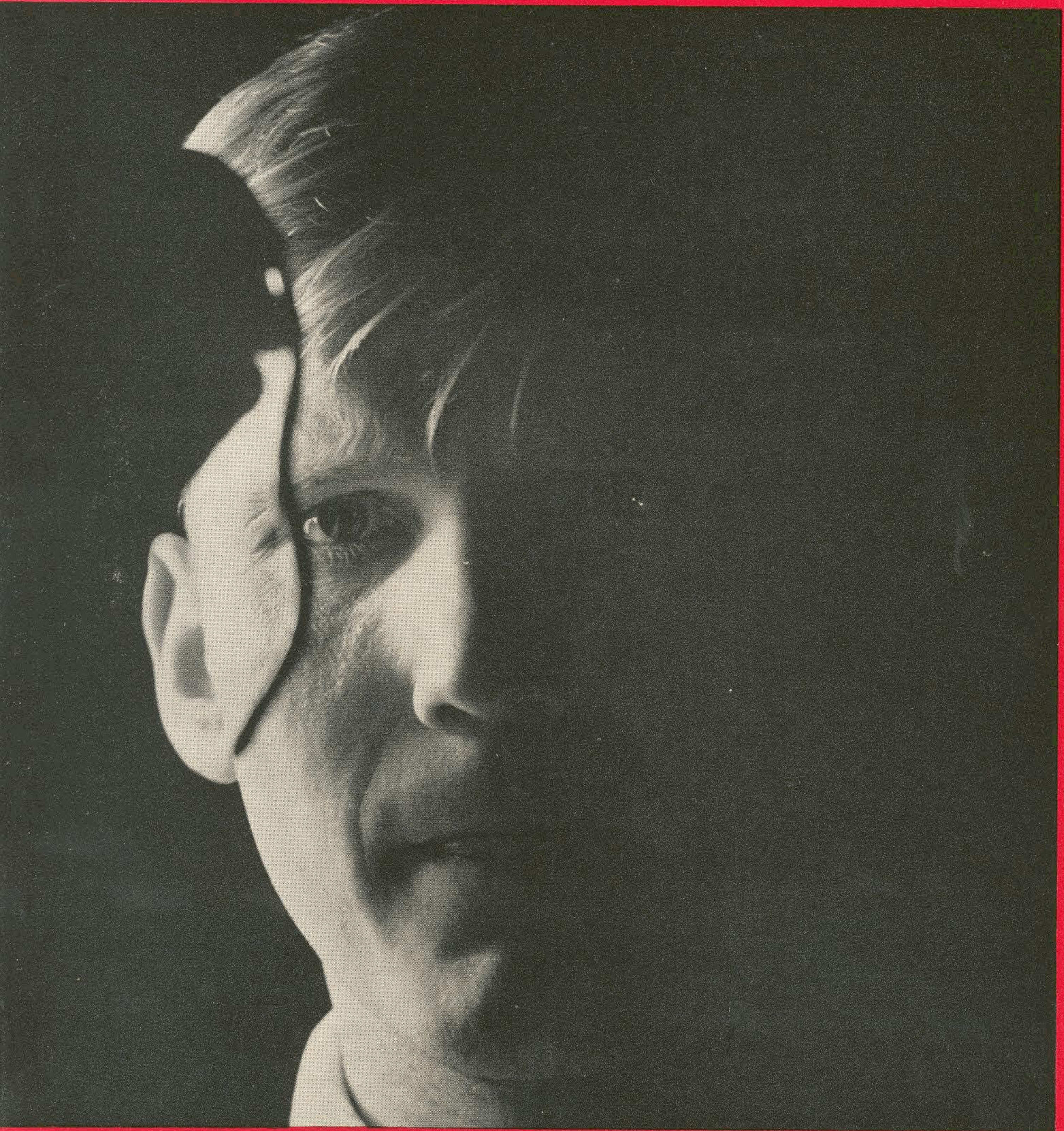
ENGINEERING | AND | SCIENCE

December 1963



Published at the California Institute of Technology

To Catch a Hummingbird

Westinghouse

How the Gemini Spacecraft will find its target ...

Suppose you had to capture alive one little hummingbird flying a known course high over the Amazon jungle. Difficult? Sure, but no more so than the job assigned to a new radar system Westinghouse is building for the NASA-Gemini space program.

The bird is an Agena rocket, orbiting the earth at 17,500 miles per hour. The hunter, in an intersecting orbit, is the Gemini two-man spacecraft being built by McDonnell Aircraft.

And so the hunt begins. The spacecraft radar finds the target and starts an electronic question-and-answer game. A computer keeps score, giving the astronauts continuous readings on angles and approach speeds until the vehicles are joined. The hummingbird is caught.

The Gemini experiments will be a prelude to the first moon trip. And Westinghouse is already working on advanced radar systems for lunar landings and deep space missions.

You can be sure ... if it's Westinghouse.

For information on a career at Westinghouse, an equal opportunity employer, write to L. H. Noggle, Westinghouse Educational Dept., Pittsburgh 21, Pa.

ENGINEERING | AND | SCIENCE

DECEMBER 1963 VOLUME XXVII NUMBER 3

On Our Cover

a Caltech biologist with an earthworm, one of the many subjects (see page 12) used in sight perception research in Caltech's new computing center.

This issue is entirely devoted to the new center, which will accelerate Caltech's whole research program by serving a wide variety of scientific and engineering projects.

At the dedication of the center on December 9, invited guests were able to see the computer system in action on a closed television circuit. One researcher tested possible values for a complex mathematical model of the sun's evolution and its effect on the earth. A student worked out a freshman physics assignment through a remote unit. Living nervous systems linked with the computer system were studied, as the nerve impulses of animals were transmitted directly into the computer for recording and analysis.

When the system is in full operation, by next spring, its services will be available to any of the 800 research projects on the campus, and also to any Caltech classes on a demand basis. Any of the Institute's 1300 students and 550 faculty members may also use it individually.

The center was made possible by gifts from the Booth Ferris Foundation of New York City and the National Science Foundation.

Picture Credits:

All photos of the computing center in this issue by Leigh Wiener.

A Special Issue devoted to

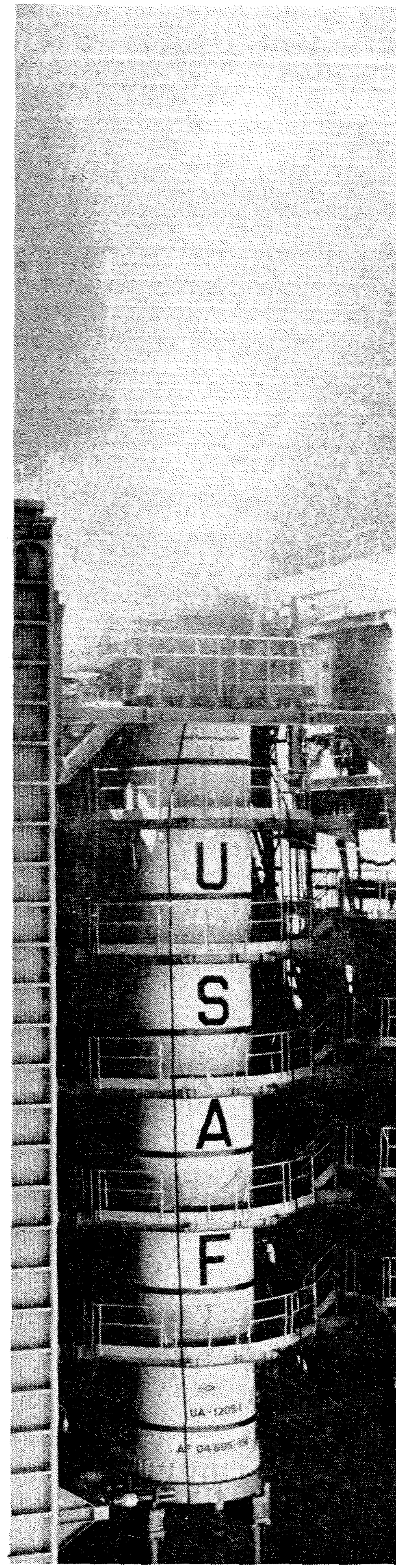
CALTECH'S NEW COMPUTING CENTER

The Willis H. Booth Computing Center, dedicated on December 9, makes possible an immediate attack on some of today's most challenging scientific and engineering problems. A pictorial report on the research and the facilities of the new center.

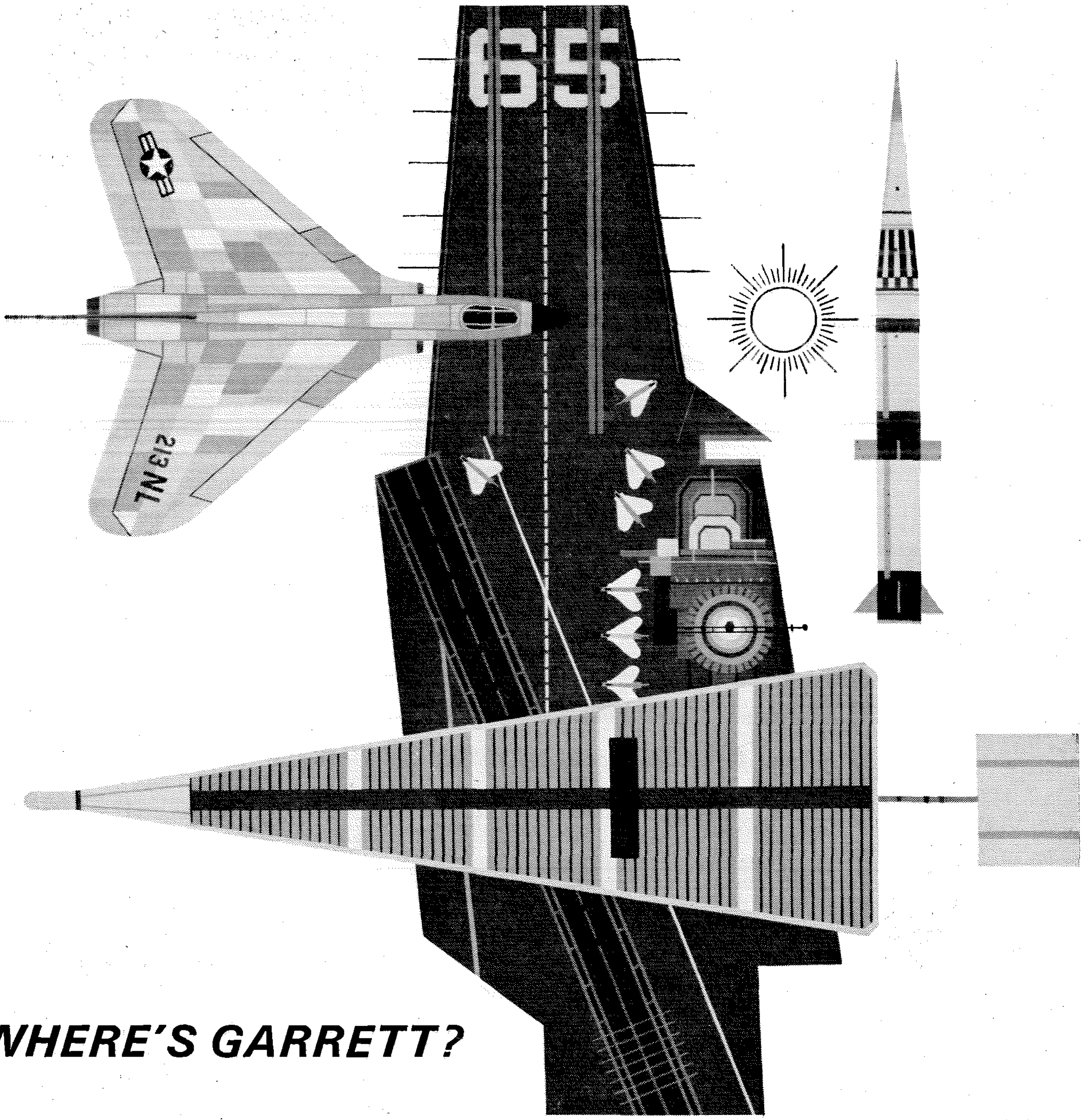
STAFF

Publisher......Richard C. Armstrong '28
Editor and Business Manager......Edward Hutchings, Jr.
Assistant to the Editor......Gerda Chambers
Photographer......James McClanahan

Published monthly, October through June, at the California Institute of Technology, 1201 East California St., Pasadena, Calif. Annual subscription $4.50 domestic, $5.50 foreign, single copies 50 cents. Second class postage paid at Pasadena, California, under the Act of August 24, 1912. Manuscripts and all other editorial correspondence should be addressed to: The Editor, *Engineering and Science*, California Institute of Technology.



U
S
A
F



WHERE'S GARRETT?

EVERYWHERE! Here are a few of the ways U.S. defense and space progress are being helped by Garrett-AiResearch: ***IN SPACE***—Environmental control systems; auxiliary power systems; advanced space power systems; research in life sciences. ***IN THE AIR***—Pressurization and air conditioning for most of our aircraft; prime power for small aircraft; central air data systems; heat transfer equipment and hundreds of components. ***ON LAND***—Auxiliary power systems for ground support of aircraft and missiles; standard generator sets; cryogenic systems; ground support instrumentation and controls. ***ON THE SEA***—Auxiliary, pneumatic and electrical power for ships; auxiliary power systems and air conditioning for hydrofoil craft. ***UNDER THE SEA***—Environmental systems for submarines and deep diving research vehicles; pressurization systems, computers and control systems for submarines and underwater missiles.

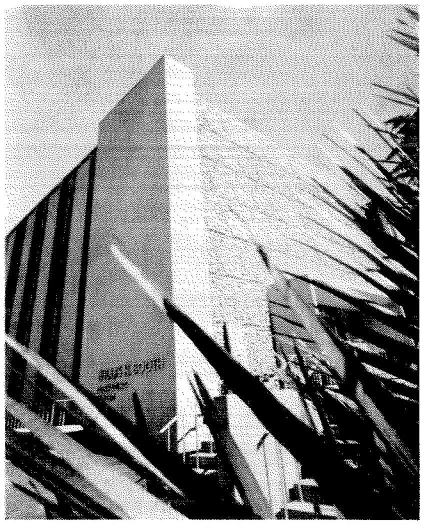
For further information about many interesting project areas and career opportunities at The Garrett Corporation, write to Mr. G. D. Bradley at 9851 S. Sepulveda Blvd., Los Angeles. Garrett is an equal opportunity employer.

THE FUTURE IS BUILDING NOW AT GARRETT

Los Angeles • Phoenix

ENGINEERING AND SCIENCE
December 1963, Volume XXVII, No. 3

CALTECH'S NEW COMPUTING CENTER



With the dedication of the Willis H. Booth Computing Center on December 9, the Institute launches one of its most significant research efforts. The new center will accelerate Caltech's entire research program, and will make it possible to attack some of the most challenging scientific and engineering problems.

The center, on the northeast corner of San Pasqual Street and Chester Avenue, is a two-story-and-basement building. The computer system occupies the main floor, while the other floors contain offices, classrooms, and laboratories. It is probably the most advanced facility now in use for multiple applications of a single computer system to a variety of research and educational programs.

When the system is operating at full capacity, by next spring, the computing center will be available to any of the 800 research projects on the campus. It will also be available, on a demand basis, to any Caltech classes, or to any of the Institute's 1300 students and 550 faculty members individually.

The center was made possible by gifts from the Booth Ferris Foundation of New York City and the National Science Foundation.

A VERSATILE SYSTEM

The versatile computer system in the new center has been tailored to meet Caltech's specific needs. It is for use on a wide variety of research projects, and is designed to interact with the people, the research, and the educational activities of the Institute.

At the hub of the system are two large IBM computers – a 7090 and a 7040. Caltech electronics engineers, in cooperation with IBM engineers, have linked the two so that the 7040 handles all the "housekeeping chores" – input and output monitoring, printing, file maintenance, and other slower-speed routines. Thus, the 7090 is kept available for high speed calculations.

Just as the 7040 monitors the 7090, so does an IBM 7288 Multiplexor control the traffic of communication between the 7040 and other components. These include consoles remote from the computing center; various display devices, such as printers; a Burroughs 220 computer; and data-gathering units capable of controlling experiments, gathering data from them, and relaying the information to the computing center.

Main computer room of the new center: the 7090 control consoles with magnetic tape units in the background.

Frederick C. Lindvall, chairman of the division of engineering and applied science; G. D. McCann, director of the computing center; President DuBridge; and Kendrick J. Hebert, head of the center's programming group.

SCIENTISTS AND COMPUTERS

"One of the major purposes of the new center is to make it possible for Caltech to undertake big research programs," says Gilbert D. McCann, professor of electrical engineering and director of the center.

"The tremendous data reduction tasks required of many complex modern research programs, such as those involved in understanding the origins and evolution of the universe, the geophysics of the earth, or the workings of the brain, find the human mind incapable of coping with them. Such data reduction tasks are so great that scientists, without computers, could not reduce the data in their lifetime."

The Caltech computer system is designed to handle — simultaneously, if necessary — the problems of many different research projects. Data can be fed into consoles to be relayed to the interplexing system, where the data will be reassigned. Some problems may be referred to the Burroughs 220 for solution. The 7040 may resolve some itself. It will refer complex ones to the 7090. The 7040 may stop the 7090 from working on one problem, direct it to store the information concerning that problem so that it may tackle a more pressing problem, solve it, then resume work on the original one. This may take from a few seconds up to a few minutes.

File of IBM punchcards of current computing programs indicates the variety of fields of science and engineering already making use of the center.

800 CUSTOMERS

At any "average" moment, scientists connected with any of the 800 active research projects at Caltech can make arrangements to use the new computing center. Engineers, mathematicians, programmers, and other personnel on the center's staff are available to coordinate with research scientists to adapt computational systems to the requirements of any individual project.

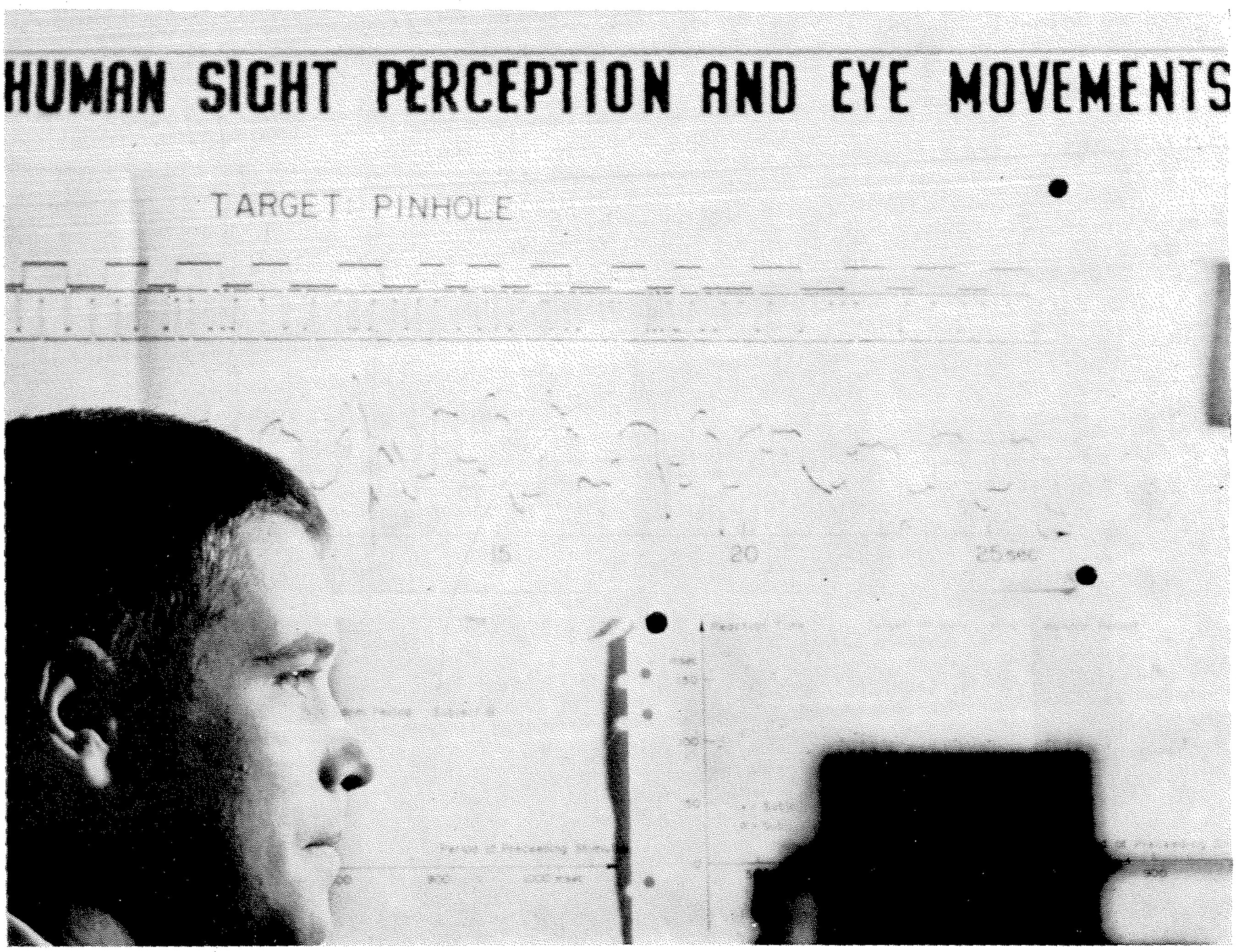
Soon, scientists working on special projects will have consoles set up right in their own laboratories or work areas, so they can enter the factors of their problems and, almost immediately, get the computer's printout on the same typewriter at which the data was entered.

Remote console, designed and built under the direction of Charles B. Ray, electronics engineer, has been installed in the computing center for use by faculty and students. Several such consoles will soon be in operation on the campus, each specially designed to meet the needs of the scientific discipline which will utilize it.

BIOLOGICAL SYSTEMS

Research interest in living nervous systems has grown rapidly in the past few years. Now it is not only the field of the biologist and the experimental psychologist; it is receiving the interest of systems, communications, and computer engineers.
In the new computing center, electrical engineers and biologists work together in a joint research program on the nervous system and sensory perception.
Since 90 percent of all sensory information in the nervous system is received by man through his eyes, the Caltech scientists are concentrating their efforts on many forms of eye structures, from the simple light receptor cells in worms, flies, and crabs to the highly complex human eye. The light-perception nerves are connected directly to the central cortex of the brain, so this research promises to yield much-needed information on brain functions.

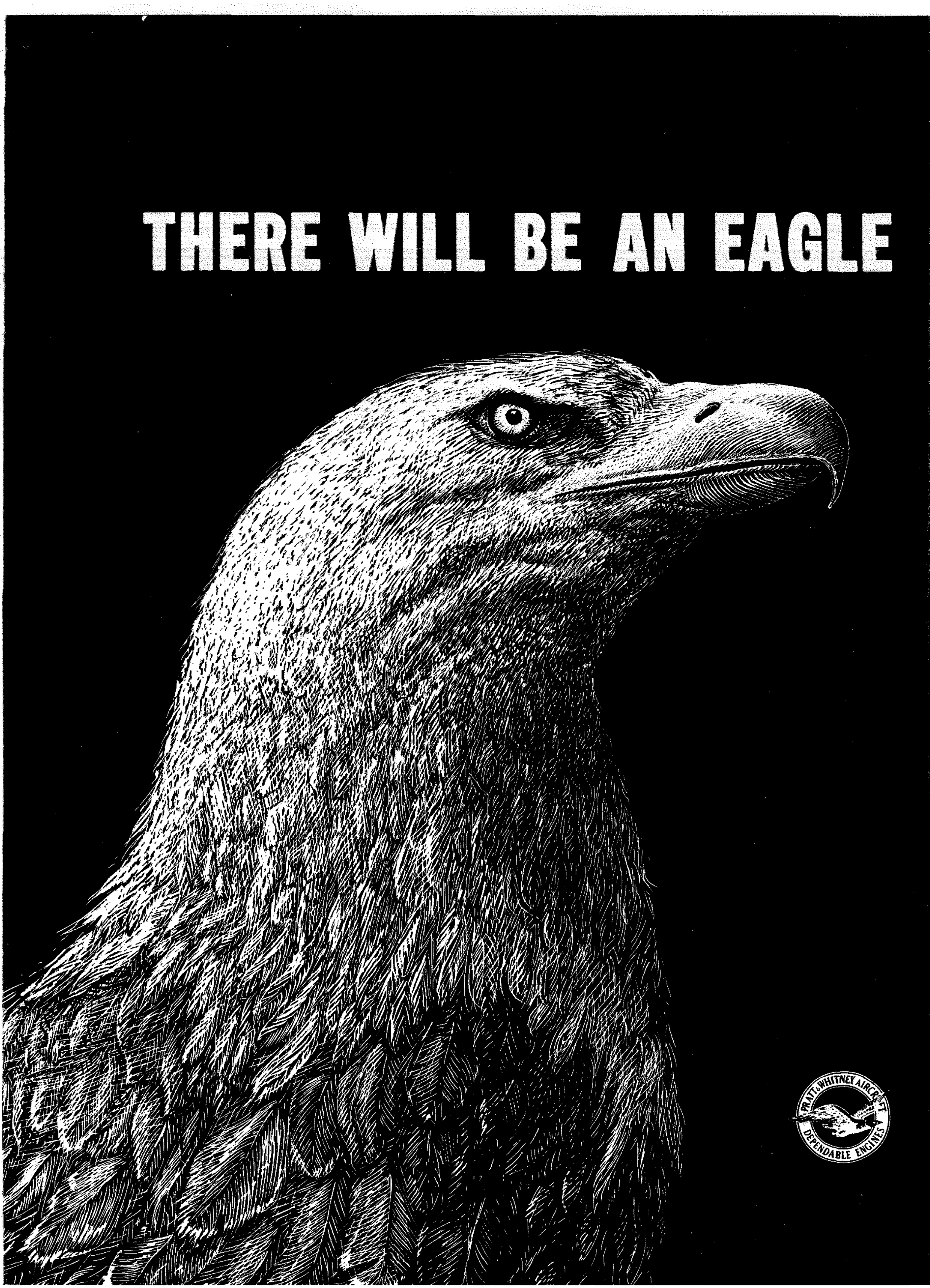
Studies of the human eye in the computing center reveal that the constant movement of the eyes in higher animals and humans is necessary for sharp vision.

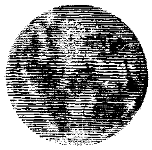


Housefly, attached to torque meter which measures wingbeat response as the fly tries to follow a visual target

HOUSEFLY

The optic system of a fly is sufficiently complex to be challenging and yet sufficiently simple to be useful in visual research. In neurobiological studies at the center, houseflies are attached to ultra-sensitive torque meters which measure the flight and activity of a fly as it responds to light in a controlled environment. Because the electrical "noise" generated by the nervous system makes many of the directly-read signals unintelligible, it takes a computer to analyze these signals. The simple flight of a housefly, for example, may require literally millions of calculations by the computer before scientists can analyze the data.


THERE WILL BE AN EAGLE
PRATT & WHITNEY AIRCRAFT
DEPENDABLE ENGINES



ON THE MOON...

Our world-recognized trademark—"the P&WA eagle"—has been identified with progress in flight propulsion for almost four decades, spanning the evolution of power from yesterday's reciprocating engines to today's rockets. Tomorrow will find that same Pratt & Whitney Aircraft eagle carrying men and equipment to the moon and to even more distant reaches of outer space.

Engineering achievement of this magnitude is directly traceable to our conviction that basic and applied research is essential to healthy progress. Today's engineers at Pratt & Whitney Aircraft accept no limiting criteria. They are moving ahead in many directions to advance our programs in *energy conversion for every environment.*

Our progress on current programs is *exciting,* for it anticipates the challenges of tomorrow. We are working, for example, in such areas as advanced gas turbines . . . rocket engines . . . fuel cells . . . nuclear power—all opening up new avenues of exploration in every field of aerospace, marine and industrial power application.

The breadth of Pratt & Whitney Aircraft programs requires virtually *every technical talent* . . . requires ambitious young engineers and scientists who can contribute to our advances of the state of the art. Your degree? It can be a B.S., M.S. or Ph.D. in: **MECHANICAL • AERONAUTICAL • ELECTRICAL • CHEMICAL and NUCLEAR ENGINEERING • PHYSICS • CHEMISTRY • METALLURGY • CERAMICS • MATHEMATICS • ENGINEERING SCIENCE or APPLIED MECHANICS.**

Career boundaries with us can be further extended through a corporation-financed Graduate Education Program. For further information regarding opportunities at Pratt & Whitney Aircraft, consult your college placement officer—or—write to Mr. William L. Stoner, Engineering Department, Pratt & Whitney Aircraft, East Hartford 8, Connecticut.

Pratt & Whitney Aircraft

DIVISION OF UNITED AIRCRAFT CORP.

CONNECTICUT OPERATIONS EAST HARTFORD, CONNECTICUT
FLORIDA OPERATIONS WEST PALM BEACH, FLORIDA

An Equal Opportunity Employer

SPECIALISTS IN POWER... POWER FOR PROPULSION—POWER FOR AUXILIARY SYSTEMS. CURRENT UTILIZATIONS INCLUDE AIRCRAFT, MISSILES, SPACE VEHICLES, MARINE AND INDUSTRIAL APPLICATIONS.

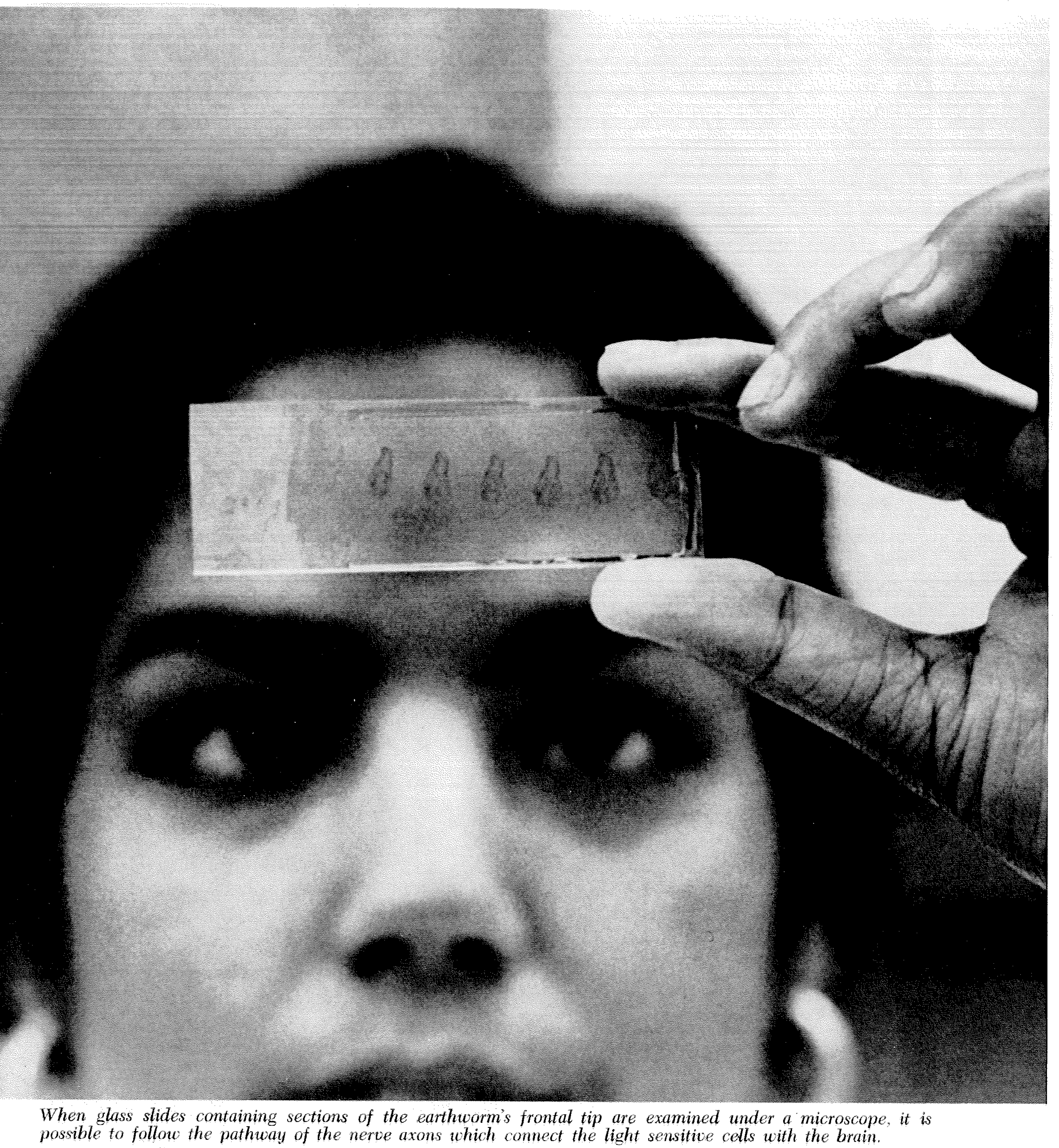
EARTHWORMS

Earthworms are used in experiments with light perception because their frontal tips have a great concentration of light sensitive cells which are relatively simple to study. The cells contain nerve fibers which connect the light-sending portion of the worm's anatomy with the animal's brain.

Although scientists cannot isolate single nerve fibers mechanically, the computer can isolate the responses of one tiny individual fiber out of the recorded activity of an entire bundle of fibers.

As the cells are stimulated by light, their electrical responses are fed directly into the computer, which analyzes the data and enables scientists to learn how light stimulus is converted into nervous energy.

The common earthworm makes a good subject for light stimulation studies.



When glass slides containing sections of the earthworm's frontal tip are examined under a microscope, it is possible to follow the pathway of the nerve axons which connect the light sensitive cells with the brain.

Caltech's synchrotron is now linked directly with the computing center.

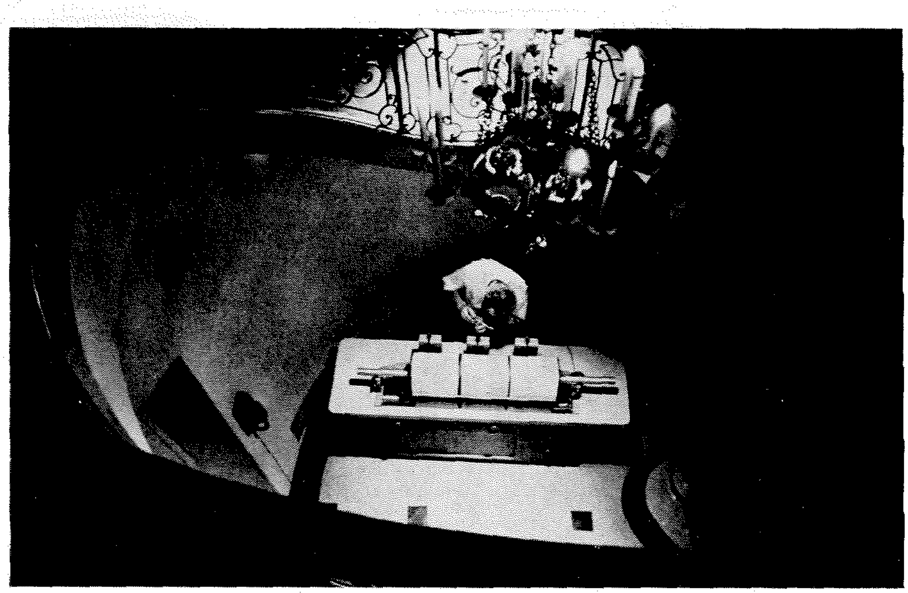
NUCLEAR PHYSICS AND SEISMOLOGY

The computer system is already directly linked to other research facilities on the campus, such as the synchrotron.

The synchrotron, which can accelerate electrons to energies of a billion and a half electron volts, makes it possible for nuclear physicists to produce and examine some of the most fundamental particles of matter. It takes hours – and sometimes days – to set up each experiment. By taking data directly from the synchrotron, the computer system makes results available immediately.

In much the same way, the system enables Caltech's seismologists to obtain more precise information concerning earthquakes, and will make possible more detailed analyses of the structure of the earth's crust and interior.

Worker adjusts recording drums in the lobby of the Caltech Seismological Laboratory, which is linked by magnetic tape digitizer with the computing center.



Research laboratories in the computing center use remote data transmission stations like this one to send data directly from the laboratory to the central computer system.

EDUCATIONAL TOOL

With computers becoming more and more useful in science and engineering, the need to understand their theory and operation becomes urgent. Caltech students are being taught how to program and operate computer systems as an important part of their technical education.

Dr. McCann proposes to put the computer system to work to foster creative thinking. The computer may provide the mathematical insight, he says, for beginners in a field of creative research to follow their curiosity beyond their present limits.

Although the system is sophisticated, it is simple to use. Thus scientists and engineers who make use of it do not have to take time to study computer programming.

Gilbert D. McCann, director of the Willis H. Booth Computing Center.

Personals

1922

RALSTON E. BEAR retired as manager of distributor sales for the apparatus sales division of the General Electric Company in Los Angeles in July. He had been with the company for almost 41 years.

1936

CLARENCE F. GOODHEART, chairman of the electrical engineering department at Union College in Schenectady, N.Y., has been named a Fellow in the Institute of Electrical and Electronics Engineers (IEEE) for "his contributions to the teaching of electrical engineering."

JOHN L. WEBB, PhD '40, professor and chairman of the department of pharmacology at USC, received the $1000 USC Associates award for 1963, for creative scholarship and research – specifically for his four-volume reference work, *Enzymes and Metabolic Inhibitors.* Volume One was published early this year. Dr. Webb has taught at USC since 1940, and in 1960 was the recipient of a $1,000 Associates award for excellence in teaching.

1938

JOHN G. McLEAN, vice president of Continental Oil Company's international operations, has been promoted to vice president and general manager of European operations. He makes his headquarters in London.

1946

ROBERT H. GRUBE, head of detector systems analysis in the avionics division of the Aerojet-General Corporation in Azusa, is one of five authors of *Infrared Physics and Engineering,* just published by McGraw-Hill.

L. WAYNE MULLANE, MS, AE'47, has been appointed vice president and general manager of Aerojet-General Corporation in El Monte.

1949

HOWARD J. COHAN is now assistant chief of the water conservation branch of the Bureau of Reclamation in Denver, Colorado. He has been with the Bureau since his graduation from Caltech.

1950

ROBERT C. HOWARD, MS, PhD '53, is corporate engineer at Giannini Controls Corporation in Duarte. He has been with the company since 1957 and was formerly chief engineer of the GCC Systems Division.

DONALD A. DOOLEY, MS, PhD '56, is corporate vice president and general manager of the engineering division of Aerospace Corporation in San Bernardino.

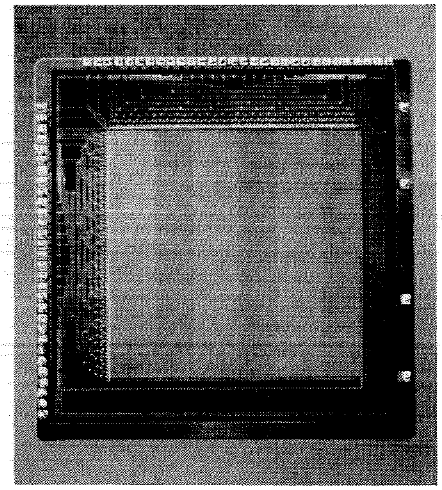
RICHARD H. PERRY has been appointed senior engineer for Aeronutronic, Division of Philco Corporation, a subsidiary of the Ford Motor Company.

ROBERT C. MILLER, MS, is at MIT for a year, studying management on an Alfred P. Sloan Fellowship.

1956

IRVING STATLER, PhD, is now head of the applied mechanics department of the Cornell Aeronautical Laboratory in Buffalo, N.Y. He has been with Cornell for more than 16 years.

Research at RCA Laboratories



Superconductive Computer Memory

Pictured above is a radically new type of thin film superconductive array capable of storing 16,384 bits of data in an area smaller than a playing card. This array is a step toward a high-speed all electronic memory of hundreds of millions or billions of bits, which is a storage capacity now attainable only in slow electromechanical devices.

The structure becomes superconducting with its immersion in liquid helium; two pulses of positive or negative electric current are sent through the selection trees to a selected intersection. Their combined effect at the chosen intersection produces a "normal" or non-superconducting area in the tin layer directly beneath.

When this occurs, a microscopic ring of electric current is induced and instantly trapped in the tin at this point. As the pulses cease, the area again becomes superconductive, and the stored current remains, moving in its microscopic circle in either a clockwise or counterclockwise direction according to the positive or negative character of the pulses that induced it. In computer language, this stored current represents one bit of information—a "zero" or a "one," depending upon its direction.

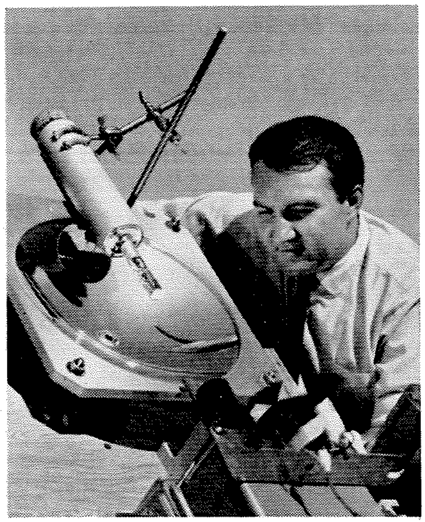
When the information is to be recalled by the computer, two pulses are again sent to the same intersection. If their polarity (positive or negative) is the same as that of the stored current, nothing happens. If it is opposite, the direction of the stored current will be reversed and a read out voltage will be induced in a simple box-like structure extending under the whole memory plane. The presence or absence of this signal is part of a code which is deciphered electronically to obtain the desired information.

Reference—L. L. Burns, Paper presented at the Fall Joint Computer Conference, Las Vegas, Nov. 12-14, 1963 and published in the Proceedings of the Fall Joint Computer Conference.

Sun-Pumped Continuous Laser

Laser (optical-maser) action has been achieved in $CaF_2:Dy^{2+}$ at liquid neon temperature (27° K) using the sun as the pumping source. The minimum power required to obtain laser oscillations could be supplied with a 10-inch-diameter condensing mirror. Laser action at liquid-nitrogen temperature is anticipated using a 20-inch-diameter condensing mirror.

Laser action in the $CaF_2:Dy^{2+}$ system was reported at 2.36 microns. The laser oscillation takes place in the sharp $^5I_7 \rightarrow {}^5I_8$ 4f - 4f transitions, and it is pumped in broad 4f - 5d absorption bands starting at 10,000 cm^{-1} and extending throughout the visible region of the spectrum. The low pulsed laser threshold, the long lifetime (10 msec for a 0.05 molar % Dy^{2+} in CaF_2) and the convenient location of



the broad pumping bands of this system make it especially suitable for sun-pumped operation.

The photograph shows the experimental arrangement. A 1-inch long, ¼-inch-by-⅛-inch cross-section CaF_2: 0.05 M % Dy^{2+} laser crystal is placed in a dewar filled with liquid neon just outside the focal point of a 14-inch spherical mirror. The dewar was wrapped with aluminum foil except for the area of illumination to insure better optical coupling.

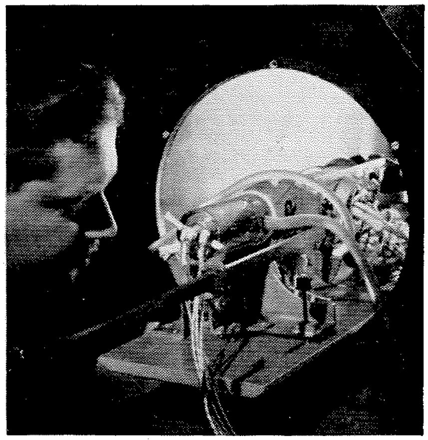
From the known values of the pulsed laser threshold at 27° K and at 78° K, we estimate that a 20-inch-diameter condensing mirror will be sufficient to operate the laser at liquid nitrogen temperature. Experiments using much larger mirrors are in progress to evaluate the high power output capabilities of the sun-pumped laser.

Reference—Z. J. Kiss, H. R. Lewis, R. C. Duncan—Applied Physics Ltrs. 2, 93, 1963.

Beam Plasma

An experimental RCA tube which may open new communication and radar channels near the frequencies of infrared light is shown being prepared for test at RCA Laboratories. The device uses the interaction of an electron beam with a cesium plasma to amplify 23 Gc microwave power.

The device consists, basically, of an electron gun, input and output helixes and a cesium plasma. The gun sends an electron beam through the input helix where the input signal impresses a space-charge wave on the beam. The beam then traverses a three centimeter length of plasma. The plasma is generated by a cesium Penning-type arc. The resonant frequency of the plasma electrons, which is proportional to the square root of the plasma density, is set equal to the signal frequency. Interaction occurs between the space-charge wave and the plasma oscillations which results in an amplification of the space-charge wave. In the above tube, power in the space-charge wave is amplified ten thousand times. The



amplified signal is delivered to the load by the output helix as the beam passes through the helix.

Reference—G. A. Swartz and L. S. Napoli, Proceedings of Conference on Wave Interaction and Dynamic Non-linear Phenomena in Plasmas, Pennsylvania State University, February 1963.

These are only a few of the recent reports by Members of the Technical Staff of the David Sarnoff Research Center. Many scientific challenges await the advanced degree candidate in Physics, Electrical Engineering, Chemistry and Mathematics.

An Equal Opportunity Employer

To learn more about these research programs you are invited to meet our representative when he visits your university or write to the Administrator, Graduate Recruiting, RL 9, RCA Laboratories, Princeton, New Jersey.

The Most Trusted Name in Electronics

THE GREAT DISCOVERY

Last month we announced our intention to describe in Engineering and Science *a variety of important Institute needs. This month's article is the second of a series.*

As you have read, the Russians claim to have discovered almost everything from the wheel to the cotton gin – and more. Just ask them. But they could truthfully claim title to one discovery for which they wouldn't like to take credit. It was the Russian space feat of October 4, 1957, which jarred the American public to critically scrutinize our educational system from kindergarten to graduate school. The nation's educational program eventually passed the test, but a great "discovery" was made. The financial rewards of our teachers – especially in higher educaton – were found to be pitifully unrewarding.

This predicament was hardly news to those in teaching. Even at the ten highest-paying universities, the average faculty member received only $10,300 annually.* The average salary at all the remaining universities was only $7,875.

Caltech at that time was considerably below the average of the top ten universities.

In 1957 President Eisenhower's Committee on Education above the High School recommended immediate reform. The committee resolved to double faculty salaries in the decade to end in 1967-68. There is evidence to show that this pronouncement has produced results.

At the end of the 1962-63 school year the nation's higher education faculty were receiving a salary of $9,975, an increase of 27 percent. While this rate of increase is not enough to double salaries in ten years, it is at least a rather big step in the direction of an *adequate* salary scale.

Fortunately for Caltech and its professors, the Development Program was launched at a very opportune time. Approximately 1.2 million dollars were secured specifically for increasing faculty salaries during the 1958-60 period. Without this running start we would have been hard pressed to achieve the results obtained in only five years.

Today, Caltech ranks at the top of the national salary scale: no school is classified higher.

Why then do we suggest that alumni consider support of the Institute's faculty salary fund? The answer is this: Development funds are all but depleted after five years of specific and across-the-board increases. Future increases will come from the *annual operating budget* which, unfortunately, is generally strained from a myriad of other important programs.

Too, consider this rather common occurrence. Some of our June 1963 PhD graduates received industrial salaries which are higher than the average CIT. full professors' – and our professors' average teaching experience spans a quarter of a century! No one is advocating matching industrial salaries, but a more equitable balance must be achieved if quality education is to thrive.

Your gift for faculty salaries will be greatly appreciated.

– G. Russell Nance '36 and David L. Hanna '52
Directors of the Caltech Alumni Fund

---

* All references to salaries are based on an eleven-month year, not including fringe benefits. References: AAUP Summer Issues, 1959, 1963.

ALUMNI DIRECTORY SUPPLEMENT

A supplement to the 1963 Alumni Directory will be ready for distribution some time after the first of January, 1964. This supplement will list the names and addresses of those who received degrees in June, 1963. Copies of this supplement will be sent automatically to Association members who received degrees in 1963. Other Association members may secure a copy of this supplement by filling in the form below and sending it to the Alumni Office.

Please send the 1963 Supplement of the 1963 Alumni Directory to:

Name..

Address..

City..............................State..............................

CALTECH CALENDAR

ALUMNI EVENTS

February 15	Alumni Dinner Dance
May 2	Alumni Seminar
June 10	Annual Alumni Meeting

ATHLETIC SCHEDULE

Basketball

January 7
Air Force Systems at Caltech

January 10
Claremont-H. Mudd at Claremont

CALTECH YMCA ATHENAEUM LUNCHEON FORUM

Reservations by Tuesday noon

January 8
Southeast Asia
—Willard Hanna

January 15
The Negro and the American Promise—filmed interviews with Martin Luther King, Malcolm X, and James Baldwin

FRIDAY EVENING DEMONSTRATION LECTURES

Lecture Hall, 201 Bridge, 7:30 p.m.

December 20
The Application of Ruby Lasers to High-Speed Photography
—Albert T. Ellis

January 11
Mariner Two
—Robert J. Parks

January 18
The First 20 Years of the Nuclear Age
—Ward Whaling

PLACEMENT ASSISTANCE TO CALTECH ALUMNI

There are two ways in which the Placement Service may be of assistance to you:

(1) To help you seek new employment or a change of employment.

(2) To inform you when outstanding opportunities arise.

This service is provided to Alumni by the Institute. A fee or charge is not involved.

If you wish to avail yourself of this service, fill in and mail the following form:

To: Caltech Alumni Placement Service
California Institute of Technology
Pasadena, California 91109

Please send me:

☐ An Application for Placement Assistance

☐ A form to report my field and operation so that I may be notified of any outstanding opportunities.

Name .... Degree (s) ....

Address .... Year (s) ....

....

ALUMNI ASSOCIATION OFFICERS AND DIRECTORS

PRESIDENT
Peter V. H. Serrell, '36

VICE PRESIDENT
Patrick J. Fazio, '53

SECRETARY
Donald S. Clark, '29

TREASURER
John R. Fee, '51

Robert Boykin, '34
Wm. H. Corcoran, '41
David L. Hanna, '52
Wm. L. Holladay, '24

G. Russell Nance, '36
Richard W. Powell, '40
Richard P. Schuster, Jr., '46
H. M. Worcester, Jr., '40

ALUMNI CHAPTER OFFICERS

NEW YORK CHAPTER

President Victor Wouk, '40
Electronic Energy Conversion Corp.
342 Madison Ave., New York 17, N.Y.

Vice-President Bruno H. Pilorz, '44
75 Echo Lane, Larchmont, N.Y.

Secretary-Treasurer Harry J. Moore, '48
590 Madison Ave., New York, N.Y.

BOSTON CHAPTER

President Robert C. Kausen, '56
21 Seven Oaks Rd., N. Billerica, Mass.

Vice-President Thomas C. Stockebrand, '53
10 Bulkely Rd., Littleton, Mass.

Secretary-Treasurer Charles K. Daniels, '59
8 Cutler Farm Rd., Lexington, Mass.

WASHINGTON, D.C. CHAPTER

Chairman Willard M. Hanger, '43
4720 Sedgwick St., N.W., Washington, D.C.

CHICAGO CHAPTER

President Laurence H. Nobles, '49
Dept. of Geology, Northwestern Univ., Evanston, Ill.

Vice-President Philip E. Smith, '39
Eastman Kodak Co., 1712 Prairie Ave., Chicago, Ill.

SAN FRANCISCO CHAPTER

President Edwin P. Schlinger, '52
G.E. Vallecitos Atomic Lab., Pleasanton, Calif.

Vice-President Dallas L. Peck, '51
U.S. Geological Survey, Menlo Park, Calif.

Secretary-Treasurer Thomas G. Taussig, '55
Lawrence Radiation Lab., Univ. of Calif., Berkeley, Calif.

Meetings: 15th Floor, Engineers' Club, 206 Sansome St., San Francisco
Informal luncheons every Thursday at 11:45 A.M.
Contact Mr. Farrar, EX 9-5277, on Thursday morning for reservations.

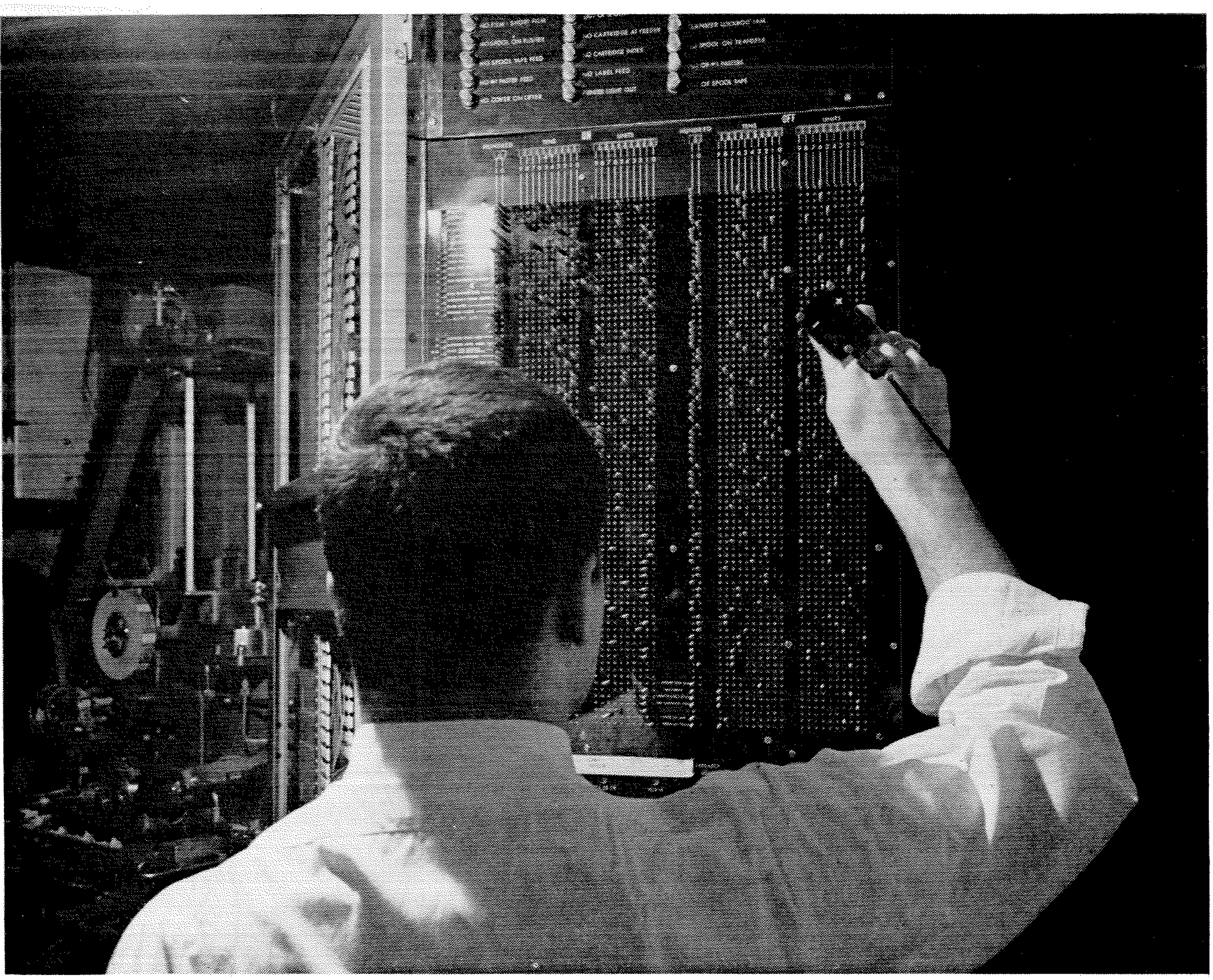
SACRAMENTO CHAPTER

President Joe A. Dobrowolski, '49
P.O. Box 1952, Sacramento 9, Calif.

Vice-President Dudley A. Bennett, '47
4535 Marble Way, Carmichael, Calif.

Secretary-Treasurer Harris K. Mauzy, '30
2551 Carson Way, Sacramento 21, Calif.

Meetings: University Club, 1319 "K" St.
Luncheon first Friday of each month at noon.
Visiting alumni cordially invited—no reservation.



COULD YOU OUT-THINK A COMPETITOR?

Consider a Career in Technical Marketing

An Interview with G.E.'s J. S. Smith, Vice President, Marketing and Public Relations

Mr. Smith is a member of General Electric's Executive Office and is in charge of Marketing and Public Relations Services. Activities reporting to Mr. Smith include marketing consultation, sales and distribution, marketing research, marketing personnel development, and public relations as well as General Electric's participation in the forthcoming New York World's Fair. In his career with the Company, he has had a wide variety of assignments in finance, relations, and marketing, and was General Manager of the Company's Outdoor Lighting Department prior to his present appointment in 1961.

For more information on a career in Technical Marketing, write General Electric Company, Section 699-08, Schenectady, New York 12305.

Q. Mr. Smith, I know engineering plays a role in the design and manufacture of General Electric products, but what place is there for an engineer in marketing?

A. For certain exceptionally talented individuals, a career in technical marketing offers extraordinary opportunity. You learn fast what the real needs of customers are, under actual industrial conditions. You are brought face-to-face with the economic realities of business. You participate in some of the most exciting strategic work in the world: planning how to out-engineer and out-sell competitors for a major installation.

Q. Sounds exciting. But I've worked hard for my technical degree. I'm worried that if I go into marketing, I won't use it.

A. Don't worry—you'll use all the engineering you've learned, and you'll go on learning for the rest of your life. In fact, you'll have to. You see, the basic purpose of business is to sense changing customer needs, and then marshal resources to meet them profitably. That means that you must learn to know each customer's operations and needs almost as well as he understands them himself. And with competitors trying their best to outdo you, believe me—every bit of knowledge and skill you've got will be called into play.

Q. Is that why you said you wanted "exceptionally talented people"?

A. Technical marketing is not everybody's dish of tea. It takes great personal drive and energy, and a talent for managing the work of others in concert with your own. It takes flexibility . . . imagination . . . ingenuity . . . quick reflexes . . . leadership qualities. If you're nervous with people or upset by quick-changing situations, I don't think technical marketing's for you. But if you are excited by competition, like to help others solve technical problems, and enjoy seeing your technical work put to the test of real operation—then you may be one of the ambitious men we're looking for.

Q. Now what, actually, does a man do in technical marketing?

A. Let me describe a typical situation in General Electric. A field sales engineer is in regular contact with his customers. Let's say one of them makes an inquiry, or the sales engineer senses that the time is right for a proposition. With his field application engineer, he determines the basic equipment needed. Then he contacts the marketing sales specialist in the G-E department that manufactures that equipment. The sales specialist, working closely with his department's product engineers, specifies an exact design—realistic in function and cost. Then the sales engineer and his supporting team try to make the sale, changing and improving the proposition as they get cues from the competitive situation. If the sale is made—a very satisfying moment—then the installation and service engineers install the equipment and are responsible for its operation and repair. With the exception of the product design engineers, all these people are in technical marketing. Exciting work, all of it.

Q. In college we learn engineering theory. How do we get the sales and business knowledge you mentioned?

A. At General Electric, a solid, well tested program of educational courses will quickly advance both your engineering knowledge and your sales capacities. But perhaps even more important, you'll be assigned to work with some of the crack sales engineers and application and installation men in the world, and that's no exaggeration. A man grows fast when he's on the sales firing line. As a FORTUNE writer once put it, the industrial sales engineer needs "that prime combination of technical savvy, tactical agility, and unruffled persuasiveness." Have you got what it takes? 699-08

Progress Is Our Most Important Product

GENERAL ELECTRIC