for implementation. To Bill Murray, Awards Program Chairman, Past President of the Alumni Chapter (1966) and nominee for Director of Eta Kappa Nu, goes the credit for the attractive arrangements at the Hilton. The luncheon was arranged in coordination and cooperation with the 1969 WESCON, which is the outstanding annual Western Electronic Show and Convention, alternating each year between San Francisco and Los Angeles.

Illustrative of Award winner Tom Niemeyer's achievements, he ranked first of 82 Senior Electrical Engineering Students at Ohio State University. Although carrying an academic workload ten percent greater than normal, he maintained a near perfect grade point average. Concurrently, he was a recognized leader in many other University and community related activities.

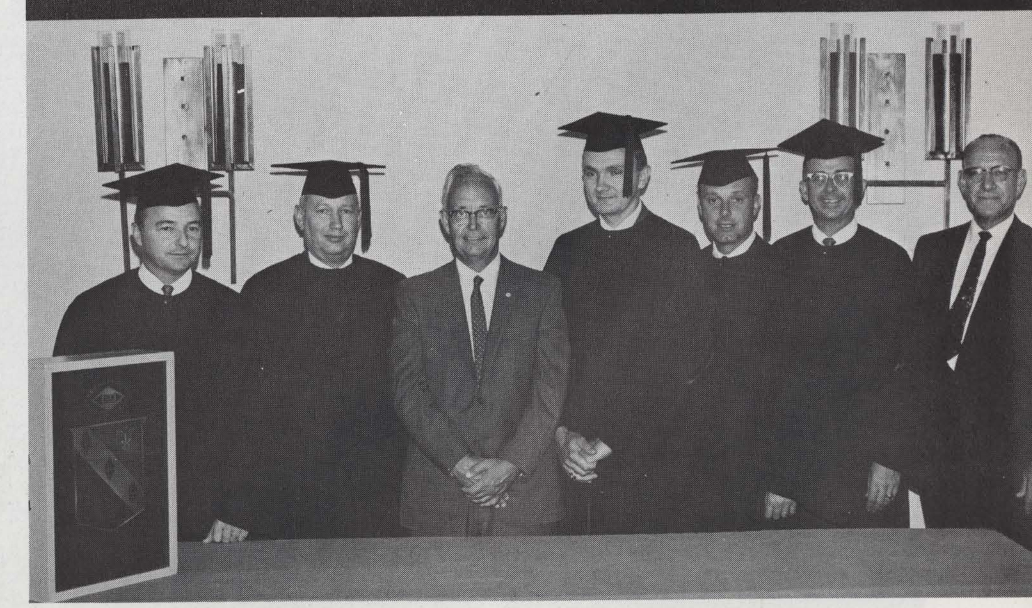
Honorable Mentions Bert Baray, Jim Cox and Dennis Kertz also have outstanding records. The Jury of Award encountered a difficult task in selecting the winners from the great slate of candidates presented to them.

Dr. Haggerty was inducted as Eminent Member at a very impressive induction ceremony in the morning just preceding the luncheon. National President Hancock convened a blue ribbon induction team which included Bill Murray, Bob Macmillan, National Vice President Anthony Gabrielle, Director Bill Bonser who should be credited with the effective arrangements, Past National President Carl Koerner (1957-58), as well as President Hancock, himself. Eta Kappa Nu's induction ritual has never lacked inspirational values, and this morning's ceremony was no exception, right down to President Hancock's closing words, "By virtue of the authority vested in me, I now declare you, Mr. Patrick Haggerty, duly inducted as Eminent Member of Eta Kappa Nu".

Eminent Member Haggerty was named Chairman of the Board, and Chief Executive Officer of Texas Instruments in 1967. He was born in Harvey, North Dakota and received his BSEE degree at Marquette University. His graduate studies were at Southern Methodist University. He has Honorary Doctorate Degrees from the University of Dallas, Polytechnic Institute of Brooklyn, Marquette University and St. Mary's University. He is a Fellow of the Institute of Electrical and Electronic Engineers and was President of the Institute of Radio Engineers in 1962, at the time of its merger with the American Institute of Electrical Engineers to form the present IEEE.

Dr. Haggerty graciously accepted his Eminent Member certificate from President Hancock at the luncheon. Dr. Haggerty then revealed in a spectacular and thought provoking luncheon address, some of the far reaching new instrumentalities undergoing development in the field of semi conductor technology. It was a fitting conclusion to a noteworthy and inspirational event.

l to r, Patrick Haggerty, Bob MacMillen, John Hancock



IDENTIFICATION: Top photo, head table, from left, Anthony Gabrielle, National Vice President; Carl Koerner, Past National President; John C. Becket, Chairman of the Board of WESCON; John Hancock, National President; Patrick Haggerty, Chairman of the Board of Texas Instruments and new Eminent Member; Robert S. MacMillan, President of the Los Angeles Alumni Chapter; Center photo, head table, from left, Robert S. MacMillan, Thomas L. Niemeyer, Outstanding E.E. Student in the U.S.; Jimmy Cox, Honorable Mention; Lawrence Hamilton, Chairman of Student Award Committee; William Murray, National Director Elect: Emmet G. Cameron, Chairman of the Executive Committee, 1969, WESCON. Bottom photo, from left, William Murray; Robert MacMillan; Patrick Haggerty; John Hancock; Anthony Gabrielle; William Bonser, National Director; Carl Koerner.

Eminent Member...

Emanuel R. Piore

Dr. Emanuel R. Piore was inducted into Eminent Membership in Eta Kappa Nu on November 6, 1969 in Boston, Massachusetts. The program was held in conjunction with N.E.R.E.M. and also a Regional Visitation of HKN. The induction team was made up of Mr. John Tucker, Past National Director of HKN, Dr. John Handcock, National President of HKN, and Dr. Bruce Wedlock, Past President of the Boston Alumni Chapter.

Dr. Emanuel R. Piore is vice president and chief scientist and a member of the board of directors of International Business Machines Corporation. He joined IBM in 1956 as director of research and was elected a vice president in 1960.

Dr. Piore was associated with the Office of Naval Research from 1946 to 1955, serving as chief scientist for the last four years of this period. Pior to joining IBM, he was vice president for research of the Avco Corporation.

He is a member of the National Science Board and a former member of the President's Science Advisory Committee. Other memberships include the New York State Science and Technology Foundation, and the board of Science Research Associates, Inc. He is a trustee and member of the Executive Committee of the Sloan-Kettering Institute for Cancer Research, chairman of the Committee on Scientific Policy of the Memorial Sloan-Kettering Cancer Center, and a trustee of the Woods Hole Oceanographic Institution, Chairman of the Board of Trustees of the Hall of Science of the City of New York, and member of Board of Directors of Directors of Resources for the Future, Inc.

Dr. Piore is a member and Treasurer of the National Academy of Sciences, a member of the National Academy of Engineering, the American Philosophical Society, a fellow of the American Physical Society, the Institute of Electrical and Electronics Engineers, the American Academy of Arts and Sciences and the American Association for the Advancement of Science.

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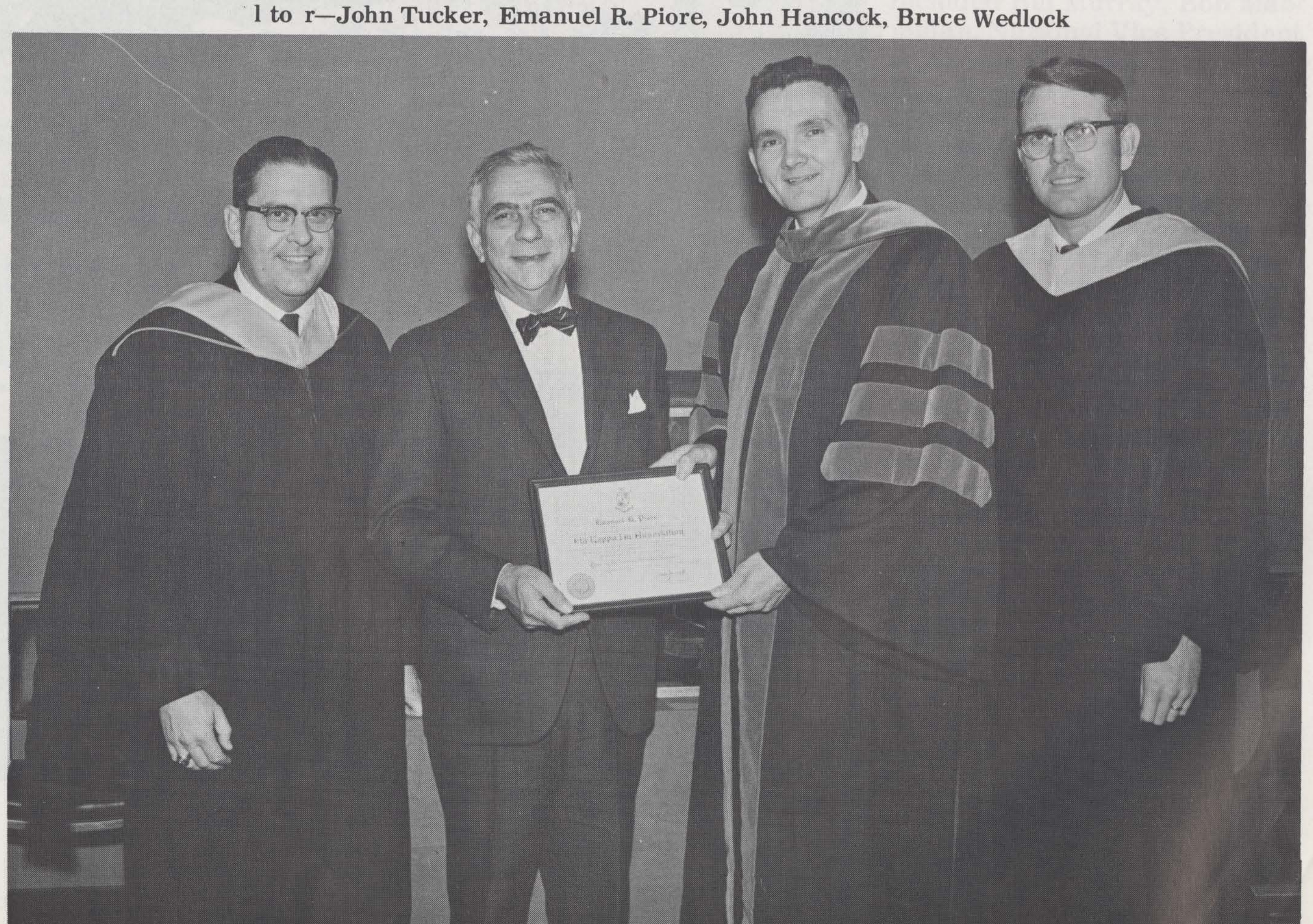
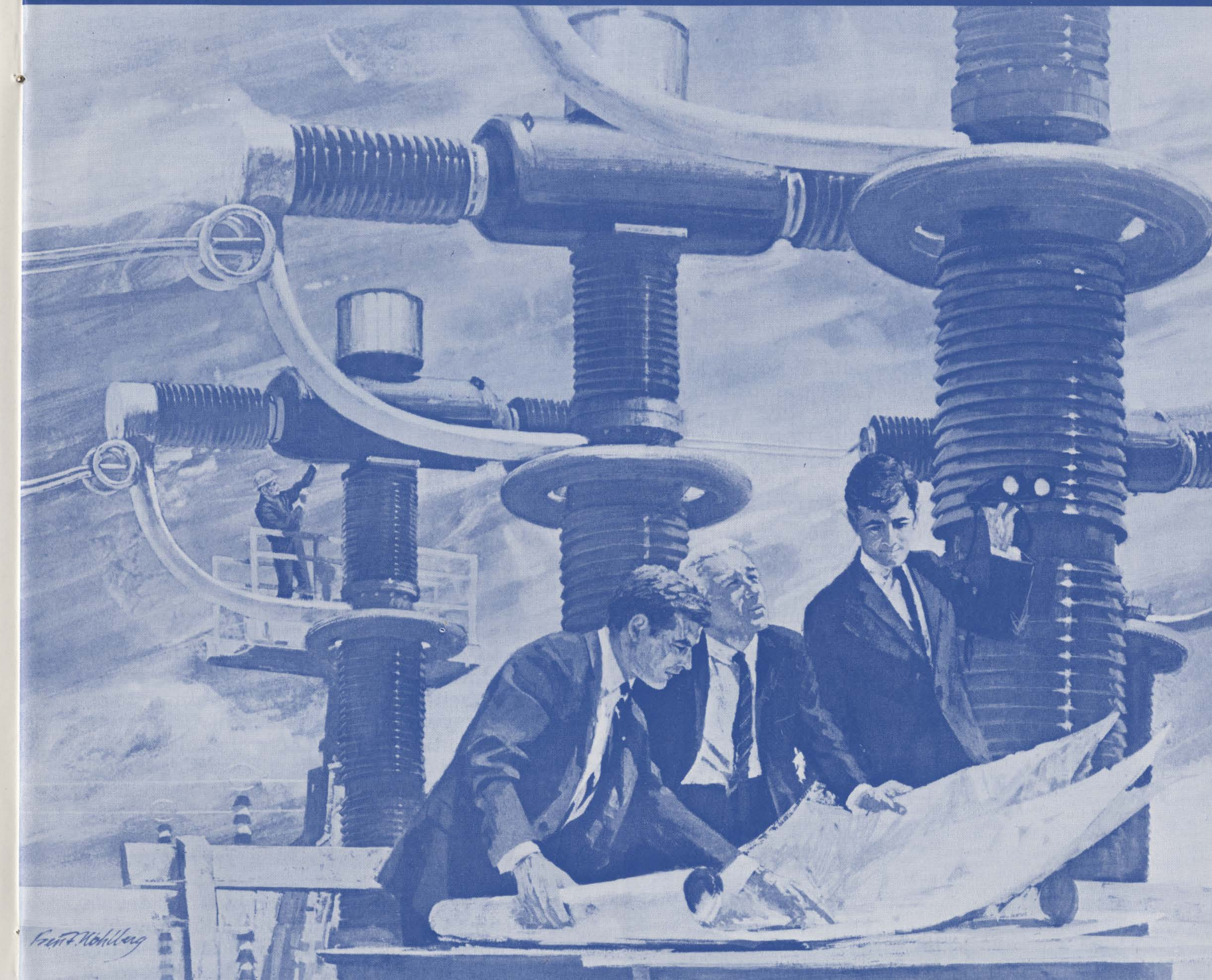
l to r—John Tucker, Emanuel R. Piore, John Hancock, Bruce Wedlock



POWER



THE NATION'S LARGEST INDUSTRY

By C. E. ASBURY
Southern Services, Inc.

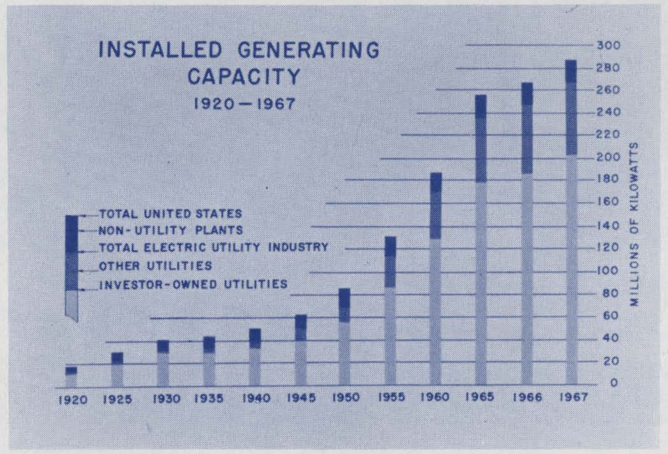
ELECTRIC POWER

Power engineering is really a young profession compared to many other major engineering disciplines such as civil engineering and mechanical engineering. Although electrical scientific principles were discovered in the laboratory during a period of about 1737-1850 by such well-known scientists as Galvoni, Volta, Oerstead, Maxwell, Ohm, Ampere, Coulomb, Faraday and many others, it was not until the practical developments and inventions by Thomas Edison, in 1882, when his Pearl Street Station supplied the first street lights in New York City, that electrical power became a reality. This first Edison direct-current system was followed, within a few years, about 1886, by an alternating-current system in Massachusetts, which was installed by George Westinghouse.

The power industry, through research and development, has made many breakthroughs in technology and advances during this short period of about 86 years to the present.

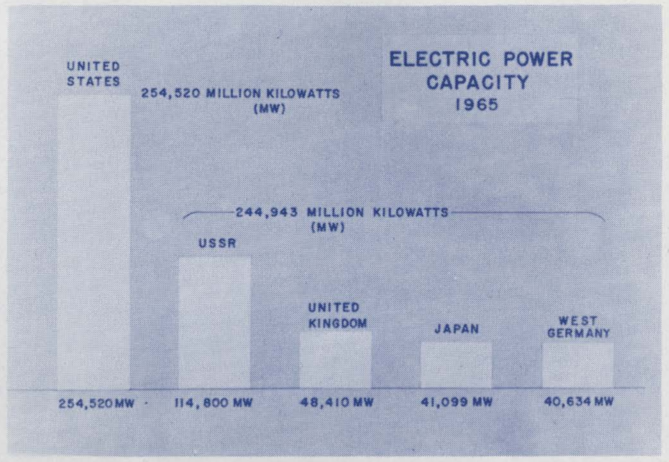
Charles F. Avila, President of Edison Electric Institute, recently described the growth of the American power industry this way:

"The electric power industry of our country has increased its productivity more than three times faster than the rest of the economy. It is, by far, the largest industry in the United States, being about 60% larger than the next largest." The total net capital investment made by the American public in installed plant today is over $70 billion and by the turn of the century it has been estimated that this may well be over a half trillion dollars. See figure 1, below.



Research in this area has been truly dramatic and has made possible this amazing progress. For example, if sixty years ago we had wanted 1,000,000 kilowatts worth of generation, we would have had to use 200 generators, 5,000 kilowatts each. This, physically, would represent one mile in length of machinery. Today one million kilowatts are available in just one unit about 200 feet long.

Generating electric power is essentially a process of transforming energy. Today more than 20% of our primary energy is converted into electricity. By 1980 it will be about 30% and by the turn of the century, it has been estimated that it will have increased to about 40%. People rely on electricity as never before and those in the electric power business have a tremendous responsibility and welcome the challenge demanded of them. The capacity and progress of a society may be measured by its electrical energy requirements. This is apparent when comparing the electric power capacity of the United States with other nations of the world. See figure 2, below.



Perhaps one of the outstanding reasons for this unusual progress in our nation is due to the broad research and development program made available through the industry's far-sighted view of the future in anticipating the needs of its customers.

Over the years the power industry has strived to anticipate and satisfy the needs of its customers and we certainly have every reason to believe that they will continue to do so. Twenty years ago the largest generating unit in operation was in the order of 200,000 kilowatts and the average kilowatt hour cost was over 2¢. Today units of 1,000,000 kilowatt capacity are in operation and the average price per kilowatt hour has been reduced by as much as 25%, even in a rapidly rising economy.

There have been many forward strides in power transmission. During the initial developments in the power industry, in the early 1900's, most of the power stations were isolated, but later became interconnected at rather low voltages in the order of 30,000 volts. As the industry has grown, this transmission capacity has been increased manyfold and transmission lines of 500,000 volts are in operation today. Lines are under construction with voltages up to 765,000 volts. Research and development are being actively pursued well beyond the million-volt range.

These advances, as well as numerous new uses and applications for electricity, have resulted from research. In a recent survey, more than 1,800 research and development projects, involving many millions of dollars, were reported, either under way or recently completed by investor-owned companies, exclusive of the many atomic power projects also in progress. These projects cover the entire spectrum of the industry's operation, with specific titles of projects ranging from "Weather Modification Testing Program" to "Agricultural Engineering Research in Farmstead." Main subject headings for the reported projects include research on power plants covering many aspects of steam and hydro generation and studies on direct energy conversion. Also, there is research in system planning, engineering and operation, including load forecasting and associated electrical and physical phenomena and characteristics. Of course, transmission and distribution is a major category covering many aspects of material and equipment, construction methods, maintenance and operation, instruments and methods of testing, relaying and metering. An extensive group of projects was also reported under the heading, "Customers Utilization," covering the leading characteristics of many electrical applications, as well as farm electrification, where conducive, space heating and the heat pump.

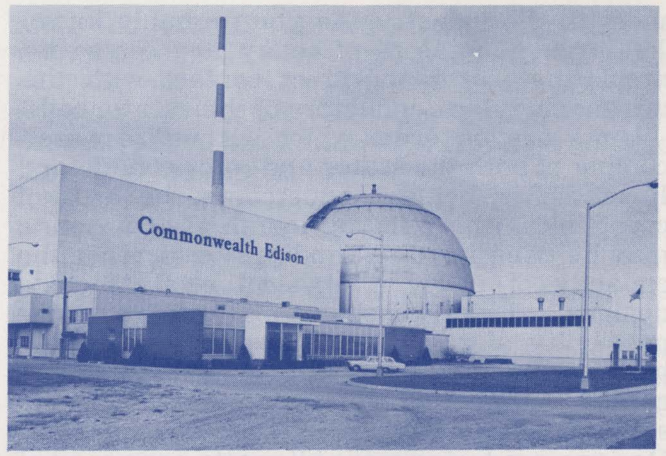
Other classifications are sales, economic subjects, company management subjects, electronic computer applications, personnel, and area development.

Depending on the nature and scope of the problem, the companies may work singly, in groups, or on an industry-wide basis in their research activities. Equipment manufacturers continue to spend additional millions of dollars for electric utility research and development, which is financed by the electric utility industry in the purchase of equipment.

One area in which the benefits of research are apparent is that of nuclear power. As of early 1968, more than 130 electric utility companies, in cooperation with the Atomic Energy Commission and equipment manufacturers, are participating in projects aimed at making nuclear energy a practical, economical source of electric power competitive with other fuels. These projects involve the construction of nuclear power plants, as well as research and development pertaining to, or advanced, concepts in this field.

There are currently 11 nuclear power units in operation, with 58 more under design. These nuclear units and R&D projects involve electric utility company commitments of over five-and-a-half billion dollars.

Nuclear energy is becoming an increasingly significant factor in the production of electricity in this country. Evidence of this is the fact that during 1967 nearly half of all of the steam capacity ordered by electric utility systems was nuclear. Figure 3 shows a view of the Commonwealth Edison Dresden nuclear plant near Morris, Illinois. Unit No. 1, which was placed in service in 1960, is a 200 mw unit. Units No. 2 and 2 will each have an ultimate capacity of 809 mw and are now under construction.



While nearly all of the nuclear plants under construction are in the planning stage, or are being built to meet immediate demands, nuclear R&D is going forward to perfect advance reactor concepts. Some of the research is aimed at making better use of plutonium fuel and some is aimed at the development of fast breeder reactors.

Another encouraging development for supplementing fossil fuels and uranium lies in controlled nuclear fusion—harnessing the hydrogen bomb to generate electric power. Research in the field of controlled fusion is being sponsored by the Texas Atomic Research Foundation, a group of electric utility companies in Texas. There are, obviously, many problems requiring solution in the controlled fusion efforts, such as extremely high temperatures which these types of reactors develop.

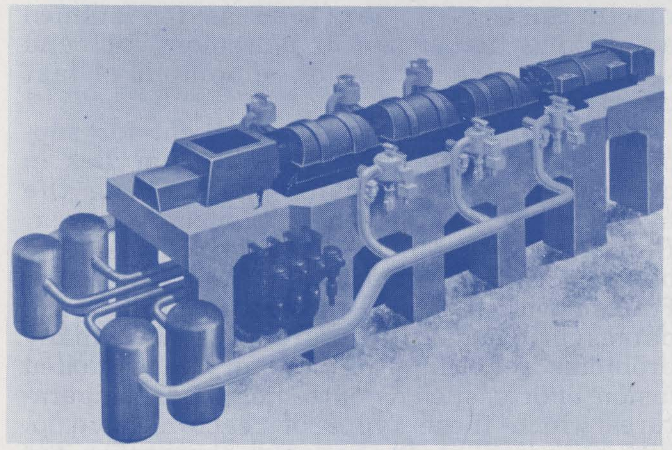
Much more could be said concerning the general aspects of research and development in the broad power field, however, let us concentrate on a few of the accomplishments—progress in some of the specific areas such as power generation, transmission-distribution, system control, relays, switchgear, computer science, and transportation.

Generation

Research and development of turbine generators has resulted in considerable strides in increased efficiency, as well as a lower cost in investment per unit of capacity. For example, during the initial operation of power stations, ten pounds of coal was required to generate a kilowatt hour. Today only about two-thirds of a pound is required—a ratio of 15 to 1. Much of this has been brought about through technology which made it possible to utilize high temperatures and pressures, and higher capacity units, more compact in size.

As mentioned, only a few years ago the largest unit was 200,000 kilowatts. Today units are in operation of 800,000 to a million kilowatts, and it has been predicted that units of two million kilowatts and larger will be in operation by the turn of the century. These challenges are being met by research engineers in the industry. As you probably know, the large generators of today are cooled by circulating water in direct contact with the current-carrying conductors of their stator coils.

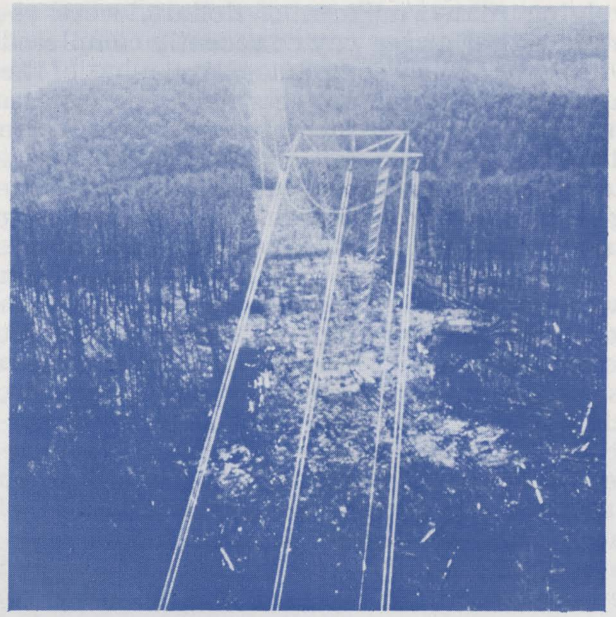
Units are on order which will utilize water-cooling of both the stator and rotor conductors. Research is being conducted in the area of cryogenics, where liquid helium at 4° absolute may be used in rotor windings to increase the capacity of a given physical size. Machine designs, utilizing cryogenic materials, offer the possibility of radical changes in design, and higher capacities. More compact sizes and machines of high reliability appear to be among some of the advantages of such development. Designs producing more kilowatts per pound of material used should pave the way for the high-capacity machines of the future, which the growth of the power industry has continuously demanded. Figure 4 shows a general view of a large General Electric generator.



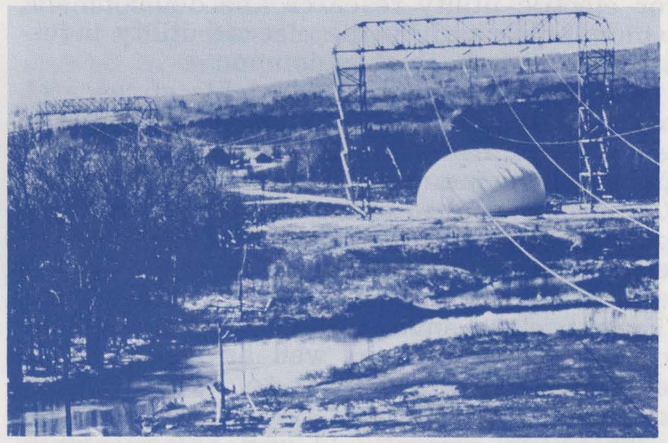
Research is still being continued on exotic forms of generation, such as magnetohydrodynamics (MHD), thermonics, fuel cells, thermoelectrics, as well as controlled fusion. Although most of these forms of energy conversion are technically feasible and some are being utilized in special applications on a small scale, much remains to be done to make them economically competitive with other forms of energy conversion on a mass production basis.

Transmission

Transmission lines in the early years of their development consisted of rather small conductors, often No. 4 or No. 6 wire, but as the quantities of power to be transmitted increased, high voltage and larger conductors have become common usage. For economic reasons most of these transmission lines have utilized overhead construction and many miles are in service today with voltages of 230,000 volts and higher. Conductors about 1″ or more in diameter are not uncommon. As voltages of 345,000 and above were developed, they were referred to as extra high voltage and EHV lines of 500 kv are now in operation. These EHV lines utilize bundled conductors of 2, 3 or 4 for each of the phase positions. Figure 5

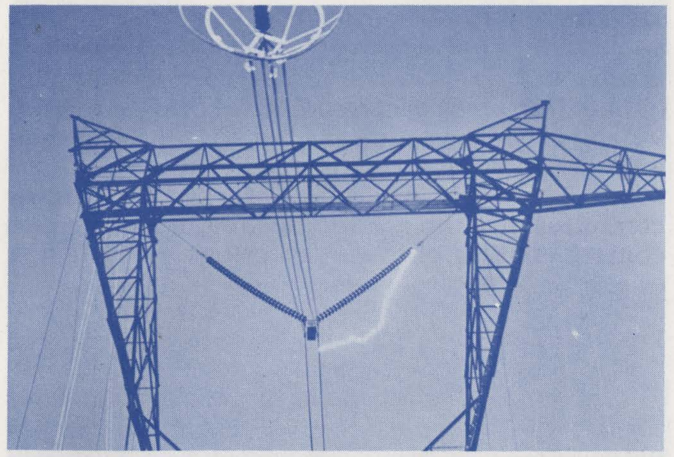


shows an EHV transmission line constructed, using bundled conductors on the American Electric Power Company system. These bundled conductors are usually required to control voltage gradient and radio influence rather than for current-carrying requirements. Transmission lines are now under construction for 765,000 volts and research is being carried forward for voltages up to one-and-a-half million volts. A research project, involving ultrahigh voltages (about 1,000 kv) is now being sponsored by the Edison Electric Institute in the General Electric Company's extra high voltage facilities near Pittsfield, Mass. Figure 6 shows



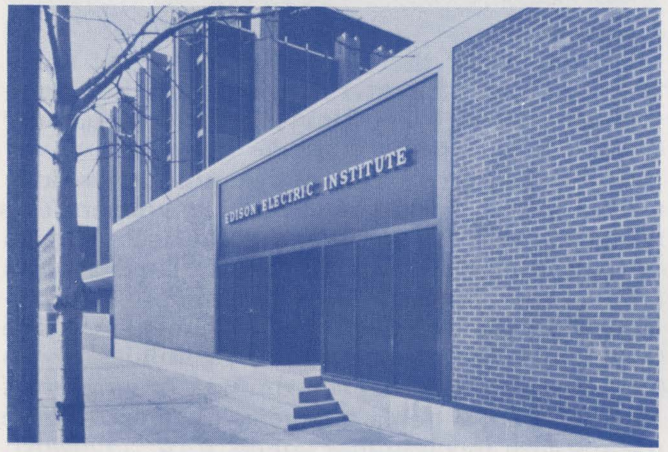
some of the facilities at Pittsfield utilized in this research. As a result of this research, an "EHV Transmission Line Reference Book" for lines in the range of 230 kv to 765 kv has been made possible. This information is available for sale from EEI.

The design and development of systems make it desirable to test many prototypes to establish optimum design criteria such as insulation levels, electrical clearances, etc. The American Electric Power Service Corporation has recently developed a 765 kv system. Figure 7 indicates tests at the Ohio Brass High Voltage Test Laboratory in Ohio to determine the switching



surge insulation levels and tower design clearances for this 765 kv system.

About two years ago, the Edison Electric Institute's AC/DC System Operation Research Laboratory was installed on the University of Pennsylvania campus in Philadelphia. The building shown in Figure 8 houses the largest



model of its kind ever assembled to study the behavior of AC and DC transmission lines operating in parallel between two AC systems.

Several EHV DC transmission lines are operating throughout the world, and the largest of these is now under construction on the West Coast and this line will be capable of transmitting about 1,500 kilowatts for 850 miles. It will operate at +-400 kv.

From overhead high voltage transmission to underground is a long, costly leap, but we know it will have to be taken in many regions as population density increases. The electric utility industry is sponsoring an extensive research program on underground transmission, which will require an estimated $17 million over the next five years. The first phase has already been launched, with work on a $5 million underground cable-testing installation in Waltz Mill, Pa. This facility, which is being built by the Westinghouse Electric Corporation under contract with EEI, will be one of the highest voltage testing projects in the world, capable of testing underground cable systems at voltages as high as a million volts.

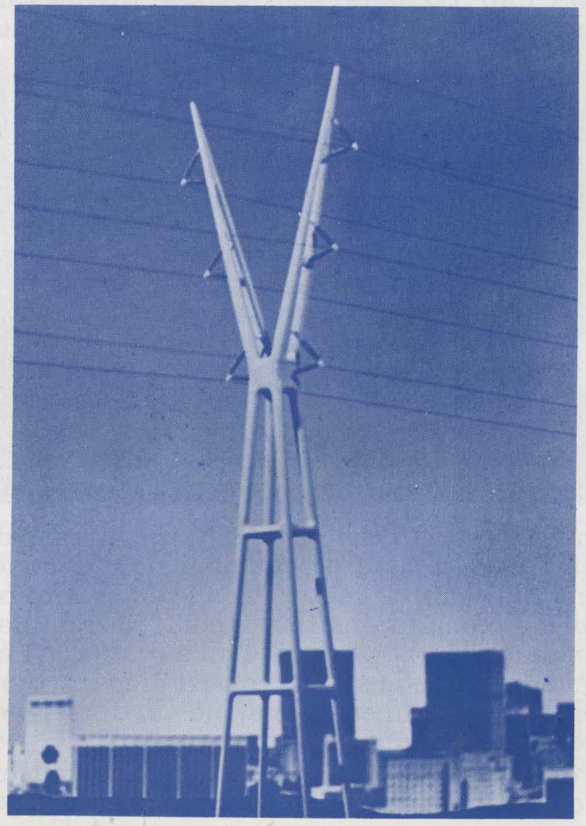
Also, in the area of underground transmission, the Edison Electric Institute has signed an agreement with the Massachusetts Institute of Technology to establish a grant in aid to conduct research on the application of compressed gas as insulation for extra high voltage transmission cables.

Now in its fifth year, a research program initiated by Edison Electric Institute to gain a better understanding of the lightning threat to power lines, involved the installation of some 5,000 lightning flashover indicators on approximately 450 miles of selected transmission lines in the Midwest. These indicators consist of polarity sensitive circuits and several visible targets. When flashover occurs, an electro explosive uncovers one or more of the targets. A reading of the exposed symbols, which are visible from the ground or from a patrol aircraft, provides information on the nature of the lightning stroke on circuits.

Both copper and aluminum cables have been in extensive usage for many years and within the last few years, several experimental installations of sodium cable have been made.

A project has recently been initiated for extensive research utilizing cryogenic cable.

The industry is also concerned about environment and aesthetics. Earlier this year, completion of an eighteen months' research program to design a group of aesthetic, pleasing electric transmission structures was initiated by an industrial designer, Henry Dreyfus. The project resulted in about 100 aesthetic designs of towers carried on transmission lines of up to 500,000 volts. Figure 9 shows an innovation of some of these designs.

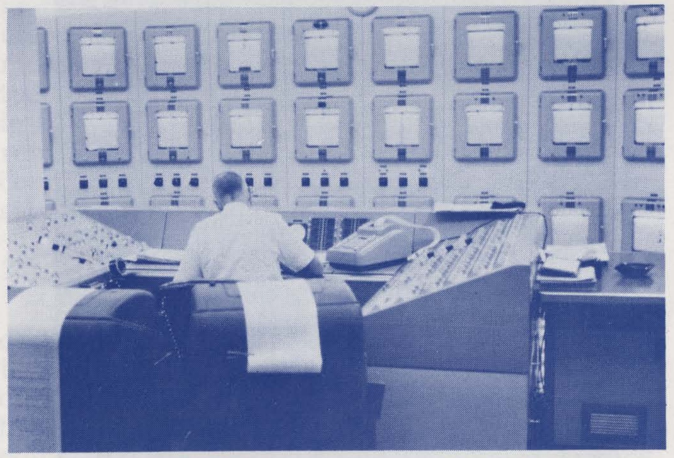


System Control, Relays, Switchgear, Communications and Computer Science

As the electric power system has become more complex and more sophisticated, the development of higher speed control and protection has been essential. In the individual power stations, complex instrumentation and control systems are essential to regulate the high pressures and temperatures of the large steam generators, as well as the minitoring and control of the turbine generator sets and the multiplicity of associated station auxiliaries supplying water, air and fuel to the station. Most large power stations being placed in operation today have computers installed for extensive station monitoring and control. Some units are completely controlled by a computer, including the starting of the unit, bringing it to full speed, synchronizing it to the system and loading it. It may also be systematically and safely removed from service by computer.

Television cameras and receivers are commonly used in the control room so the operator can observe, at any time, certain important remote areas. One of these is usually one or two views of the combustion inside the furnace.

Unique system control centers are established to monitor and control the many power generating plants, transmission lines and interconnections. One of these early control centers was developed on our own Southern Company power system by Mr. Don Early, about 1954, when he invented the first dispatch computer, the "Early Bird," to automatically and economically control system generation. This computer permits increase or decrease of generation automatically, factoring in the fuel costs and transmission losses to the load centers. Figure 10 shows a view of this system



control center. This, obviously, requires many high speed, accurate communication channels from the control center to all power stations and interconnections throughout The Southern Company's 120,000 square mile system. These communication channels consist of many types, including wire lines, telephone carriers, power line carriers and microwave channels.

Power control centers are being established to communicate, control, and coordinate extensive power pools covering large areas. Research is under way, utilizing the latest computer, electronic, and control technologies to monitor and control more of the complex functions to further improve the performance and reliability of today's modern power systems. Plans are now being worked out where computers will be talking to computers between control centers of these power pools. Figure 11

shows some of the computers in one of these modern control centers located in the Pennsylvania-New Jersey-Maryland (P.J.M.) Power Pool.

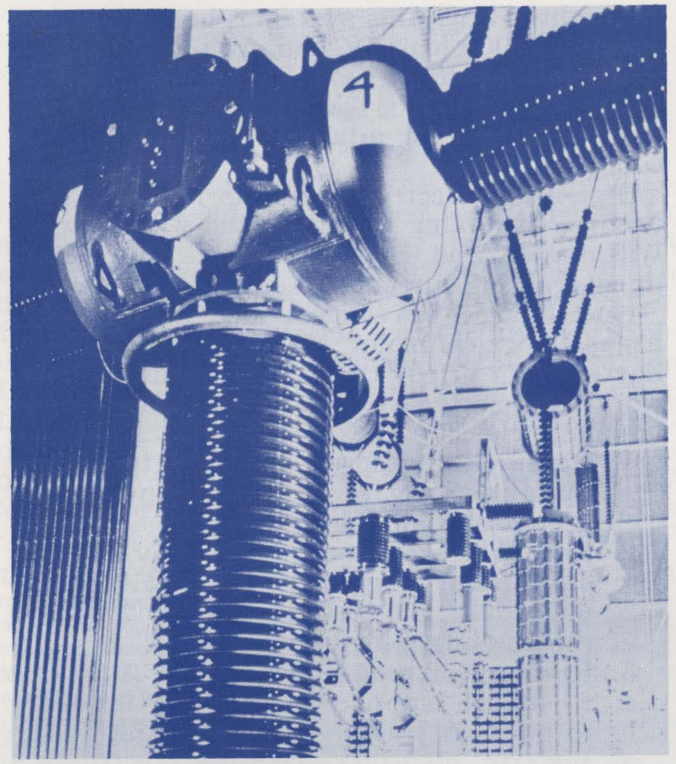
Much research and development work is under way in the electronic and computer fields to adapt and expand some of the technologies to power control, communication and system protection applications. For example, electromagnetic relays have been developed over the years to a high speed (20 to 50 milliseconds) into rather sophisticated devices but many of them are now being replaced by electrostatic relays with much higher speed.

Also, in the area of switchgear, great strides have been made in increasing the speed of interrupting short circuit currents. While some of the early circuit breakers required interrupting times of one-half second, modern electromechanical circuit breakers operate in about two cycles (or 33 milliseconds). Circuit breakers utilizing SCR's have recently been announced with no moving parts that can interrupt fault current in three or four electrical degrees, a ratio of speed improvement of about 200 microseconds. These modern solid state devices interrupt the fault current before it reaches its maximum crest value.

Research and development on circuit interrupting devices require high current, as well as high voltage testing.

Figure 12 is a view of the compound circuit— a new test facility for simulation of short circuit interruption testing. This circuit, using the laboratories' test generators, raises the test capability from 3.2 million KVA to 72 million KVA.

We have briefly indicated how computers are used for poer plant monitoring and control, as well as for system security and control.



There are many other areas of the power business where computers are used extensively, such as engineering, planning, design and accounting.

For many years digital computers have been applied to such power system problems as: Load Flow, Economic Dispatch, Inventory Control, Short Circuit, Stress Analysis, Scheduling, Transient Stability, Customer Accounting.

Most of these applications require large volumes of data. Historically, data has been furnished by those who use the computers. However, with recent advances in technology, large volumes of data may now be stored once and accessed many times very rapidly. For example, transmission and generation constants would be submitted only once. They would then be available to anyone for load flow, short circuit, or transient stability studies.

Likewise, in large power systems computers are often not readily accessible to remotely located personnel. Data is mailed in and reports returned by mail. It has now become practical to place the power of a large central computer at remote locations.

For example, our company is implementing plans to install terminals in many of its business offices. Presently if a customer inquires about the status of his bill, large files must be manually searched. With a terminal, an office can direct the computer to perform the search. Response would be almost instantaneous. If a customer pays his bill, his file could be immediately updated.

Engineering terminals are also being studied. Terminals permit an engineer to retrieve power system data from previously established files. A diagram would then appear on a visual display device. With his light pen and typewriter keyboard, he could modify the system. He may then direct the computer to perform a study on the modified system. His results would be shown graphically on the visual display device. Only when needed would he request a complete report from the computer center.

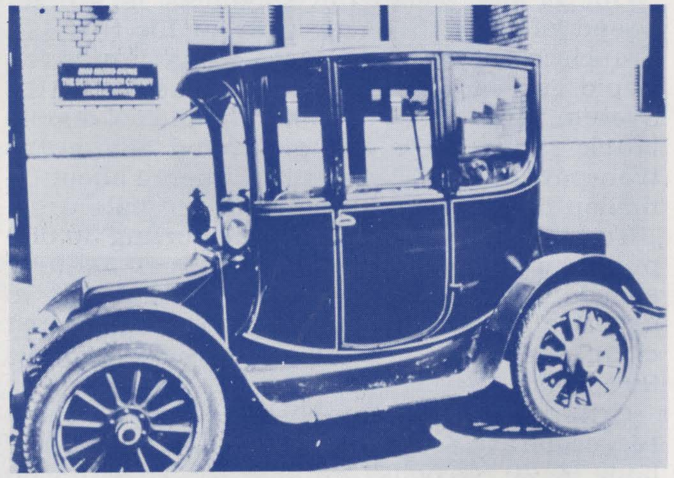
By combining engineering and accounting interests, several advantages have been realized: (1) Larger, more powerful equipment (2) Elimination of duplicate data files (3) More efficient operation (4) More efficient utilization of personnel (5) Greater computer accessibility.

As computers become more powerful and more accessible, more power system people will be freed for creative work. For example, with most of his data already stored in the machine, the power system engineer needs only to submit changes. Instead of submitting large quantities of data to keypunch operators, he will be able to communicate directly with the computer.

Likewise, the terminal will reduce the paper work flowing from the computer. It will present the results in a more understandable form and in a vastly improved time frame. The application of computer science to power system problems is limited only by the imagination and creativity of the people of the power industry.

Transportation

We may remember some of the earlier developments of the electric automobile, such as shown in Figure 13. Although the development



of the combustion engine postponed the advancement of the electric automobile, there are indications that it will become a major mode of transportation in the future. Many organizations are doing research on electric batteries and on their application to the electric automobile. The EEI, in 1967, organized a task force on electric vehicle development to determine the present stat of technology of electric power vehicles and changing systems and to recommend areas of study for expediting and developing a practical electric vehicle. A promising program is the joint research effort by EEI and Gulf General Atomic, Inc.

on a zinc-air storage battery system for motive power applications. The over-all joint program, running through 1968, is expected to total about $3,000,000 in research. The objective of the projects is to develop a high-capacity storage battery that has substantially less weight per kilowatt hour of output than available industrial storage batteries.

Ford Motor Company's sodium sulphur batteries operate at 500° F. Satisfactory fuel propulsion with this battery is expected in the 1970's. General Motors has a lithium chlorine battery project and also expects to have batteries for vehicles in the 70's.

Westinghouse has manufactured a two-passenger electric vehicle for short-range neighborhood use. This car, called the Markette, has a top speed of 25 miles per hour and a range of about 50 miles.

Several electric cars have been demonstrated in various countries of Europe and several experimental electric cars are operating in this country at the present time.

The electric railway has been in use in this country and Europe for many years. Practically all rail transportation today utilizes electromotive power for high speed acceleration and deceleration. Much research work is still being carried on in this area and it appears that the modern, new high-speed railways now being planned can be made possible only by the use of electric power to provide the necessary high-speed, smooth acceleration and deceleration necessary.

One of the recent developments is a high-speed electric railway system for the San Francisco metropolitan area. This Bay Area Rapid Transit System, referred to as the BART System, will consist of about 75 miles of double track railway for a high speed commuter transportation system and will serve about 54 million people in a 110,000 square mile area.

To fulfill the objective of transporting 30,000 people per hour, the trains must achieve speeds of 80 miles per hour, yet be able to decelerate, load and unload passengers, and clear stations on headways as frequent as 90 seconds.

Criteria has been established for these trains to accelerate from standstill to 50 miles per hour in 20 seconds. From a top speed of 80 m.p.h., the train must stop in 40 seconds, load and unload passengers in 20 seconds with a performance margin of 10 seconds, and clear the station in 20 seconds. The entire operation is to take only a minute and a half (90 seconds).

A considerable amount of research and development was done with test cars on about a four and a half mile test track over a period of about three years.

These trains will be under completely automatic control. The train attendant is not required to perform any functions nor take any actions except in the case of an obstruction on the right-of-way. This system is being designed utilizing 1,000 volt DC motors to provide the propulsion effort. The control systems have resulted from much research and will incorporate the latest adaptations in computer control.

High-speed electric trains, up to 140 m.p.h., are likewise being experimented with between Washington and New York City. This will be an alternating current system.

Now that we have described a few of the areas in which major research is being conducted, let's briefly review where this research work is being carried on. This can be conveniently classified into four major categories:

1. Research sponsored or supported by individual electric utility companies or groups of companies.
2. Research work carried out by electric equipment manufactures, which is financed by the electric utility industry in the purchase of equipment.
3. Research on atomic power.
4. Research sponsored by the industry through its trade associations, the Edison Electric Institute and the Electric Research Council.

By far, the greatest number of research projects are being carried on with the individual utility companies. Over 1,800 projects, covering a wide range of subjects, are under way or have recently been completed.

A comprehensive survey made in 1963 indicated that 14 equipment manufacturers invested approximately $100,000,000 on research and development activities, specifically indentified with the electric utility industry.

The fourth part of the industrial research picture is the rapidly expanding program of the Edison Electric Institute. This phase of the Institute's work has increased markedly during the past decade and at the present time, 34 projects are being sponsored or supported by the Edison Electric Institute. The total cost of these projects approaches $10 million.

Much has been said in the past concerning the over-all electric city. This has now emerged from the dreaming stage and is really placed on the planning board. This city will have controlled climate, pure air that is heated and cooled electrically and kept at a comfortable humidity level. Climate control will extend to covered sidewalks and malls. Outside the buildings, the shopper will be moved along by electrically operated sidewalks. He will travel from home to work, or the city, in an electric car or high-speed electric train. Improved lighting will illuminate the city streets and highways, bringing a high degree of safety and security. Industries and farms, and factories located near the city will be electrified. The neighborhoods will also have controlled climate.

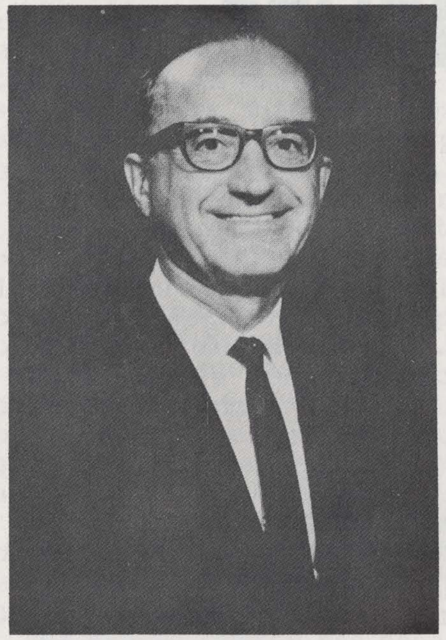
Exciting opportunities are within the grasp of each of us in this dynamic industry. Let's reach for them!

TUSKEGEE INSTITUTE

The Epsilon Upsilon Chapter of Eta Kappa Nu was installed at 7:00 p.m. on Wednesday evening, November 26, 1969, on the campus of Tuskegee Institute. The installation was in Room 201 of Moton Hall. Dean Lloyd B. Cherry of Lamar State College of Technology served as the installing officer. He was assisted by the following: Dean Emeritus Fred H. Pumphrey, Auburn University; Dr. Russell E. Lueg, University of Alabama; Dr. Charles H. Holmes, Auburn University; Dr. Odis P. McDuff, University of Alabama; Mr. Hal S. Burton, President of Delta Nu Chapter, University of Alabama; Mr. James L. Lowry, President, Eta Kappa Nu Chapter, Auburn University; Mr. William C. Willis, II, Auburn University.

Following the installation, a delightful banquet was held in Dorothy Hall at 8:00 p.m. On this occasion Dr. Pumphrey spoke, and both Dr. Lueg and Dr. Holmes made brief remarks. Dean Z.W. Dybczak gave a response, and Dean Cherry made a few concluding remarks.

Top photo: Charter for new chapter at Tuskegee Institute is officially presented, l to r, Dr. Z. W. Dybczak, School of Engineering, Tuskegee; Dr. Michael R. A. Erdey, Faculty Advisor, Epsilon Chapter; Dean Lloyd B. Cherry, National Director of HKN and Installing Officer; Dean Emeritus Fred H. Pumphrey, School of Engineering, Auburn University. Bottom Photo: The new initiates, seated, l to r, Samuel J. Johnson, Kanoiyalal J. Hathi, Vernon I. Holmes, Ernst A. Grant, Jr., Gregory B. Ford, Dr. Michael R. A. Erdey, Eustis J. Blakley. Standing l to r, K. R. Vmashankar, Dr. J. G. Tryon, A. J. Lzilriai, Burdette Rowe, Kenneth Rocker, S. G. Patel.



A FIRESIDE CHAT with Cledo Brunetti

COMPUTERS

Computers are being used in every type of design. . .

Industries, hospitals and universities are busy studying the types of information doctors, nurses and hospitals managers need. Soon 60 San Francisco Bay area hospitals will be linked to a central computer. Each hospital will share time on it, making computer capability available to all without each having to bear the cost of installing its own. The computer systems are being designed to handle the complete cycle of information beginning with that taken from the patient checking into the hospital through the time he is discharged. It also will record correspondence between the hospital, the doctor, and the patient after he leaves the hospital. . .

. . .information can be put into the computer ahead of time so that valuable time will be saved registering patients when they enter the hospital. . .

Dr. Brunetti is Assistant to the President of FMC Corporation. He was named by HKN as the Outstanding Young Electrical Engineer in the United States in 1941. Editorial Assistance by Kathleen Ryan.

The computer will also handle health insurance forms.

Lockheed is working with the Mayo Clinic in Rochester on a long-range study of how to use the computer for their hospital-medical practices. . .This program will feed into the computer complete medical information on all types of illnesses, treatments, operations and convalescences. . .doctors will be able to go into consultation with the computer to determine what action to take in cases where they have not had sufficient experience. The computer will describe the types of diagnoses and medications that can be applied to the patient. It will know what equipment is available to diagnose the case, what treatment is necessary, types of operations that may be performed and where the expert surgeons are.

A doctor can look at all his patients' records on the screen and call up orders for the nurses, prescriptions and other instructions to the hospital personnel. . .

Education is one of our real growth activities. . .How to handle the job with limited numbers of teachers and school facilities is the problem. Just how far do we go in applying mass production methods to education?. . .

In nearby Palo Alto, the Brendwood grade school is using computers to teach its students arithmetic and other courses. When Johnny comes to class the computer says, "Johnny, how are you today? We had a good session yesterday. Let's start where we left off. Remember, we were talking about addition. . ." And so on. (In fact, one day when the computer went out due to electrical difficulties the children sent him a get-well card!)

Yet our colleges and universities are discouragingly delinquent in adopting computer help. They still allow pile-ups at fall and spring registration —lines blocks long and sudden death registration. "Sorry. We can't let you take this course; we're full." After the student has been in line from 5 a.m. to 10 a.m. waiting. And there are still discouraging delays in transmitting grades from junior to senior colleges.

There are some who advocate teacherless schools for the future. One Harvard professor says that anything that can be put into words can be taught in a teaching machine. Although a computer is really an excellent beast for spouting out information, it really cannot be said to have any personality, nor can it take the place of the valuable discussions that take place between teacher and student. From the standpoint of developing personality and measuring the response of the student in all factors, other than repetition of information, we will still need teachers and in large numbers. These new devices should be considered the new tools of the good teacher just as the blackboard, textbooks and laboratories are now. . .

Another concept being considered is to automatically bar entrance to freeways when the amount of traffic on the freeway exceeds a certain safe limit. The entrance ramps will automatically be opened when the traffic lowers to the proper level. The barrier gates no doubt will have a high coefficient of infuriation for motorists but will keep them from

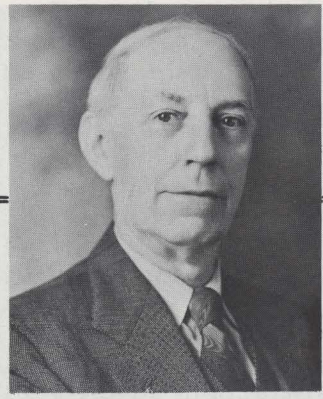
getting caught in hopeless jams up the freeway. By 1975 the highway departments will have traffic control centers radioing instructions on the congestion ahead and specific alternate routes to take. It will also warn of traffic hazards or obstructions that have recently developed in the traffic lanes.

Systems which automatically steer automobiles have been successfully produced and engineers are presently trying to reduce the cost of these systems to be acceptable for mass production. Coupled with a proximity device to warn of the presence of cars ahead a driver could doze off travelling at high speeds without danger of a crash. The system is a simplified version of automatic pilots now used on aircraft to steer them on the right course, combined with proximity warning devices, such as the VT fuzes developed during World War II and perfected to a much higher degree today. They would automatically measure the distance between cars and warn the driver or apply the brakes if he is approaching the other car too fast. . .

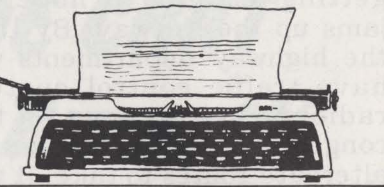
We have visualized the possibility of computer service supplied to the home just as we supply television programs, telephone and electric power today. Each house would not need a computer but a computer-console with which it would contact the main computers downtown, either for information or to carry out calculations such as figuring out income tax returns. It could also help with family budgeting, banking and converting a recipe for four people to a family of eleven.

The system could be used to dial library information, to handle shopping services, theatre and plane reservations and even plan your entire next dinner. Tied into the medical computer, one could get first-aid instructions instantly. This would not be more difficult than it is to dial for the time of day. Why not dial for all the information services you need. Some wives are a little concerned about extending the concept to where executives may stop going to the office and do their work at home using T.V. and a computer console both tied by telephone wires to the office.

Computer 'teaching' students at Brentwood Elementary School in East Palo Alto. Students hold 'light sensing' pens which they use to give the computer answers to questions it asks.



LETTERS from Ellery



REMAINDER ARITHMETIC

Several years after my retirement I was asked to make a short talk on any topic I was interested in to close a meeting of students and staff members of our department. As an old man Istill found great interest in numbers which so intrigued me when a boy. In arithmetic by addition, subtraction and multiplication each yielded a single quantity whereas in division two quantities might result, namely the quotient and the remainder. In the problems I solved when a boy it was the quotient which was important. However I had run across a publication issued in 1924 by Claude Bachet dealing with numbers in which it was the remainder from division which was important. Bachet used remainders to determine the number chosen by a companion when the companion told what were the remainders when the number was divided by three or more prime numbers. Ihad been working with Bachet's method for small numbers for which only two remainders were required for the solution. Therefore I decided to use remainders for the topic of my short talk.

I introduced my talk by asking if they ever had met a charming young lady whose age they would like to know. The young lady might be offended to be asked her age but she might not object to telling the remainder when her age is divided by a small number. If two such remainders were known how might her age be determined?

I then asked that each one present write down the remainders when his age is divided by seven and by eight. The remainder from division by 7 is to be multiplied by 8, and the remainder from division by 8 is to be multiplied by 49 and the two products added.

Then the sum of the two products is to be divided by 56 and the remainder noted. Is it the age of the person? As I waited for them to do that simple computation I noticed the excited expression on the face of a staff member as he exclaimed "It works".

When I asked those who found the method worked in their case to raise a hand all in the room raised a hand except a former student who was visiting the campus and I had invited to sit beside me at the banquet. I had not told him I had planned to bring him to notice. When I asked him if the method worked in his case he replied "No". Then I tried to act surprised and exclaimed "Oh, I neglected to state this method fails for ages above 56". The former student replied that he was older than that.

I ended that talk by saying "Class is dismissed. Next lesson is how to find age of a charming young lady who is a bit over a hundred years old and who knows how to divide."

There are many ways this may be done. For example Nine and Thirteen may be used for dividing. In that case the remainder from division by 9 should be multiplied by 9 and the remainder from division by 13 multiplied by 27 and the sum of the two products divided by 117. The remainder from that division should be the age.

Another method is to divide by Three by Five and by Seven. In that case the remainder from division by 3 should by multiplied by 70, the remainder from division by 5 to be multiplied by 21 and the remainder from division by 7 is to be multiplied by 15. The remainder from division of the sum of those three products when divided by 105 should be the age.

Another method is to use Ten and Eleven for dividing. In this case the remainder from division by 10 is to be multiplied by 11 and the remainder from division by 11 is to be multiplied by 100 and the sum of those two products divided by 110 when the remainder is the desired age.

The simplest method of finding the age of one not much over a hundred years old is to write down the remainder when age is divided by 11 then next to the right hand of that digit to write the remainder from division by 10 and to the right hand of those two digits again to place the remainder from division by 10. When those three digits are divided by 110 the remainder is the desired age.

To illustrate consider my age which is 94. Remainders from divisions by 11 and 10 are 6 and 4. When arranged as mentioned above we have 644, which divided by 110 gives remainder of 94.

Consider the case of a baby one year old. The remainders from division both by 11 and 10 are 1, which arranged as mentioned above is 111 which divided by 110 yields a remainder of 1, the baby's correct age.

Try this method for your own age and tell me if you do not find the method works. And in this method do you not see that by following this procedure you have without mental effort determined the sum of the two products which is to be divided by 110 to obtain the desired remainder. I take this as another interesting example of use of numbers in computations.

I end this letter with the statement that from the time of my boyhood I have found numbers wonderful, and in a way the older I become the more marvelous do numbers seem to be. ELLERY PAINE

◀ 8 Piore

Dr. Piore received his A.B. and Ph.D. degrees in physics from the University of Wisconsin in 1930 and 1935. He also served as an instructor at Wisconsin from 1930 until 1935. He received the honorary degree of doctor of science from Union University in 1962, and from the University of Wisconsin in 1966. Upon completion of his work with the Office of Naval Research, Dr. Piore was awarded the Navy Distinguished Civilian Service Award in recognition of exceptionally outstanding service to the Navy. In 1967 he received the Industrial Research Institute Medal, and in 1969 the Eta Kappa Nu Award.

He has been associated also with the Radio Corporation of America, Columbia Broadcasting System and the U.S. Navy Bureau of Ships. During World War II he served as a lieutenant commander in the Navy.

George Warner Swenson

1893–1969

George Warner Swenson, Past National Director of Eta Kappa Nu, died on December 9, 1969 in Davis, California. He was born in Willmar, Minnesota in 1893 and was educated in the public schools of that city and at the University of Minnesota where he received the degrees of B.S. in E.E. (1917) and M.S. in E.E. (1921). In 1961 he was awarded the honorary degree, Doctor of Engineering, by the Michigan Technological University, Houghton. He taught at the University of Minnesota from 1918 to 1928, when he left to become founder and Head of the Department of Electrical Engineering of the Michigan College of Mining and Technology, Houghton, Michigan, a position which he held until his retirement in 1960. During summers and leaves of absence, he was employed at various times by the Western Electric Company, the National Bureau of Standards, the Northwestern Bell Telephone Company, and the Bell Telephone Laboratories.

He was an Army sergeant during World War I and held the commission of first lieutenant in the Signal Corps Reserve from 1918 to 1928.

During World War II, he served as Special Consultant to the Secretary of War for radar operational analysis at Orlando, Florida, returning in 1944 to resume the headship of Electrical Engineering at Michigan Tech.

He was active at various times as a consultant for the Saint Mary's Mineral Land Company, the Calumet and Hecla Mining Company, the Essex Wire Company, and the Copper Range Company.

He was a member of Tau Beta Pi, Phi Eta Sigma, and Eta Kappa Nu. He was active in Boy Scout work, having been president of the Copper Country and Hiawathaland Councils for many years, and had received the Silver Beaver Award. He was active in the affairs of the Presbyterian church and of the Rotary Club having served as officer and trustee of regional organizations of these establishments.

In 1920, he married Vernie Edna Larson who died in 1965. In 1967, he married Myrtle Fisher. He is survived by his wife and two sons, George W. Swenson, Jr., Professor of Electrical Engineering and Astronomy, University of Illinois, and Ward V. Swenson, Associate Director of Publications of the University of Illinois at Chicago Circle.

◀ 2 Real & Imaginary

Nero but in England, King Henry VIII did his best. This fun and food loving monarch had his tempting dishes of plum ushered in with trumpets blasting—carried on horseback! Guests were not only treated to tournaments but a favorite entertainment of King Henry was arranging for live birds to fly out of a pie when the crust was cut.

A successor to Henry, King James I—in an effort to give his guests a truly noble dish is said to have knighted his favorite cut of meat. According to legend, he saw a large loin on the banquet table, stopped, and tapped the meat with his sword proclaiming, "I hereby dub thee Sir Loin!"

While Ahasuerus, Lucullus and Caligula might be renowned for the size and splen-

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CHAPTER NEWS

BETA CHAPTER, Purdue University—A student-faculty picnic was the first activity of the 1969 fall semester for Beta Chapter at Purdue University. This afternoon of fellowship provided the opportunity for students to meet and talk informally with EE professors. It also gave potential pledges the chance to meet HKN members and discuss the program of Beta Chapter.

With a student body of this size, a significant problem is communications. Beta Chapter, with the backing of the School, edits and distributes the EE Student Newsletter (or "The Electric Student Newsletter") roughly once a month. The Newsletter contains news articles, letters expressing student opinion, and general information pertinent to EE students at Purdue. With the help of a cadre of pledges, a special pre-registration issue was prepared, including updated course listings and other administrative data.

This and other pledge projects of value have been devised, in conjunction with ongoing projects of Beta Chapter. In an effort to improve the pledge program, early participation by the pledges has been encouraged. Chapter meetings have been opened to pledges on a non-voting basis. An effort has been made to replace the mystical with the meaningful.

BETA CHI CHAPTER, South Dakota School of Mines and Technology—Initiated twenty student members and one professional member at our initiation ceremony on December 10, 1969. Our first female student member of recent years was among the twenty initiated.

On the evening of January 14, 1970 the annual E.E. Dept. Open House was held. The purpose of which was to familiarize the general curriculum freshman class with the E.E. Dept. and the work of the E.E. student. Arrangements as well as most of the presentations were handled by HKN. Senior projects were presented, graduate and undergraduate labs were open for inspection, and the HKN film "Engineering—A Challenge of the Future," was shown. by Melvin D. Frerking.

GAMMA GAMMA CHAPTER, Clarkson College of Technology—Activities were diverse this past semester. Of primary interest was the problem of incoming E.E. students becoming disheartened with E.E. upon their first course exposure to it. The problem was mainly in the students' inability to coordinate course material, theoretical in nature, to what actually would be done on the job. The GG chapter with the help of the E.E. faculty arranged for a series of five talks by engineers working for various companies on a variety of assignments. Through the use of films, slides, and lectures these men described what their jobs entailed and stimulated continued interest in E.E. for those students who attended.

A GG chapter field trip, available to all senior E.E.s, to the nuclear power project near Oswego, N.Y. is tentative for the present semester. The Fall semester saw the induction of nine seniors and four juniors into the chapter. by Ralph Sorrentino.

GAMMA PI, University of Virginia—Outside of fall initiation the most concrete accomplishment of our chapter of the University of Virginia was the building and installation of a large replica of the Association's Bridge.

Encouraged by our new Electrical Engineering Department head, Dr. L.T. Rader, and our newly-elected faculty advisor, Dr. R.J. Mattauch, our chapter has many projects in the planning stage, including:

1) Co-sponsoring (with I.E.E.E.) a power-supply design contest aimed at encouraging undergraduate electrical engineering students to use their knowledge to develop a cheap and efficient power supply for use in the laboratories.

2) Trying to obtain computer time on the university's computer for the exclusive use of chapter members.

3) Setting up a special workshop-lab where any student could come in after-hours to work on some project of his own. by Thomas Gauss.

GAMMA PHI, University of Arkansas—On Tuesday night, 30 September, the Gamma Phi Chapter of Eta Kappa Nu, a national honor society for electrical engineers, held their first meeting at the University of Arkansas. President William J. Hayes appointed members to head the committees that will organize the chapter's activities. Gary Christenson will head the Awards Committee that will plan awards for the outstanding electrical engineering sophomore and an award to be given at the high school science fair. George Henry is to head the Pledge Committee. Mike Harkey was appointed the chairman of the Social Committee and will organize the smokers, the treasure hunts, the annual picnic, and any other social event. James Walden is in charge of the Special Assignment Committee which handles the annual report to national headquarters, publicity of meetings, the lounge, procurement of magazines, etc. The Major Projects Committee is the responsibility of Donald Malone; some of the projects include exhibits for open house, scholarship program, and a slide projector to advertise electrical engineering to high school students in Arkansas. by Charles Gray, Jr.

GAMMA CHI, New Mexico State University—In the fall semester of 1968, the Gamma Chi Chapter activities consisted of a pledge class of 19 pledges, fall banquet, and presentation of various awards. Our fall banquet was held in November at a local first class restaurant with Professor Bradley A. Blake of the Anthropology Department as our guest lecturer. His talk was concerned about engineering and human person. At this banquet slide rules were presented to the outstanding freshman and sophomore in electrical engineering.

In the spring semester of 1969 our activities were a pledge class of 18 new pledges which included 3 graduate students and one faculty member, spring banquet, and other awards. However, this semester a new project was started to promote interest among high school students for electrical engineering. This was accomplished by a twenty-five dollar cash award to the best electrical engineering orientated project at the local. high school science fair. by Dan Farris.

EPSILON IOTA CHAPTER, San Jose State College—On December 5, 1969 the brothers of Epsilon-Iota Chapter attended an initiation banquet for new members. The speaker for the banquet was Dr. John Edwards a member of the Biology Department at San Jose. Dr. Edwards discussed hiking, mountain climbing, and backpacking equipment. He also showed slides from some of his backpacking trips.

During the semester the pledges of the Chapter worked on pledge projects. One of the more interesting and rewarding of which was tutoring underprivileged kids in the San Jose area.

EPSILON LAMBDA, Vanderbilt University—The Chapter participated in a university-wide day of self study in December. The program included a dinner for all engineering students followed by student-faculty discussions of curricula on the departmental level. The day was subtitled "What the hell are we here for?" by Richard Johnsson.

Grace L. Hudowalski

February 1, 1970

Mr. Paul K. Hudson
Editor
THE BRIDGE of Eta Kappa Nu
P.O. Box 2203, Station A
Champaign, Illinois 61820

Dear Mr. Hudson:

THE BRIDGE is always coming up with something thought-provoking to me and I feel I am fortunate to be the wife of an E.E., otherwise I wouldn't see THE BRIDGE.

As a result of the February issue, which just arrived, we are planning to do a display on your fascinating and unique "The World of Computer Art." Can we obtain another copy so we can show not only the cover, but each page of the special supplement.

You may be interested to know that this display will be used in the narthex of Trinity United Methodist Church, Albany, New York - and THE BRIDGE will get full credit!

I am enclosing a check in the amount of two dollars. I would greatly appreciate receiving the February issue special delivery so the display will be "on view" by next Sunday, if possible. Many thanks for your cooperation.

I also greatly enjoyed your editorial on "Serendipity." Keep up the good work!

Sincerely,

Grace L. Hudowalski

EDITOR'S NOTE

We wish to acknowledge with thanks and gratitude the many communications we have received regarding the February issue of BRIDGE. A special thanks to Everitt Lee for a long lovely letter. We would publish them all if we could. We are pleased to let Mrs. Hudowalski and all the other wives of readers in on a secret: The next issue of BRIDGE will contain a special supplement that we have prepared especially for you.

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dor of their parties, across the ocean, the Americans, who eliminated peerage and royalty, continued to throw parties fit for a king. One smaller-sized party that hasn't had time to acquire its historical reputation is the Sunday brunch. (Since it is a 20th century phenomenon, it is believed that its historical importance will not begin until the 21st century).

There is one problem, however. Sunday brunch experts are divided as to when a brunch is a breakfast or when a brunch is a brunch.

King Ahasuerus or even Caligula would have agreed that a meal which includes such delicacies as mushroom quiche or spinach souffle is truly a brunch. But what about fluffy eggs and hot coffee?

Thomas Jefferson tangled his guests up in knots with one of the most novel treats ever tasted by the new colonists—spaghetti! Imagine trying to eat spaghetti for the first time! His "Italian" ingenuity made him as famous as a host, as a statesman, and his dinner party gave entertaining a new modern twist.

Not to be outdone, George Washington planned perhaps the largest surprise party in the nation's history—even though he breached etiquette to do it.

He crossed the Delaware Christmas night, and interrupted the festivities of 1,000 Hessian troops. Unofficially, the Hessians, whom he took captive, might have considered the Father of our country history's first gatecrasher.

So, whether your party is a seven-day feast or a small gathering of good friends on a sunny Sunday morning, the chances are your reputation is an original host or hostess will improve if you know what your predecessors have been doing. As to your historical reputation. We'll let history decide that.

Miggs

The Great Sahara Mousehunt

Catherine Collins and Miggs Pomeroy

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4TH APRIL

HOW CAN ONE drop into bed so bone-weary and awaken so new and made over? None of us like sleeping indoors. How spoiled we are. Catherine is quite pettish about it. She says that she is beginning to think of New York as a prison. If Alan will only turn up they will let the rest of us go home and they will stay and wander perpetually about the desert periodically visiting lovely French posts and enjoying pâté, champagne and good company. Still no word from Alan but Catherine has received a letter from Duff. None of us had thought of giving Largeau as a postal address, and we are furious with ourselves and with her. And she is furious with Duff, who has merely sent a carbon copy of a letter which she had had in Benghazi three weeks ago. 'Of course,' she says wistfully, 'he is busy studying very hard.'

'What does your son study, madame?' Captain Lecomte asks sympathetically, and Catherine shrugs and says, 'Oh, *le futball* and *les jolie filles*.' And the Captain grins and says in that case he can't possibly have time to write to his mother.

Captain Lecomte has been endlessly helpful and hospitable, whizzing us through the streets in his power-wagon, entertaining us at his club and appearing at all hours to see if we need anything. He has seen that Francis has his leg X-rayed and attended to and helped us with our many errands. We have permission from the Colonel to replenish our food supply at the commissary and to purchase the dashing French Army bush hat with which we have all fallen in love. None of us has any Chad money, which was impossible to purchase out of the country. There is no bank in Largeau—but we hear of a merchant in the market place who will change money. Supplied with dollar bills we converge upon him happily only to find that he has never seen a dollar, never heard of a dollar and is not at all sure that there is such a place as the United States. Captain Lecomte comes to our rescue. We can charge everything to him and he will take our dollars. France has heard of the United States and he is sure it will still be there when he returns home this summer, when he can exchange our dollars in a French bank. He invites us to luncheon where we are served pâté with French bread, grilled doves, salad and cheese with a delightfully smooth Burgundy.

In the afternoon on our way to the market place we see a string of eighty camels plod into the Place d'Orano, part payment of a blood-debt. The market place is brilliantly white, arched and arcaded, a Moorish Agora. Within its courtyard and along its arcades is a veritable rookery of women. Black robed, sad, hawk featured, they squat before the woven platters on which they display their wares. There is nothing for sale in the market but food; dried tomatoes, onions, ocra, little heaps of henna, red peppers, fine little nests of noodles, all of the quantities are small and neatly arranged. Now and again we see a brilliant dress, but for the most part these women are in black. Black-clad women are descended from slaves. Some of them, captured as children, have no memory of another home and no real understanding of their officially free status. Traditionally the Tebu is a warrior and nomad. Farming or work of any sort he considers beneath him. In the old days while the master was out raiding or wandering with his flocks, or hunting gazelle, the slave, whose Achilles tendon had been cut to keep him from running away, was left to tend the dates and gardens. Today, with the slave trade illegal, there is little cultivation of any sort in the Tibesti. Nobody wants to work, and nobody can be forced to do so. Among these self-unemployed people perhaps the most lowly, the most looked-down-upon, are the metal workers, also former slaves. To call a Tebu a tinker is the worst insult you can throw at him. In an alley near the market we come upon one of these men at work. With a tiny charcoal fire and goatskin bellows he is forging a spearhead from the raw material—tin cans his customer has brought him. These people are also said to make jewelry and charms and to have the spell-casting powers of gypsies. It is also they who beat the tom-tom for the dances. That they are thought such a despicable bunch seems to us proof that the Tebu consider any kind of work dishonourable. Far more noble to raid a caravan, or, since that is frowned on these days, to wander with the flock, to stalk gazelle, spear in hand—for the Tebu are not permitted to carry guns—or perhaps to sit on the ground and make tea and meditate.

There are many *metisses* or half-castes in the streets, dusky children with golden curls or young girls gaudily dressed and jaunty. In fact so gaily dressed we think their income couldn't come from selling dried noodles in the market place, and say as much. The Captain shrugs, 'What will you? there is not much for a man to do in Largeau.'

In the afternoon we go to the Captain's for refreshment. From the tower of his house he points across the desert to a heap of rubble, or rocks, barely visible among the dunes.

'That,' he says, 'was a fort. It was built in 1913 and abandoned in 1932 because of the moving dunes. It has just begun to reappear. The present fort is the third which has been built here.'

We try to photograph the shapeless mass, but are sure the picture will make no sense.

We would like, this last night, to entertain Captain Lecomte but we do not prevail. We dine at his club again. The soldiers are at the N.C.O.s' mess whooping it up. They obviously have more stamina than the rest of us, for we make gratefully for our beds at an early hour. Liv and I bed down in the garden; we will sleep well, for we're under the stars again. Fortunately this trip has made us flexible and taught us not to count on anything, for at 2 a.m. one of Hank's traps goes off under our noses with a snap that brings us upright in our cocoons. Liv's curiosity compels him to get up and see if Hank has caught a new species, but he finds nary a whisker. At 3 a.m. someone shines a flashlight in our eyes. This is accompanied by a choir of male voices rendering bawdy songs. With fascinating consideration the boys, returning from a lively evening, douse their lights as they enter the guest house, and promptly fall over every box, bag, pot, pan and jerry-can stacked in the halls. The walls reverberate and Catherine insists that the language that accompanies this débâcle is early Celtic because she cannot understand a word. She has a charitable nature. They awaken Hank, dangling a mouse in his face, and calling, 'Wake up, mon, wake up and see what ye've caught.'

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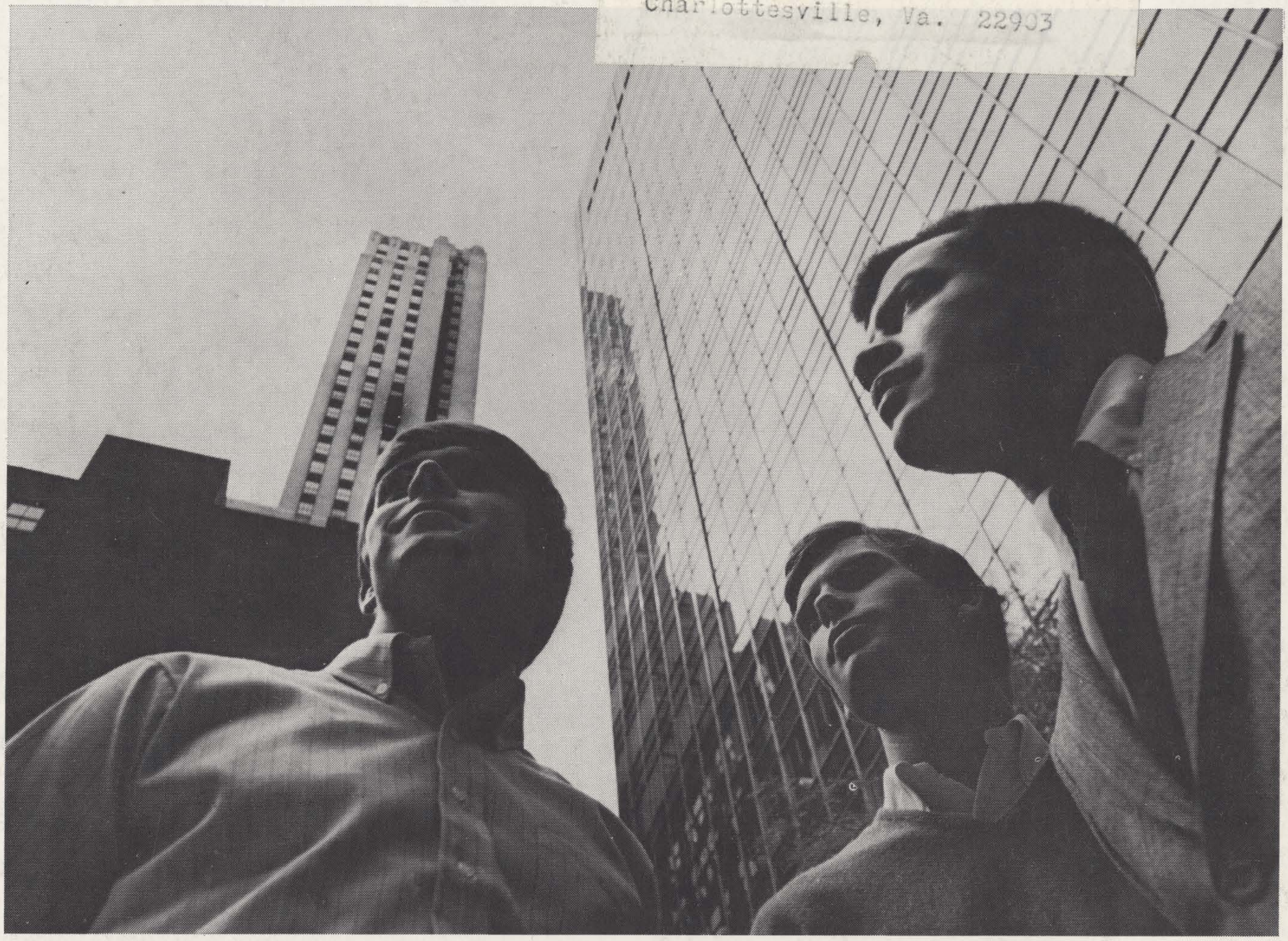

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