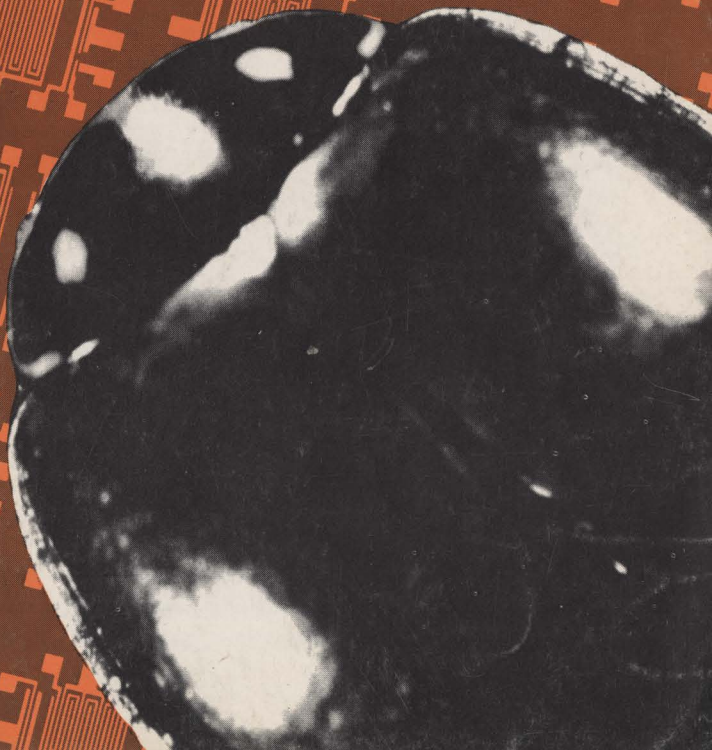
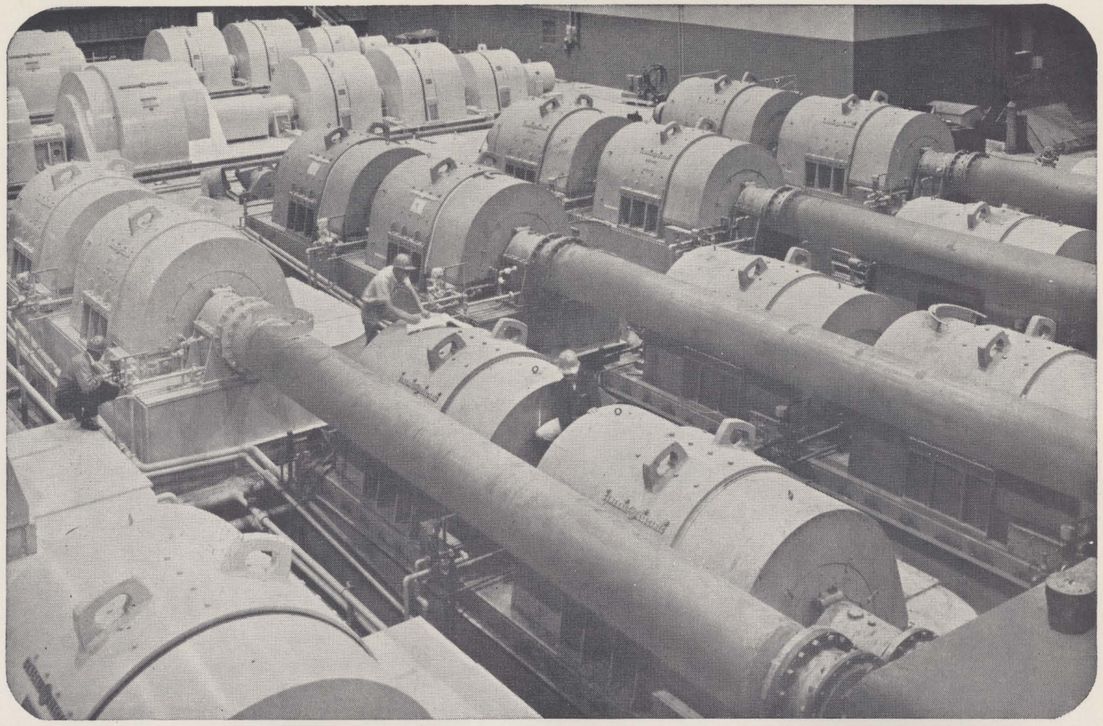
BRIDGE OF HKM





DRIVE POWER by General Electric: one section of Bethlehem Steel Corporation's new mill at Burns Harbor, Indiana.

INDUSTRY CONTROL engineer Bob Vaughn, Virginia Polytechnic Inst., worked on drives, control and the new SCR armature regulator, from design through installation.

PRINTED CIRCUIT PROCESS heart of automatic control, was checked by Glenn Keller, Lehigh U., on the Manufacturing Program at Specialty Control Department.

CUSTOMER REQUIREMENTS for d-c motors were met by Jim Johnson, U. of Cincinnati, on a Technical Marketing Program assignment at Large Generator & Motor Department.

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Electrical Engineering Honor Society

NOVEMBER, 1965, Vol. 62, No. 1

Editor and Business Manager
Paul K. Hudson

OUR COVER

When the man on the street thinks of transistors, his hand-held radio with components as small as his little fingernail comes to mind. But in the age of microelectronics, he'll need a new measuring stick — say a ladybug. She looks like a giant with this field of microelectronic thin film transistors, which have been developed by a new technique at North American Aviation's Autonetics Division. Each circuit pattern contains not one, but half a dozen transistors. That's about a gross of transistors per ladybug.

Features

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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Real and Imaginary

HISTORY OF THE CHRISTMAS TREE

To most modern Americans the Christmas tree is a dazzling symbol of Yuletide gaiety. People flock to see such famous firs as the giant tree in New York's Rockefeller Plaza. But many people are unaware of the long and fascinating history behind this familiar Christmas sight.

The Bible tells how Jesus "bore our sins in His own body on the tree" (I Peter 2:24). According to Dr. Oswald Hoffmann, who is heard by 30 million listeners on radio's The Lutheran Hour, the Christmas tree does have great religious significance for many people around the world. However, trees were not always looked upon in the way we see them today.

In ancient Greece, for example, the fir was sacred to the worshippers of Dionysius, and a branch tipped with cones and twined with ivy was carried in his honor. The wood of the silver fir was used in the ceiling of Solomon's temple.

Romans of pre-Christian times decorated a tall conifer in celebration of the arrival of winter. And primitive European tribes took fir trees into their homes to please the "tree spirits" who might then reward them with immortality.

In the Votjak tribe of early Finland, the fir tree was regarded as sacred, and certain branches were thought of as family gods to which sacrifices must be made. Offerings of bread, meat and drink were given to a tree placed on the mantle; and the Votjaks believed that a new house couldn't be built unless a fir was placed under the roof, a cloth spread before the tree, and sacrifices laid out on the cloth!

The Ostyak tribe of Siberia used a fir pole to represent the fir tree, and they, too, placed sacrifices before it. One of the probable reasons for the popularity

(Continued on page 16)

MICROELECTRONICS

Technical Staff, Autonetics Division

North American Aviation

The science of Microelectronics is an exciting and challenging pygmy world that has been developed in recent months. In July 1962, when it appeared that the practical application of microelectronics was not likely until the 1967-1972 era, the challenge of applying microelectronics to the guidance and control system and automatic ground checkout equipment for the Air Force Minuteman II intercontinental missile was accepted.

The successful first flight of Minuteman II in September 1964 eliminated at least three years from that forecast and heralded a major contribution to a new era of military electronics—the first practical application of microelectronics to a major weapon system.

Today, a variety of microelectronics methods are used in designing, developing and manufacturing a new generation of electronic products characterized by small size, light weight and ability to operate with high reliability and accuracy over long periods of time and under the most adverse conditions.

Effectiveness of many modern weapon systems is due to the capabilities of their electronic subsystems. In the past, calls for further improvements in performance resulted in increasingly complex, unreliable, bulky and power-consuming electronics equipment. The transition from vacuum tubes to transistors improved the situation momentarily.

For example, the change from a miniaturized vacuum-tube airborne digital computer to a transistorized model resulted in weight, volume, and power reductions by factors of 7, 10, and 3 respectively. At the same time, mean-time-between-failure (MTBF) rose from tens of hours to hundreds of hours under field conditions. This gives some measure of the salutary impact of transistors on the electronics industry.

While etched circuit boards were used in the transistorized computer to reduce hand wiring, the problems of numerous solder connections, bulky complex cabling, and the handling of many discrete components in manufacture still remained. Maintenance spares were a problem due to the large number of different discrete components which had to be stocked. Use of transistors, while an important advance, did not solve the military electronic systems problem.

Benefits of increased performance in armament control, surveillance radar, navigation systems, communications, and command and control—for example—justified a major development program to improve field operational capabilities of electronics systems.

Goals of the program were increased probability of mission success through improved reliability and ruggedness, together with an increase in field utility through reductions in power requirements, and reductions in size for ease in transportation.

To achieve application of microelectronics in Minuteman II guidance and control systems and ground checkout equipment, it was necessary to advance the state of the art — particularly with new techniques to produce integrated circuits, functional electronic blocks, multilayer circuit boards, ceramic printed circuits and microminiaturized discrete components.

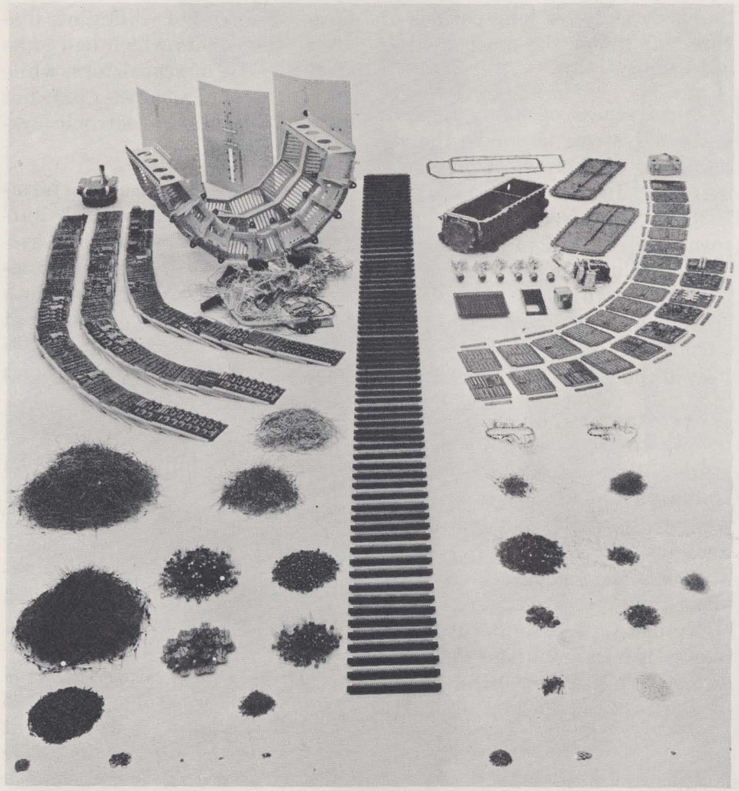
(Continued on next page)

Photo at left: PETITE PACKAGE—Mighty mite computer capable of guiding aerospace, marine or land vehicles rests lightly in the hands of Carol Lee. The D26J-1 is the tiniest member of a new family of compact, lightweight computers. Its statistics: 5 by 6.5 by 13.5 inches; wt. 13 lbs.; 1024-word memory. Its microelectronics are equal to the circuitry of approximately 400 TV sets.

As early as 1960, cooperative programs were arranged with integrated circuit manufacturers to determine which electronic circuits were most suitable for integrated application and to establish optimum design procedures and techniques for applying such circuitry.

The D37 computer for Minuteman II is the first production-designed microelectronic computer for military use. It is one-fourth the size and one-half the weight of its predecessor, the D-17 computer for the Minuteman I, yet it has two and one-half times more memory capacity.

For Minuteman II, the complex problem of interconnecting large quantities of integrated circuits was solved by mounting them on multilayer etched circuit boards. In addition to providing an effective wire harness to interconnect the integrated circuits, this multilayer board furnishes an effective means of cooling the circuits. With this packaging technique, all integrated circuits are in the open and the module can be easily repaired by replacement of an entime integrated circuit.



MINUTEMAN COMPUTERS—Graphically displaying size reductions through use of microelectronic devices are the two Autonetics general purpose, digital computers shown above. At left is the D17 computer with all of the 14,711 component parts for the Minuteman I intercontinental ballistic missile, including the connector boards which divide the computers. At right is the new D37 microelectronic computer and component parts for the Minuteman II. It has 5510 parts, weighs less than half of the other computer, uses less power and occupies .39 cubic feet. It has three times the memory capacity and is more rugged and does more tasks than the Minuteman I computer.

Microelectronics in Minuteman II ground support equipment reduced size and weight and also achieved increased operational flexibility. For example, Minuteman I ground support equipment consisted of a two-bay console housed in a van. For Minuteman II, this equipment has been reduced to the size of two small suitcases and total weight has shrunk from 950 pounds to 90 pounds.

If any consistent trend can be discerned in the many demands placed on the aerospace electronics industry, it is the requirement for increasingly complex, more reliable systems and for continual reduction in size and weight. Microelectronics makes significant improvements possible in all three of these requirements. It also offers greatly increased reliability—both the increased reliability inherent in microelectronics itself and the increased reliability possible from circuit redundancy derived from the small size and low-power characteristics of microelectronic circuits.

There are numerous approaches to microelectronic circuitry:

1. Three-dimensional stacking, where individual (discrete) microminiaturized electronic components (i.e., transistors, resistors, diodes) are packaged in layers.
2. Ceramic printed circuits, where resistors and connectors are laid down on ceramic bases through a silk screen process, and remaining discrete components are added.
3. Thin film hybrid circuits, where passive components (i.e., resistors and capacitors) and connectors are deposited in layers on a base, and discrete active components are added.
4. Integrated circuits, where all effective discrete components are produced on a small silicon chip through diffusion and photolithographic techniques.

The approach of using standard circuits rather than discrete components as building blocks for electronics systems is novel. This promptly raises the question of degree of applicability.

System studies of a typical digital computer show that 12 standard circuits can take care of more than 90% of its electronics. In such diverse applications as flight control systems and inertial navigators, more than 75% of the electronics requirements can be supplied by standard circuits. Furthermore, many of these circuits — such as general-purpose amplifiers, power switches, and flip flops, circuits with two stable states—are common to all applications. In our analysis of the infra-red amplifier for a typical airborne radar receiver, it was determined that five different standard circuits were sufficient to build the unit.

It has been found that each of the microelectronics techniques has natural areas of use depending on the frequency of operation, power handling capability required, and the degree of microminiaturization needed. The one possible exception is the three-dimensional component stack, which is included primarily because it led engineers to first consider a circuit as a design unit, and so has some historical value. In today's electronics, one of the other techniques is normally preferable. The most spectacular, as far as size reduction is concerned, is the integrated circuit.

Presently, systems using integrated and ceramic printed circuit microelectronics are in production. Equipments employing thin film hybrid circuits are expected to be in production soon while completely thin film circuits, with both active and passive elements, may be two to three years in the future.

Recently a technique has been developed for growing single crystal silicon on an insulating substrate. This technique can lead to integrated circuits with the same component isolation previously available through thin film techniques. This could extend the useful frequency range for integrated circuits from 10 to 100 times beyond current performance.

As design engineers become more familiar with the standard circuits approach, present restrictions on their use can be expected to be lifted. As an example, through use of two standard drivers plus four standard power switches, inertial navigation platform stabilizing servos can now be built to deliver 20 watts of useful output power with less than 2 watts dissipated in the standard circuits.

Improved device performance also can be expected as designers realize that with integrated circuit techniques active elements are competitive in cost with passive elements. This was certainly not true in designs using discrete components, and performance

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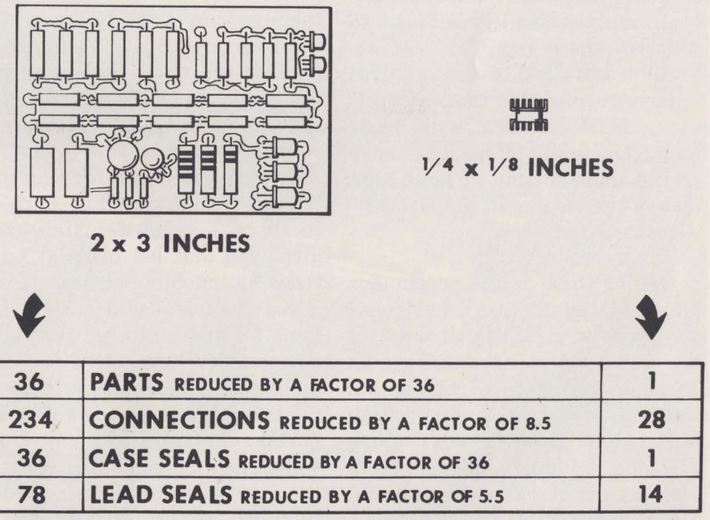


DISCRETE VERSUS INTEGRATED—This figure shows a detailed comparison between the characteristics of a flip-flop made by assembling discrete components as opposed to the fabrication of an integrated circuit. The number of components and fabrication processes has been greatly reduced by going to the integrated circuit.

Electrical Industries of America VII.

North American Aviation--Autonetics

The success of major manufacturers has been variously attributed to a number of more or less pat causes—the building of better products, the discovery of a highly marketable, profitable, exclusive item or technique, or often one or more of a number of contributing factors such as better-trained men, long-time leadership in a particular field, or similar advantages.

North American Aviation, Inc., as is the case with many companies, certainly could give credit to some of these more or less expectable parallels to success. But it is more probable that two primary factors, along with basic management intelligence, have placed the company at least high among the leaders in the aircraft-aerospace industry.

One of these is the continuous effort of the company to spread its developing talents throughout the many fields that have grown through the needs of the nation and the world, a diversification that has stretched out from airplane building into electronics, microelectronics, communications, space in all of its facets, science from pure to applied, and to many of the aspects of the defensive/offensive demands of the military. For example, the company has many hundreds of contracts calling for it to study the feasibility of production of various items or the development of techniques, or to produce specific items. These, of course, are of an almost infinite variety and yet all falling within the capabilities of one or more of its seven divisions.

This onetime "airplane builder" company is producing the most advanced aircraft today. But it also is shepherding the Apollo phase of the moon voyage under the direction of the National Aeronautics and Space Administration. It continues to develop tiny electronic components to gain space, reduce weight, assure a reliability that a few years ago was unheard of. It developed a lubricant that wouldn't burn up in space, a paint for high speed airplanes that led to today's lustrous automobile finishes. It produces command and control systems for the military, navigation devices, develops lasers for communication, ejection systems for pilots, lighting systems for airports, simulators of many kinds, welders that can do the work on the job where once such welding required an aircraft hanger to secure a seam on a wing. It makes computers, warning signals for airplanes, antennas, nuclear reactors, rocket engines with an unmatched record of performance.

Diversification undeniably has contributed vastly to the success of North American Aviation. But there is a more nebulous attribute that is able to be pinpointed only by somewhat isolated instances. This is the willingness on the part of the company to try new ways of doing things and most often making them come out right.

The late James H. "Dutch" Kindelberger was a noted exponent of trying new techniques especially when they had appeared to be too simple for much of the industry to try before. Early plane building provided some of the more intriguing examples.

Early in the war years jokes were bantered about, telling of the midgets who were hired to crawl inside of airplane fuselages to secure the parts unreachable by larger men. Within the body of the plane were hundreds of bolts, conduits, other fixtures which had to be set despite the cramped quarters. In the early years plane designs even were modified to avoid these tiny quarters.

There actually were midget employees and they did their work well. But to build airplanes in quantity, new ideas were needed, and Dutch had them. In the past, airplanes had always been built from the outside in. The shell of the craft was build first, and the "plumbing and spaghetti," hydraulic lines and electrical conduits, were then installed.

This meant long hours of tedious, uncomfortable work for assemblers, who had to crawl as best they could into the fuselage of an airplane and string the plumbing and spaghetti.

As far as Dutch was concerned, this was wasteful, paying off only in delayed delivery and exploding tempers. And he did something about it.

He established a new motto for the industry . . . "Don't let 'em get too big too soon" . . . and he backed up his slogan with an entirely new way of building airplanes—from the inside out.

Beginning with an "exploded" drawing of an airplane, the end product was divided into a number of smaller sections and subsections which could be worked on independently of the others.

The small sections were built on vertical jigs which held the

(Continued on next page)

FACTORY CENTER—Home of the X-15 and XB-70, the original site of North American's plant at L.A. International Airport is the main aircraft factory building of the Los Angeles Division.

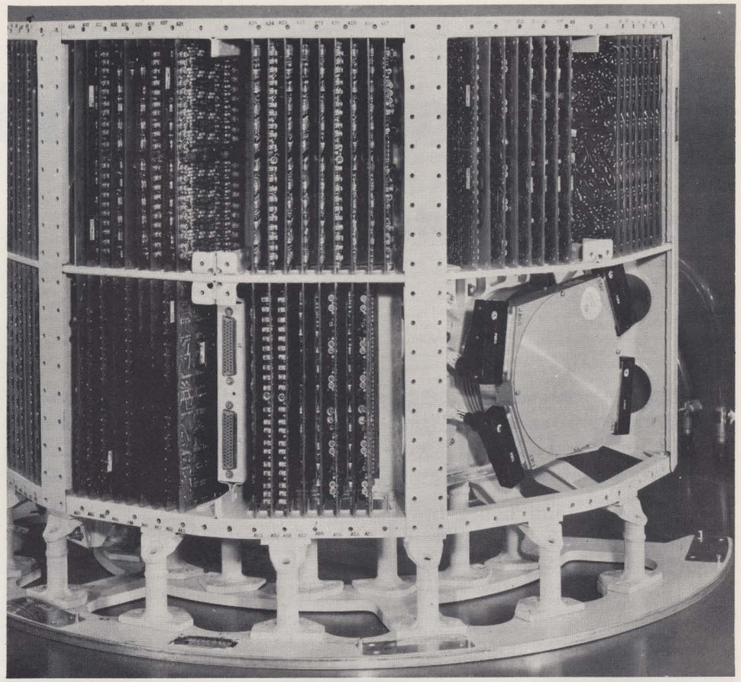
section in a vertical position so that an assembler could stand in front of his upright jig and get the job done comfortably.

The principle was much the same as that used in prefabricated housing today. Each wall is built as a unit and the plumbing and electrical work is done before the walls are pulled together to form a completed structure.

In the same way, the internal fittings of an aircraft, which had been such a problem in the past, could now be installed out in the open on the relatively small sections of the airplane, eliminating the need for crawling through the fuselage to string spaghetti and plumbing after the shell of the plane had been completed.

Some of the new ideas of Kindelberger and his associates during the early days were seemingly too obvious—after they had been tried—to have escaped discovery before. For example, all aircraft had been either open cockpit or had windows placed beside the pilot, gunner or bombardier through which he would attempt to spot his target. Kindelberger, during the course of building the P-47, made a radical departure.

With the pilot and gunner placed forward and aft under a sliding cockpit canopy in the upper portion of the fuselage, the observer was provided with a station in the large belly of the fuselage from which he could obtain good vision of the terrain below, and with an auxiliary station under the cockpit canopy between the pilot and gunner. Equipped with the latest long range radio and provisions for the latest types of aerial cameras, the plane became standard observation equipment in most units o the American air services. It was described at the time as "an observation airplane built around the observer."



COMPUTER IN THE ROUND—Digital computer used in the guidance system of the Air Force's Minuteman ICBM shown here was built by Autonetics, a division of North American Aviation, Inc. The cylinder shape fits compactly into the missile's guidance compartment. Computer had ground checkout functions in addition to in-flight duties.

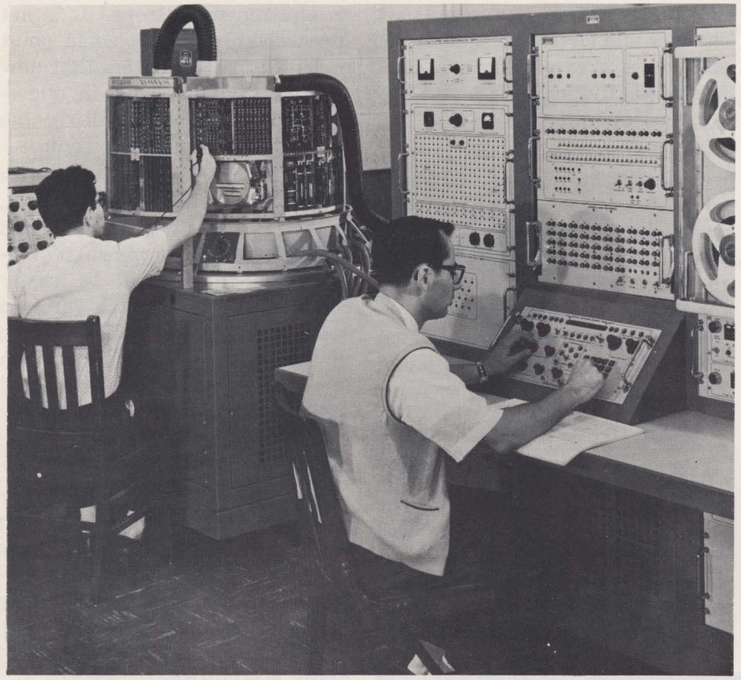
Kindelberger was quick to "clear the decks"—an attribute he repeately demonstrated when major programs were at hand—by getting to the basic problem. When he first took over North American Aviation, Inc., which had been a holding company attempting to engage in several types of businesses, he found the company owned a single plane. He summarily sold it for junk and then began to work to rebuild North American in its new character, airplane manufacturer.

He said that there was almost no work load when he first moved to Baltimore from the Douglas Company in 1934. "There wasn't even an idea of how to get a work load. The morale was negative. It was hot and most of the people were there because there just didn't seem to be another place to get a job. We started with an obvious advantage: it couldn't have been worse."

Kindelberger said the best chance seemed to be the remarkably simple technique of "building 'em quicker and delivering on time." He began then to preach his oft-repeated advice to plan before doing. He had a commonplace way of saying it:

"By various means of putting rabbits carefully in the hat before we pulled them out, we did a real good job of getting things done. And that helped."

In 1935, the company, consisting of 76 employees—moved to California. Kindelberger and his



SYSTEM CHECK—Autonetics engineers test the digital computer, left, which guides the Air Force's Minuteman intercontinental ballistic missile. Assigned several duties, the computer not only directs the missile while in flight but also automatically checks the calibration and alignment of the missile's guidance system at periodic intervals during solo storage. Autonetics is associate prime contractor responsible for Minuteman's inertial guidance and flight control.

associates who had been at Douglas with him—J. L. Atwood and J. S. Smithson — had carefully considered the move. It had three outstanding advantages. First, there were more flying days for testing aircraft. Second, there was a plentiful labor market. And third, with the warmer California weather a manufacturer could take advantage of sharply reduced costs for heating factories.

According to Smithson, "From the outset, the plant was designed for (1) efficient production of aircraft, and (2) for smooth expansion of facilities without rupture of the pre-arranged production system."

In early 1936, just two years after North American Aviation was established as a manufacturing company, 250 employees reported for work in the organization's brand new plant in Inglewood.

The factory involved a tremendous advance in the state of the art for the aircraft industry, for it was the first in which the aircraft to be produced and the plant to produce them were deliberately geared to complement each other.

This meant that not only would the planes that North American was to build be designed in terms of flight characteristics, but also with regard for the methods by which they would be produced.

Another basic ingredient of the specifications for the success formula which Dutch Kindelberger had laid out when he took over the command post of the new company was freedom of thought for his design engineering staff.

It was the ingredient which made it possible for North American engineers to take the original Kindelberg design for a new type of basic trainer and turn it into the most widely flown trainer in the world.

Dutch had sketched out preliminary designs for a basic trainer in 1934, and when the Air Corps announced that a competition for a contract award would be held in 1935, the design was molded into an airframe, equipped with a Wright Whirlwind engine, and entered in the competition.

To the Air Corps experts at Wright Field, where the preliminary demonstrations were held, the NA-16, as the design was known, was the closest approach to a tactical type trainer that had been advanced at that time in the trainer field.

From this demonstration came the good news for which North American employees and stockholders had been waiting. The Army placed an order, the first military aircraft contract the young company had won, for 42 of the trainers, designated the BT-9. Total value of the contract: $560,000.

This contract put the company in the black and enabled the posting of another milestone: The first payment of dividends to stockholders.

Ater preliminary engineering had begun in Dundalk, men and machinery were moved to the West Coast, where production was temporarily housed in the old Moreland factory adjacent to Mines Field while construction

(Continued on next page)

was being completed on North American's new factory.

The BT-9 and its successor, the T-6 Texan, both evolved from the original NA-16 experimental airplane which Dutch had designed in 1934.

All told, over 15,000 of the trainers were built by North American, and during World War II, the T-7 trainer was used to train the pilots of 34 Allied nations. Many of the reliable planes are still in use all over the world.

During the Korean War, the Texans were called back to duty, this time for a combat mission. In the rugged Korean hill country, United Nations fighter-bombers were having difficulty locating enemy targets. The slower moving T-6's were pressed into duty to locate target and guide the fighters in.

But perhaps the greatest changes and advances came in the electronics area of North American's greatly expanded and diversified operations.

In the electronics industry it was developing lighter and smaller means of accomplishing various tasks. It was only 12 to 15 years ago that transistors reduced the size of radio sets from a tabletop full of vacuum tubes, condensers, and rheostats to the small set one carries around in the hand. That was miniaturization.

The industry is now manufacturing whole circuits containing several transistors, capacitors, resistors, etc., that are no larger than a single miniature transistor. And in North American laboratories work is being done on electronic components so small that they can be seen only with an electron microscope. It is not inconceivable that at some point in the future computers that now weigh 40 pounds, even in microminiaturized form, will be no larger than a transistor radio.

Dr. N. F. Parker, Autonetics Division executive vice president, says: "But don't think that this shrinking is a simplifying process. The future will be vastly complex. It will stretch far into space and far beneath the surface of the ocean. It will be built on machines and mechanisms and systems that are unbelievably complicated. It will have automatic planners, automatic controls, and automatic production. It will have controlled environments. It may even have smooth-flowing, safely controlled traffic on our freeways. And as distasteful as it may be to tomorrow's executives, it may even have automatic secretaries."

The Autonetics Division is one of the nation's largest electronic manufacturers. It produces guidance systems for the Minuteman ICBM and for the Polaris submarine; radar for F-104 and F-105 aircraft; bombing-navigation systems; computers of various sizes, some of them microminiaturized and no bigger than a shoe box. Very significant progress is being made by this division in such fields as solid-state functional electronics, microelectronics, lasers, and microwaves.

Like most divisions, Autonetics is also active in the fields of oceanography and antisubmarine warfare. For example, research and development work is being conducted on the possibility of deep-diving vehicles than can go down and operate thousands of feet under the ocean.

The general objective in all these fields has been to build lighter, smaller, and more reliable

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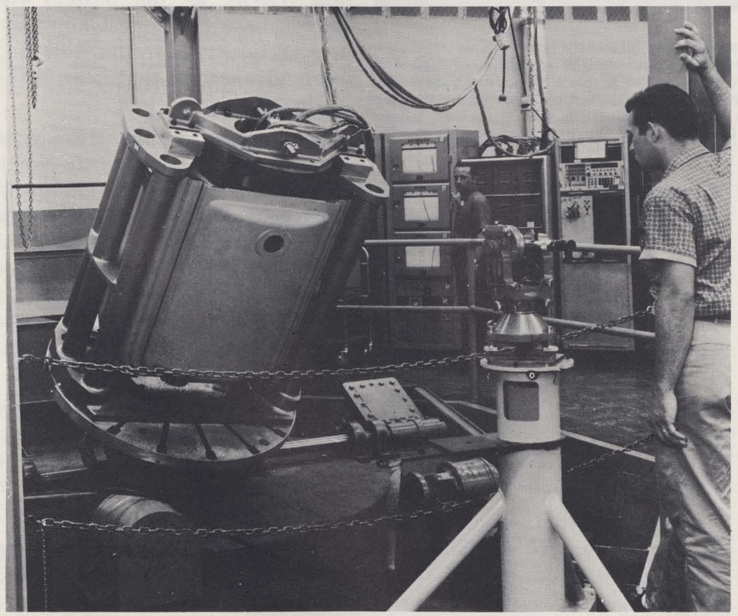


PERFECT POSITION—Autonetics' electronic navigation equipment for ships of the U.S. Navy gets a realistic checkout on dry land as scientists fake the motion of a ship by mechanical means. Stabilized by a gyroscope, this submarine automatic navigator keeps an accurate eye on the submarine's underwater position, allowing for pitch, roll and heading, so the Polaris missile can be launched "on target." Equipment is known as Autonetics' Ship's Inertial Navigation System (SINS).

The Eta Kappa Nu Award

for

OUTSTANDING E.E. STUDENTS

Los Angeles Alumni Chapter officers met early in 1961 to discuss the development of a program to help further the objectives of the Eta Kappa Nu Association. Those present were Jim Arnett, President; Tom Rothwell, Vice-President; Larry Hamilton, Secretary; and Gene Mleczko, Treasurer. They felt that additional effort and emphasis should be placed upon student activities, to provide greater incentive for electrical engineering students to become more proficient.

Many ideas and program possibilities were explored and a decision was reached about mid-1962 that the most appropriate and beneficial program would be one in which performance of electrical engineering students could be evaluated with a view to granting recognition for outstanding achievement. Tom Rothwell, now West Coast Regional Director of Eta Kappa Nu, was then President of the Los Angeles Alumni Chapter.

Problems which could be expected to be encountered were studied for some time by the Chapter's Executive Committee and the Advisory Council. Principal considerations were then set down by Tom Rothwell for further review and definition. The program was additionally refined during Larry Hamilton's 1963 term as president. A detailed first draft of the program, prepared by Gene Mleczko, who was then Vice-President, included a comprehensive development of operating procedures, student and school questionnaires, correspondence and definition of the entire program. This was studiously reviewed during the balance of 1963 and was additionally refined by Gene Mleczko early the following year and at Tom Rothwell's request it was prepared for preliminary presentation to the National Board of Directors March 1964 meeting in Philadelphia.

Following Director Tom Rothwell's presentation, the national directors authorized a survey of scholastic standards and practices at various universities at which undergraduate Eta Kappa Nu chapters were operative. The Board also requested that the program be fully defined and planned, and asked that a report of the chapter survey and a comprehensive schedule of activities for the first student selection and award presentation be prepared and presented at the August 1964 meeting of national directors in Los Angeles.

The program was fully developed by Gene Mleczko during his term as 1964 President and a survey of scholastic standards was conducted by Larry Hamilton, Bill Murray and Stu McCullough. A comprehensive planning report, progress report and schedule presentation given to the national directors, was intensively studied then unanimously approved and Los Angeles Alumni Chapter was authorized to implement the program schedule, the selection of the first Outstanding Student, and presentation of the first award.

A vital element of the program approved by the directors is the definition of what constitutes an "Outstanding Electrical Engineering Student." Much thought was given to properly describing such an individual. The definition developed and now included in the Operating Procedure, is: "The Outstanding Electrical Engineering Student may be described as being 'outstanding by virtue of his scholastic excellence and high moral character; coupled with demonstrated exemplary service to his classmates, university, community, and country'."

The directors also took note of and approved the objectives of the new Eta Kappa Nu award program. These are to: annually honor the outstanding American electrical engineering student by providing accepted nationwide recognition of his accomplishments in this field; provide recog-

(Continued on next page)

nition to his school; provide motivation to all electrical engineering students to earn membership in Eta Kappa Nu; provide recognition to the undergraduate chapter of Eta Kappa Nu from which the outstanding EE student was chosen; provide additional opportunity for publicity and recognition of the Eta Kappa Nu Association and its objectives; and provide an incentive for electrical engineering schools not having a chapter of Eta Kappa Nu to qualify for and establish a chapter.

Gene Mleczko, who was largely responsible for the award program as it is now practiced, set the machinery in motion to select the first student for this award. Forms and procedures were given a final editing and were printed, and the first mailing of nominating questionnaires went to all Eta Kappa Nu chapters last December, with the responses due by February 15, 1965.

During the period between the mailing out and return of the nominating questionnaires, Gene Mleczko corresponded with and organized a jury of award which was established in accordance with the Operating Procedure to perform the final judging. The jury consisted of six nationally recognized men identified with the electrical/electronic industry and electrical engineering schools. It included:

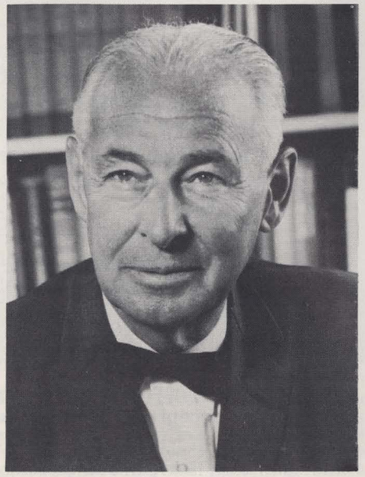
DR. LLOYD V. BERKNER, President, Graduate Research Center of the Southwest. Dr. Berkner was formerly president of Associated Universities, Inc., which organized and directed the Brookhaven National Laboratory and the National Radio Astronomy Observatory. He was a member and is now a Consultant to the President's Science Advisory Committee.

DR. JAMES HILLIER, Vice President, RCA Laboratories. Dr. Hillier first came into prominence for his contributions to the development of the electron microscope and for his subsequent role in encouraging the growth of electron microscopy as a research technique of wide importance in biology, medicine, chemistry, and other sciences.

DR. MERVIN J. KELLY, formerly President, Bell Telephone Laboratories; now retired. During his Bell System service, he was most active in the service of his country in science and technology, giving aid to the programs of the military departments, the Atomic Energy Commission, and the Department of Commerce.

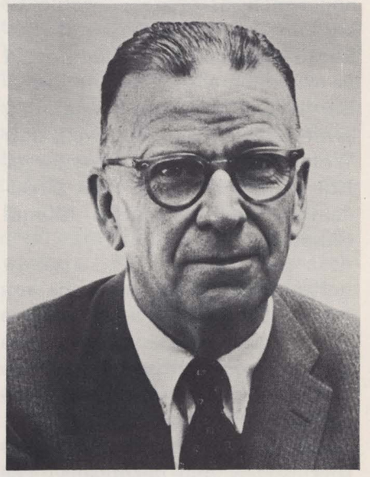
DR. WLLIAM H. PICKERING, Director, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California. Dr. Pickering is well known for the recent accomplishments of his JPL team in photographing the surface of the Moon and Mars with successful flights of the Ranger VII and Mariner IV.

DR. CHAUNCEY STARR, President, Atomics International. Dr. Starr joined North American Aviation in 1946 when the company launched a vigorous program of product diversification. At North American, he initiated and directed vital programs on the development of several successful nuclear reactor systems. Dr. Starr became general manager of Atomics International and a vice president of North American when the division was formed in 1955.



DR. LLOYD BERKNER

DR. JAMES HILLIER



DR. MERVIN KELLY

DR. JEROME B. WIESNER, Dean, School of Science, Massachusetts Institute of Technology. Dr. Jerome B. Weisner became Dean of the School of Science at the Massachusetts Institute of Technology in 1964 after having served for three years as Special Assistant for Science and Technology to the President of the United States.

Following receipt of the nominating questionnaires from the undergraduate chapters in February, the work of selecting the outstanding student began. All questionnaires were examined to verify that the required procedures had been followed. The LA Alumni Chapter 1965 Outstanding Electrical Engineering Student Award Committee then began the difficult task of screening the records of all of the qualified candidates. Gene Mleczko served as committee chairman. The committee included Tom Rothwell, a past president of the Los Angeles Alumni Chapter and, currently Director of the Western Region of Eta Kappa Nu and Manager of Test Systems Marketing for the Hughes Aircraft Company; Stuart McCullough, President of the Los Angeles Alumni Chapter and a Project Engineer with the Tasker Instrument Company of Encino, California; Clayton L. Stevens, a past president of the Los Angeles Alumni Chapter and Chief of Vibration and Acoustics for the Space and Information Systems Division of North American Aviation; Arnold L. Rose, a past president of the Los Angeles Alumni Chapter and an Independent Company Relations Supervisor with Pacific Telephone and Telegraph Company; George L. Yelland, Jr., a Division Equipment Engineer with Pacific Telephone and Telegraph Company; Warren D. Parsons, an Assistant Department Manager for the Ralph M. Parsons Company in Los Angeles; and Frank Dubsky, an Engineering Consultant in Los Angeles.

After it reviewed the nominations, the Screening Committee selected the ten highest ranking nominees for final consideration by the Jury of Award. Data on each of the ten was sent to the Jury of Award members for consideration. Jury of Award members were not informed who their fellow members were until after the judging was completed, in accordance with the operating procedure. Judging took place on an individual basis, with each member of the Jury of Award expressing his judgment of the ten outstanding nominees on a preferential ballot.

The first young man selected as the Outstanding Electrical Engineering Student in the United States for 1965 is Carl Anthony Cooper of Upsilon Chapter of Eta Kappa Nu at the University of Southern California. Two students selected for honorable mention are Dennis Thomas Mangano of Beta Beta Chapter at Brooklyn Polytechnic Institute and Richard Latham Didday of Beta Chapter at Purdue University.

It was proposed that an award of this importance should be presented at an appropriate and well-recognized forum of the electrical engineering profession, and it

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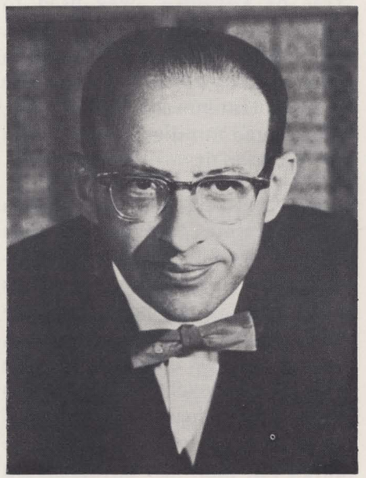
DR. WILLIAM PICKERING



DR. CHAUNCEY STARR

DR. JEROME WIESNER

was suggested that Eta Kappa Nu and WESCON jointly sponsor an annual award luncheon for this purpose. The suggestion was endorsed by the national directors of Eta Kappa Nu, and Gene Mleczko then suggested the idea to WESCON and found WESCON's directors quite enthusiastic about this program and completely in accord with the proposal for an annual WESCON/Eta Kappa Nu Award Luncheon. The WESCON Board went on to say, "As part of its program of continuing encouragement to young engineers, WESCON is pleased to be associated with Eta Kappa Nu in providing a suitable forum for the award of this, the highest honor which can be bestowed on an electrical engineering student."

Mr. Cooper will receive his award at a joint WESCON/Eta Kappa Nu luncheon to be held in conjunction with the Western Electronics Show and Convention on August 24, 1965, at 12 noon in the Continental Parlor of the Hilton Hotel, San Francisco.

The next full cycle for selection of the second Outstanding Electrical Engineering Student will commence in October of 1965, and will be repeated every year thereafter.

The newly inaugurated award program of Eta Kappa Nu is well on the way to becoming a traditional activity honoring exceptional electrical engineering students. The award takes into consideration not only the scholastic achievements of the student but also pays due attention to his other attributes: his participation in service to his classmates and university in the form of curricular and extracurricular activities, his demonstrated interest in his community and his fellow man, and his regard for his country. These all play a vital part in the considerations leading to his being chosen. It measures the student against the traditional yardstick established by Eta Kappa Nu in its goal to achievement of the well-rounded man; a man who is neither scholarly drudge nor gregarious sport, but what might be considered an appropriate combination of the best qualities of both.

REAL & IMAGINARY (from page 2)

of the fir tree as a religious symbol was the fact that it was an evergreen: it always flourished through each of the four seasons, and was symbolic of a beloved God who was immortal.

In ancient Germany, the fir was said to cure gout! Some patients believed that if they went to a fir tree after sundown on three successive Fridays and recited a rhyme, they would transfer their gout to the tree; if it withered and died, the cure was thought to be working.

Germans of the Middle Ages put on church plays in which a "tree of Paradise" was used to represent the garden of Eden. When authorities put a stop to public displays of this nature, the tree was transferred to the home, where some families hung cookies and fruit on it.

The first person to put candles on a Christmas tree was the 16th century German theologian Martin Luther. Dr. Hoffmann relates that while walking home one night shortly before Christmas, Martin Luther felt a strong tie between the lovely forest he was in, the starry heavens above, and his love for God. At home he placed tapers on a little evergreen tree to recapture the scene for his children by showing them how beautiful the stars had looked through the high branches of the fir forest as they winked in the skies.

The custom of decorating a Christmas tree spread throughout Germany, and eventually throughout Europe. It was introduced in England in 1841 by Prince Albert, Queen Victoria's German husband. German imigrants brought the practice to the U.S. in the 19th century. The first Christmas tree in America was displayed in Cambridge, Mass., in 1832.

The early twentieth century saw candles replaced by electric light bulbs as a safety measure, but fondness for setting up a glittering tree remained strong.

Some people regard it as unlucky to have an odd number of Christmas lights on the tree, and there are many who believe it is necessary to remove the tree before Twelfth Night, or Epiphany. Other people say it is important that decorations be removed before Candlemas (February 2nd) or "misfortune" will follow.

In Central Europe it was thought that death of the master or mistress of the household would follow if a fir tree outside the home were struck by lightning. And in medieval Bavaria, poachers ate the seeds of a fir tree before dawn on St. John's morn to make themselves invisible from lawmen!

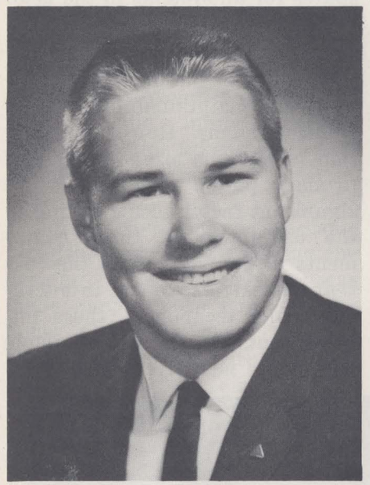
In modern America, however, the Christmas tree is looked upon as a symbol of joy and good will to others. And, although it's straight and green, many children see it as curved and many-colored —as the rainbow at the bottom of which, on Christmas morning, they find the treasures they've waited for breathlessly.

Carl Anthony Cooper

Outstanding Electrical Engineering Student for 1965

DENNIS T. MANGANO and RICHARD L. DIDDAY

Honorable Mention



CARL A. COOPER

Mr. Carl Anthony Cooper, the designated Outstanding Electrical Engineering Student for 1965, was born October 23, 1943, in Norfolk, Virginia. His permanent residence during the last few years has been in Los Angeles during his attendance at the University of Southern California. Mr. Cooper has been a member of Eta Kappa Nu for almost two years. He has served as president of the student branch of the IEEE, has been a vice president of the Delta Chapter of Tau Beta Pi, business manager of the Engineering School magazine, the

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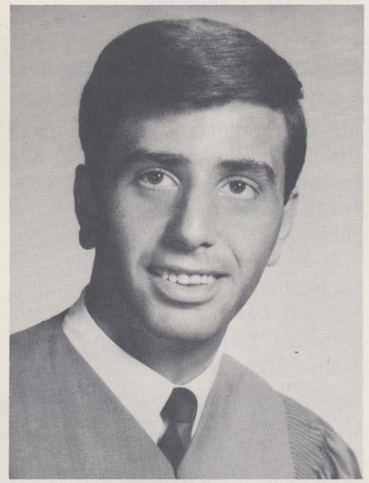

DENNIS T. MANGANO

Mr. Dennis T. Mangano was born September 2, 1943, in Brooklyn, New York, and currently resides at 31 Dolphin Green, Port Washington, New York. He has been a member of the Beta Beta Chapter of Eta Kappa Nu at the Polytechnic Institute of Brooklyn for almost two years. He is somewhat of a linguist, using four languages in addition to his native English. He has been president of the Beta Beta Chapter of Eta Kappa Nu, secretary of the Society of American Military Engineers, Student Chapter, cataloguer of the Tau Beta Pi Chapter

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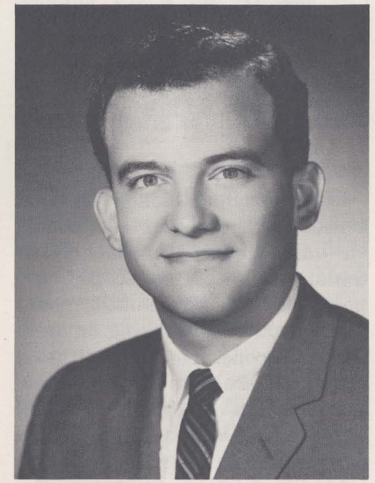


RICHARD L. DIDDAY

Mr. Richard Latham Didday was born on July 14, 1944, in Cincinnati, Ohio. His current permanent residence is at 7155 Groves Road, Cincinnati, Ohio. Mr. Didday is a member of the Beta Chapter of Eta Kappa Nu at the School of Electrical Engineering, Purdue University, Lafayette, Indiana. Mr. Didday is also somewhat of a linguist, speaking three languages in addition to his native English. He is a member of Tau Beta Pi, Phi Eta Sigma, the IEEE and a member of the editorial staff of the Purdue Engineer. He has a num-

(Continued on next page)

CARL A. COOPER (from page 17)

USC Engineer, and has been BRIDGE Correspondent of the Upsilon Chapter of Eta Kappa Nu.

During his four undergraduate years at USC, Mr. Cooper was elected to Phi Eta Sigma, the Freshman Honor Society; to Phi Kappa Phi, the All-University Honor Society; and to Blue Key, the USC Service Organization. He received undergraduate scholarships from the State of California, the Engineers Club of Los Angeles, and the Scholarship Service Club. He has been awarded a National Science Foundation Fellowship next year when he intends to enroll for graduate study at USC.

His principal hobby is concerned with amateur astronomy. He has completed a 6-inch Newtonian reflector telescope supported by an altazimuth mount and is currently working on an 8-inch telescope. He has written a computer program for the automatic design of achromatic doublets to be used as objective lenses for refracting telescopes. In his capacity as business manager for the USC Engineer, he has been responsible for the finances, advertising, printing and mailing of the magazine which is published four times a year.

He has been on the Dean's List every semester that he has been in school and has received the Certificate of Scholastic Achievement from the Los Angeles District of the IEEE and a Student Achievement Award from the San Fernando Chapter of the California Society of Professional Engineers. He has written a technical article on inertial guidance which was published in two parts in the USC Engineer and he is quite interested in literature and has done a lot of reading, including many of Shakespeare's works which he enjoys tremendously.

DENNIS T. MANGANO (from pg. 17)

and vice president of the Newman Club on campus. His hobby is reading in the fields of literature and psychology and he also has a liking for Shakespeare. He has been the recipient of two scholarships, has been on the Dean's List every semester and has prepared talks and papers on a variety of engineering subjects.

RICHARD L. DIDDAY (from page 17)

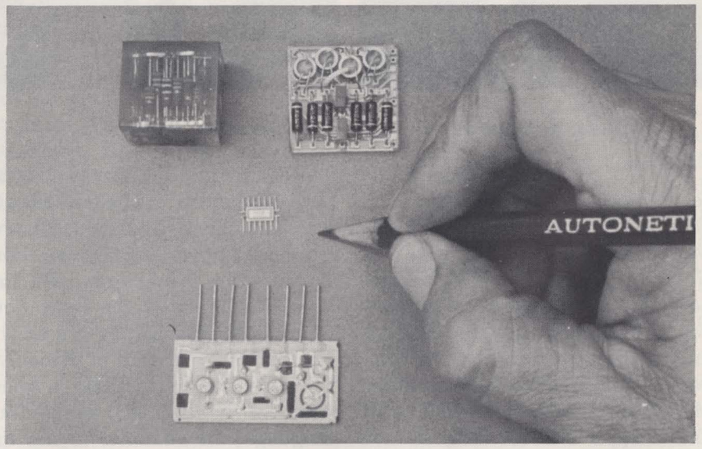
ber of hobbies in which music plays an important part. He plays the piano and the guitar and has built a transistorized theremin. He does short story writing and reading. Mr. Didday has been a National Merit Finalist, a "Distinguished Student" every semester and has been honored at the Purdue University President's Honor Banquet.

MICROELECTRONICS (from page 5)

was often sacrificed due to economic pressure. Intelligent use of redundancy — as in the triple-redundant autopilot electronics— can lead to improvements in systems reliability even greater than that expected due to the extended MTBF's in individual circuits.

Finally, field maintenance concepts may well be changed when it becomes possible, with a stock of less than 100 circuits, to supply more than 75% of the electronic spares for all systems in the field.

The major advantage of the standard microelectronics approach lies in the improved reliability and maintainability of electronics systems. However, reduction in systems size, weight and primary power requirement are significant factors contributing to the usefulness of these equipments in the field. With the current explosive advances in microelectronics technology, these improvements could be available within the next five years.



APPROACHES TO MICROMINIATURIZATION—This shows four methods of fabricating a standard flip-flop, a circuit with two stable states. The circuits are grouped to give a comparison of relative sizes. In the upper left is the three-dimensional packaging of microminiature components. The upper right shows a thin film pattern on the mounting substrate. The ceramic printed circuit mechanization of the flip-flop is shown at the bottom of the picture. Here again the discrete diodes and transistors are combined with screened interconnections and resistors to form the flip-flop circuit, the equivalent integrated circuit shown in the center of the picture. This very small device performs the same functions as the other three circuits.

LETTERS FROM ELLERY

NOVEMBER DAYS

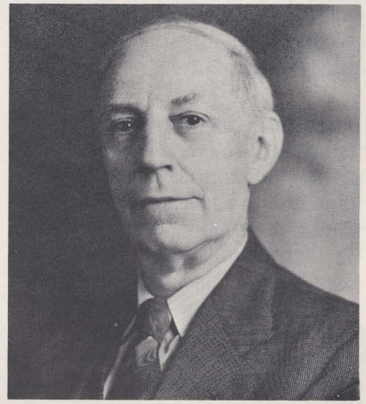
Dear Friends:

November brings to my memory the days I spent when a boy tending my traps. School always closed late in October. So until the Monday following Thanksgiving I was free for other activities than going to school. And I knew that when November arrived the furs of the animals became "Prime." Skins taken before that date would spoil and so be useless.

During November as we came from the barn after finishing the evening "Chores" I always was made happy if, in going to the house from the barn, the sky above looked dark with no stars visible. Then, especially if the light from the lantern I carried showed signs of fog and rain the thought in my head would be "It's a good night for skunks to run."

As soon as possible after the morning chores were ended (and of course breakfast) I would put bait for traps and extra wood traps to extend my lines into my leather bag and set out. I had two "Lines" of traps and one morning I would start on one and the next on the other. Until November was well on its course I would add more traps at places I had decided were promising to catch the animals I was after. The selection of the additional places would be made from my observation of "Signs" of skunk activity. One of the signs was to see in certain places the small conical holes made by a skunk as it dug in the ground for an insect to eat. Then I learned by catching skunks that the animals were likely to go through certain openings in the stone walls. It was good to set a trap near such a passageway.

Then too, I used my nose and was rejoiced whenever I got the odor of the animal I was so much interested in. And to this day I can honestly say that I truly like the smell of the skunk. When



ELLERY B. PAINE
EMINENT MEMBER HKN

this, to me, pleasing odor came to my nostrils I first hoped it meant a skunk was in a nearby trap. But if that didn't prove to be true then I was made happy by the thought it was a promising location to set another trap or two.

As a matter of fact, the skunks I caught seldom left much smell behind them. This was because it was my practice to have such weight to fall on the animal that it would be killed before it had time to give off its protective smelly liquid. I remember I was asked by Irvie how I managed to set such heavy traps as he saw when he was going on his hunting trips. He told me he tried to set one of my traps he found sprung with nothing in it and he couldn't lift it up. (I was still small and formed the habit of setting the trap with most of the top stones off and when set put the stones back on.)

Perhaps I had no legal right to set traps without first getting permission to do it from the owner of the land. But in those days that idea never entered my head. I did watch out and planned never to come within speaking distance with any human. Also I was always on the alert for cattle in a pasture, especially if a bull was in that region. I still remember the scare I got one day in crossing a certain pasture the first time that fall. It was in Abel Haven's pasture and suddenly a bull with upturned horns caught sight of me and leaped over the stone wall in my direction as easily and with the graceful motion of the deer I sometimes saw several decades later. (There were no deer in southern New England until long after my trapping days were ended.) When I saw that bull I at once dropped flat on the ground where I waited for some little time. The bull didn't see me on the ground and instead of coming up to investigate he jumped back over the wall to join the other cattle. After

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that I never ventured into the open part of that pasture without first learning where the bull was.

The sight of something in a trap from a distance always gave a joyous thrill to me. Sometimes after the first thrill came I soon began to doubt if actually a fur animal was in it. Many times a trap could be seen from a considerable distance and I learned that grass, weeds or shadows from a branch could give the impression of a captured skunk and so I learned not to let my feelings of a victory sweep me away too quickly. But when near enough to know definitely an animal had been caught I let the elation carry me away. That is unless on coming up close to it I found the animal was a cat. The cat was not worth the trouble to skin it and too, I did not want anybody to know I had caught a cat of theirs.

The skunk caught and then the thing to do was to skin it. To do this I would carry it to a spot where I was sheltered from the wind and had a comfortable place to sit and also a convenient limb of a tree to hang the skunk on for the final detachment of the skin. The skin off, the next job was to cut off all the fat from its back and stuff the fat into the hide to be carried in the game-bag for "Trying out" on the kitchen stove on reaching home. I would then cut off the portions of the body which made good bait for the traps. I remember once I chanced to meet a neighborhood boy who came along as I was at this work and when I cut off the parts he asked, 'How can you cut off those pieces and never hit a bone to dull your knife?" He had not learned, as I had done, the anatomy of the skunk.

I think I one time told you how I read that "Skunk Oil" brought a high price per gallon. So I decided to get oil from the skunk fat in the same manner that lard was obtained from the fat of the hogs. The skunk, during the fall, accumulated a big bunch of fat on its back to be used as food during the winter when the time was spent in a hole in the ground. This fat was wholly free of skunk odor and when put into an iron container on top of the kitchen stove the oil soon appeared as a slightly yellowish colored liquid which I poured into a bottle. But I never got a market for the quart or two of oil so collected during a trapping season. The only use of it that I remember, was to be applied to the neck and chest of a member of the family who had a bad cold. This oil was considered excellent for such purpose.

Once or twice in a season I found a mink caught in a trap set for the skunk. This was the cause of great rejoicing because the skin of the mink was worth at least double the price of the best of the four grades of skunk furs which was called "Black." The three other grades were named "Half Stripe," "Striped," and "White" in the order of value. During my trapping days the value of the four grades were $1.00, 50 cents, 25 cents, and 10 cents, depending on the amount of white in the two stripes from the animal's head down over the back.

The total distance around each of the two trap lines amounted to a considerable number of miles. One of the lines took me up into Massachusetts. I never took anything for me to eat in my game-bag. As I became hungary I would stop under some nut tree to eat chestnuts or hickory nuts. Then I had the habit of visiting some farmer's turnip field if I found nobody was in sight. I also knew where apples were to be obtained—some from an orchard, some from the wild apple trees that grew in the pastures. Then too, there were checker and partridge berries which always were good to eat. And the bark of black birch seemed good to chew. It always was late in the afternoon before I got back home and when I did get there the first thing to do was go to the pantry and fill up with good things left over from dinner.

Then it would be time for the evening chores. Such work did not have the pleasure I found during the hours of visiting traps. I suppose that was the reason that I made plans to live wholly by myself in a place where nobody would find me. I had the spot selected under the shelter of an overhanging ledge some two miles from home. There I would store provisions for the winter as did the squirrels. And from that place I could watch folks going to church. I wouldn't have to go.

AUTUMN

A haze on the far horizon,
The infinite, tender sky,
The ripe rich tint of the corn-fields,
And the wild geese sailing high—
And all over upland and lowland
The charm of the golden-rod—
Some of us call it Autumn
And others call it God.

CARRUTH

CHAPTER NEWS

UPSILON, University of Southern California — All prospective candidates were invited to a smoker at which they were introduced to the members. Following this smoker, those candidates elected to pledge status participated in pledge week. This week was culminated by an informal initiation, during which the pledges underwent tests and interviews.

Those pledges elected to membership were formally initiated on May 8. Upsilon Chapter was proud to initiate Dr. Malcolm R. Currie into Professional Membership and to hear him speak at our initiation banquet. Dr. Currie was selected as the Nation's Outstanding Young Electrical Engineer for 1958. Dr. Currie is currently Vice President of Hughes Aircraft Corporation, and is the Associate Director of Research at Hughes, Malibu.

The Annual Engineering Awards Banquet, held on May 21 at the University of Southern California, climaxed a highly successful year for Upsilon Chapter and its members. Upsilon Chapter received the Award for the Most Outstanding Engineering Honor Society at the University. HKN member Howard A. Hyman received the Archimedes Circle Award for the engineering student with the highest grade point average. Howard also had the highest grade point average of any student in the entire University. HKN member Carl A. Cooper received the Gilliland Memorial Award for outstanding service to the Engineering School. Robert Solis, Upsilon Chapter's 1964 Fall Semester president, received the Biegler Memorial Award for the engineering student showing outstanding promise. Dr. Willard Rush, Upsilon Chapter's faculty adviser, received a special award citing his outstanding teaching ability and contributions to the University.

On June 10, the Saturday after finals were over, Upsilon Chapter sponsored a picnic for the Electrical Engineering Department. All Electrical Engineering students and faculty members were invited; and it turned out to be quite a big day. There was very enthusiastic participation on the part of the entire Department, with approximately ninety faculty members and students in attendance. The day consisted of playing baseball and volleyball, eating barbecued hamburgers, drinking beer, and informal chatting between the students and faculty members.

CHI, Lehigh University — The goal of Chi Chapter of Eta Kappa Nu has been to render the greatest possible service and assistance to the department of electrical engineering at Lehigh. This has taken many forms, ranging from the carrying out of requested improvements, to self-inspired group activities in the best interests of the department. In addition, a reading room has been maintained by the members of Eta Kappa Nu. Recent magazines and periodicals pertaining to electronics and electrical engineering are kept in large supply. An atmosphere conducive to study generally prevails and it is widely used for this purpose.

Mr. Andrew Alford, Gamma Beta '54, President of Alford Manufacturing Company, Boston, has received the Pioneer Award from the Institute of Electrical and Electronic Engineers Professional and Technical Group on Aerospace and Navigational Electronics.

The annual award was in recognition of Mr. Alford's contributions to civilian and military aircraft Instrument Landing Systems, very high frequency Omni-Range Antennas, and other air navigation aids.

As President of Alford Manufacturing Company he has made numerous contributions in the field of military tactical antennas, commercial Television and FM broadcasting antennas and diplexers, and instruments for the measurement of RF impendance, phase, attenuation, and insertion loss or gain.

BETA OMICRON, Marquette University — The Beta Omicron Chapter at Marquette University, initiated 21 new members this spring, bringing the total active membership up to 61. In addition, the Faculty Membership and the Graduate Membership were 12 each.

The most outstanding activity was the helping of underclassmen with their technical and engineering problems. This was a two-hour program, scheduled daily, whereby different members of the Chapter volunteered as tutors on an advance notice.

This Chapter achieved a goal of 114% participation in competition with all student organizations in the Greater Marquette University Fund Raising Program.

The Electrical Engineering Department requested this and received the Chapter's assistance in the making of an IBM listing of all student records.

BETA PSI, University of Nebraska— Beta Psi Chapter completed the spring semester activities by establishing the criteria for selection of the "Distinguished Graduate Award." The award consists of placing pictures of prominent graduates of the EE Department who have become prominent in education, industry, or politics in the halls of Ferguson Hall.

Our HKN chapter and IEEE financially and enthusiastically supported the "double E's" projects for "Open House" during the annual Engineering Week. The EE Department won the over-all honors for E-Week as well as the "Open House" competition.

The highlight of semester activities occurred in April when Beta Psi Chapter initiated nine new members. One of the new members, Barbara Holden, was the first lady to be initiated into membership in our chapter. A banquet honoring the new initiates, immediately followed the initiation. Dr. Theodore Jorgensen, physics professor, was the featured speaker.

DELTA DELTA, University of Denver — Delta Delta Chapter of the University of Denver initiated two juniors and one senior on May 1, 1965. At the initiation banquet that night, Dr. Philip B. Callaghan spoke about recent developments in the fields of artificial organs and bionics. In addition, Dr. Callaghan's comments ranged over some of the administrative and financial aspects of medical and engineering research. Dr. Callaghan is an M.D., but he is currently working on his degree in electrical engineering. We were very much impressed by the challenges in the interdiscipline of medical engineering.

At the final business meeting of the year the chapter elected officers. Carl Shinn is the new president and Dr. H. D'Angelo is the new faculty adviser. We discussed ideas for making the chapter more vital and active next year. Some of the more promising proposals were to inaugurate a program to help sophomores through circuit analysis, and to invite high school students to visit the College of Engineering.

(Continued on next page)

ELECTRICAL IND. (from page 12)

systems. Autonetics achieved another first in 1963 when it put its microminiaturized D37B computer into an advanced version of the Minuteman ICBM.

The division has around 25,000 employees and did $600 million worth of business last year.

Autonetics is the second largest division in terms of employment and sales. It has developed, and in some cases has pioneered, a number of highly advanced electronic and electromechanical products. Among these is the inertial navigator, which can guide a vehicle without reference to outside check points, using a combination of gyros and accelerometers. This was originally designed to provide long-range missiles with navigation equipment that would be jam proof. It is, of course, embodied in the guidance and flight control equipment that Autonetics makes for the Minuteman ICBM. But it was also found to be ideally suited for navigation by atomic submarines in long cruises where they would have no opportunity to surface and take a star fix. It was this equipment that enabled the Nautilus and Skate submarines to make their historic cruises under the polar ice cap.

This is only one of several major types of equipment—including armament control, flight control, and data processing equipment — manufactured by Autonetics. The division is currently engaged in developing microelectronic equipment, which we consider to be as far reaching in its effects as the advent of the transistor was a few years ago. The most obvious advantage of microminiaturization is a dramatic reduction in size and weight. However, even more important is the improvement in reliability due to a drastic reduction in the number of soldered connections and other parts subject to wear or breakage. Microcircuitry is being widely incorporated in an advanced version of the Minutemtn; an autonavigator and a computer using this technique are also in an advanced stage of development.

These products, all within the division, are typical in their variety, of the diversification that is practiced by North American Aviation as a whole and in each of its divisions. It's not a case of careless, unpatterned demonstrations of talents but, to the contrary a strictly regimented application of these talents to products related through electronics.

In other divisions, such as the Los Angeles Division, there is a similar diversification with the keynote being aircraft. The Columbus Division, which follows a similar pattern in aircraft design and development, also has a number of interests in the broad field of communications, particularly communications through the use of antennas. Rocketdyne, Atomics International and the Space and Information Systems Division have reaped similar benefits through diversification in their special fields.

The two primary factors, referred to earlier—diversification and the willingness of trying new ways of doing things—continue to play vital parts in North American's development with the broad and unplumbed field of space still challenging the industry, this trend surely will continue.

CHAPTER NEWS (continued)

DELTA EPSILON, Ohio University —Early in March, the Delta Epsilon Chapter of Ohio University elected new members. As a part of their pledge project they devised and circulated a faculty evaluation sheet among the junior and senior students in Electrical Engineering. The majority of the students responded positively without having to indicate their names. This questionnaire was collected and kept by the individual professor.

Delta Epsilon started publishing a monthly newsletter, the "Nu's News," with EE departmental news, articles by students engaged in research, engineering problems, etc.

In late April the initiation ceremonies for the new members was held. Five undergraduates ,three graduates and an acting instructor were initiated.

A banquet for all members, the faculty and their guests followed the initiation ceremonies. At the banquet the recipient of the 'Sophomore Award" was introduced. A commemorative gift donated by the active members was given to him. The evening was climaxed by the guest's speech on 'Cybernetics."

Before the end of the school year, a picnic was held at the residence of Professor Selleck with both faculty and the chapter's members participating.

DELTA ETA, University of Massachusetts — On May 5, 1965, Delta Eta Chapter initiated four new members into Kappa Nu, three juniors and one professional member. The professional member was Professor Bernard Lovell of the E. E. Department. After the initiation, the annual Spring banquet was held at the Williams House in Williamsburg, Massachusetts.

At the banquet, the Chapter's third annual "Outstanding Senior Award" was presented to Joseph Kos. Joe was selected by the electrical engineering students and faculty as the senior who has best shown excellence in scholarship, leadership, and interest in his profession and his school. Joe, we are proud to say, is a member of Delta Eta Chapter.

This semester the Chapter sold General Electric Transistor Manuals as a fund raising project. Delta Eta is pleased to welcome Professor Fitzgerald as its new advisor for the coming year.

DELTA KAPPA, University of Maine — On April 24, 1965, Delta Kappa Chapter initiated one senior and eight juniors into Eta Kappa Nu. The same evening our annual banquet was held in honor of the new members, with student members, faculty members, and their guests attending.

During the spring semester Delta Kappa has continued the tutoring sessions for Sophomores in Electrical Engineering and the upkeep of the department reading room. We also showed the film, "Engineering—A Career for Tomorrow," in three different high schools to a total of about 700 students.

As pledge projects, the new members in Delta Kappa Chapter obtained catalogs from various engineering colleges to be placed in the reading room, arranged the magazines in the reading room in alphabetical order, and placed displays in various buildings on campus telling about Electrical Engineering.

DELTA NU, University of Alabama —This past semester the Delta Nu Chapter arranged to co-sponsor a display case in the lobby of the electrical engineering building. Previously, the displays had been set up there by the IEEE. This project is important to our publicity program because the displays are convenient to freshmen.

A permanent membership roster was completed during the spring semester. The roster was hung in the electrical engineering building. Provision was made to continue the chapter project of hanging in the hall pictures of the graduating, electrical engineering students.

The spring semester pledges were required to obtain the signatures of all the members of Eta Kappa Nu, who were on campus. They were also asked to polish brass emblems. After the initiation ceremony, when seven new members were inducted, the chapter met at the home of Professor Russell E. Lueg for a picnic. The new initiates had arranged for an excellent barbecue to be provided.

At the last chapter meeting this spring, officers for the fall semester were elected. The new president is Guy Dryden.

The chapter will continue to work to stimulate professional attitudes and an interest in scholarship, not only by setting an example, but through active, enthusiastic encouragement.

DELTA SIGMA, University of Notre Dame — During the second semester Delta Sigma Chapter continued its efforts to contact alumni who graduated before the founding of this chapter. It is hoped that these men may be initiated into Eta Kappa Nu as professional members at one of the class reunions.

Informal meetings were held this spring to assist the juniors in the area of graduate study. At these meetings the seniors explained the factors influencing the choice of a graduate school. The general procedures in applying for admission and for financial aid were also discussed. Unwanted graduate school catalogs were collected from the seniors and made available for use of the underclassmen.

Plans are now being made to establish a system of course evaluation within the electrical engineering department. The purpose of this would be to assist students in their choice of electives and to suggest improvements in existing courses. It is hoped that this evaluation procedure will be started next year.

The electrical engineering department has established a weekly seminar, addressed by prominent speakers from other universities and industry, primarily for graduate students. This is not, strictly speaking, an activity of the chapter but through chapter efforts permission has been extended to members of the chapter to attend lectures in which they are interested. The lecture on bio-electronics was particularly popular. Hearing lectures of this type during one's undergraduate years has the advantage of giving information and guidance before a choice of graduate specialization is made.

DELTA PHI, University of South Carolina — This past semester saw the induction of five new members into the Delta Phi Chapter of Eta Kappa Nu. They were honored at the Spring Banquet held March 19. There was an excellent meal followed by an interesting talk on the Viet Nam Crisis by the guest speaker, Professor Frank Sloan of the Law School. After the meal and talk came an informal get-together with music and dancing for those so inclined.

This spring the "Delta Phi Engineering Review" was published. It reviewed the year's activities of the various professional and honorary Engineering Societies.

In February, thanks to the efforts of many Delta Phi members, the 2nd Annual Engineering Exposition was a tremendous success. We look forward to an even better Exposition next year.

On May 7th the last meeting of the Delta Phi Chapter was held. Particular emphasis was placed on ideas concerning the furthering of Eta Kappa Nu's image throughout the campus in general. Also, methods were discussed by which incoming freshmen and rising sophomores in Engineering could be better acquainted with the aims and requirements of Eta Kappa Nu.

EPSILON GAMMA, University of Toledo — Epsilon Gamma Chapter of Eta Kappa Nu has taken in 14 new members, with two being graduate students.

The Annual Smoker for prospective members was held on April 11, 1965. A meeting for selection of new members followed.

On May 2, 1965, following the initiation, the Annual Banquet in honor of new members, was held.

This year's pledge class will be finishing off a 24-inch-high bronze casting of the "Bridge." The form for the casting was donated by Beta Epsilon Chapter. When completed, the "Bridge" will be mounted on a wall near the Electrical Engineering Department.

GAMMA THETA, University of Missouri — Gamma Theta Chapter at the University of Missouri at Rollo held its initiation banquet for the spring semester on Saturday evening, April 24, 1965, at Baxter's Restaurant in Rolla. Fifty-two persons, 23 of which were initiates, attended the banquet. Larry Robinson received an award as the Outstanding Eta Kappa Nu Pledge. Robert Tyra, one of the initiates, was also presented a check for $200.00, as the recipient of the Eta Kappa Nu Scholarship for this semester. The speaker for the evening was Carl G. Christie, Associate Professor of Economics here at U.M.R.

Election of officers for the fall semester of 1965 was held during the chapter meeting of May 11, with the following members attaining these offices: James Stangel, President; Larry Robinson, Vice-President; Robert Snell, Corresponding Secretary; Charles Borgman, Recording Secretary; Roger Gray, Treasurer; and Loy Roberts, Laboratory Insurance Chairman.

DELTA ALPHA, Wayne State University — At the end of the winter quarter the annual IEEE-HKN Banquet was held. Over 120 students, faculty, and alumni filled the banquet hall. Also present were Dean J. Stuart Johnson and Associate Dean Howard M. Hess of the College of Engineering. At the banquet keys were presented to the newly initiated members.

In May the Delta Alpha chapter sponsored a talk by Mr. T. A. Alessi of the Detroit Edison Company on the subject of "Direct Conversion of Energy to Electric Power." All of those present were brought up to date on the current state of the art of such devices as fuel cells, MHD generators, and thermionic devices. Also discussed were a couple of systems of power generation which have been proposed for these devices.

As soon as final exams are over this spring the annual IEEE-HKN-EE Department Picnic will be held. Once again a student team will attempt to defeat a faculty team in the annual Student-Faculty Baseball Game. Regardless of which team wins the game, though, the day promises to be funfilled for all participating.

California State College at Long Beach Chapter Activities

The most important event of this year was the installation of our chapter into the national society of Eta Kappa Nu. This was accomplished on February 13, at which time the name of the chapter became Epsilon Theta. The installation officer for this event was Thomas L. Rothwell, one of the national directors of Eta

(Continued on next page)

Kappa Nu. Helping in these proceedings were some members of the Upsilon chapter of the University of Southern California. It was this chapter that initiated our first members into the Eta chapter on December 19 of last year.

Initiation ceremonies for 15 additional members were held that afternoon on campus, with the installation banquet for the chapter being held in the evening. In attendance at the banquet were many distinguished gentlemen. including HKN's own Dr. Clyde Hyde, and the President of our college, Dr. Carl W. McIntosh. Speeches were given by both of these men, along with the installation ceremonies handled by Thomas Rothwell.

During the spring semester, the chapter participated in Engineering Week activities. This included the writing and grading of tests given high school students on Engineering Day, held at the end of that week on Saturday, February 27. This event is held every year by the students in the engineering department in order to encourage the interest of high school students in engineering as a career, and in the facilities offered by CSCLB. This year, over forty high schools from the surrounding area took part in this program.

A smoker with the Theta chapter of Tau Beta Pi was held on the evening of May 8, in order to acquaint prospective pledges of Eta Kappa Nu with the members of Epsilon Theta. Induction ceremonies for the elected pledges was scheduled for June 12, which is just following the completion of final exams. That night, a joint banquet with the Tau Beta Pi chapter was held in their honor.

One of the highlights of the year came at the Engineer's Dinner Dance Banquet held on May 1. At this time a member of Epsilon Theta, Robert Allen, was presented with the "Associated Engineering Outstanding Service Award." It should also be noted that another member of Epsilon Theta, David Civils, was President of the "Associated Engineering Student Body" and chaired the committee that organized this Banquet, held annually for all engineering students.

THE OLD PROFESSOR SAYS:

Now that it is about time to make the All-American football selections, I hope they won't overlook Dusty Rhodes of Kansas, Frosty Knight of Minnesota, Hale, Columbia, and Banks of Wabash.

FROM THE MAIL BAG

Dear Paul:

I have enjoyed reading the BRIDGE articles and also the clever and original editorials you write which contain gems of wisdom hidden amongst the humor. I particularly enjoyed the proposal for a B.S. in W.E. Such a degree might well be more important for future deans than a Ph.D.

Sincerely,

W.L.EVERITT
Urbana, Illinois

Dear Paul:

You are certainly to be congratulated not only upon your choice of subject to be presented under the heading, "Real and Imaginary," but the stature of the author's contributions. Prof. Collidge X. Ray's "A Penetrating Look Into a New Frontier" is a classic example and worthy of special commendation even though obviously "ghost-written."

Sincerely yours,

ALLAN KIDDER
Philadelphia, Pa.

AUTUMN

Like tides on a crescent sea-beach,
When the moon is new and thin,
Into our hearts high yearnings
Come welling and surging in—
Come from the mystic ocean,
Whose rim no foot has trod,—
Some of us call it Longing,
And others call it God.

CARRUTH

HOWARD HUGHES DOCTORAL FELLOWSHIPS. Applications for the Howard Hughes Doctoral Fellowships in engineering, physics, or mathematics are now available for the academic year beginning in 1966.

The program offers the qualified candidate the opportunity for study and research at an outstanding university plus practical and rewarding industrial summer experience at a Hughes facility.

Each Doctoral Fellowship includes tuition, books and thesis preparation expenses, plus a stipend ranging from $2,200 to $3,100, depending upon the number of the candidate's dependents. Full salary is paid the Fellow during his summer work at Hughes.

Fellowships are awarded to outstanding students of promise. A master's degree, or equivalent graduate work is required before beginning the Doctoral Fellowship Program.

HUGHES MASTERS FELLOWSHIPS. The Hughes Masters Fellowship Program offers rewarding opportunities leading to the master's degree. More than 100 new awards are available for 1966-67 to qualified applicants who possess a baccalaureate degree in engineering, physics or mathematics. Tuition, books and other academic expenses are paid by the Company. A significant advantage offered by the Work-Study Program is the opportunity to acquire professional experience while pursuing the degree. Selected Fellows are allowed to work in several different job assignments during the Fellowship period. This experience often helps the Fellow to decide on his field of concentration and type of work. Fellows who associate with a Company facility in the Los Angeles area usually attend the University of Southern California, or the University of California, Los Angeles.

A major economic advantage is that Fellows earn full salary during the summers and work 24 hours per week during the academic year. The resulting salary, added to the annual stipend of $500 to $850 enables the typical Fellow to enjoy an income in excess of $6,000 per year. Fellows' earnings increase commensurate with their professional growth. In addition to these benefits, the Program enables the Fellow to affiliate with a recognized leader in electronics and aerospace engineering. Fellows are eligible for regular Company benefits.

Work assignments at Hughes are matched closely to the Fellow's interests. The primary emphasis at Hughes is research and development in the field of electronics. Company projects include space technology, including stability and trajectory analysis, energy conversion, and structural design and analysis — computer and reliability technology, circuit and information theory, plasma electronics, microminiaturization, and human factor analysis — research, development and product design on such devices as parametric amplifiers, masers, lasers, microwave tubes, antenna arrays, electron-tube and solid-state displays, and components — design, analysis, integration and testing of space and airborne missile and vehicle systems, infrared search and tracking systems, radar systems, communication systems, undersea warfare systems, and computer, data processing, and display systems — theoretical and experimental work in atomic, solid-state and plasma physics.

The classified nature of work at Hughes makes American citizenship and eligibility for security clearance a requirement.

Most of the awards are Work-Study, however, a small number of Full-Study Fellowships are awarded which permit the Fellow to attend a university on a full-time basis during the academic year.

Upon completion of the Masters Program, Fellows are eligible to apply for a Hughes Doctoral Fellowship and are given special consideration for these awards.

Closing date for all applications: February 1, 1966. (Early application is advisable, and all supporting references and transcripts should be postmarked not later than February 1, 1966.)

How to apply: To apply for either the Doctoral Fellowship or the Masters Fellowship, write to: Mr. David A. Bowdoin, Director, Corporate Personnel — Education Relations, Hughes Aircraft Company, P.O. Box 90515, Los Angeles, California 90009

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