ENGINEERING | AND | SCIENCE

March 1964

Published at the California Institute of Technology

Westinghouse is building a remarkable craft, a free-roaming explorer of the underseas. Unlike the famous bathysphere, which dangled at the end of cables, *Deepstar* has no strings attached. She will rise, dive, turn and back at will, self-propelled and independent. Her 3-man crew will be able to set instruments, sample the bottom at depths of two miles, salvage, photograph, and most of all, *explore* the vast oceanic world that has hidden itself so long from man.

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New Undersea Craft: Swims Deep, Carries Men

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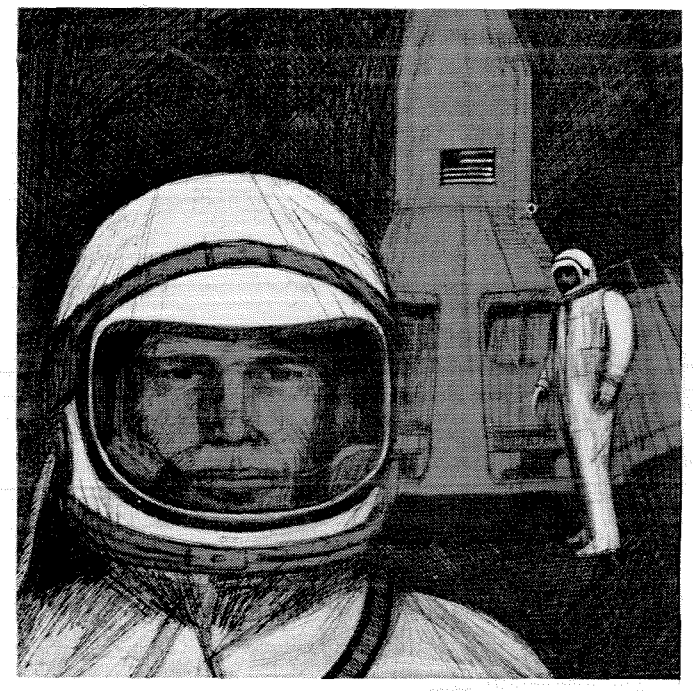

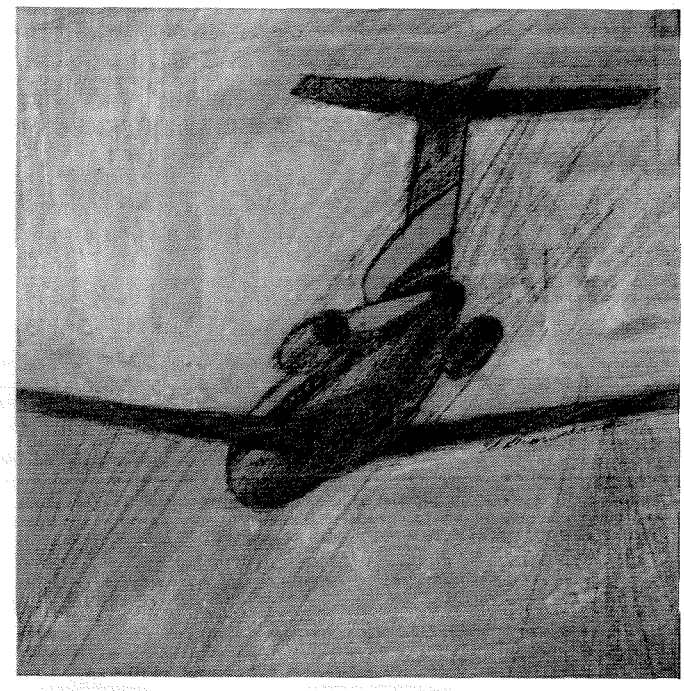

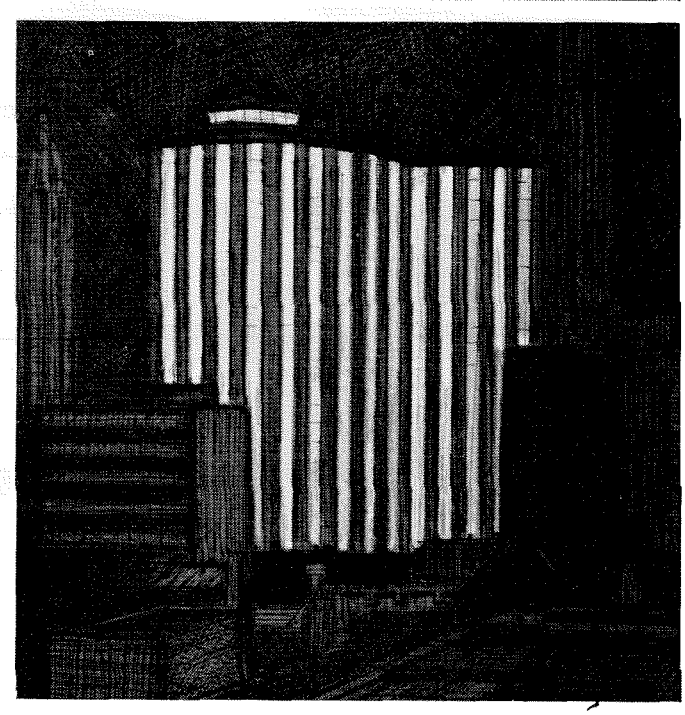

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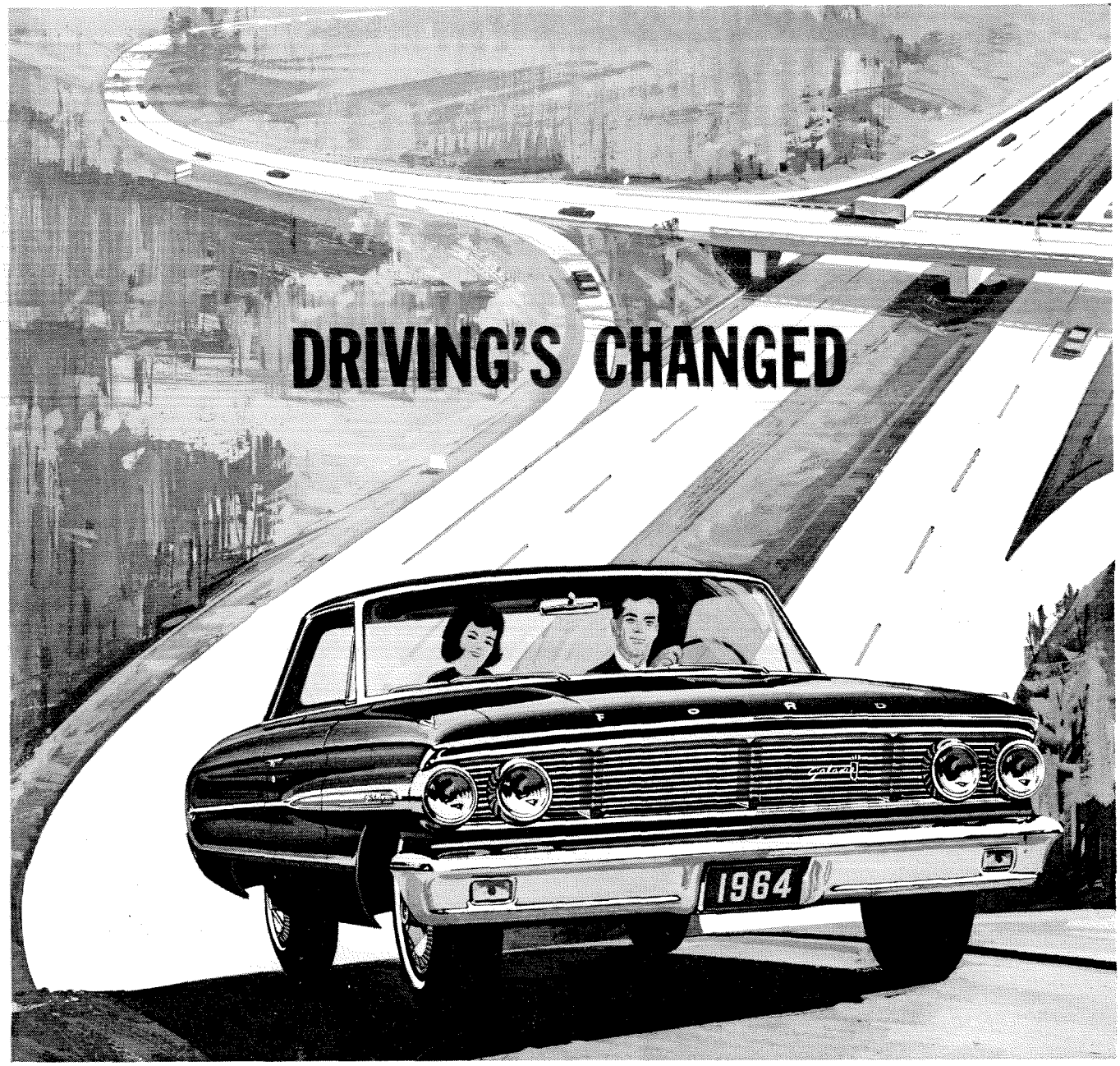

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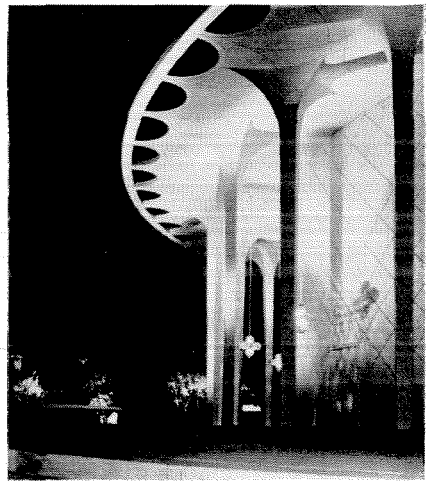

On Our Cover

Caltech's new Beckman Auditorium lights up for its dedication on February 25. For more pictures of the auditorium, and the dedication ceremony —pages 14-16.

The Eightfold Way,

the great advance in theoretical physics described on page 12, is the work of Dr. Murray Gell-Mann, Caltech professor of theoretical physics, and Dr. Yuval Ne'eman of Israel, now research fellow in theoretical physics at the Institute.

Dr. Ne'eman came to Caltech last year on leave from Tel Aviv University, where he serves as head of a newly established physics department. He is also scientific director of the Israel A.E.C. Research Establishment at Soreq. It was while working for his PhD at the Imperial College in London three years ago that he published his version of the "eightfold way," simultaneously with Dr. Gell-Mann, and independently.

A Cosmic Synchrotron

on page 8 is a new look at an exploding galaxy first photographed in 1962. The new pictures indicate that the galaxy is surrounded by a magnetic field filled with high energy electrons. This is probably the first proof that magnetic fields exist outside of the solar system.

Illustrations:

Cover —M. Opalenik, Graphic Arts Facilities
8-11—Mount Wilson and Palomar Observatories
12, 14-15—Kent McCaulley '67
16—James McClanahan, M. Opalenik, Stan Kistler — Graphic Arts

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Books

REGGE POLES AND S-MATRIX THEORY

by Steven C. Frautschi

W. A. Benjamin, Inc. .....*$8.00 cloth*
$3.95 paper

Reviewed by Yuval Ne'eman, research fellow in theoretical physics.

S. Frautschi is one of the originators of the "new look" at elementary particles, according to which they are not really elementary but should be considered as "compounds." This is based on a formal description derived from Schrödinger theory, where bound states appear as poles in the analytically continued complex angular momentum plane – otherwise known as "Regge" poles.

Frautschi, since 1962 an assistant professor of physics at Caltech, is a Harvard graduate who took his PhD at Stanford under Professor S. D. Drell. It was while teaching at Cornell in 1961-2 that he started developing the material of this book, finally shaping it in its present form for the Summer School in Theoretical Physics held at Bangalore, India, in June 1962. The book provides one of the best available textbooks in the dynamics of elementary particle processes, including the latest developments.

ORGANIC CHEMISTRY (2nd Edition)

by Donald J. Cram and George S. Hammond

McGraw-Hill *$10.75*

Reviewed by John D. Roberts, chairman of the division of chemistry and chemical engineering.

The revision of Cram and Hammond brings to consummation a prodigious scholastic and artistic effort by two of the most imaginative and productive organic chemists of the century. (Dr. Cram is professor of chemistry at UCLA and Dr. Hammond is Arthur Amos Noyes Professor of Chemistry at Caltech.)

The revision is a deep-seated one, carried on with loving care and scrupulous attention to improving the unique and now famous Cram and Hammond approach, with the intent of making it more useful as an introduction to organic chemistry for students of variable preparation and quality.

The artistic motif is green – green formulas, green figures, green backgrounds for the tables, green endpapers, and a green cover design. The use of color is highly imaginative and it certainly permits emphasis on those parts of the features of figures and formulas to which the authors wished to draw special attention. Without doubt a great book.

CATALOGUE OF GALAXIES AND OF CLUSTERS OF GALAXIES

California Institute of Technology....$10

Prepared by Fritz Zwicky, Caltech professor of astrophysics, with the collaboration of E. Herzog, Volume II of this catalogue contains the positions, photographic magnitudes, and other data for about 6700 galaxies in the area from Decl. +15° to +33° of the north galactic cap, as well as positions, populations, sizes, and estimated distances for about 2350 clusters of galaxies in the same area. Volume I, published in 1961 ($6), covers the area between Decl. –3 to +15°.

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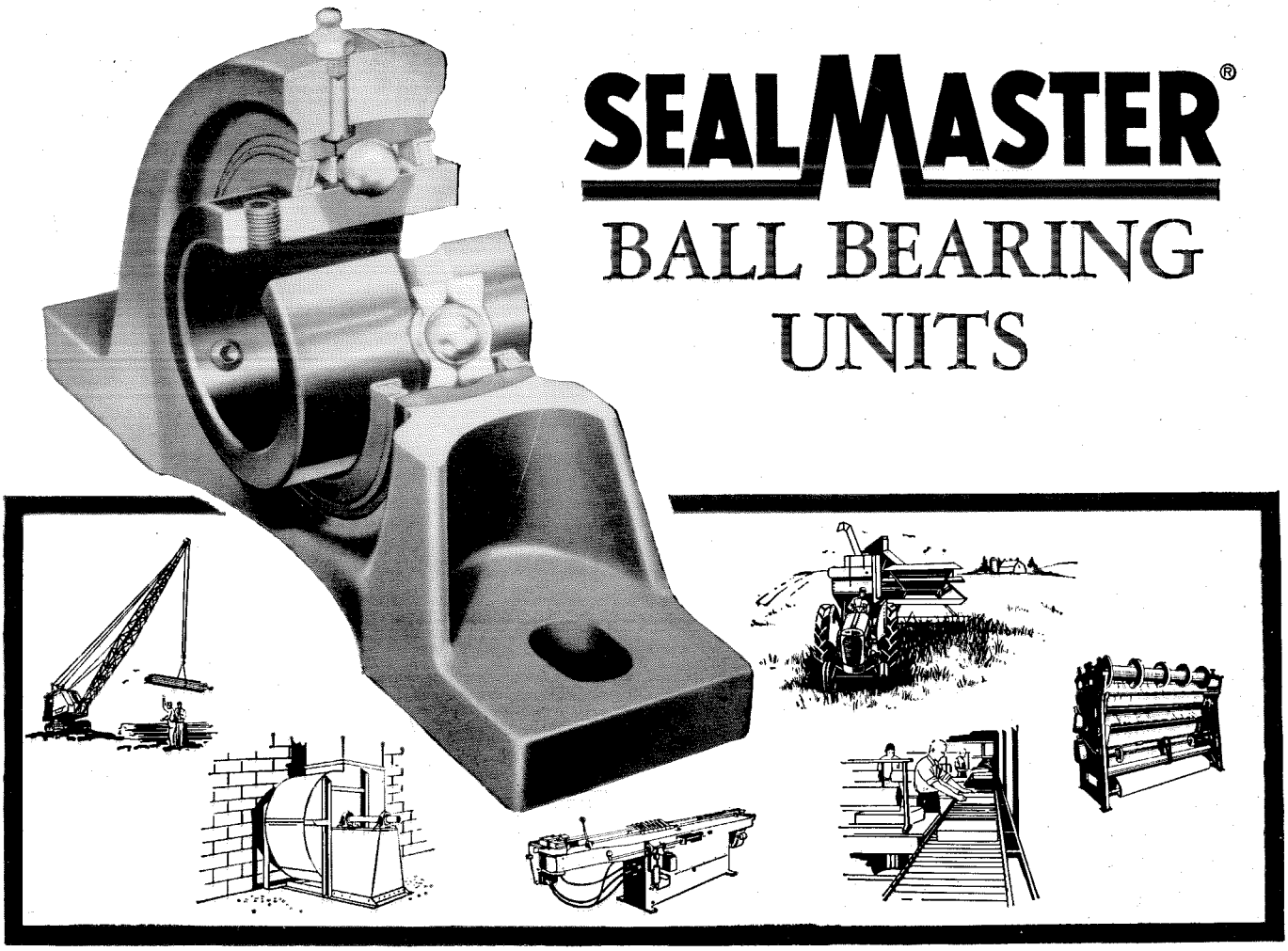

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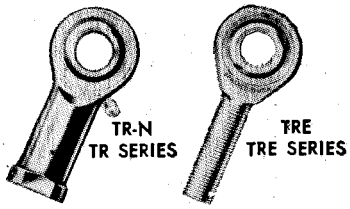

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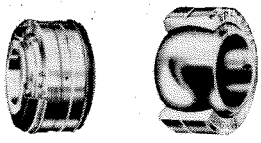

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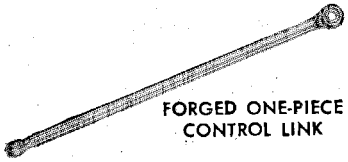

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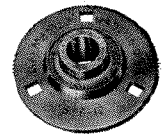

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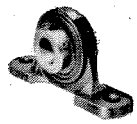

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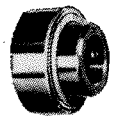

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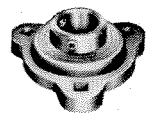

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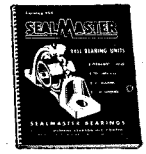

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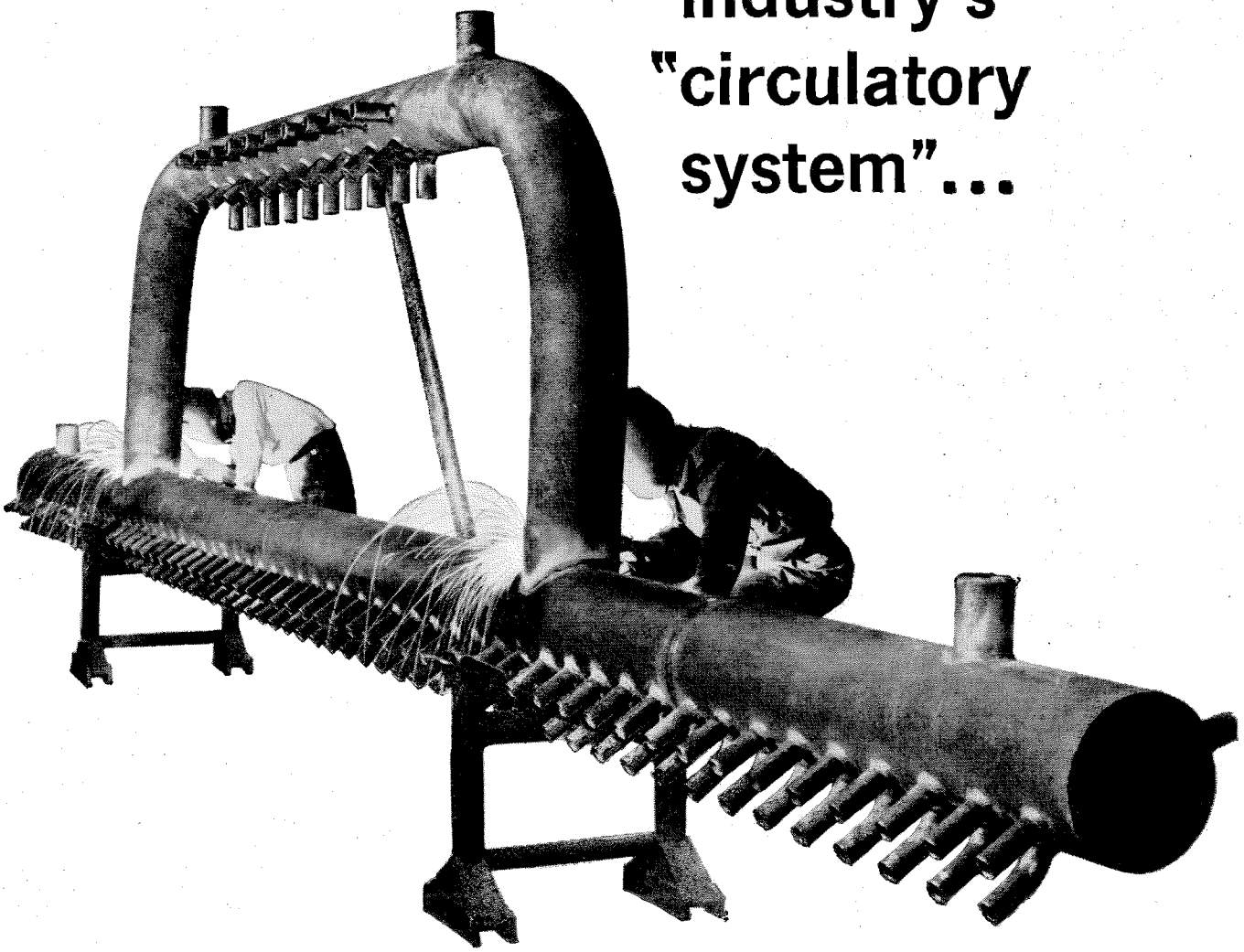

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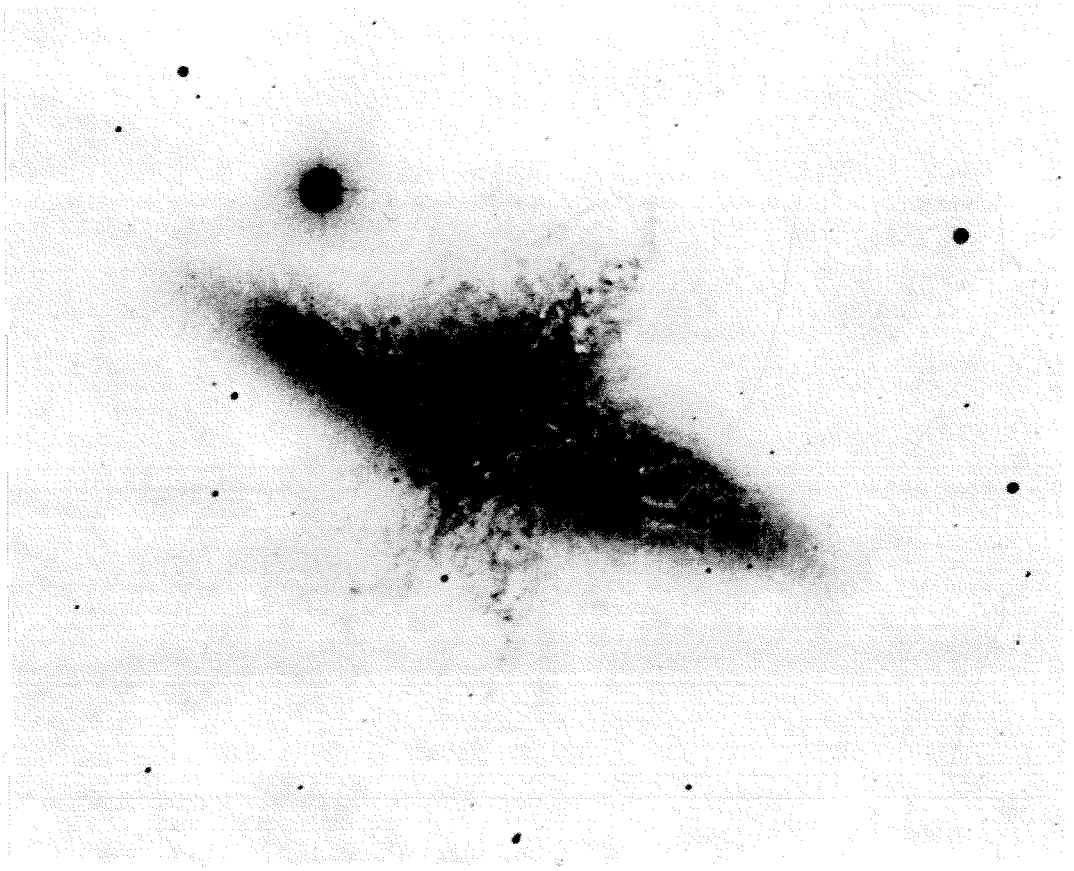


First photograph of the exploding galaxy M 82, taken in 1962.

A COSMIC SYNCHROTRON

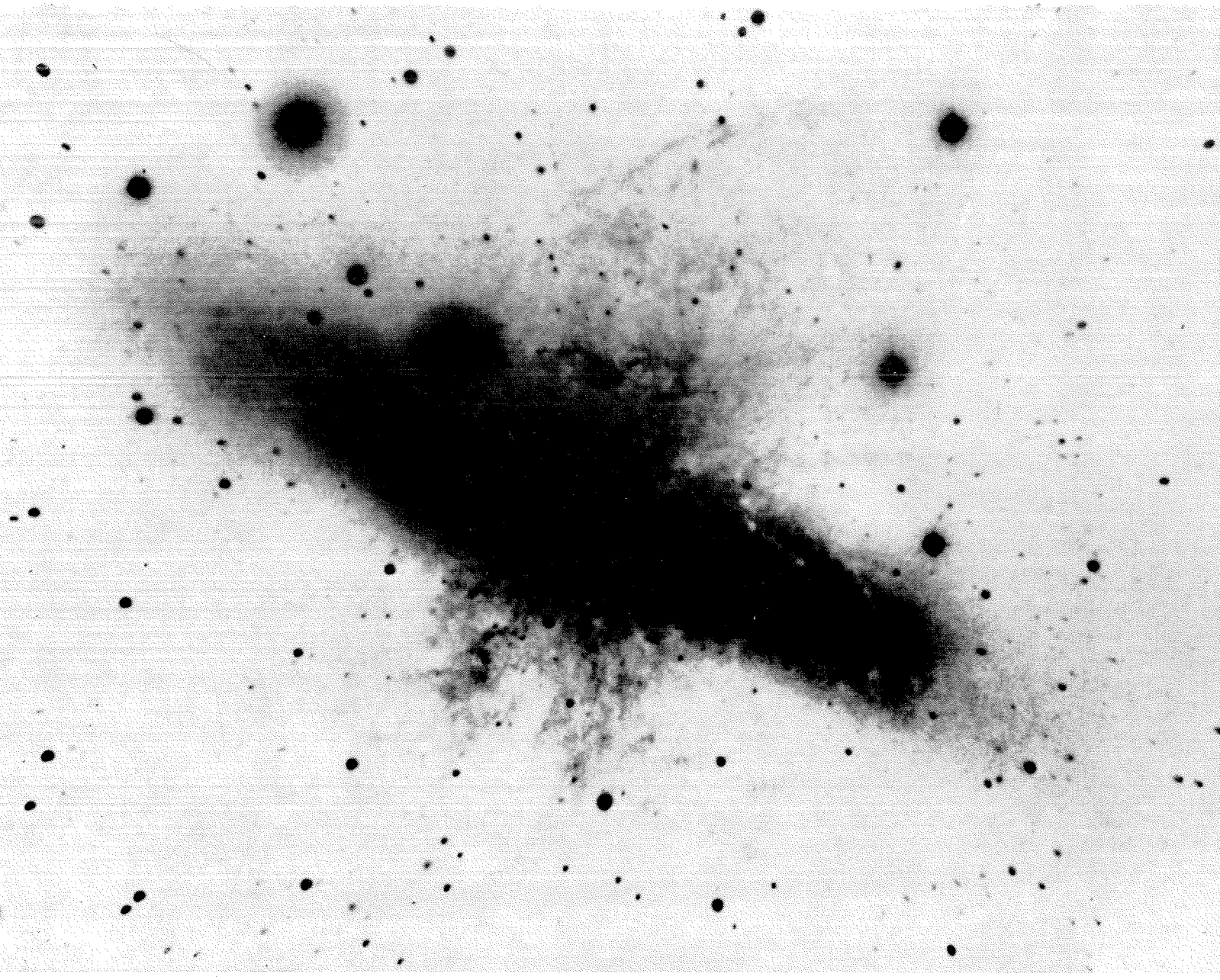
New photographs of an exploding galaxy reveal that the object is a celestial particle accelerator.

A magnetic field like that which surrounds the earth is most easily thought of in terms of magnetic lines of force affecting a moving charged body. Such fields are caused by large electric currents — but how these currents are generated and transmitted in the stars or in space has yet to be determined.

Now, one of the most direct proofs that magnetic fields exist in distant galaxies has been found by Allan Sandage, staff member of the Mount Wilson and Palomar Observatories. Recent photographs of an exploding galaxy have revealed the presence of high energy electrons in the outer filaments streaming from the galaxy's nucleus. This evidence may provide clues to the origin of cosmic rays, and may even reveal how nature accelerates them to such enormous energies.

The object known as M 82 was photographed for the first time as an exploding galaxy in 1962 by the 200-inch telescope at Palomar Observatory. (*E&S*, October 1963). The galaxy is comparatively nearby (only 60 billion billion miles or 10 million light years away). The photographs revealed that tremendous jets of matter, stretching out 60 billion million miles (10,000 light years), streamed out from the galaxy's nucleus.

Spectral work on the galaxy, done at Lick Observatory by Dr. C. R. Lynds of the Kitt Peak

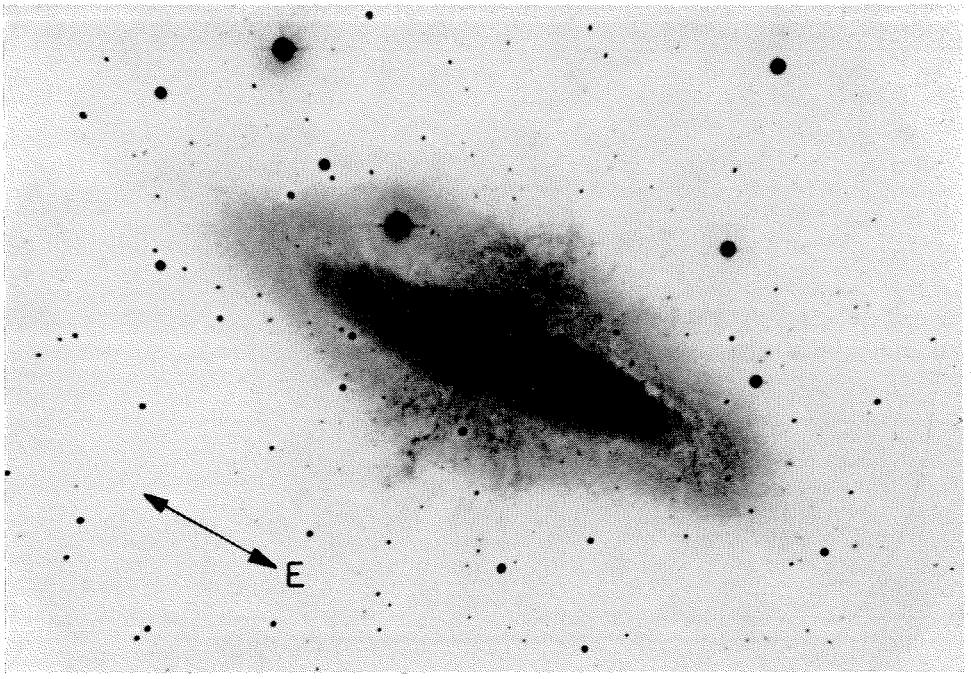


The exploding galaxy M 82, photographed in February 1964. In this picture, taken in blue light, the filaments extend much farther beyond the galaxy than the bright hydrogen filaments shown in the original photograph. This second set of filaments radiates in continuous light, indicating the presence of high energy electrons.

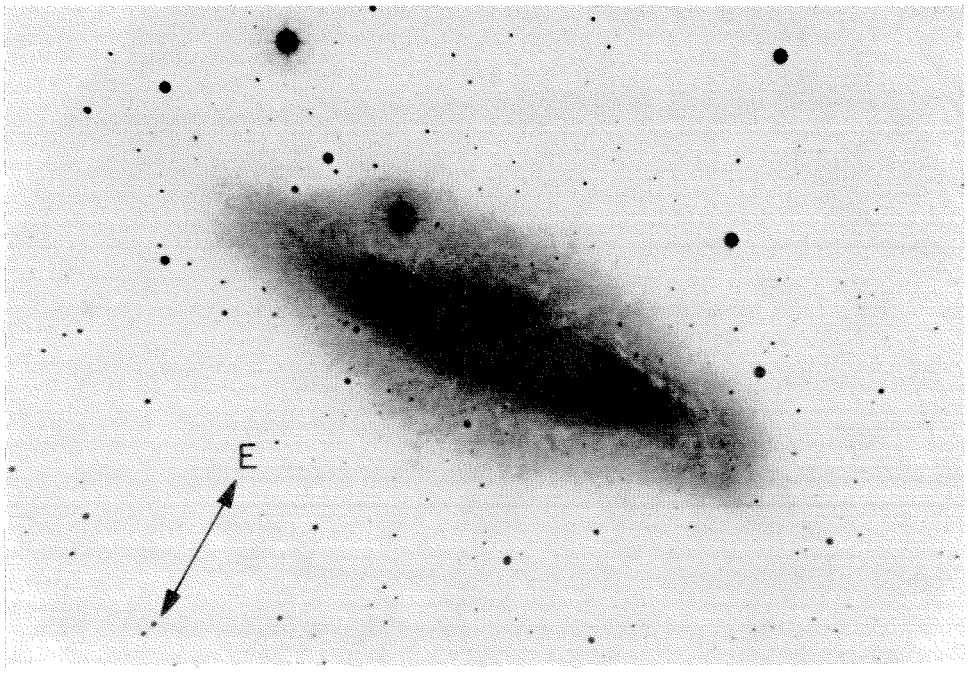
National Observatory, revealed the presence of a vast system of hydrogen filaments of several million solar masses, expanding outward from the galaxy at speeds up to 20,000,000 miles an hour. The evidence suggested that an explosion had taken place in the center of this galaxy about a million and a half years ago (as seen from the earth).

One of the important problems raised by the original photograph of M 82 was the source of the energy required to ionize the hydrogen that is combining and recombining in the galaxy. The astronomers found partial evidence that optical synchrotron radiation caused by ultra-high energy electrons might be present. The electrons are accelerated to such high energies that they radiate radio noise and visible light.

In February 1964 Dr. Sandage obtained new photographs of M 82 with the 200-inch telescope, and William C. Miller, staff photographer of the Mt. Wilson and Palomar Observatories, used a special technique of reproduction to bring out faint details. These pictures revealed a second set of filaments streaming out beyond the first set, but radiating light in a continuous spectrum. The astronomers are convinced that these filaments are due to acceleration radiation which is produced by the same mechanism which causes electrons to radiate in a particle accelerator.



The second set of filaments in M 82 is clearly revealed when the polaroid sheet in the plate holder on the telescope is aligned parallel to the major axis of the galaxy, as indicated by the arrow E.



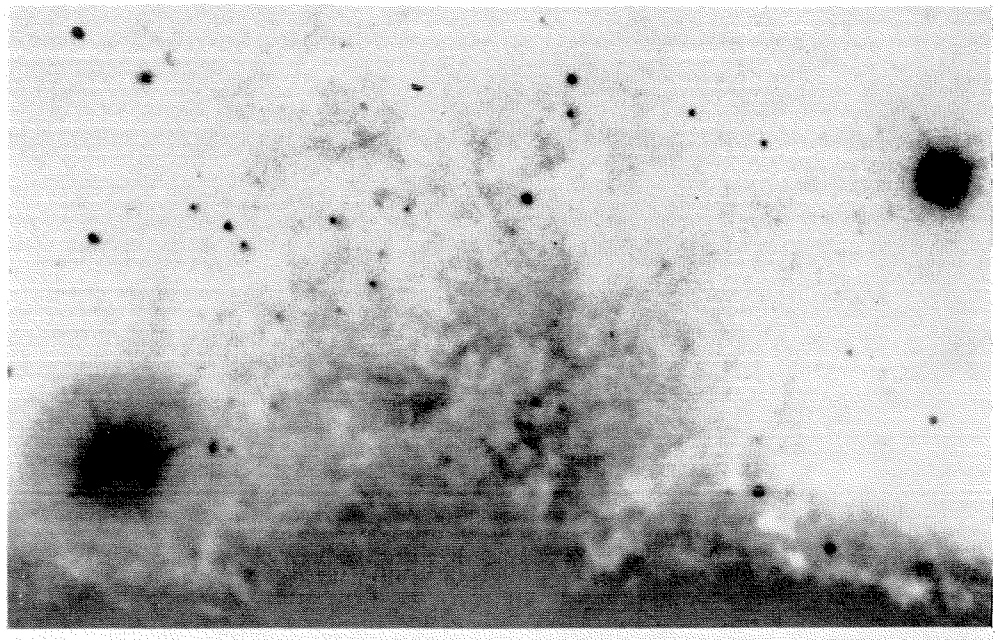
When a photograph is taken with the electric vector of the polaroid sheet perpendicular to the major axis of the galaxy, the filaments almost completely disappear, proving the existence of synchrotron radiation.

This type of radiation has the unique property of being almost 100 percent linearly polarized; that is, the light is vibrating in a single plane.

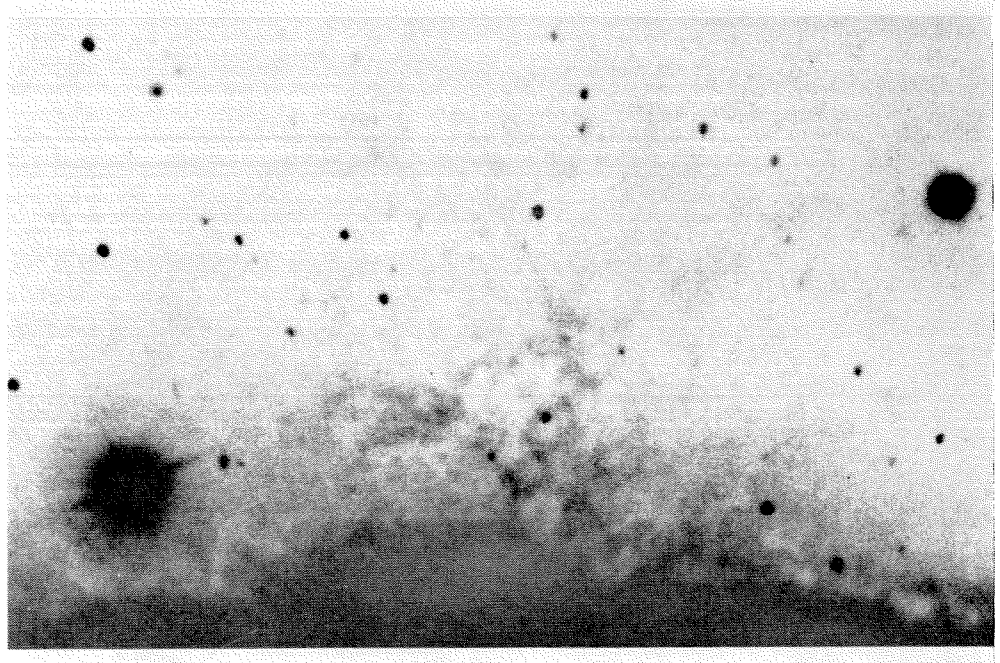
To test this requirement, photographs were made on the filaments in M 82. The upper picture on this page shows that the filaments shine brightly when the electric vector of the polaroid sheet in the plate holder of the telescope is aligned parallel to the major axis of the galaxy. The lower photo is from a second series of photographs taken with the electric vector perpendicular to the major axis. Here, the filaments almost completely disappear. This discovery suggests that a remarkably regular magnetic field exists in M 82 at large distances (13,000 light years) above and below the fundamental plane seen in the original photograph of the galaxy taken in 1962. Calculations show that these electrons must have very high energies — nearly 500 times that of the electrons produced in the Caltech synchrotron.

Although more research is needed to define the exact configuration of the magnetic field, these new results appear to prove the existence of magnetic fields and also to indicate the presence of high energy electrons in radio galaxies. Thus the information learned from M 82 could very well be a part of the pattern of research revealing clues to the origin of cosmic rays.

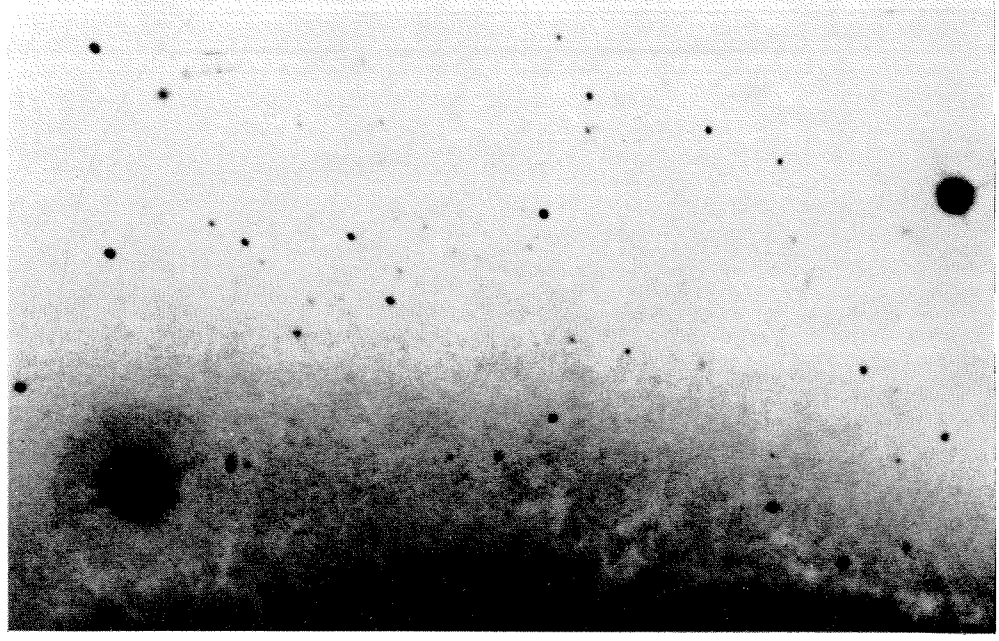
A CLOSER LOOK AT AN EXPLODING GALAXY



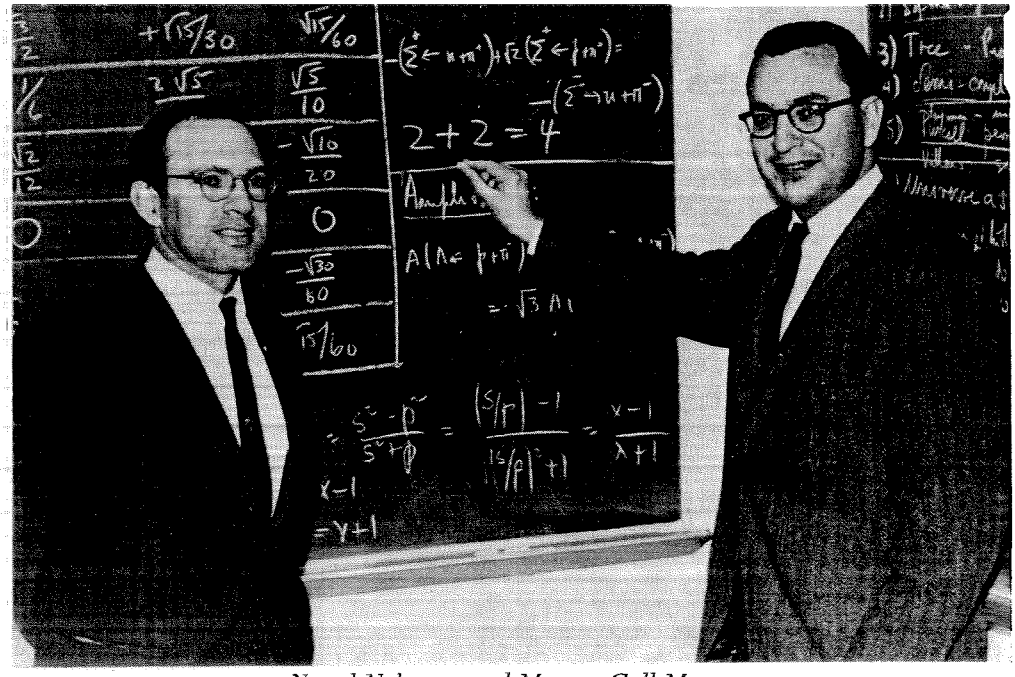
An enlargement of a portion of the photograph on page 9 shows the intricate loop structure and fine detail of the filaments in blue light.



An enlargement of a portion of the upper photograph on page 10, taken with the electric vector of the polaroid sheet aligned parallel to the major axis of the galaxy, shows the brightly shining filaments.



The filaments are almost completely gone in this enlargement of a portion of the lower photograph on page 10, taken when the electric vector of the polaroid sheet is aligned perpendicularly to the major axis of the galaxy.



Yuval Ne'eman and Murray Gell-Mann

The Eightfold Way

by Rodger F. Whitlock '65

Physicists welcomed the news last month of the discovery of a subatomic particle which may bring some order out of the apparent chaos among nuclear particles. The omega-minus, discovered by scientists working with the particle accelerator at Brookhaven National Laboratory in New York, confirms a theory proposed independently, three years ago, by Murray Gell-Mann, professor of theoretical physics at Caltech; and Yuval Ne'eman of Israel, now research fellow in theoretical physics at Caltech. The theory relates nuclear particles to each other in a manner reminiscent of Mendelyeev's periodic table of the elements. It sets up "family relationships" between many of the strongly interacting particles now known. (Strongly interacting particles are those subject to the force known, appropriately enough, as strong interaction. This is one of the four known fundamental forces, the other three being weak interaction, electromagnetism, and gravitation.)

Called the eightfold way, after Buddha's list of eight virtues that lead to the cessation of pain, the theory is based on eight quantum numbers, assignable to almost any particle, which evaluate certain characteristics of a particle. These quantum numbers, especially formulated for the manipulations of the eightfold way, are such novel concepts that several of them do not yet have names. From the values for these quantum numbers, which can be predicted via the eightfold way, many of the particle's properties (such as mass, decay time, or decay products) can be predicted to a high degree of accuracy.

Just as Mendelyeev's periodic scheme brought some order into the elements known in 1870, so does the eightfold way bring about an orderly and symmetric arrangement of many of the nearly 100 fundamental particles known today. It also provides a logical base for a naming system for particles to replace the current colloquial names. Though the names are still primarily Greek letters, they now have more meaning.

As proposed, the eightfold way had a gap – an unknown particle, conspicuous by its absence. To fill this gap, a new particle, the omega-minus, was hypothesized. If the particle were to be discovered, the gap would be filled and the Gell-Mann-Ne'eman theory would be verified in one important respect.

It was felt, moreover, that this verification would make the eightfold way a certainty, since the properties prophesied for the omega-minus were so unusual that they could not be predicted by extrapolation alone.

The omega-minus was discovered using the 33 BEV alternating gradient synchrotron at Brookhaven to accelerate protons for the production of K-minus mesons. These were separated from the beam by a 400-foot array of magnetic and electrostatic devices. The K-minus mesons were then directed into the 80-inch bubble chamber and photographs taken of the trails left in the chamber. Out of 100,000 photographs, one omega-minus trail was found and confirmed by analysis with an IBM 7094.

The omega-minus has a mass of 1676 million electron volts or about 3400 times the mass of an electron. It decays into a xi particle and a pi-meson. The xi particle eventually decays into a proton, with the production of two more pi-mesons, one at each decay step. It has a spin angular momentum of 3/2, and a positive parity.

THE BELL TELEPHONE COMPANIES SALUTE: CHUCK SCHNORENBERG

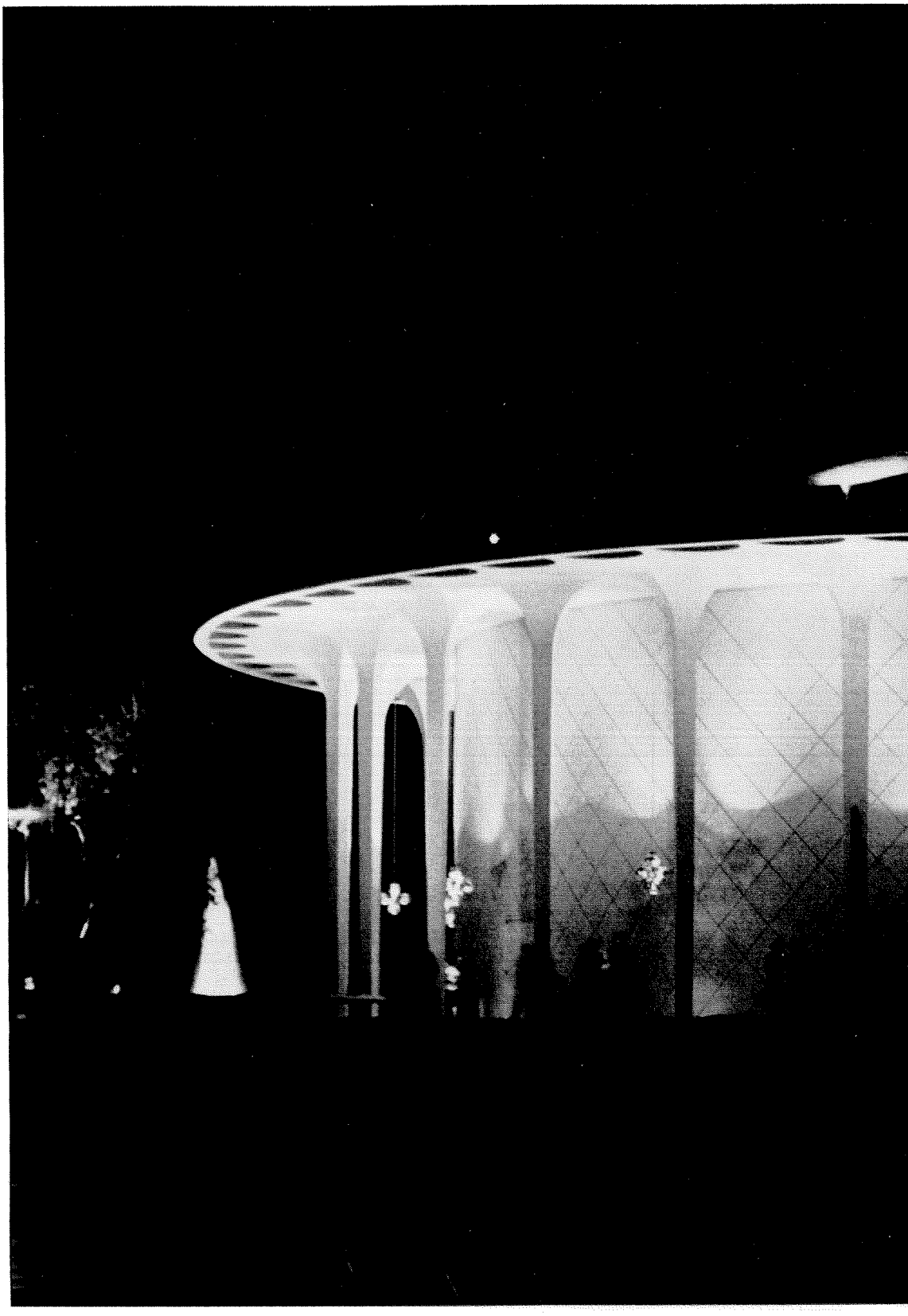
Chuck Schnorenberg (B.S., 1957) is plant manager for Pacific Northwest Bell at the communications center in Roseburg, Oregon. He is responsible for the economical and efficient operation of all communications in the area.

This is quite an assignment for a man less than 3 years with the company. But Chuck's career has been based on increased knowledge of the company and its operations, which has been followed logically with the increased responsibility and authority he has proven he can handle.

As a supplies foreman and in subsequent positions in the accounting, engineering and plant departments, he has never reached the limit of his managerial capacities. No doubt he has a long way to go and grow with the company.

Chuck Schnorenberg, like many young engineers, is impatient to make things happen for his company and himself. There are few places where such restlessness is more welcomed or rewarded than in the fast-growing telephone business.

BELL TELEPHONE COMPANIES



CALTECH'S NEW BECKMAN AUDITORIUM

DEDICATION

The Institute formally dedicated its new $1,450,000 Arnold O. Beckman Auditorium on February 25. Designed by Edward Durell Stone, the circular building stands at the end of a landscaped mall north of the present campus. Seating 1200 people, it provides a place on campus for the entire student body to meet, and will enable the Institute to share more of its programs with the community.

Dr. and Mrs. Beckman, donors of the auditorium, get a standing ovation at the dedication ceremony. Dr. Beckman, now chairman of the Institute's board of trustees, received his PhD from Caltech, and taught chemistry here for 14 years before leaving to found Beckman Instruments, Inc.

The interior of the auditorium is dramatically decorated in red, white, and gold. The ceiling, made of anodized aluminum discs attached to fiberglass tape, gives the effect of a filigreed gold curtain.

SAUL KAPLUN

1924 - 1964

Saul Kaplun, senior research fellow in aeronautics, died of a heart attack on February 13.

Dr. Kaplun was born in Lwow, Poland, in 1924. He became a naturalized citizen of the United States in 1944 and served in the United States Navy in 1944-46. He spent his entire academic life — a total of twenty years — at Caltech, where he received four degrees. After his PhD in 1954 he became a research fellow in aeronautics and was made a senior research fellow in 1957.

He is survived by his father, Morris J. Kaplun, of New York.

A memorial ceremony was held in Dabney Hall on February 27, with eulogies spoken by President DuBridge and Dr. Clark B. Millikan. In Dr. DuBridge's words, "Saul Kaplun had a brilliant analytical and creative mind and made many profound and original contributions to the theory of fluid mechanics. He was an applied mathematician of extraordinary ability and had already won wide and admiring recognition for his work."

Dr. DuBridge mentioned that Saul Kaplun was modest and retiring. His close friends had a profound affection for the man as well as the deepest admiration for the scientist.

Dr. Millikan, professor of aeronautics and director of the Graduate Aeronautical Laboratories, spoke on behalf of Saul Kaplun's Caltech colleagues and former students. "Saul Kaplun's very special hallmark as a scientist," said Dr. Millikan, "was his unusual intuition. He lived with a problem till he 'saw' the solution. This enabled him to understand the essence of some fundamental problems but also made it difficult for others to understand his work. His work could in general not be explained by discursive reasoning; one had to make an effort to share his intuitive thinking."

Dr. Millikan spoke about the very high standards Saul Kaplun had set for himself. He was reluctant to publish anything he considered incomplete or not sufficiently fundamental. "Few publications bear his name as author," Dr. Millikan said; "however, in very many publications by others the author expresses his thanks to Saul Kaplun for having contributed some fundamental ideas to the work, or states that he has used methods due to Kaplun.

"By now his work has won world-wide recognition among specialists. He was invited to give a lecture at the XIth International Congress on Theoretical and Applied Mechanics to be held in Munich, August 30 to September 5, 1964. Some of his colleagues will try to reconstruct this lecture from the notes Saul Kaplun left behind and the lecture will be delivered in his name."

As an example of Saul Kaplun's work, Dr. Millikan singled out his research on the theory of slow motion of a viscous fluid. Very little fundamental progress had been made on this important problem since Stokes' original research about a hundred years ago. Various difficulties — in particular, the famous Stokes paradox — were inherent in Stokes' original work. Kaplun's profound analysis of the problem explained the nature of the difficulties and gave the method for solving the problem. His ideas were so profound that they transcended the original problem; they are now recognized as fundamental mathematical ideas of wide applicability. Here, and in many other instances, Saul Kaplun's work played a decisive role in the development of applied mathematics at the California Institute.

Morris Kaplun spoke a few words of thanks for the tribute to his son. He spoke of his son's great devotion to Caltech. Saul Kaplun never spent for himself the money he had received from his family; instead he left a large bequest to the Institute. "In appreciation of my son's devotion to his Alma Mater," the elder Kaplun said, "I intend to add to this bequest in order to provide a suitable memorial in the name of Saul Kaplun. It will take the form of a fellowship, a reading room, and part of a building for study and research in the field of applied mathematics, the field in which Saul worked so devotedly till the day of his untimely death."

Alumni Speak Out... V

In the more than 5,000 Alumni Survey questionnaires that have been returned to the Institute to date, responses to the back-page invitation for "comments" have been gratifyingly numerous. Although there is no such thing as a typical comment, these are some representative ones.

Humanities department should put greater emphasis on fewer courses (same total quantity but less choice). English important! Literacy in writing and speaking *very* important! At least as important as technical knowledge. History soon forgotten. Similar "one-shot" courses of little value. Memory Courses (ME 3) soon forgotten. Emphasis should be on *thinking out* problems.

I feel that the greatest asset CIT gave me was the ability to recognize and solve problems with the facts available. It is much more important to be able to do a lot with the facts you have than simply to be able to regurgitate vast quantities of facts. So, although I haven't used most of my course material in years and would probably flunk exams in most of the courses I took if I took the exams now, I find the ability to reason and solve new problems of immense, fundamental value every day. Somehow Caltech gave me this and it is priceless.

I also learned how to work under and survive great pressure. After my undergraduate years there anything seems easy. In surviving the process I feel I'll never really be afraid of anything again. I may be slowed down but I'll never be overwhelmed.

At the same time there are difficulties. The undergraduate school is still definitely the stepchild of the whole Institute. Interest seems to be in (1) faculty research (2) graduate school (3) undergraduate school. Many faculty members regard undergraduate courses as a chore and bore, their interest being confined to (1) and (2) as much as possible. The undergraduate school appears to be a place to unload gradstudents as T.A.'s instead of giving them fellowships, and I challenge any accounting that purports to prove that the undergrad school costs more to run than it brings in as tuition.

There is still the problem of grades. An undergraduate gets poorer grades at CIT than he would at another school and this hurts when he tries to go on to a grad school. Despite the myth that "a Caltech C is like an A anywhere else" (it may be in terms of training), most schools assume a C is a C when they consider admitting you. Hence, a CIT undergrad is often forced into a lower quality grad school than he could get into with a higher GPA from another school.

I wasn't in the grad school long enough to really criticize but it appears that qualified people are being held in grad school for far too many years because they have to do "peon labor" tasks in setting up and running experiments that could be done far faster and more competently by engineers and technicians. It is nonsense to scream we need more scientists and engineers when you keep them for 6 - 9 years to get a PhD.

This sort of scathing criticism is a result, of course, of the thinking, critical type of person Caltech turns out. Caltech is a good place and I'm grateful to it. But it isn't perfect. In some regards it is a long way from perfect, and most alumni know it. Why does only 8 to 15 percent of a class show up at a reunion even if most of the class is in that area? And why do many CIT alums, when hearing some faculty member name, say "oh, that bastard!" The point that has to be faced by the CIT faculty and administration is that the criticism has a basis in reality, that something is really wrong, and that this isn't just griping and cynicism.

We tend to think of ourselves without reference to time. While we are still the youth we once were, we were also never a different person from the one we are now! A survey such as this evokes a perspective uncommon in our busy lives.

If we changed before, being influenced by our environment and associates, may we not still be changing?

If we are changing, is the direction to our liking? Or is it merely the line of minimum nonconformity?

If we have been helped by older people when we were young, just what is our reciprocal obligation?

And finally, if we do *not* subscribe to the ubiquitous goals of wealth and power, what are we doing to help establish the validity and status of other equal or superior goals?

Is it true that the leading producer of oxygen for steelmaking had a hand in preparing Tricia McDonald's orange juice?

You'd expect that a company with 50 years' experience in extracting oxygen from the air would lead the field. You might even assume—and you'd be right—that it knows a lot about how oxygen can speed the making of steel. As a result, the company sells oxygen by the ton to steelmakers to help them produce faster and more efficiently.

You'd also expect that a leader in cryogenics, the science of supercold, would develop an improved process for making the frozen orange juice concentrate that starts Tricia McDonald off to a bright, good morning.

But there might be some doubt that two such activities as helping to speed steel production and helping to improve frozen orange juice could come from one company. Unless you knew Union Carbide.

For Union Carbide is also one of the world's largest producers of petrochemicals. As a leader in carbon products, it is developing revolutionary graphite molds for the continuous casting of steel. It is the largest producer of polyethylene, and makes plastics for packaging, housewares, and floor coverings. Among its consumer products is "Prestone" brand anti-freeze, world's largest selling brand. And it is one of the world's most diversified private enterprises in the field of atomic energy.

In fact, few other corporations are so deeply involved in so many different skills and activities that will affect the technical and production capabilities of our next century.

We're growing as fast as Tricia McDonald.

UNION CARBIDE

UNION CARBIDE CORPORATION, 270 PARK AVENUE, NEW YORK, N.Y. 10017. IN CANADA: UNION CARBIDE CANADA LIMITED, TORONTO
Divisions: Carbon Products, Chemicals, Consumer Products, International, Linde, Metals, Nuclear, Olefins, Ore, Plastics, Silicones, Stellite and Visking

B-52. 8-engine jet bomber with range of over 9000 miles. Backbone of the Strategic Air Command.

Are you ready for a multi-million-dollar responsibility?

If you are, there's a place for you on the Aerospace Team—the U. S. Air Force.

No organization in the world gives young people a greater opportunity to do vital, responsible work.

For example, just a short while ago a 23-year-old Air Force lieutenant made a startling breakthrough in metallurgy. And a recent All-America tackle is doing advanced research in nuclear weapons.

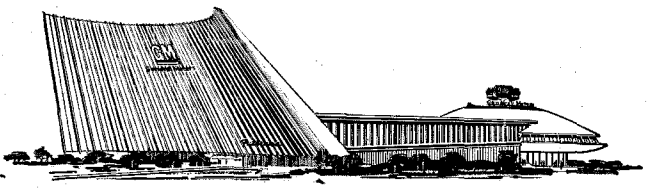
If you have talent, you'll have a chance to show it in the Air Force. Your work can put you and your country ahead.

You can earn your commission at Air Force Officer Training School, a three-month course open to both men and women. To apply, you must be within 210 days of your degree.

For more information, contact the Professor of Air Science. If your campus has no AFROTC, see your Air Force recruiter.

U.S. Air Force

FUTURAMA



Created by the People of General Motors—One of the highlights of the World's Fair will be the General Motors Futurama. This magnificent, ultra-modern building and the wonders it contains represent the skill and work of GM people—*stylists, engineers, scientists, architects, show specialists.*

The building is 680 feet in length (a very long par three on any golf course). It's 200 feet wide (forty more than a football field), and from the stark beauty of the ten-story-high canopy entrance to the wide scope of the domed pavilion at the rear, it expresses one thing very clearly: *tomorrow!*

A high spot of the Futurama is a ride that surrounds you with wonders. In an unforgettable experience, you'll be carried through time and space—through desert and jungle—to polar regions and across the ocean floor. In a single day this dramatic ride can accommodate 70,000 people—the entire population, for instance, of Muncie, Indiana or Boulder, Colorado.

In the Futurama's Avenue of Progress, you'll see the newest sources of power described and demonstrated in fascinating ways. Also shown are research projects in transportation mobility, including a vehicle traversing jungle terrain and a moon-rover conquering a rugged lunar landscape. At the Futurama you can visit a host of other colorful displays designed to attract, interest and challenge the imagination of every member of your family.

Futurama, in an inspiring way, symbolizes the progress of GM. And the major reason behind this progress is people—*the people of General Motors.*

GENERAL MOTORS IS PEOPLE ...

Making Better Things For You

Alumni News

Board Nominations

The Board of Directors of the Alumni Association met as a Nominating Committee on February 25, 1964, in accordance with Section 5.01 of the By-Laws. Seven vacancies will occur on the Board at the end of the fiscal year, June 1964. Three of these vacancies will be filled by the President, Secretary, and Treasurer, ex officio, and four will be filled by direct election. The present members of the Board with the years their terms expire are:

Robert Boykin '34	1964	William L. Holladay '24	1964
Donald S. Clark '29	1964	G. Russell Nance '36	1964
William H. Corcoran '41	1965	Richard W. Powell '40	1964
Patrick J. Fazio '53	1964	Richard P. Schuster, Jr. '46	1965
John R. Fee '51	1964	P. V. H. Serrell '36	1965
David L. Hanna '52	1965	H. M. Worcester, Jr. '40	1965

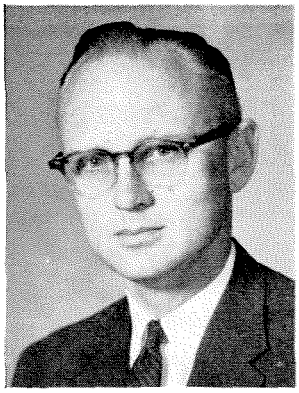
The following nominations have been made:

President – Patrick J. Fazio '53	(1 year)
Vice-President – David L. Hanna '52	(1 year)
Secretary – Donald S. Clark '29	(1 year)
Treasurer – John R. Fee '51	(1 year)
Director – James L. Adams '55	(2 years)
Director – John T. McGraw '38	(2 years)
Director – John L. Mason '47	(2 years)

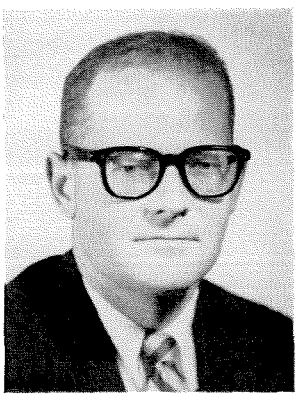
Section 5.01 of the By-Laws provides that the membership may make additional nominations for the four (4) Directors by petition signed by at least twenty-five (25) members in good standing, provided the petition is received by the Secretary not later than April 15. In accordance with Section 5.02 of the By-Laws, if further nominations are not received by April 15, the Secretary casts a unanimous ballot for the members nominated by the Board. Otherwise a letter ballot is required.

Statements about the nominees are presented below.

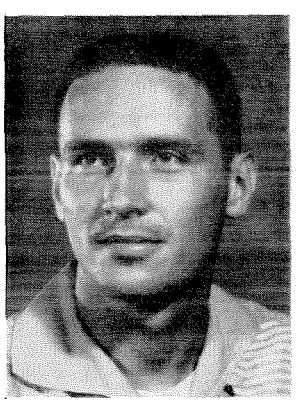
– Donald S. Clark, Secretary



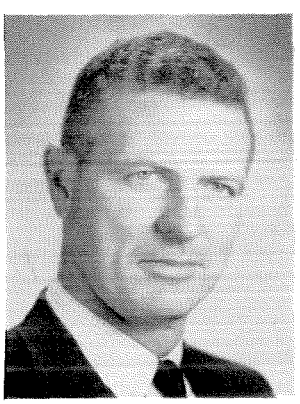
SIDNEY K. GALLY received his BS in electrical engineering in 1941 and joined the Southern California Gas Company the same year. During World War II he served as an instructor in electronics at Harvard and MIT Radar Schools and also as a member of the destroyer squadron commander's staff. He has held various positions with the gas company – laboratory supervisor, staff engineer, and now Northeast division engineer. He served as a member of the program committee for the Alumni Seminar in 1962 and 1963, and this year he is serving as general chairman of the Seminar.



JOHN L. MASON received his BS in meteorology from the University of Chicago, then came to Caltech to receive a BS in applied chemistry in 1947, an MS in chemical engineering in 1948, and a PhD in 1950. He then joined the AiResearch Manufacturing Company in Los Angeles as group supervisor of the preliminary design department. He is now chief engineer at AiResearch and has directed the design and development of the life support systems on the Mercury, Gemini, and Apollo space vehicles. He served as a member of the program committee for the 1956 Alumni Seminar.



JAMES L. ADAMS received his BS in mechanical engineering in 1955. After two years as an officer in the U.S. Air Force and a year as an art student at UCLA, he enrolled at Stanford University, where he received his MS and PhD. While at Stanford he was employed as an instructor and as a research associate, investigating the problems involved in controlling lunar roving vehicles from earth. After leaving Stanford, he joined Caltech's Jet Propulsion Laboratory, where he is now supervisor of the advanced technology group of the Electromechanical Engineering Section.



JOHN T. MCGRAW received his BS in mechanical engineering in 1938 and started his career as an engineer with Douglas Aircraft. He then spent eight years as engineering group leader and section chief in the hydrodynamics laboratory at Caltech and at JPL. In 1955 he joined the Axelson Division of U.S. Industries as chief engineer. He is now executive vice president in charge of manufacturing and engineering at the Vard Division of Royal Industries, Inc., in Pasadena. In 1960 he served as chairman of the program committee for the Alumni Seminar.

FORGINGS—HOW THEY IMPROVED THE RELIABILITY OF THIS CROSSHEAD . . .

yet cut cost 20%

Originally, this crosshead for a lift truck was not a forging. Now it is **forged** in steel. Here's why . . .

The lift truck builder wanted to increase the safety factor to meet greater bending and shear stresses. He also wanted to increase the fatigue strength of the part. And all without any increase in weight or cost. He also wanted to reduce tool breakage caused by irregularities, voids, and inclusions.

He changed over to FORGED crossheads.

Now the crosshead has the required strength and stress-resistance, costs 20% less when machined and ready to assemble, increases production rates 14% by reducing tool breakage and increasing machining speeds.

Forgings are better for these reasons; they:

1. Are solid, free from voids and inclusions
2. Have high fatigue resistance
3. Are strongest under impact and shock loads
4. Have a higher modulus of elasticity
5. Have a unique stress-oriented fiber *structure*
6. Are low in mechanical hysteresis

Memo to future engineers:

"Make it lighter and make it stronger" is the demand today. No other metalworking process meets these two requirements so well as the forging process. Be sure you know all about forgings, their design and production. Write for Case History No. 105, with engineering data on the lift truck crosshead forging shown above.

DROP FORGING ASSOCIATION
55 Public Square • Cleveland 13, Ohio

When it's a vital part, design it to be

FORGED

Personals

1926

ROY DIXON, general manager of the Stauffer Chemical Company's fertilizer division, has now been made vice president of the company, with headquarters in San Francisco.

1928

NICOLAI K. SENATOROFF, supervisor of technical services for the Pacific Lighting Gas Supply Co., retired in December after more than 35 years with the Pacific Lighting system.

A one-time lieutenant in the Russian Imperial Army, he was forced to retreat to China after the collapse of the Russian White Army. He came to the United States and was graduated from Caltech in 1928. That same year he joined the Southern California Gas Company, an affiliate of Pacific Lighting Gas Company, as an assistant chemist.

1935

NORWOOD L. SIMMONS, MS, is now general manager of the West Coast division of Eastman Kodak's motion picture sales department. He has been with the company since 1937, and was formerly manager of engineering services in the Hollywood office. The Simmonses and their five children live in Pasadena.

1937

CARL F. J. OVERHAGE, PhD, director of the Lincoln Laboratory at MIT for the past seven years, has asked to be relieved of this assignment in order to initiate and direct a long range program for the application of the principles and methods of information processing to library operation. He is still professor of engineering, a rank he has held at MIT since 1961. The ultimate objective of his new research is to design a library of science and engineering which could be put into operation at MIT between 1970 and 1975.

1946

CDR. WILLIAM C. WILBURN, AE '47, is currently on duty in Paris as a member of the staff of the United States Delegation to NATO.

1949

RAFAT MIRZA, MS, according to information just received by the Institute, died after a brief illness on his 35th birthday on August 5, 1961. He had been working since 1960 in the biophysics section of the I.C.L. Akers Research Laboratories in Welwyn, England.

Raf was born in Hyderabad, India, and received 1st Class Honours in chemistry in 1946 from Madras University. After receiving his MS from Caltech in 1949, he joined St. Catherines Society in Oxford, England, and began work on the reduction of heterocyclic substances. He received his PhD in 1951 and returned to India, where he worked at the Central Laboratories for Scientific and Industrial Research in Hyderabad for about a year. After about six months in Zurich he crossed the Atlantic again to take up a research fellowship at Harvard. He spent another year in America as a postdoctoral fellow at Wayne University in Detroit, and then went to England in 1955 to join Imperial Chemical Industries Ltd., at Manchester, as a research chemist.

Raf was an excellent horseman and played a good deal of polo. A skilled gardener, he reared many types of unusual plants. Photography was another of his hobbies, as was flying, aero-modeling, walking and climbing. He was married in 1956 and his wife survives him.

1951

ROBERT G. ADLER is now a research chemist at the North American Aviation Science Center in Canoga Park. He was married last November to Marilyn Canfield, in Upland, California.

1957

LT. COL. GEORGE F. BABITS, director of science and assistant for propulsion at Edwards AFB in California, is the author of *Thermodynamics*, an undergraduate-level textbook published last year by Allyn & Bacon Inc., Boston, Mass.

ALAIN M. A. CHAVEREBIERE DE SAL, MS, Ingenier Principal du Genie Maritime, is head of the technical section of the programming center of the French Navy. He was married in 1959 and has a daughter.

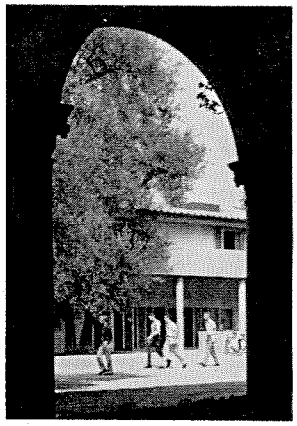
1963

JAMES M. PETERSON, PhD, is now a research chemist at the Chemstrand Research Center in Durham, N. C.

DONALD F. JENSEN, MS, is now associate engineer in the advanced technology department of the IBM Corporation in Endicott, N. Y.

GEORGE SEIELSTAD, PhD, is on the staff of the Geophysical Institute at the University of Alaska. ED GAUSS '54, who sends along this information, says that "George is learning to fly so as to enhance his ability to hunt moose. His appointment brings to three the number of Caltech men at the Geophysical Institute — the others are CARL BENSON, '60, and myself. George is also teaching in the physics department."

CALTECH CALENDAR



ALUMNI EVENTS

May 2 Alumni Seminar

June 10 Annual Alumni Meeting

ATHLETIC SCHEDULE

Baseball

March 28
Cal Lutheran at Cal Lutheran

March 30
Azusa at Azusa

March 31
Upland at Caltech

April 4
Whittier at Caltech

Track

April 3
Pomona at Pomona

Swimming

April 3
Cal Poly, Pomona, San Fernando V. State at Caltech

FRIDAY EVENING DEMONSTRATION LECTURES

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

April 3
The Mathematician's Coloring Book
—Marshall Hall, Jr.

April 10
Raselgethi
—Armin Deutsch

April 17
Laser Facts and Fancies
—Nicholas George

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

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Peter V. H. Serrell, '36

SECRETARY
Donald S. Clark, '29

VICE PRESIDENT
Patrick J. Fazio, '53

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

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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.

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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.

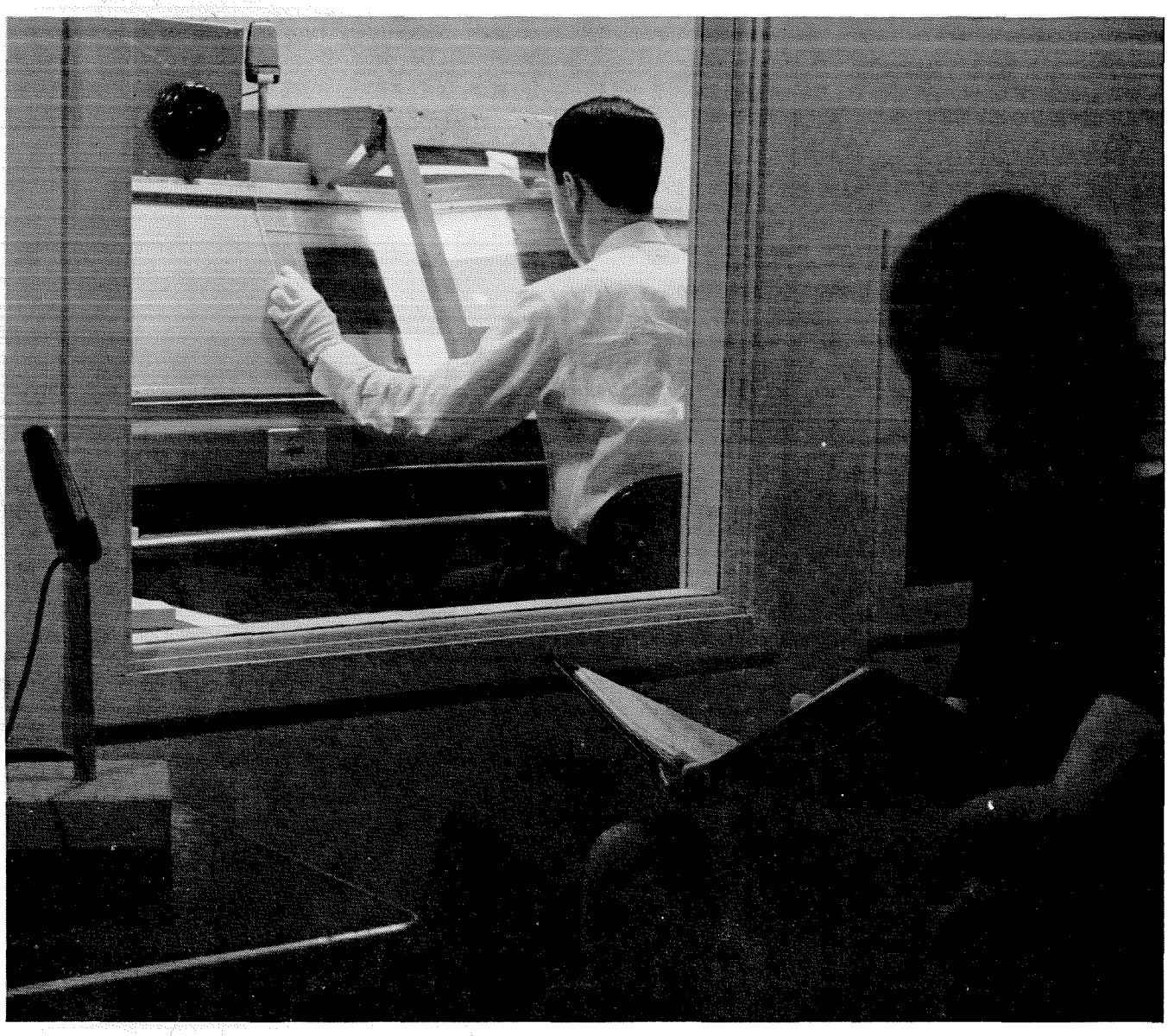
SACRAMENTO CHAPTER

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.



WE MAKE INDUSTRIAL ENGINEERS SWEAT

Might as well scare off the ones who wouldn't like it. Some of the unscared will in a few years be referred to as "they" when people say, "At Eastman Kodak, *they* can afford to do it this way—"

The reason we can afford to do things the best way is that we are successful. The success can be attributed in part to a fear worth fearing: of failing to deliver the best possible performance that the customer's hard-won dollar can buy.

Sheer devotion on the part of the work force, though beautiful to see, will not of itself deliver the goods. Somebody must first come up with a sensible answer to the question, "Exactly what is it you want me to do, mister?"

Thus a young industrial engineer may find himself acting as his own first subject in a study he has set up to find the physical and psychological conditions that best favor alertness against film emulsion defects. If he saw the need, sold his boss on his approach, and has earned the approbation alike of the pretty psychologist who will be running the experiment, the industrial physicians (who study what is humanly possible, feasible, and healthful muscularly and perceptually), the cold-eyed man from the comptroller's office, the Testing Division chief (who has dedicated his division to the descent of an asymptote), and the inspectors (who will find a month after switching to the new method that at home they are shouting at their kids less often)—then we know ways to make him glad he chose to learn the profession of industrial engineering at the company which the leaders of the profession often cite as its ideal home.

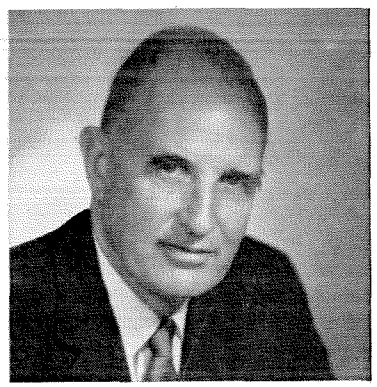
Naturally, industrial engineers aren't the only technical people we seek. Not by a long shot.

EASTMAN KODAK COMPANY,
Business and Technical Personnel Department, Rochester, N. Y. 14650
An equal-opportunity employer offering a choice of three communities:
Rochester, N. Y., Kingsport, Tenn., and Longview, Tex.

Kodak

Define Your Career Objectives!

An interview with W. Scott Hill, Manager—Engineering Recruiting, General Electric Co.



W. Scott Hill

Q. Mr. Hill, when is the best time to begin making decisions on my career objectives?

A. When you selected a technical discipline, you made one of your important career decisions. This defined the general area in which you will probably begin your professional work, whether in a job or through further study at the graduate level.

Q. Can you suggest some factors that might influence my career choice?

A. By the time you have reached your senior year in college, you know certain things about yourself that are going to be important. If you have a strong technical orientation and like problem solving, there are many good engineering career choices in all functions of industry: design and development; manufacturing and technical marketing. If you enjoy exploring theoretical concepts, perhaps research—on one of the many levels to be found in industry—is a career choice to consider. And don't think any one area offers a great deal more opportunity for your talent than another. They all need top creative engineering skill and the ability to deal successfully with people.

Q. After I've evaluated my own abilities, how do I judge realistically what I can do with them?

A. I'm sure you're already getting all the information you can on career fields related to your discipline. Don't overlook your family, friends and acquaintances, especially recent graduates, as sources of information. Have you made full use of your faculty and placement office for advice? Information is available in the technical journals and society publications. Read them to see what firms are contributing to advancement in your field, and how. Review the files in your placement office for company literature. This can tell you a great deal about openings and programs, career areas and company organization.

Q. Can you suggest what criteria I can apply in relating this information to my own career prospects?

A. In appraising opportunities, apply criteria important to you. Is location important? What level of income would you like to attain? What is the scope of opportunity of the firm you'll select? Should you trade off starting salary against long-term potential? These are things you must decide for yourself.

Q. Can companies like General Electric assure me of a correct career choice?

A. It costs industry a great deal of money to hire a young engineer and start him on a career path. So, very selfishly, we'll be doing everything possible to be sure at the beginning that the choice is right for you. But a bad mistake can cost you even more in lost time and income. General Electric's concept of Personalized Career Planning is to recognize that your decisions will be largely determined by your individual abilities, inclinations, and ambitions. This Company's unusual diversity offers you great flexibility in deciding where you want to start, how you want to start and what you want to accomplish. You will be encouraged to develop to the fullest extent of your capability—to achieve your career objectives, or revise them as your abilities are more fully revealed to you. Make sure you set your goals realistically. But be sure you don't set your sights too low.

FOR MORE INFORMATION on G.E.'s concept of Personalized Career Planning, and for material that will help you define your opportunity at General Electric, write Mr. Hill at this address: General Electric Co., Section 699-10, Schenectady, N. Y. 12305.

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