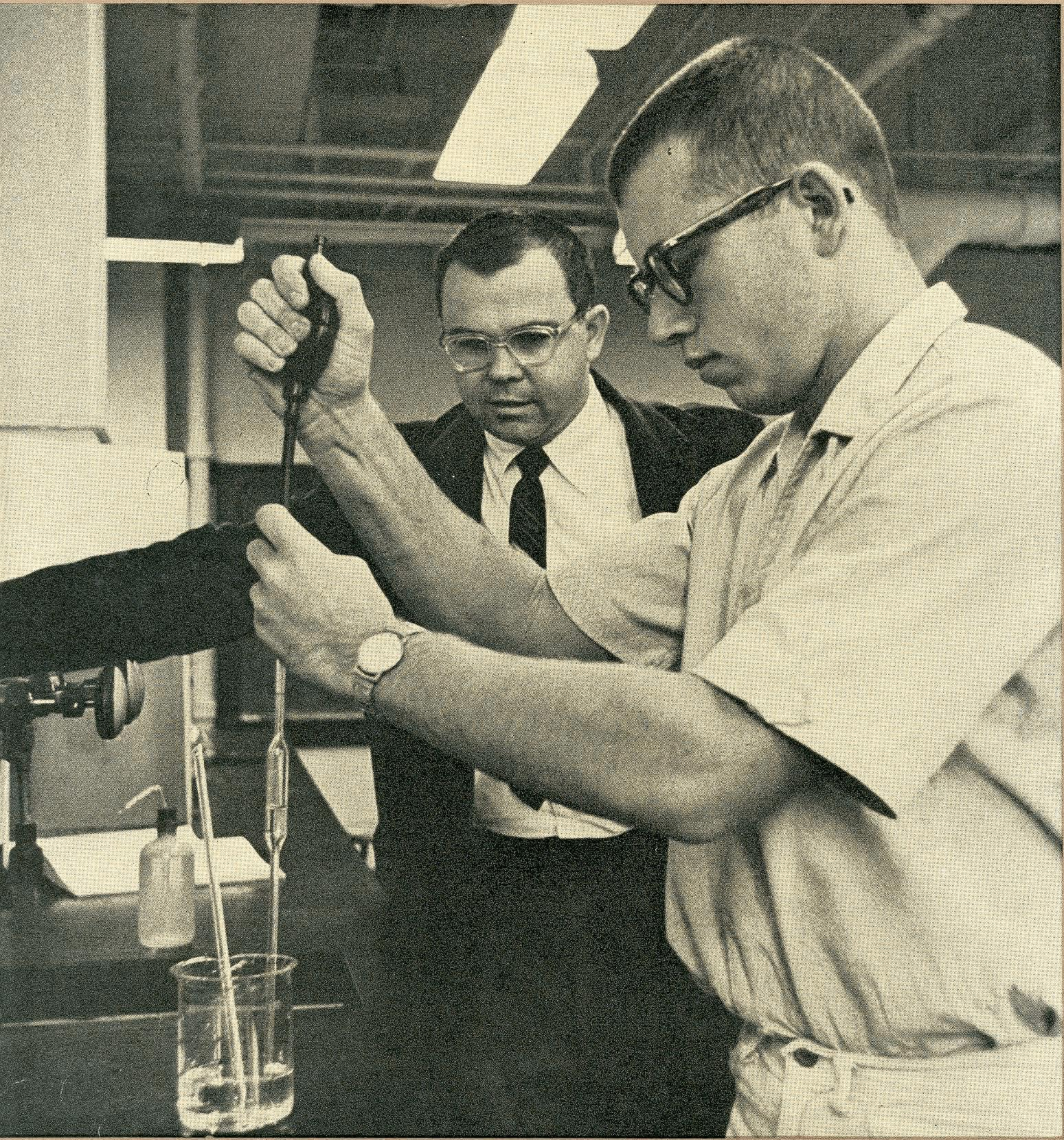
ENGINEERING | AND | SCIENCE

November 1961



Chemistry 1961 . . . page 11

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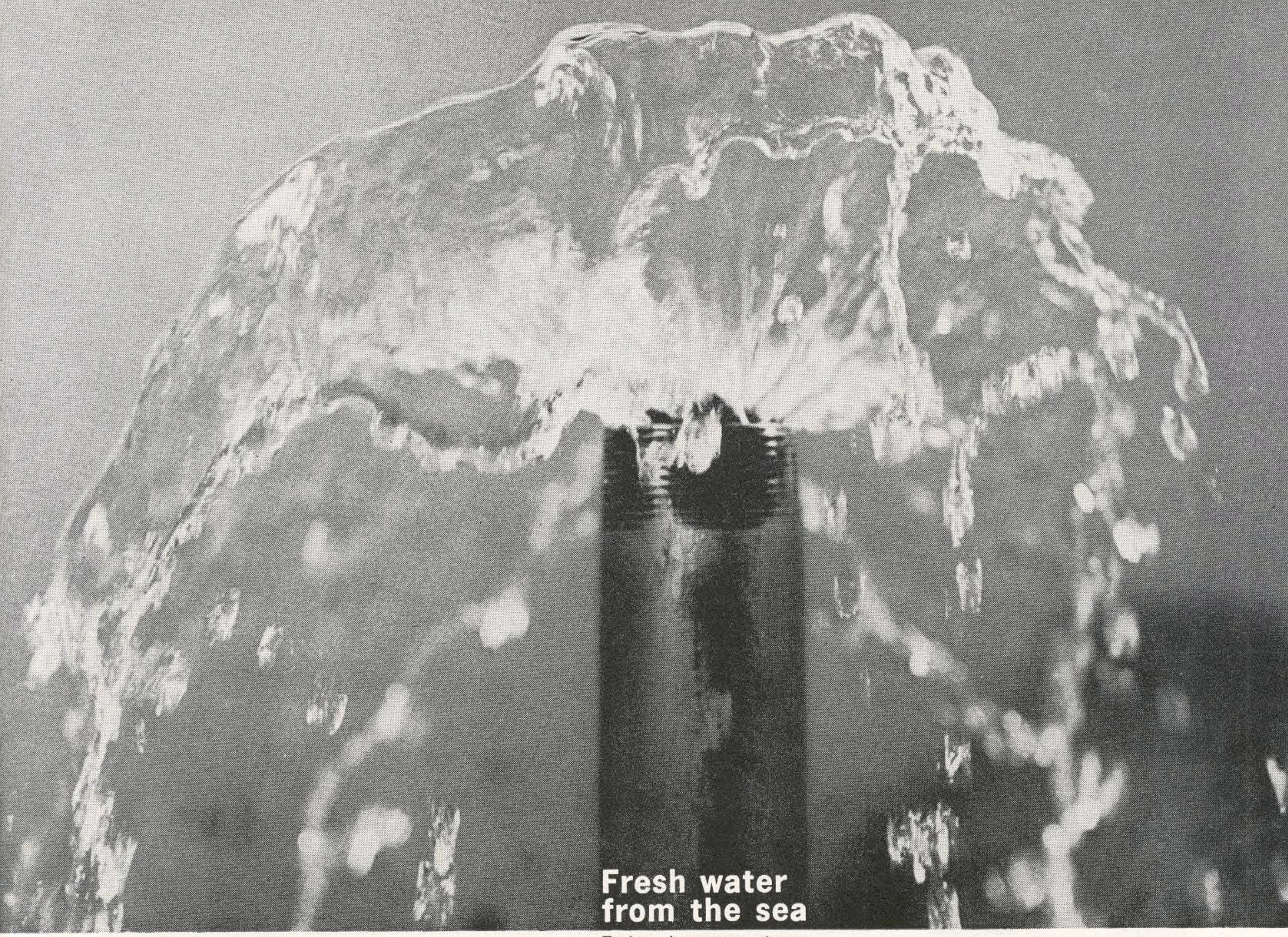

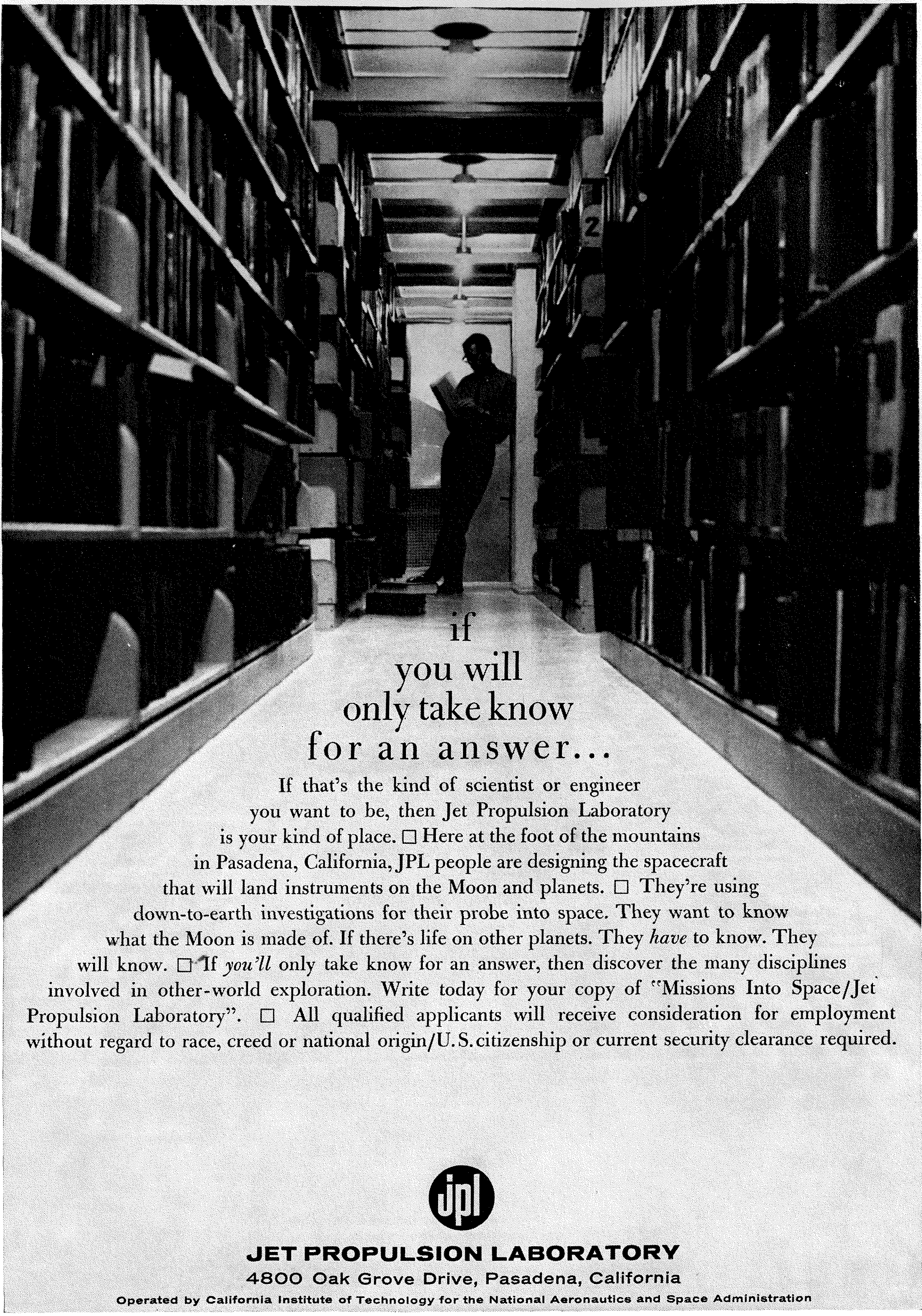
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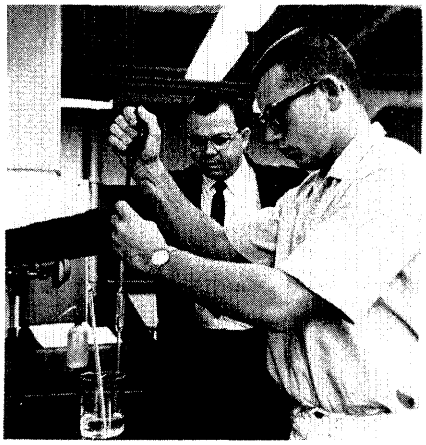
NOVEMBER 1961 VOLUME XXV NUMBER 2



On Our Cover

In Caltech's freshman chemistry laboratory, Dr. William Schaefer checks Hugh Maynard as he calibrates a pipet.

Things are not what they used to be in Caltech's freshman chemistry laboratory—or, for that matter, in the whole chemistry curriculum.

On page 11, Ernest H. Swift, chairman of the Division of Chemistry and Chemical Engineering, describes the Institute's new approach to the teaching of chemistry.

"Keeping the Curriculum Up to Date" has been adapted from a talk of Dr. Swift's at a dinner given by the Western Chapter of the American Institute of Chemists in Pasadena on September 20, 1961. The dinner, in fact, was in Dr. Swift's honor, and the AIC presented him with an honor scroll for his "many years devoted to teaching and for the promotion and development of his profession and for his concern and attention for those within the profession of chemistry."

Project New Valley

on page 20 is an account by Egon T. Degens, assistant professor of geology, of his participation in efforts to solve the water problems of the Egyptian desert.

Dr. Degens, whose principal research interest is in isotope and organic chemistry, came to Caltech as a research fellow in 1958 from Pennsylvania State University, where he was a research associate in 1956-57. He is a native of Germany, and he received his PhD from Bonn University in 1955.

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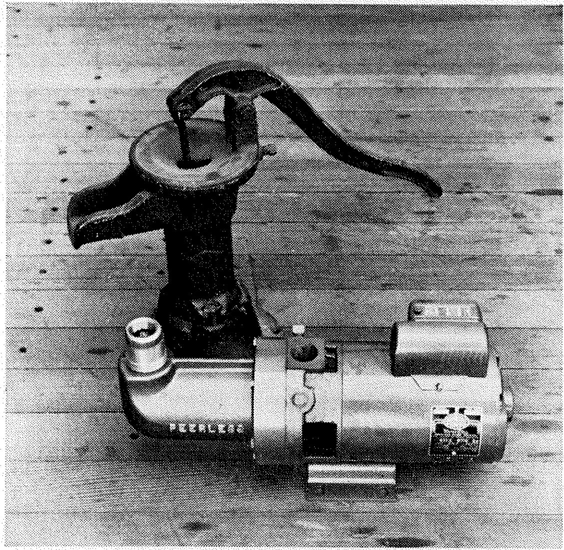
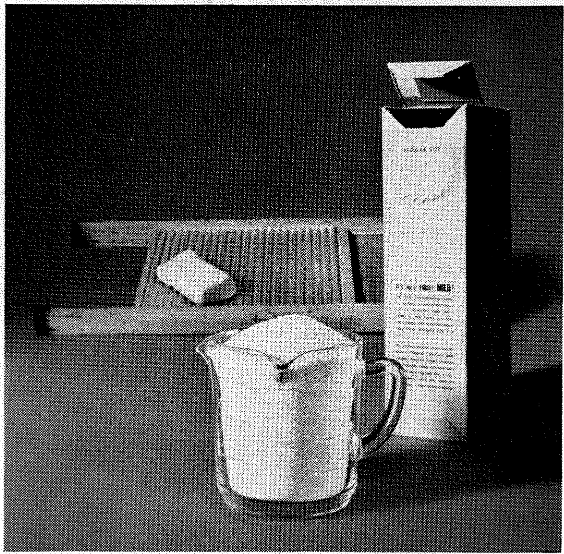
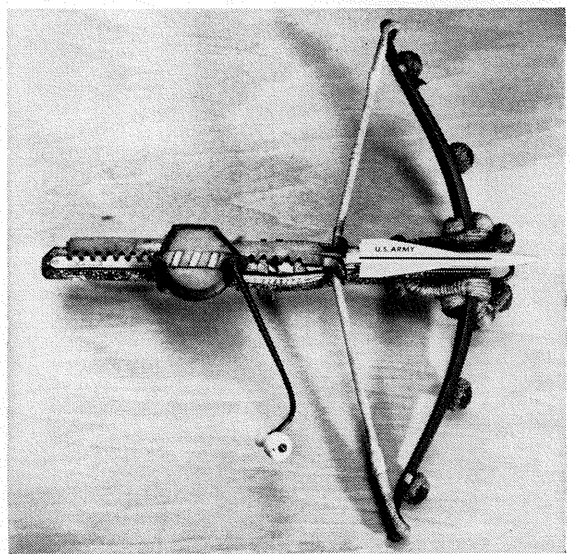






Books

The Natural History Library

Doubleday Anchor Books in cooperation with The American Museum of Natural History

It's hard to find a publisher these days who isn't bringing out a series of books on science for the layman—but it's even harder to find a series that the layman can read with much interest or understanding. These paperbacks are an exception; they can not only be understood—they are even palatable.

The first 13 titles in the series, devoted to the life and earth sciences, include:

Modern Science and the Nature of Life by William S. Beck ($1.45)
A brilliant and witty book about modern science in general and contemporary biology in particular.

From Fish to Philosopher by Homer W. Smith ($1.45)
A noted physiologist's account of vertebrate evolution and adaption.

White Waters and Black by Gordon MacCreagh ($1.45)
An absorbing record of a two-year expedition through some of South America's wildest jungle areas.

The Ocean Island by Gilbert C. Klingel ($1.45)
Shipwrecked on Inagua, in the Bahamas, a naturalist (and born writer) settles down to explore the island and make a comprehensive study of its exotic flora and fauna.

Other titles:

The Pacific Islands (revised edition) by Douglas L. Oliver ($1.45)

The Exploration of the Colorado River by John Wesley Powell ($.95)

John and William Bartram's America, edited by Helen Gere Cruickshank ($1.45)

John Burroughs' America, edited by Farida A. Wiley ($1.45)

The Mountains of California by John Muir ($1.25)

Horses by George Gaylord Simpson ($1.45)

Shearwaters by R. M. Lockley ($1.25)

The Wandering Albatross (revised edition) by William Jameson ($.95)

Dwellers in Darkness by S. H. Skaife ($.95)

Mathematical Handbook for Scientists and Engineers

by Granino A. Korn and Theresa M. Korn

McGraw-Hill $20

Reviewed by Cleve Moler, '61

This handbook is a handy reference to a wide range of mathematical definitions, formulas, theorems, methods, and tables. Any scientist or engineer who requires access to various ideas from mathematics should find it valuable.

The subjects covered include modern algebra, set theory, analytic geometry, vector analysis, Riemann and Lesbegue integrals, Fourier analysis, Laplace transforms, complex variables, differential and integral equations, matrices, Boolean algebra, tensor analysis, finite differences and numerical methods, probability and statistics, and special functions.

The book is very carefully organized with extensive cross-referencing, boxed formulas, different type faces and the like. In a few places it appears over-organized; some of the main points are obscured. But for the most part, the presentation is clear and concise. Good bibliographies of the major works in a subject are included at the end of the chapters.

The handbook can provide either a review of the results—all proofs are omitted—of a subject or an introduction to its basic concepts and methods. In addition, the index makes it a convenient mathematical dictionary.

Both members of the husband-wife author team have worked as engineers in the aircraft industry. Dr. Korn is currently Professor of Electrical Engineering at the University of Arizona.

FACULTY BOOKS

The Hubble Atlas of Galaxies

by Allan Sandage

Carnegie Institute of Washington $10

This handsome atlas, compiled by Allan Sandage, member of the staff of the Mount Wilson and Palomar Observatories, contains photographs and technical data on 176 galaxies. It is based partly on material left by Edwin Hubble, Mount Wilson and Palomar astronomer, who died in 1953. Dr. Hubble was an authority on spiral galaxies and was noted for his determination of the nature and distance of these stellar systems beyond our Milky Way.

Catalogue of Galaxies and of Clusters of Galaxies Vol. 1

California Institute of Technology $6

Prepared by Fritz Zwicky, Caltech professor of astrophysics, with the collaboration of E. Herzog and P. Wild, Volume I of this catalogue contains the positions, photographic magnitudes, and other data for about 9500 of the brightest galaxies in the area from Decl. -3 to $+15^\circ$ of the north galactic cap as well as positions, populations, sizes, and estimated distances for about 1300 clusters of galaxies in the same area.

ALUMNI BOOKS

Ballistic Missile and Space Vehicle Systems

Edited by Howard S. Seifert and Kenneth Brown

John Wiley & Sons $12

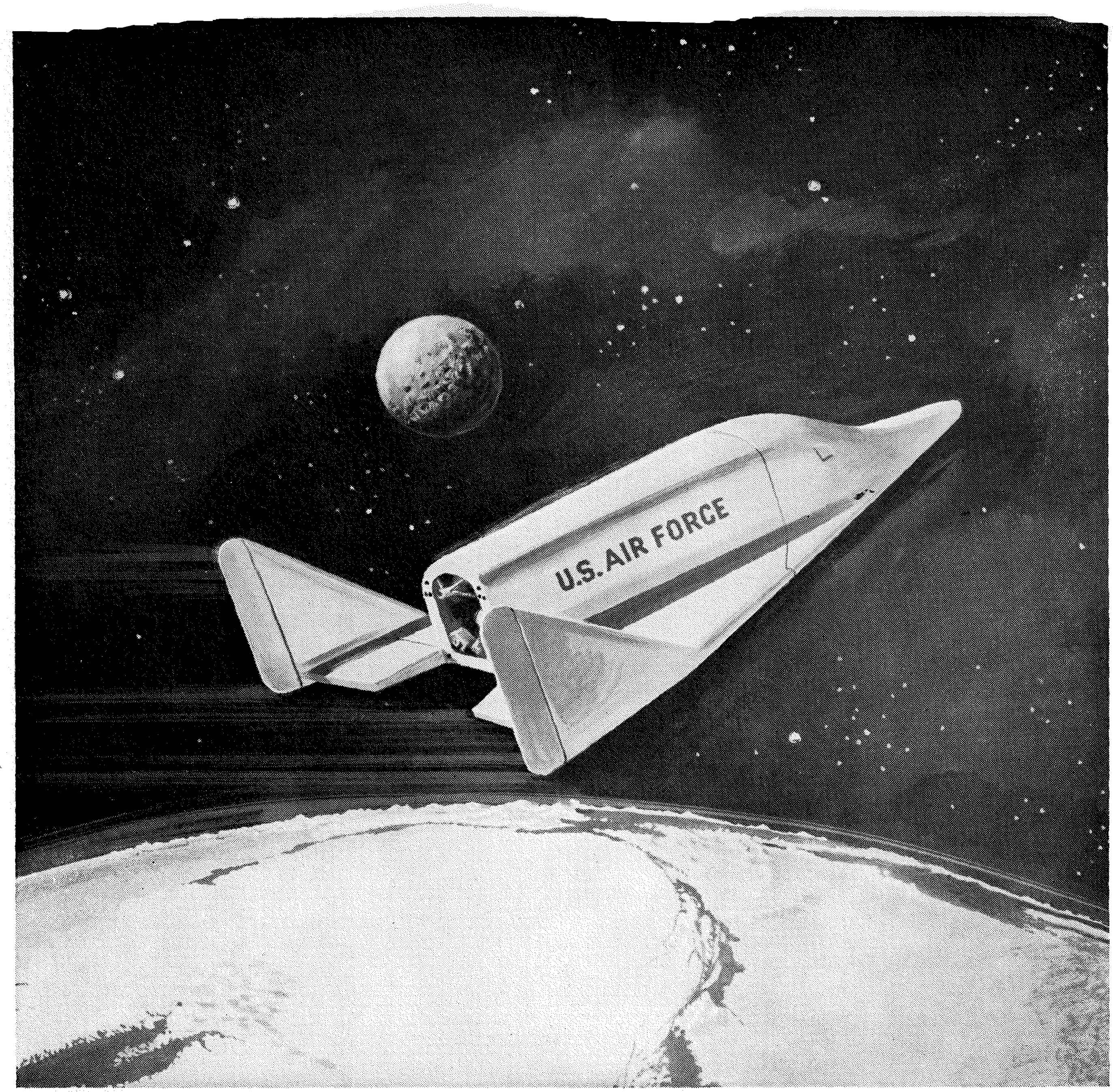
A companion volume to *Space Technology*, edited by Dr. Seifert and published two years ago. Howard Seifert (Caltech PhD '38) is professor of aeronautical engineering at Stanford University and Director of Professional Development with the United Technology Corporation.

Radioisotope Applications Engineering

by Jerome Kohl, Rene D. Zentner and H. R. Lukens

D. Van Nostrand Company . . $12.50

Based on a course in properties and applications of radioisotopes taught by Mr. Kohl at the University of California. Jerome Kohl (Caltech '40) is now coordinator of Special Products, General Atomic Division, General Dynamics Corporation in San Diego.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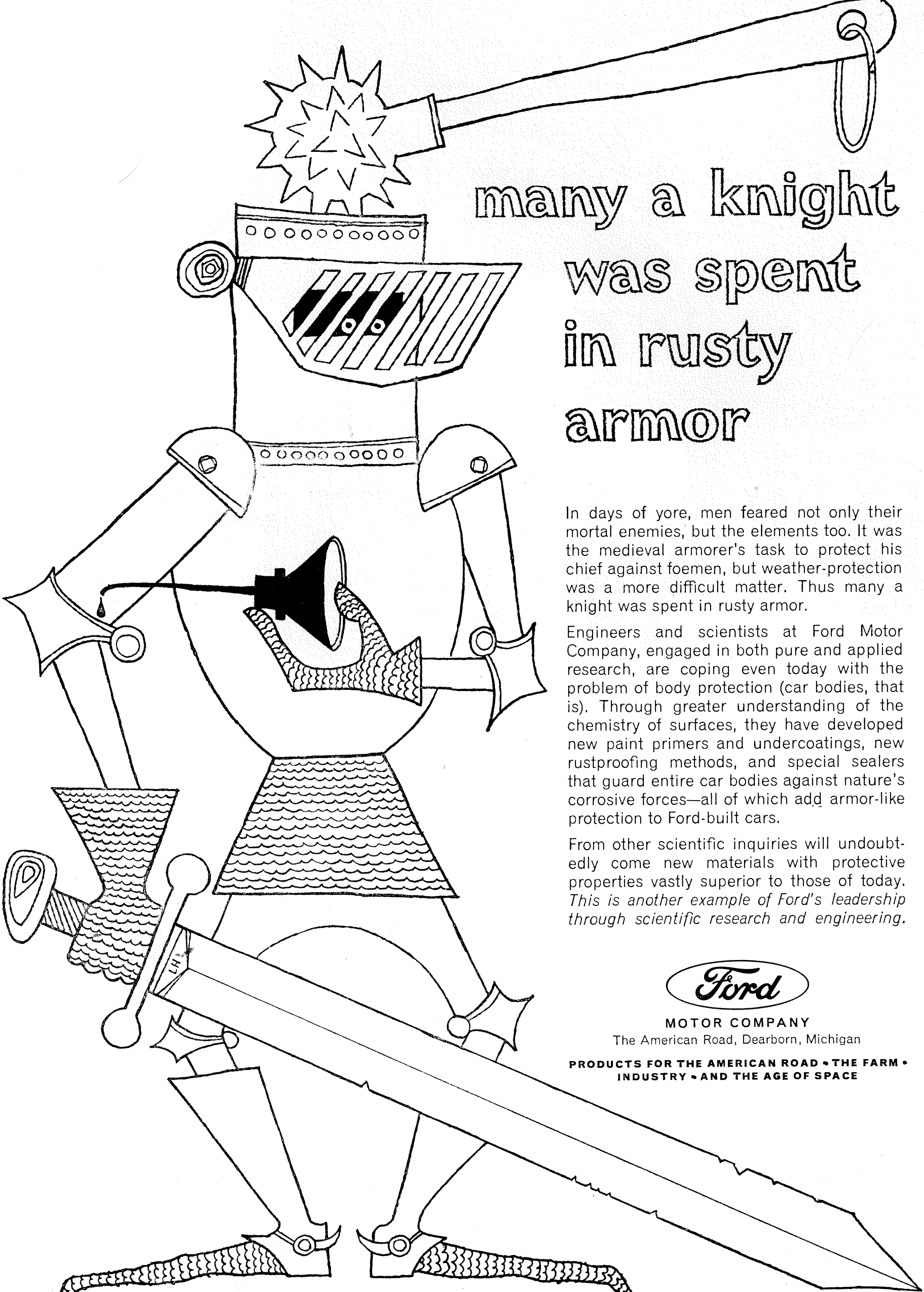

Keeping the Curriculum Up to Date

Three of the more serious challenges facing the makers of college chemistry curricula — and some changes which have been made at Caltech in an effort to meet these challenges.

by Ernest H. Swift

Three serious challenges face those who are concerned with college science courses today. The first of these challenges, and one which will demand increasing recognition, is the result of the various efforts being made to improve high school mathematics and sciences courses.

There is a general impression among the lay public that it took Sputnik I to awaken a concern for the teaching of science in our high schools. As evidence to the contrary, however, there is the ambitious project, activated a full year before Sputnik I, which had as its objective the improvement of the teaching of physics in the high schools.

This project, initially sponsored by the National Science Foundation, was centered at the Massachusetts Institute of Technology, and is still active. It has involved the cooperative effort of college and high school teachers from all sections of the country, and has cost several million dollars to date. A text and laboratory manual have been produced, supplementary monographs written, and demonstration experiments and various other teaching aids made available. The physics teachers are to be commended for taking the initiative in such a program. Some chemistry teachers are so unkind as to say that it was the quality of high-school physics courses which stimulated this initiative.

Similar, though less ambitious, programs are now in effect for improving high school courses in chemistry, mathematics, and biology. At the present time, again under the sponsorship of the National Science Foundation, two experimental high school chemistry texts are being developed. The first of these texts stresses the types of chemical bonds as a logical method for presenting chemistry to high school students; approximately 250 schools are using this text on an experimental basis this year. The second text emphasizes a more experimental approach; about 125 schools are using this text this year. It seems inevitable that increasing availability and use of these texts in the future will raise the general level of high school chemistry courses.

Also preceding Sputnik I was the National Science Foundation program of summer institutes (initiated in 1953) and academic-year refresher courses (initiated in 1956) for both high school and college science and mathematics teachers. These programs have been expanded until there were 398 summer institutes held during the summer of 1961; the cost of the program approached $23,000,000 and stipends were provided for 18,000 high school teachers. Twenty-one of these institutes were for chemistry high school teachers and ten were concerned exclusively with training teachers to use the two experimental texts mentioned. Participation in the academic-year institutes has grown from 95 in 1956-57 to over 1500 for 1961-62, and the budget has gone from $500,000 to almost $10,000,000.

Another activity, which began after Sputnik I, but which I believe has had a significant effect on high school teaching in both physics and chemistry, has

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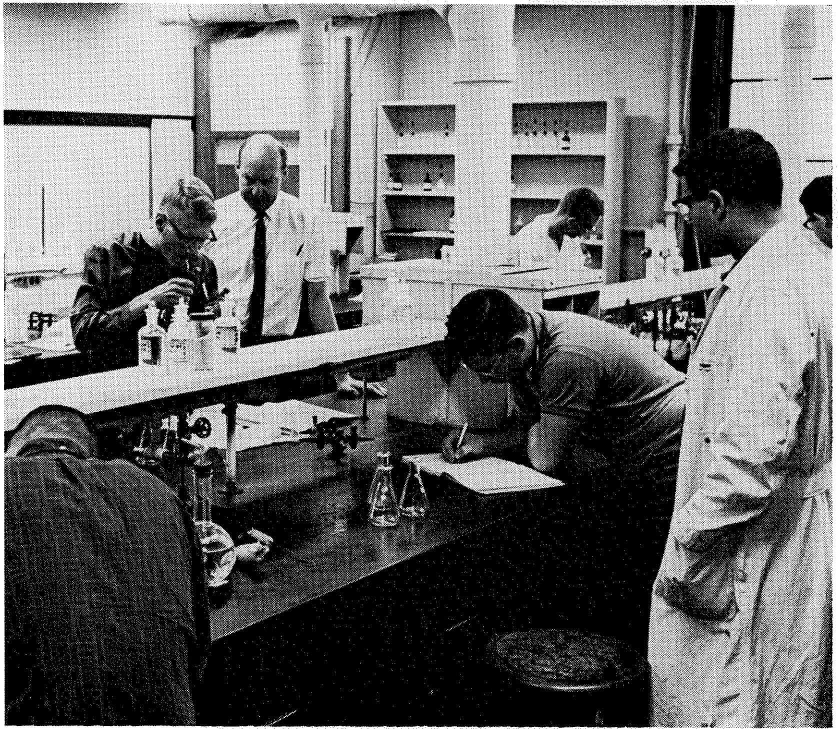


Freshmen chemistry students get more personal instruction these days. Here, Professor Jurg Waser and a graduate teaching assistant supervise a group of 10 students in the laboratory.

been the televised Continental Classroom series. These courses are exceedingly well done and are very popular. It would seem inevitable that high school teachers, knowing that their students were viewing these programs, would endeavor to prepare themselves for the inevitable barrage of questions from the students.

In addition, an increasing number of high schools, both public and private, are already giving a second chemistry course which qualifies their students to take the College Board Advanced Placement Examinations, with the resultant possibility of obtaining credit for the college general chemistry course.

In summary, there is definite evidence that these various efforts have already had a significant effect on the average quality of high school science courses. Thus the colleges are being increasingly challenged to recognize these trends and revise their curricula. Not to do so would be grossly unfair to high school teachers who have developed good courses and to students who have taken advantage of these courses.

The second challenge to college science curricula arises from what Dr. Joseph B. Platt, president of Harvey Mudd College, has called the knowledge explosion. A semanticist might prefer *publication* explosion since Dr. Platt measures this phenomenon in publication units. When both industrial and academic advancement is often dependent upon papers presented and articles published, one can question that there is a linear relation between increase in publications and increase in knowledge.

In his address to a recent Conference of Academic Deans, which was considering the effect of the expansion of knowledge on the college curriculum, Dr. Platt pointed out that John Harvard gave a library of 300 volumes to Harvard College in 1636 and that the current Harvard library has about six million volumes. These figures represent a doubling in the number of volumes every 20 years and this exponential rate of increase is representative of other university libraries. The publication rate increase for the sciences approaches a doubling every 10 years, and in the July 17, 1961, issue of *Chemical and Engineering News* the director of Chemical Abstracts Service cited data for the past 10 years showing that the chemical literature now doubles every 8.3 years.

These figures raise serious questions. Do they imply that in order to attain the same relative competence in a scientific field today 30 times as much information must be pumped into a science student as 50 years ago; or, more frightening, a thousand times as much 50 years hence? Obviously this process cannot continue indefinitely. For one thing, we have to recognize that our science curricula are likely to remain what has been termed "constant volume systems." There will be strenuous resistance to increasing the total time spent in college and an equal resistance to giving a larger proportion of the undergraduate time to science at the expense of humanistic studies. I, for one, will join the opposition to either of these proposals.

What methods remain for coping with this formidable information inflation? The improvement in high school courses represents one method which is already functioning. Another is a better organization of this expanded information. This approach implies an earlier and increased emphasis on fundamental principles and theories which the student can use to systematize the information to which he is exposed; and, of equal importance, to find or produce additional information as needed.

This approach was emphasized and pioneered almost 15 years ago by Linus Pauling in the preface to the first edition of his *General Chemistry*. He stated: "Chemistry is a very large subject, which continues to grow, as new elements are discovered or made, new compounds are synthesized, and new principles are formulated. Nevertheless, despite its growth, the science can now be presented to the student more easily and effectively than ever before. In the past the course in general chemistry has necessarily tended to be a patchwork of descriptive chemistry and certain theoretical topics. The progress made in recent decades in the development of unifying theoretical concepts has been so great, however, that the presentation of general chemistry to the students of the present generation can be made in a more simple, straightforward, and logical way than formerly."

There are some chemists who will question how far one can go in emphasizing principles and theories at the expense of experimental and factual chemistry and still be able to classify the product as a chemist. I intend to avoid debating this question. There is certainly evidence that this theoretical approach can be pushed to a degree which engenders a disregard for the experimental method and which can lead to an unrealistic, and at times woeful, misuse of theory.

A third challenge which faces the makers of curricula is the exceptional student. For present purposes an exceptional student will be defined as one with the potentialities—perhaps as yet latent—which could enable him to become a creative and productive scientist. And this country must produce creative and productive scientists in increasing numbers. Otherwise we will not keep pace with the scientific and technological advances of the future, with a consequent loss of national prestige and status and even national security.

One of the qualifications which this exceptional student must have is intelligence of a high order. But, of equal importance, he must have intellectual curiosity and imagination, scientific integrity, and exceptional motivation. The efforts which are being expended on high school science courses will bring more of these exceptional students into the colleges—students who have been motivated by good courses and inspired by good teachers. The challenge to the college is to maintain and strengthen the motivation of such students rather than to stifle their interest and curiosity with poor teaching and repetitious courses.

Independent research

One method of meeting this challenge is to arrange the college curricula so that students are given full credit for work they have done and are allowed to proceed at whatever pace they can maintain. Another method of meeting this challenge is the one which I first saw dramatically demonstrated over 40 years ago by Arthur A. Noyes at Caltech. Dr. Noyes took a personal interest in such students. He sought them out and gave them the opportunity for independent research. I purposely avoid using the term "undergraduate research;" too often this term is taken to mean a required senior thesis. I am skeptical of required research at the undergraduate level because of the belief that all students should not be required, regardless of their interests and qualifications, to go through the motions of fulfilling such a requirement. Likewise, I sympathize with instructors with large classes who are supposed to provide stimulating and scientifically productive problems for all of their students, regardless of ability and interest, and who then have to supervise the students' efforts until they produce a required thesis. There are brilliant students with predominantly theoretical interests who profit more from advanced courses; there are mediocre students who will profit more from expending the same effort in more closely supervised laboratory courses.

There is no required research in the undergraduate chemistry curriculum at Caltech. There has been a vigorous program of research in chemistry by undergraduates since the arrival of Dr. Noyes on a full-time basis in 1920. Qualified and interested students are encouraged and given the opportunity from their freshman year to undertake research under the direct supervision of members of the staff. They receive academic credit for this work and this credit can be used to satisfy elective requirements of the junior and senior years. Increasing numbers are working through the summer period and they receive academic credit for this work without payment of tuition.

I would like to cite one recent example, unusual but illustrative, of the operation of this program with an exceptional student. Two years ago Professor J. D. Roberts was approached by a freshman who stated that he had heard of Professor Roberts' use of nuclear magnetic resonance as an aid to studying the structure of organic compounds. He also explained that he had worked with electronic equipment in high school, and, although he intended to be a physicist, he would like to undertake some nuclear magnetic resonance research with Dr. Roberts. Questions showed that the student had taken the trouble to learn something about nuclear magnetic resonance, and that his academic record was very good, so he was allowed to begin work on a simple project. The student worked in his spare time for the remainder of the freshman year, worked through the following summer, then in his spare time during his sophomore year, and again during the past summer. As a result of this work three papers have been submitted for publication and another is being prepared.

Last year, as a sophomore, the student presented a report of his work before our weekly Research Conference. The level of his report can be judged by the fact that one of our staff members subsequently asked if the speaker was a visiting lecturer being considered for an appointment.

I am aware that this is an unusual case and that there are undergraduates who become disillusioned and discouraged by lack of success with a research problem. It is also true that directing the research of undergraduates is likely to be a time-consuming effort. I can only cite the willingness of our staff to give their time to directing the research of undergraduates as an indication of their estimate of its value.

Revising the chemistry curriculum

In 1956 a revision of the undergraduate chemistry curriculum at Caltech was put into effect in an attempt to meet these challenges more effectively. Honesty requires a confession that this revision was motivated by the observation that since World War II

In Caltech's freshman chemistry course each student is provided with a notched-beam chainomatic analytical balance.

there had been a continuous decrease in both the number and quality of the students electing to major in chemistry or chemical engineering. This election of a major is not made until the end of the freshman year, which at the Institute is uniform for all students. Even more disquieting was the observation that students entering the Institute with an expressed interest in chemistry were electing other fields at the end of the freshman year.

These observations indicated that the laboratory work of the freshman general chemistry course was failing to meet the first two of the challenges mentioned. First, although substantially all of our students had had high school chemistry courses, the laboratory work was failing to take advantage of this previous training. Most of the experiments were largely repetitious of ones they had already done or seen demonstrated. Some so-called quantitative experiments had been introduced, but as one student observed "we were supposed to measure some constant which had been measured fifty years ago fifty times more accurately so we just dry labbed." That is, they were not being challenged.

Secondly, many of the experiments were still unduly influenced by the period when chemistry was a predominantly descriptive science, and they conformed to a pattern which has been characteristic of chemistry curricula. They followed the historical and chronological development of chemistry and required the assimilation of a large mass of descriptive material without developing the principles which would systematize this material. That is, the laboratory work was not following the approach now used in modern general chemistry texts.

As a result of these considerations a committee composed of Professors Carl Niemann, John D. Roberts, and myself was asked to consider a revision of the work of the freshman year and, if it seemed appropriate, of the entire chemistry and chemical engineering curricula. After much discussion within the committee and with other staff members, the recommendation was made that an experimental curriculum be initiated in which the conventional laboratory work of the first two quarters of the freshman year was to be replaced by work essentially equivalent to that which was then being given in the sophomore course in basic quantitative analysis. At first this recommendation will appear questionable, since the freshman chemistry course is general in nature, and is taken by all freshmen, and since quantitative analysis is usually considered to be a specialized professional course. The recommendation was based on several observations and conclusions, however.

First, there was convincing evidence that the freshman laboratory work had not adequately recognized that science and engineering were becoming progressively more quantitative in both theory and practice. For this reason there seemed strong justification for including in the freshman chemistry course experiments which would develop the ability of a student to plan, execute, and critically interpret quantitative measurements of various types. Also, because of the increasing emphasis on theoretical material in modern general chemistry texts, it seemed almost imperative that students should develop an appreciation and respect for the experimental method and a realization that it is the basis of scientific progress.

It was further hoped that subsequent laboratory courses, regardless of their fields, would be modified to take full advantage of this early proficiency in quantitative techniques.

Second, the committee believed that by proper selection of these quantitative experiments the general principles underlying the various types of chemical reactions could be more clearly illustrated than by the multiplicity of descriptive and qualitative experiments conventionally used.

The recommendation of the committee also involved the assumption that it would not be much more difficult to teach freshman students quantitative techniques than it had been to teach these techniques to sophomores; there would even be some advantage because of the absence of dubious habits acquired from the use of pseudo-quantitative instruments and techniques in the freshman year. Subsequent experience demonstrated the validity of this assumption.

Also, it was believed that present-day freshman students, at least those who had taken a high school course in chemistry and had enrolled in a science and engineering course, were sufficiently mature and motivated to be interested and challenged by quantitative work done on a professional level.

Finally, this recommendation was based on the assumption—perhaps gamble would be a better word—that quantitative analytical experiments could be so taught that they would be more effective than the descriptive experiments previously used in arousing the interest and maintaining the motivation of the general students entering the Institute with an interest in chemistry.

The reaction to this assumption has ranged from raised eyebrows to profanity—both used to express the belief that no course in the curriculum has driven more students from chemistry than quantitative analysis. Too often this has been true, because the teachers and the texts of quantitative analysis have still taught the course as it was taught 50 years ago. At that time there was economic justification for training the student by repetitive drill with typical gravimetric and volumetric procedures to be able to go out after four years and start his career doing routine work in an analytical or control laboratory. This is not true today. In fact, it is believed that the success of such a course, especially for those students not having a strong interest in chemistry, will in large measure depend on how effectively both students and staff are convinced that training analysts is not the primary objective of the work.

The laboratory course

Initially there was justifiable criticism that too large a proportion of the work in this laboratory course was conventional gravimetric and volumetric procedures. Subsequently, under the direction of Professor Jurg Waser, there has been continuous experimentation to obtain diversification of measurements. As of last year, in addition to conventional gravimetric and volumetric methods, there were gas volumetric methods; there were coulometric and electrolytic methods involving measurements of electrical potential, current, resistance, and total quantity of electricity passing in a given time; and there were colorimetric methods involving measurements of light intensity.

As a result of shifting the quantitative analysis from the second year into the first, there has been a general shifting downwards of the chemistry courses. The basic organic course, both class and laboratory, was moved from the junior to the sophomore year. The basic physical chemistry course remains in the junior year; in place of the organic laboratory of that year there is now a one-quarter course in advanced quantitative analysis, and two quarters of physical chemistry laboratory which was formerly given in the senior year.

Because of these shifts, a student now completes his basic courses by the end of his junior year. Consequently the senior year is completely free, except for required humanities work, for a student to take research or graduate-level courses in special fields. As an alternative, serious consideration is being given to advising unusually mature and capable students to enroll in graduate school after completing their junior year.

To what extent has this curriculum been successful? An objective quantitative evaluation is difficult. The results have been most apparent in the first year where there has been a dramatic improvement in the application and apparent interest of the students in laboratory work. We believe that this has resulted in part from elimination of any repetition of high school work and from the challenge involved in using professional instruments to their full capacity. For example, freshmen learn to weigh on notched-beam, chainomatic balances.

Perhaps the most objective evidence of the relative effectiveness of the revised freshman course is the fact that after the first year there was an increase of approximately 60 percent in the number of students electing to major in chemistry or chemical engineering. This increase has been maintained in spite of the current glamor of mathematics and physics. Also, this revised freshman work has enabled greater emphasis to be placed on research by exceptional students. The proficiency in quantitative measurements and the understanding of principles now obtained in the freshman year not only enables but stimulates students to undertake research work earlier than they did before. In addition, the acceleration of the basic courses has left more time available for research or advanced courses in the last two years.

Indefinitely experimental

I wish to emphasize that the curriculum I have described is still considered to be experimental, although it is now in its fifth year. I hope that this attitude continues indefinitely. Also, even though this curriculum has been reasonably successful at the California Institute, one cannot conclude that it would be equally effective at other schools. Recently I was invited to participate in a project to establish "the ideal chemistry curriculum." Such a concept frightened me, since if it were generally accepted, further experimentation would be inhibited. I believe that the ideal curriculum for a given school is determined by the interests and capabilities of the staff and of the students of that school at that particular time. One of the most promising current developments in connection with the undergraduate chemistry curriculum is the widespread willingness to re-examine the objectives, content, and sequence of the various courses and to apply the experimental method to this re-examination.

The establishment of this revised chemistry curriculum at Caltech has been a cooperative undertaking in both planning and execution by the members of the Division of Chemistry and Chemical Engineering. The time and effort they have contributed has been responsible for whatever degree of success has resulted. To those concerned, it is obvious that continuous expenditure of both time and effort will be required if this or any other curriculum is to meet the challenges of our rapidly changing modern world.

IRIS GENETICS

by A. H. Sturtevant

Professor A. H. Sturtevant, Thomas Hunt Morgan Professor of Genetics, not only carries on an active research program with the famed Drosophila fly at Caltech, but manages to find time to carry out basic investigations on a very different form of living matter, irises. Actually, his scientific publications include investigations on heredity not only in flies and irises but also in moths, snails, evening primroses, rabbits, mice, race horses, and men.

Several different groups of irises are widely grown as ornamental garden plants. In southern California many types are grown: the California natives, the Louisiana, the Dutch, the spuria, the stylosa or winter iris, and others. But here, as elsewhere, by far the most frequent type is the bearded iris—and it is with this group that I have been making genetic studies.

Iris genetics is slow. The minimum time from seed to seed is two years, and three or four years is not unusual. To one who has worked chiefly with Drosophila this requires patience; the difference between two weeks and two years is considerable! One may well ask—in fact many people *have* asked—why then would one study such an unfavorable organism?

Perhaps the real answer is that I like iris, and get a great deal of pleasure from the blooms that come in the spring. But I also have a few other reasons which are, I hope, more convincing to people who are not infected with the iris virus, as I am.

The old-fashioned "German irises" that our grandmothers grew were diploid bearded types—that is, they had 12 pairs of chromosomes. They were descended from complex crosses involving two wild species—the lavender *Iris pallida* and the yellow and red *I. variegata*, both from southern Europe.

Beginning about 1910 these garden diploids were crossed with a series of wild tetraploids *(I. cypriana, I. mesopotamica,* etc.) that had 24 pairs of chromosomes. These forms, all from the eastern Mediterranean region, were all purplish blue in color, and were taller, larger, and more susceptible to cold and other unfavorable conditions than the older diploids. The modern tall bearded irises of our gardens have been developed from these crosses. Nearly all of these are now tetraploid, and the range of colors and patterns is far greater than in the older types, and is being extended every year.

The complex origin of the modern forms has resulted in a complicated genetic situation. There are, for example, at least four genetically quite distinct types of whites, of which only one can be identified with reasonable certainty by its appearance. The genetics of the various patterns that occur is very sketchily known; and almost nothing is known about the inheritance of properties other than flower colors and patterns.

The long time between generations is a distinct disadvantage — but there are some compensating advantages. The flowers are only rarely pollinated naturally, but set seed freely when hand-pollinated. It is, therefore, unnecessary to remove the anthers and enclose the flowers in bags when making crosses —which makes it a lazy man's job to cross-breed them.

Irises are usually propagated by planting the underground stems, or rhizomes (often incorrectly called bulbs), which perpetuate the genetic composition of the original plant. It is, therefore, easy to keep parents indefinitely for comparison with (or crossing to) their descendants. I have one old diploid that was first offered for sale in 1844; and the common winter and early spring-blooming white iris in Pasadena is *albicans*—a nearly sterile hybrid that has been propagated through rhizomes for at least 500 years. It is an Arabian plant that has long been grown in Mohammedan graveyards, and it has escaped and grows like a wild plant from Spain to India.

I started crossing irises because I wanted to get first-hand familiarity with the genetic behavior of a tetraploid form, and this seemed to be a favorable plant to use, since both diploid and tetraploid forms are available and can be crossed to each other.

Since the mid-thirties, irises of another group from the eastern Mediterranean area have begun to be intercrossed with the tetraploid tall bearded. These are members of the *Oncocyclus* group. They are short-stemmed, large-flowered types, and they are very difficult garden subjects. However, they have added new colors, patterns, and shapes, and now some fertile and more easily grown hybrid types are ap-

Dr. A. H. Sturtevant and his wife, Phoebe, maintain their experimental field of irises right on the Caltech campus, just west of the new Keck engineering building.

pearing. These raise a whole series of new genetic questions—and are of interest in connection with the old problem of interspecific sterility.

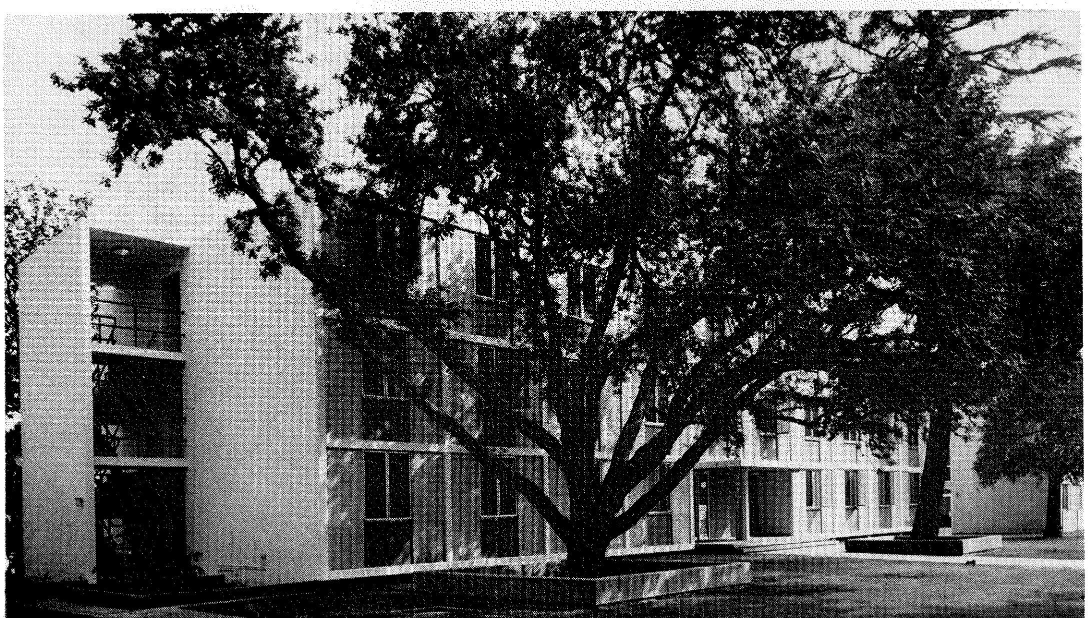
A great many people are interested in crossing irises. It has been estimated that something like a million new seedlings are flowered each year in this country—many of them by amateurs, and nearly all of them by people whose knowledge of genetics is rather slight. There is widespread interest in the basic relations—which are in fact not yet well enough understood to make possible a coherent general account of the genetics of the iris.

Helicopter view of the campus, October 9, 1961.

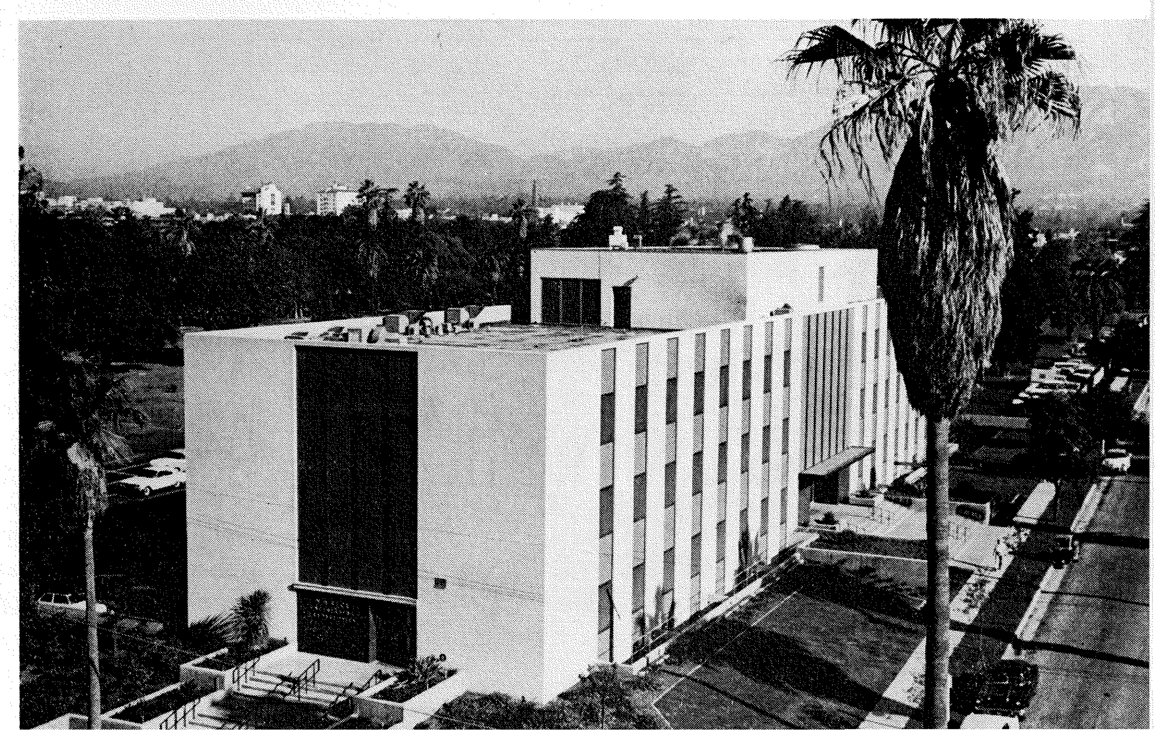
THE CHANGING CAMPUS

Caltech's graduate houses opened for business at the start of the 1961-62 academic year. The dedication of the four new houses (Keck, Braun, Mosher-Jorgenson, and Marks) on October 2 marked the completion of the 13th new structure in the Institute's 18-building development program. Still to come: the Karman Laboratory of Fluid Mechanics and Jet Propulsion which will be dedicated in January; the Firestone Aeronautics Research Laboratory and the Winnett Student Center, now under construction; and the Arnold O. Beckman Auditorium and Robert A. Millikan Memorial Library, now only in the planning stage. On the opposite page, some new faces on campus.

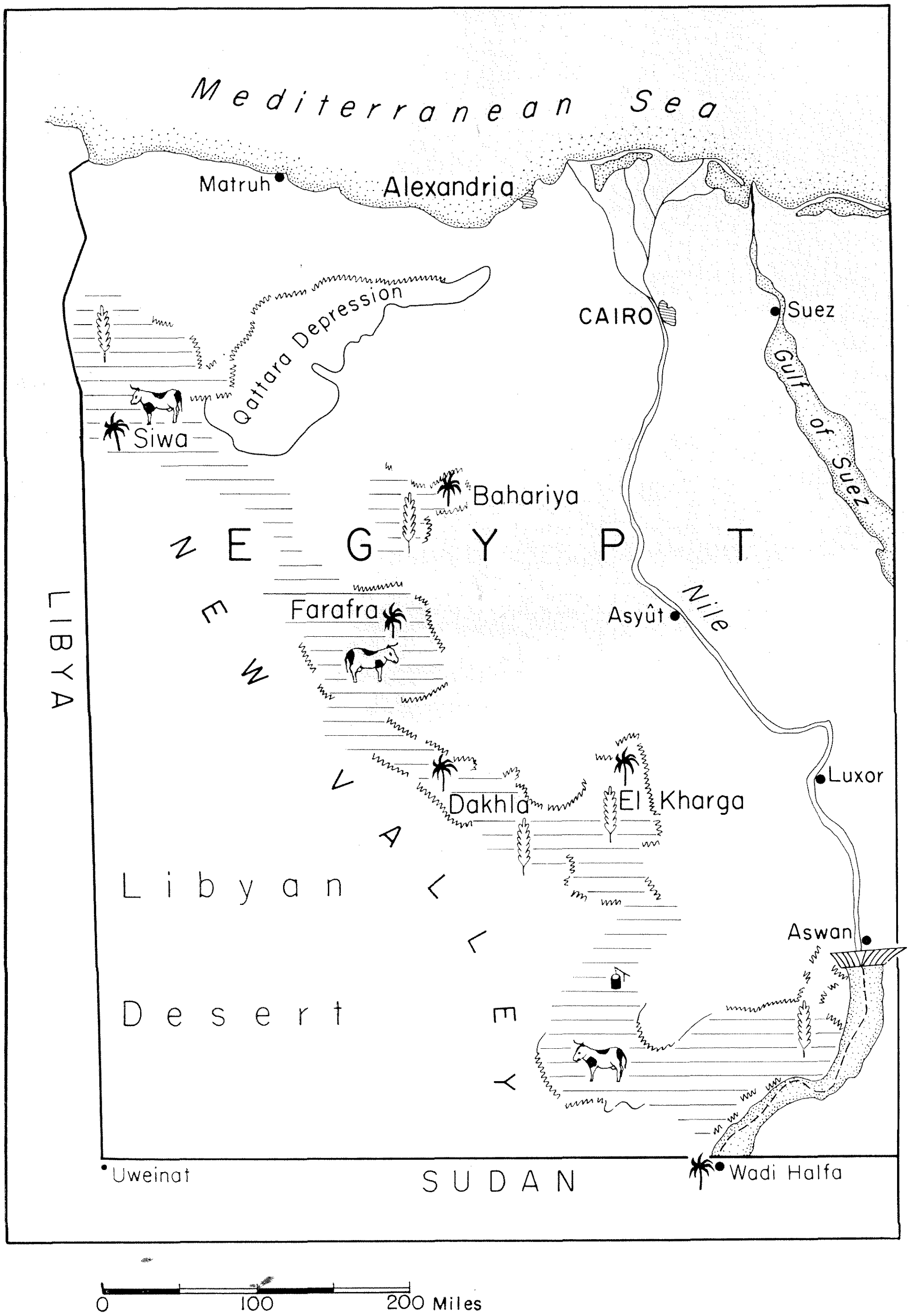
Campbell Plant Research Laboratory



Keck Graduate House



W. M. Keck Engineering Laboratories



The hatched portions in this map of the Egyptian desert show the areas that are now, or will be, irrigated by artesian water in Project New Valley, a long range plan which will bring from 10 to 15 million people to this arid area.

Project New Valley

by Egon T. Degens

In the spring of 1960, a geologist, a physicist, and a geochemist landed at Cairo airport. Their visit, which was sponsored by UNESCO, the Federal Republic of Germany, and the Egyptian Government, concerned the water problem of the Western Egyptian Desert.

It was the time of Ramadan (which literally means "hot month") when strict fasting is practiced during daylight hours, until the Great Bairam, the highest Mohammedan festival, ends the fasting. Actually, it seems that a great percentage of the Egyptian people

Αριστον μέν ὕδωρ

"Water is the best of all things"—Pindar (475 B.C.)

practice Ramadan more or less permanently, for many of them live on only one or two cupfuls of hot beans a day.

One may ask why these people cannot make a decent living in a Nile Valley which often looks like the Garden of Eden. The answer is quite simple. Egypt covers an area of about 400,000 square miles and has a population of about 26 million; that means 65 people per square mile—a population density very much like that of California. But the inhabitants of Egypt are concentrated in the small valley of the Upper Nile and delta region—an area which embraces only 14,000 square miles. In other words, there are 1,800 people per square mile here, making this one of the most densely populated spots on our planet. The rest of Egypt is just plain desert, with here and there an oasis; but only a couple of thousand people call such oases home.

The population of Egypt increases by more than 500,000 per year. A few years ago, people all over the world realized that something had to be done immediately to forestall even more serious famine, and the erection of a high dam near Aswan was planned. This would make possible the development of some industry and the irrigation of an additional few thousand square miles of desert.

Because of the external political situation, the construction of the Aswan Dam is now in progress under Russian management and will be completed in 8 to 10 years. The succeeding irrigation program will provide subsistence to about 5 million people—but, since this is precisely the expected increase in population over the coming decade, it is somewhat unrealistic to regard the Aswan Dam as the final solution to Egypt's problems.

Ancient history

Not long ago, in the period of about 100,000 to 10,000 B.C., the Western Egyptian Desert, which is a part of the Libyan Desert, was a center of culture and civilization. Since that time human beings have gradually disappeared from this region. The population has declined from an estimated few million people in the Mesolithic era to just a few thousand fellaheen today.

In Mesolithic times, which cover the period from about 50,000 to 10,000 B.C., huge fresh water lakes developed naturally in the Western Egyptian Desert. They were fed by streams which branched from the old Nile near Wadi Halfa and then flowed northwesterly along the line of the so-called desert depressions—in which the oases Kharga, Dakhla, Farafra, Bahariya, and Siwa are located—to end ultimately in the Mediterranean.

This picture, as outlined, is like a mirage seen across the sands of time, for today one sees only growing sand dunes, dry lakes, and a precipitation of less than one inch in 25 years.

The past — key to the future

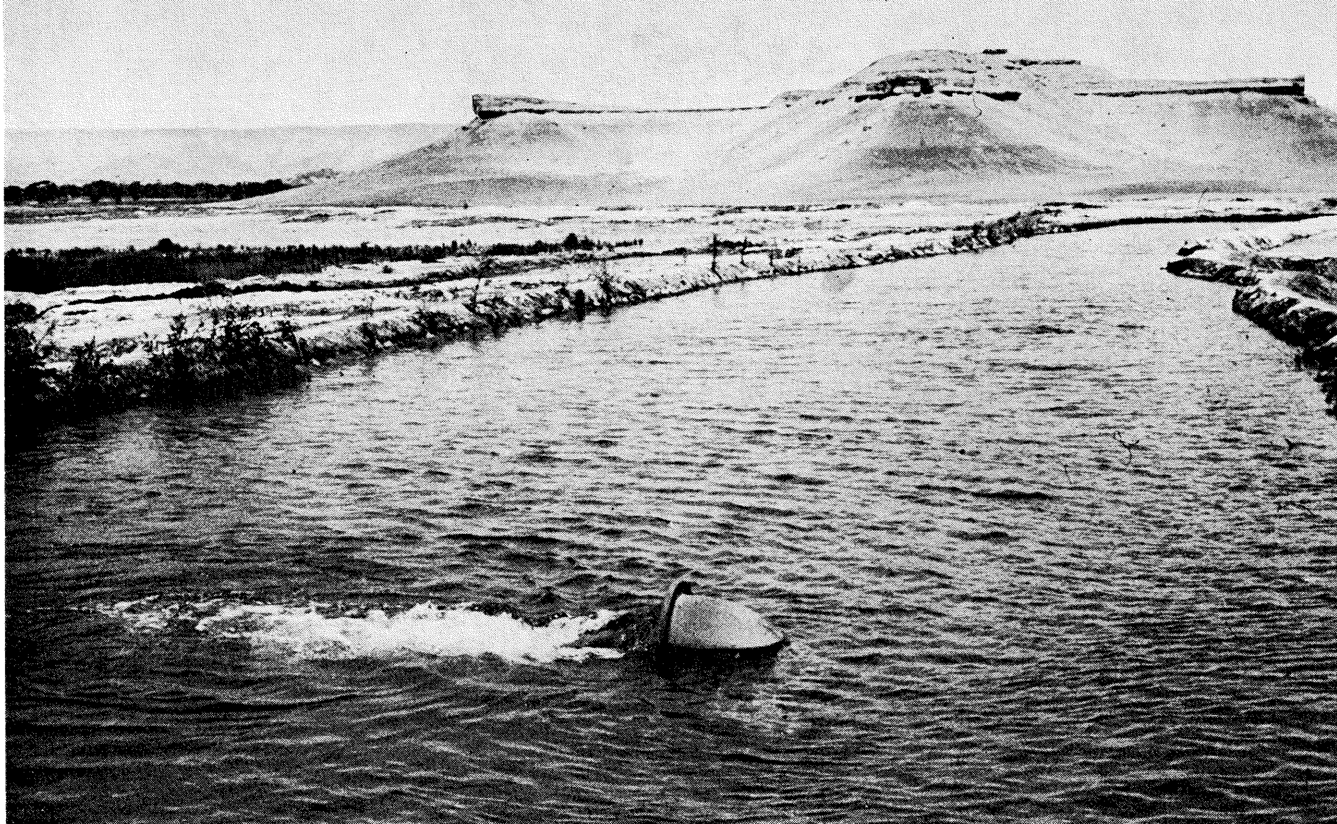
Oases are located sporadically throughout the Libyan Desert, and it is a common belief that they have unlimited water resources at depth. It is further assumed, without adequate basis, that this water reservoir is continuously recharged from the south (Abyssinia-Sudan) and southwest (Equatorial Africa) where precipitation is abundant.

This belief is based largely on the fact that the oases have stayed as a bastion in the desert for at least the last few thousand years, and that during this period the water supply has not changed significantly.

The water is mostly artesian—brought to the surface by natural water or gas pressure. It is stored at depths from 100 to 3,000 feet below the present surface. It is well established by geological studies that there is subsurface water intercommunication between some of the oases, which could mean that water reservoirs of larger dimensions are developed at greater depth beneath the Libyan Desert.

This assortment of facts and vague hypotheses has led to one of the most fantastic cultivation programs the world has ever known—Project New Valley. Although this program will change the economy and the face of Egypt in a profound manner, little is known about the ultimate goal of the project outside of Egypt. Basically, the project intends to irrigate land now occupied by desert by means of subsurface waters, supplied from hundreds of bore holes to be drilled in the depressions of the Western Egyptian Desert. Some additional water will be furnished from the Aswan High Dam reservoir along an artificial river flowing through the New Valley.

The area under consideration is hatched in the map at the left. This is the very same area where prehistoric man lived, and the aim of Project New Valley is, therefore, the recultivation of ancient farmland which has gradually developed into desert over the last 5 to 10 thousand years. As an indication of how



Project New Valley produces irrigation water at a rate of about 300,000 cubic meters a day at the oasis of Dakhla. Pipes like that above bring artesian water from hundreds of feet below the surface. At present the water is overflowing and evaporating, leaving thick layers of salts on the newly developed acres.

the project will affect the population structure of Egypt, approximately 10 to 15 million Egyptians are expected to settle in this area within the next 10 to 15 years.

New Valley is an outgrowth of the General Organization for the Rehabilitation of Deserts which was founded at Cairo about 10 years ago. One of the first activities of this organization was to drill a great number of bore holes across the desert depressions, hoping for unlimited water resources beneath the desert.

The project is only a few years old and still in its initial stage, yet millions of cubic meters of water are being continuously extracted from the subsurface reservoir. At Dakhla, a small community of less than 1,000 people, the daily outflow of water is about 300,000 cubic meters, a quantity sufficient to supply a town of 1-2 million inhabitants. At present, the water is just running down from the slope to evaporate at the rate of about one inch a day, leaving layers of salts up to a half inch in thickness on the newly developed acres.

One important necessity for the success of Project New Valley is that the extraction rate of the water be matched by an influx rate of comparable magnitude. However, there are convincing reports that such a sound water balance does not exist. For instance, a significant decrease in gas pressure and water outflow rate has already been registered in the first five years of the project. This might be an indication that the water resources are not as plentiful as generally assumed.

This was the situation when our three-man research team landed at Cairo airport to study the origin, source, and distribution of the artesian waters in the Western Egyptian Desert. Over a period of three weeks we collected water samples from various places in the desert depressions, the location site of New Valley, to be analyzed later in our laboratories at home. A two-engine Ilyushin aircraft, furnished by the Egyptian Government, made this rapid collecting of the water specimens possible.

The group was headed by Dr. Georg Knetsch, director of the Geological Institute at Wuerzburg University in Germany. Dr. Knetsch has spent many years in Africa doing temporary work as head of the Department of Earth Sciences at Cairo University. He is unanimously regarded as the outstanding European expert on African geology. His profound knowledge of Egyptian geology was the scientific backbone of our whole investigation.

The physicist, Dr. Karl Otto Munnich, senior research associate at the Physical Institute of Heidelberg University, working with Dr. John Vogel, associate professor at the Physical Institute of Groningen University, determined the age of the waters by means of carbon-14 analysis.

As geochemist, I investigated the chemistry and stable isotope distribution of the waters and the sediments.

During our trip, we were associated with two Egyptian geologists, Dr. A. Shata and Dr. M. Shazly, both staff members at the Desert Institute in Cairo.

Geological background

To understand the water situation and the future of Project New Valley, it is necessary to have some idea of the geological setup of Egypt.

The oldest rocks exposed in Egypt are crystalline rocks of Precambrian age. They cover a small strip of about 30 to 80 miles wide along the west coast of the Red Sea. They are also present in Sinai. Westward from the Red Sea, these Precambrian or basement rocks are overlaid by sediments belonging to the so-called Nubian Series which dip gently to the west.

Spots of Precambrian rocks also crop out in the Libyan Desert, close to the border of the Sudan. These crystalline "islands" are oriented along an east-westerly line starting from about Aswan and moving westward to Uweinat, a small place located in the northeast corner of the Sudan. This is the surface manifestation of the Aswan-Uweinat Uplift, a gigantic subsurface rock dome which lifted crystalline rocks to, or close to, the present surface and has served as an effective impermeable barrier to the movement of ground water.

North of this uplift, the crystalline basement dips northward and is covered by sediments of the Nubian Series which are gently inclined to the north. The Nubian rocks represent stratigraphically all sediments from at least the Cambrian up to the Cretaceous and sometimes the Eocene, a time period covering about 400 million years of earth history. In the north, Upper Cretaceous and Tertiary limestones and clays rest upon the Nubian Series.

These features indicate that Egypt is surrounded on the east and on the south by a girdle of crystalline rocks; to the west extends the Sahara Desert, and on the north the country is bounded by the Mediterranean. Inside Egypt, moving from the Aswan-Uweinat Uplift in the south toward the Mediterranean, only Nubian and younger sediments are exposed, resting on the Precambrian basement. Toward the north, these sediment layers increase steadily in thickness from zero to about 10,000 feet. They hold the waters on which the success of Project New Valley largely depends.

"Tales Sunt Aquae . . ."

"Waters take their nature from the strata through which they flow." This statement by Plinius (23-79 A.D.) carries a profound meaning. Practically all matter found in the earth's crust is to some degree soluble in natural waters. Natural waters act as decomposing agents and solvents in the earth's crust. In turn, the waters cannot remain unchanged in their chemical composition as long as they migrate through rocks. The proportion and type of soluble matter taken up from the strata depends on a number of factors such as the chemical nature of the rocks, the purity and temperature of the water, the ease of circulation of water through the rocks, the overhead pressure, and the velocity of water flow.

In applying these fundamental hydrochemical laws to the Egyptian water problem, all the systematic variation in the chemistry of the waters can be explained in a simple fashion. Our data show that waters taken from oases in the south, close to the Aswan-Uweinat Uplift, have about 10 times less solutes than waters obtained from oases in the north, located near the Mediterranean. In other words, there is an increase in salinity toward the north, and this increase is solely caused by contributions of chlorine, sulfate, and sodium ions to the water solutes. The remainder of the ions show no significant fluctuations over hundreds of miles.

Experimental leaching studies on the Nubian Series, which serve as aquifers or water-carrying strata, reveal that chlorine, sulfate, and sodium are, in fact, the only ions that can be extracted in significant quantities from the Nubian wall rock. This feature suggests a cause-effect relationship between sediment and associated water in a manner which confirms that "Tales sunt aquae, qualis terra per quam fluunt."

Isotope analysis

Although the chemistry of the water changes consistently from south to north as a result of migration and storage mechanisms, the ratio of the two stable isotopes of oxygen (0^{18} and 0^{16}) in this water does not change and, further, the amount of the heavy 0^{18} is abnormally low.

From other studies it is known that the amount of 0^{18} in natural waters is controlled primarily by the temperature at which such waters precipitated from the atmosphere. Precipitation occurring under cold conditions is relatively deficient in 0^{18}. The fact that the Egyptian ground waters are abnormally low in 0^{18} gives a clue as to the climatic conditions under which such water fell to earth and seeped into the ground to be stored in the safe-deposit box of the Egyptian water basin.

Analyses of the carbonates of the waters made it even more possible to determine the precise age of the water. At Kharga, the age is about 25,000 years, and at Siwa, 30,000 years. The ages of the other oases fall in between, gradually increasing from south to north.

The history of the water

All geochemical, geological, and physical information indicates that the water fell in Pluvial periods of the Mesolithic era about 25,000 to 30,000 years ago and was transported in surface drainage systems from

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Abyssinia and the Sudan into the Western Egyptian Desert in the Nile drainage system of that time. A significant *sub*surface migration of former rain waters from Central or East Africa into Egypt can be completely ruled out, since the Aswan-Uweinat Uplift, which once had lifted the crystalline basement to, or close to, the present surface, operated as an extremely effective water barrier, preventing a significant subcutane influx of water from the Sudan, Abyssinia, or the region of Equatorial Africa. The infiltration of present Nile water, a hypothesis formerly suggested, can be excluded for various geological and geochemical reasons.

Prehistoric lakes

The large supply of water from outside into the center of the desert depressions in prehistoric times resulted in the formation of extensive fresh water lakes full of fish, in which sediments were deposited. These unobtrusive sediments are the only clues to the former existence of the lakes, and their present distribution makes it possible to reconstruct the ancient shore lines. Embedded in the sediments, besides prehistoric artifacts, are small gastropod shells, whose isotope ratios are consistent with ratios that would be expected if the shells were formed in isotopic equilibrium with the desert water and its dissolved carbonate.

It is even possible to calculate, from the oxygen isotope data of the desert water and the shell carbonate, the mean annual temperature of the lake environment at the time the shell creature lived. The prehistoric water had a mean annual temperature of about 15-16°C, which is appreciably lower than the present mean temperature of the Nile. This is not surprising since there was a glacial stage at about that time.

The Nubian sediments, in which shales, sandstones, and conglomerates alternate, are quite favorable for the storage and transportation of the water. Aquifers are provided by sandstones and conglomerates, which are enclosed by relatively impervious shales. In those days the lake and river water oozed rapidly into the underlying Nubian Series or was carried by surface drainage systems into the Mediterranean along the line from Kharga to Siwa.

Evaporation from the lakes that existed in prehistoric times certainly caused precipitation and affected the general climate considerably. It has to be emphasized, however, that the overwhelming part of the present subsurface water was derived from the same geographical intake area as that of the present Nile, whose chemistry is identical with that of the desert waters which have been stored in the most southern oases for the last 25,000 years.

Water is never at rest. The Egyptian water migrated slowly from an intake area bounded by the Aswan-Uweinat Uplift in the south toward the Mediterranean, picking up more and more salts from the surrounding rocks during transportation. On the basis of carbon-14 data, it has been estimated that the velocity of flow is roughly 15 miles in 100 years. The solutes of the water increase by about two milligrams per liter during one mile of transportation. The low salt concentrations in the southern oases support our inference that the water did not migrate the long distance of about 1,000 to 1,500 miles through rocks from Abyssinia to the Sudan.

Waters from greater depths rise to the surface by pressure of gases. The origin of these gases is not fully known. The most likely hypothesis is that the gas phase, which is mostly air, became entrapped in the sediments contemporaneously with the water. During storage and migration, the gases were separated from the water, and the shales, operating as a shield, prevented their escape. Just as compressed gas billows force oil to the surface in some petroleum deposits, waters present in the Nubian Series may similarly be expelled to the outside.

Future prospects

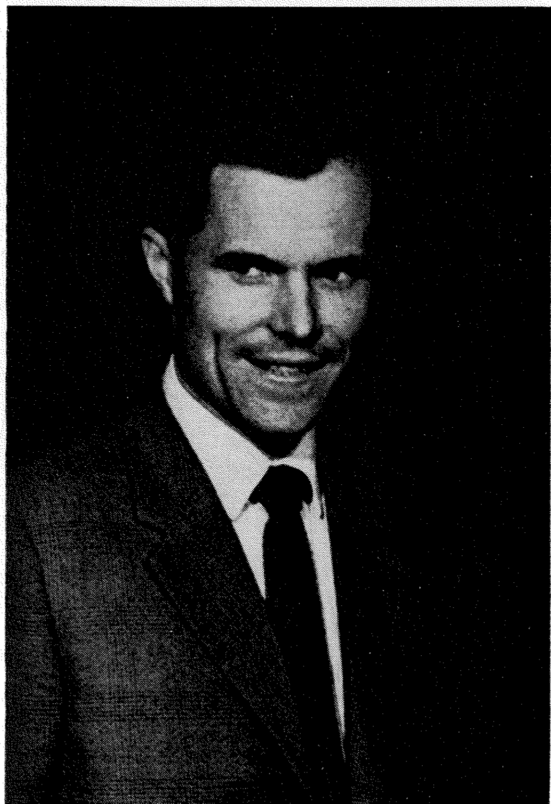
The success of a project of such fantastic dimensions as New Valley is dubious. Waters in the Libyan Desert are with great probability fossil, which means that no significant recharge from outside takes place. In addition, the water reservoirs are more or less restricted to small sediment basins below the desert depressions and do not extend over the entire Libyan Desert. Finally, the waters are presently being wasted in an irresponsible manner. There is of course no simple way to calculate the total water reserves, but the decrease in outflow in some of the oases should make people suspicious.

Under these circumstances it is advisable to stop the enormous consumption of irrigation water immediately. This can easily be done by switching from a flooding to a sprinkling technique, which would simultaneously prevent the development of salt crusts on the newly developed acres. It should also be possible to irrigate the desert on a somewhat smaller scale during the final stage of the cultivation program.

Under these conditions, the future of the many fellaheen who will eventually settle in the desert will be more secure, perhaps for the next hundred years or two.

I can already visualize a small stream, branching from the water reservoir of the Aswan High Dam into the Western Egyptian Desert and sending, as in prehistoric times, Nile water to the New Valley. More water will come from the ancient water reservoirs beneath the desert depressions. The climate will become more favorable and the New Valley will be transformed into a flourishing Garden of Eden.

This vision is the same as the one Egypt has been dreaming of ever since those seven meager years recorded in the first book of Moses.



Rudolf L. Mössbauer

Nobel Prizewinner

Rudolf L. Mössbauer, senior research fellow in physics at Caltech, is one of two scientists to receive the 1961 Nobel Prize in Physics. Dr. Mössbauer was awarded the prize for his discovery of the radiation effect that bears his name. The other half of the $48,300 physics prize goes to Robert Hofstadter of Stanford University for his discoveries about the structure of nucleons.

The Mössbauer effect is a remarkably accurate yardstick that enables physicists to measure precisely, for the first time, the effects of natural forces such as gravity, electricity, and magnetism, on infinitely small particles, such as photons and parts of the nuclei of atoms.

Basically, the Mössbauer effect states that under certain conditions both the atomic nucleus and the whole crystal that contains it will recoil when the nucleus emits or absorbs a gamma ray. Emitting and absorbing nuclei, if built into crystals, are, therefore, exactly in resonance. With the Mössbauer effect, physicists can observe this nuclear resonance more sharply than ever before, and can use it for extremely precise measurements of gravity, magnetism, and the structure of the nucleus.

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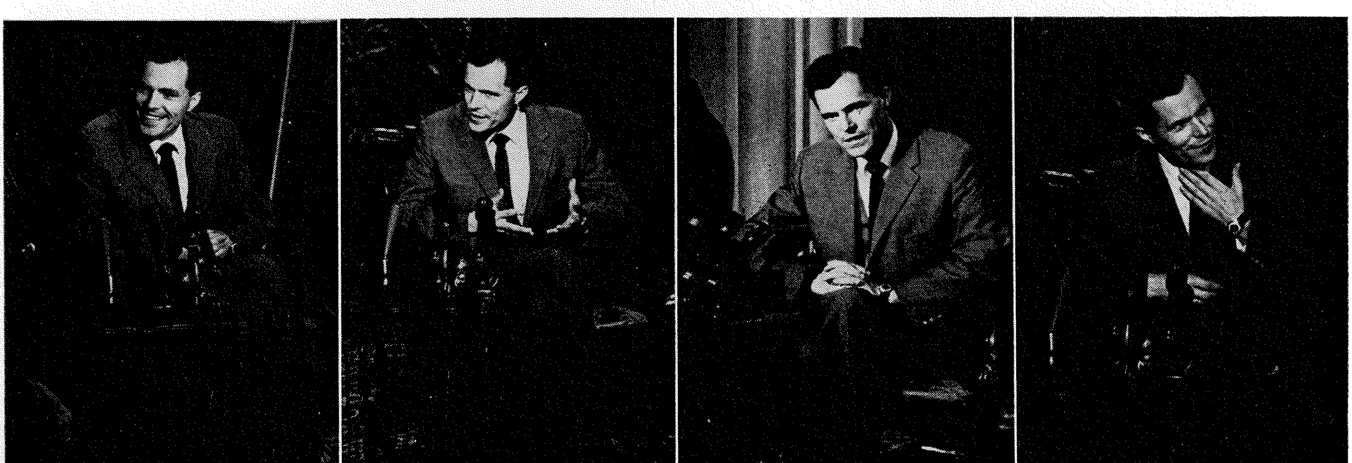
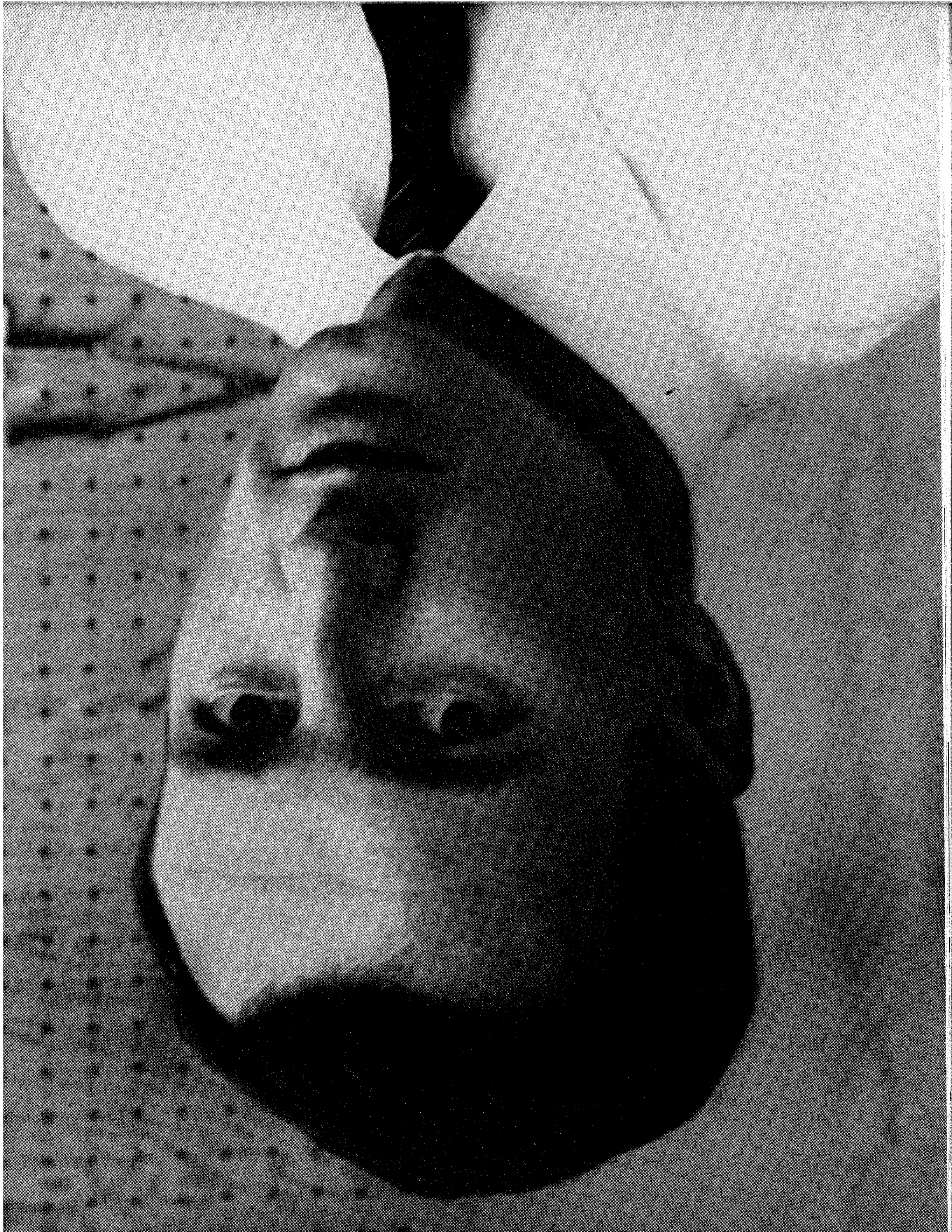
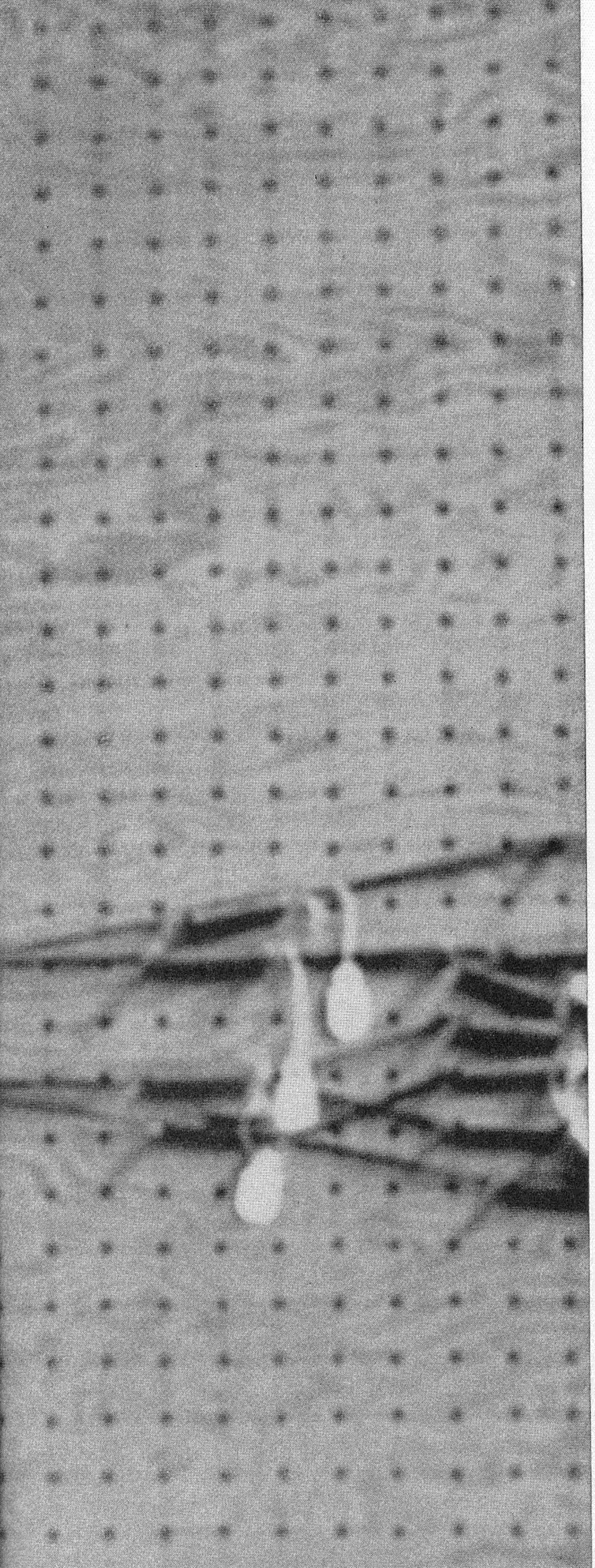


Mössbauer meets the press after being notified of his award.





Edward H. Sussenguth, Jr. (B.A., Harvard '54; M.S. in E.E., MIT '59) has investigated the theoretical requirements of an automated design system for advanced cryotron-circuit computers.

HE WORKS WITH A NEW DIMENSION IN COMPUTER DESIGN

Thin film cryotrons may make possible computers of small size and truly prodigious speeds.

The speeds of today's computers are limited mainly by device switching times. Speeds of cryotron computers would be limited mainly by signal propagation times between devices.

Automation of Logical Circuits. Edward Sussenguth has studied methods of design which will reduce the distance between devices to a minimum. He hopes that these will contribute to a completely automatic design system.

Ultimately, then, the systems designer would specify his needs in terms of Boolean equations and feed them into a computer. The computer would (a) design the logical circuits specified by the equations, (b) translate the logical circuits into statements describing the interconnections, (c) from the interconnections, position the devices in an optimal fashion, (d) from this configuration, print out the masks to be used in the evaporation process by which these circuits are made.

This is a big order, but Edward Sussenguth and his colleagues have already made significant progress. Their work may well have a profound effect on computer systems in the coming years.

Orientation: the future. One of the exciting things about computer development is this orientation towards the future. If a man wants to match his personal growth with the growth of computer systems, his future can be virtually unlimited. This is true of all the fields associated with computer systems—research, development, manufacturing, programming, marketing. The IBM representative will be glad to discuss any one of these fields with you. Your placement office can make an appointment. All qualified applicants will be considered for employment without regard to race, creed, color or national origin. You may write, outlining your background and interests, to:

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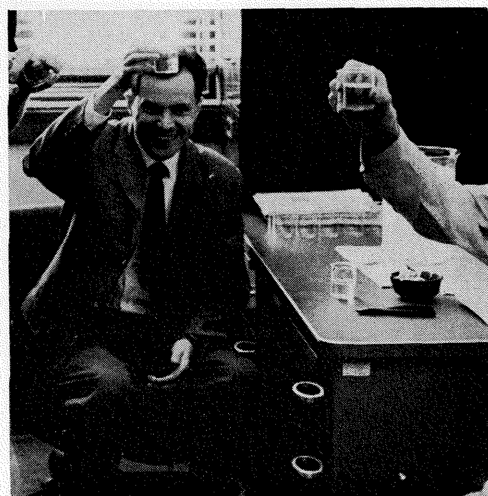


The Mössbauer effect enables physicists to test phases of Einstein's theory of relativity, and it has already confirmed Einstein's prediction that gravity can change the frequency of a light beam. It is being used in laboratories in several countries to resolve mysteries in the fields of solid state physics and nuclear physics. And it may also help to make manned space flights safer.

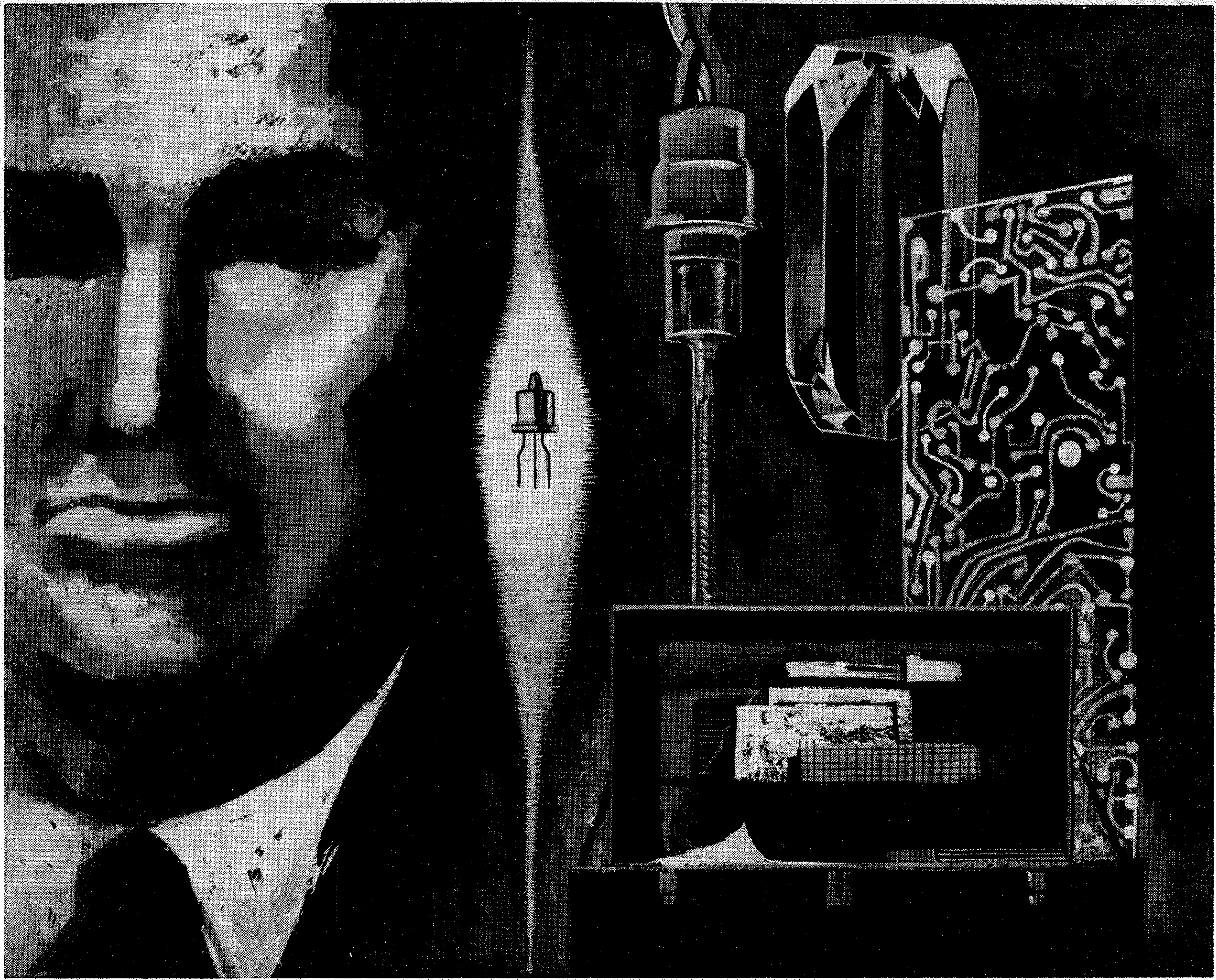
At Caltech Dr. Mössbauer and his colleagues are using his effect to study the internal magnetic and electric fields in isotopes of the rare earth elements. Information is being obtained about the complex electrical interactions in the crystalline structure of these compounds, and about the electric and magnetic properties of excited nuclear states. The work is supported by the Atomic Energy Commission.

Dr. Mössbauer has been at Caltech since March 1960, on a two-year leave of absence from the Institute for Technical Physics at Munich, Germany.

He was born in Munich on January 31, 1929, and received his academic degrees there. His PhD was awarded magna cum laude by the Institute for Technical Physics in 1957. Dr. Mössbauer worked as a research fellow at the Institute until he was granted a leave of absence to come to Caltech.

Formerly a mathematician, Mössbauer started his gamma ray research at the Institute for Technical Physics in 1953 when his supervisor suggested that he enter this new field. He made his discovery while working for his doctor's degree.

Mössbauer has received three other prizes for his research: The Research Corporation Award in 1960; the Roentgenpreis from the University of Giessen, Germany, last July; and the Elliott Cresson Medal, which he received from the Franklin Institute of Philadelphia last month. The Cresson Medal was awarded for "his discovery of recoilless emission, and for his penetrating analysis and understanding of the phenomenon which has led to a tool of unbelievable discrimination now widely employed in many facets of physical research to make measurements believed impossible as little as ten years ago."



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THE CALTECH STUDENT

— and what makes him like that

When the new freshmen arrive at Caltech each September, they are immediately bussed off to the mountains for three days of what is called New Student Camp. Quite unexpectedly, the purpose of Camp is not to haze and hector the frosh into four years of jolly college fun, but rather to ease their way into the harsh realities of Life at Tech. In recent years Camp has been remarkably successful in its chosen task.

To the gimlet eyes of the upperclassmen and professors in charge of running Camp, the frosh are usually a mixture of about equal parts of high self-opinion and idealistic naiveté. Thus, a great deal of Camp time is devoted to the twin tasks of beating down egos while building up ideals with a few hard facts. These noble aims are accomplished by a series of speeches and discussion groups in which three points are constantly reiterated:

1) Science is fun, but it is difficult. Many smart high school graduates don't know this, because most high schools haven't quite caught on to the fact that science has progressed beyond Newtonian physics (without calculus) and making iron sulphate in chemistry lab.

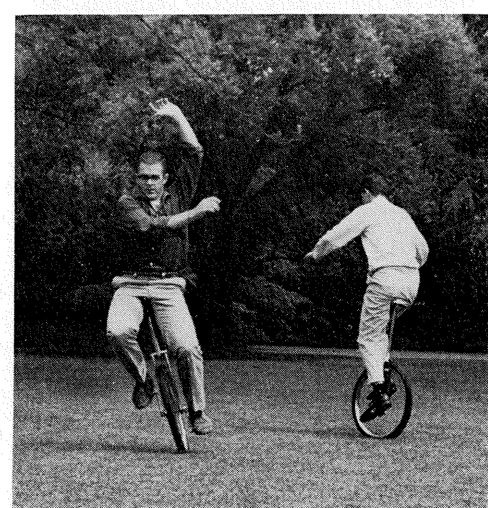
2) As a consequence, Caltech – with a sincere desire to produce at least one Nobel laureate per class – crams cubic acres of content into its courses in an attempt to turn bright, dedicated, but ignorant high school graduates into competent scientists in four years.

3) Therefore, since everybody who comes to Caltech is smart anyway, and since competition obviously breeds a love of knowledge, Caltech is operated on a strictly competitive basis – in fact, it is probably the most competitive place in the country outside of the stricter Mafia training camps.

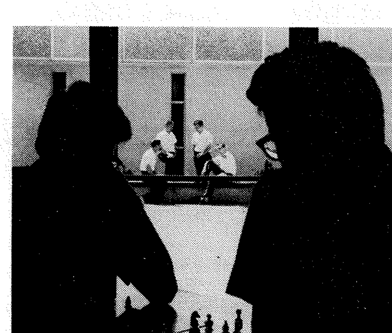
The last point of the three is most important, since it is the competition which makes life at Tech different from life at almost every other college in the country. At Friendly State U. (and even at most of the highly-rated liberal arts colleges) academics is a sort of passing diversion – a passport to a degree or a means to get a job. At Tech, academics and the competition it fosters is everything. Here you either beat out your buddy, or flunk.

Which is not to say that Tech students study excessively; in fact, rather the opposite is true. Despite all the hoary rumors, the amount of midnight oil burned at Caltech is so small as to be almost unnoticeable. After all, the College Boards do assure smart students at Tech, and (excuse the Hackneyed Phrase) you either understand how to do problems or you don't, and great amounts of pondering over a proof or formula usually don't help you understand it any more than five minutes of hard concentration does.

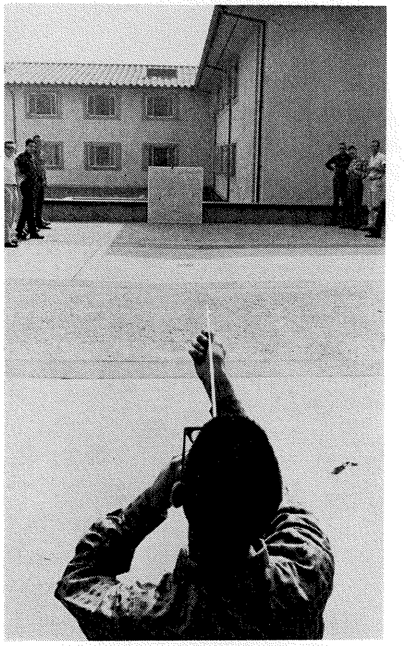
What *is* more important about the competition here is that a Techman is always trying to escape from it – in any of a vast number of ways.



Caltech student life is really one big escape from the awful realities of the classroom.



For example, all social life is predicated on an attempt to forget school. Techmen, when they date (about half of us go out once a week or more), scarcely ever do so with an eye to just friendship, or even romance. What *we* go out for is escape, liberation, or hope. Techmen, therefore, are inclined to date either artsy-craftsy types who can enthrall the addled mind with softly-sung Bach cantatas and discussion about the difficulties in translating the Mundaka Upanishad, or else party girls who can soothe the senses with fine laughter and voluptuousness. Very rarely do Techmen escort the Jane Does of the world, on the theory that unless a girl is strikingly talented in some field or another, she cannot possibly distract you from that ten-problem physics assignment due Monday.



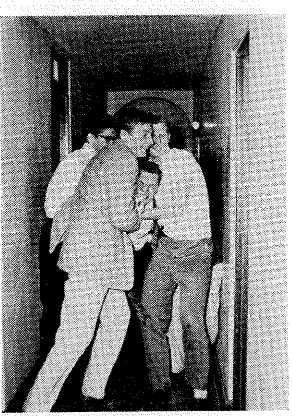
This same philosophy carries over into all other aspects of non-classroom life. Other colleges pull pranks out of youthful high spirits, while we make research projects out of them, putting in endless hours of planning, with minds half-split between schemes and finals, just around the corner. Even our sports program is anti-rah-rah, with the players stealing a few hours from academic worry for a hurried practice.

Even in its day-to-day aspects, like the interminable bridge games and the perpetual "goofing off," Caltech student life is really one big escape from the awful realities of the classroom. In short, the prevailing undergraduate attitude is that Life at Tech is Hell. We sort of work at it.

But, as the catalog and the Deans have it, there is a happy day by and by for even the most discouraged of Techmen. After only four years in this place, you graduate, we are told. Actually what happens is that four-sevenths of any frosh class can count on graduating, while the others fall by the wayside for one reason or another.

For the ones who make it, there are degrees, jobs, and a certain exhausted satisfaction at having muddled their way through. And for the three-sevenths who don't make it — well, tough luck, guys; at least you got accepted into the Toughest School in the Country.

—Lance Taylor '62



Personals

1926

Frank Streit is now vice president of the Columbus and Southern Ohio Electric Company in Columbus, Ohio. He handles all engineering and operation of the generation, transmission and distribution systems. Frank's daughter is now an art major at UCLA.

1929

Miguel A. Basoco, PhD, professor of mathematics at the University of Nebraska, received the university's 1961 Distinguished Teachers Award, consisting of a stipend of $1,000 and a medallion. Miguel has been on the Nebraska faculty for 31 years.

Emerson M. Pugh, PhD, is now associate head of the department of physics at the Carnegie Institute of Technology in Pittsburgh. He has been on the faculty since 1920.

1933

L. Eugene Root, MS '33 ME, MS '34, AE, is now president of the Lockheed Missiles and Space Company in Sunnyvale, Calif. He continues as vice president of Lockheed Aircraft Corporation.

1934

Robert Boykin manager of the gasoline plants of the Monterey Oil Company in Los Angeles, has been elected president of the California Natural Gasoline Association for 1961-62.

Garford Gordon, research executive of the California Teachers Association, has been loaned to UNESCO for a year to work with the Pakistan government on the development of a centralized agency for the collection and interpretation of educational information.

1935

Lewis B. Browder has been named manager of advanced development in the Data Recorders Division of the Consolidated Electrodynamics Corporation in Pasadena.

Jesse E. Hobson, PhD, has resigned as vice president and director of research of the United Fruit Company in Boston.

1937

George E. Mann, MS '38, is now associate professor of engineering at Los Angeles State College. He has been on the faculty since 1957. George is also owner-manager of an engineering firm in Los Angeles.

1940

W. Bertram Scarborough, MS '41, project engineer at the Standard Oil Company of California, has been busy this year building and developing the new refinery for the company in Hawaii. The family lives in Lafayette, Calif., where Bert has been active in the formation of a new library, on the school board, and on the citizen's committee for the development of a science and mathematics curriculum in the grade schools. The Scarboroughs have three children: Dave, Nancy, and Marjorie.

Willis G. Worcester, MS, is now head of the department of electrical engineering at the University of Colorado in Boulder. He also remains as assistant dean of the graduate school during 1961-62.

1941

Wallace D. Hayes, AE '43, PhD '47, professor of aeronautical engineering at Princeton University, spent the academic year 1960-61 in Zurich at the mathematics department of the Federal Institute of Technology. His wife and three daughters accompanied him.

Donald F. J. McIntosh, is now controller of the Los Angeles Exploration and Producing Division of the Mobil Oil Company. He has been with the company since 1941.

Eldred Hough, MS, PhD '43, is now professor of petroleum engineering and head of the department at Mississippi State University in Starkville. He had been professor of petroleum engineering at the University of Texas since 1952. The Houghs have four children.

1942

Capt. Sheldon W. Brown, USN (ret.), is now manager of Aerojet-General's Atlantic Division at Frederick, Md.

1943

Nicholas A. Begovich, MS '44, PhD '48, assistant manager of the ground systems group and director of product line operations for the Hughes Aircraft Company in Fullerton, Calif., has been made a vice president of the company.

1944

John A. Zivic, director of manufacturing at the Cannon Electric Company in Los Angeles, is one of 150 men selected to attend the 40th session of the Advanced Management Program at the Harvard Business School. The 13-week course (Sept. 10-Dec. 8) is designed for men between 36 and 50 years of age who are now in top management positions or are likely to be in the near future.

1945

Joseph Kelley, Jr., MS, is now president and general manager of Allied Research Associates, Inc. in Boston. He had served as executive vice president of the organization since 1953.

Robert J. Kieckhefer, Jr., is now vice president of administration and engineering at the Litho-Strip Corporation in Chicago. He was formerly assistant to the president.

1946

Sal LaFaso, MS, AE, is manager of the administration department at Aerojet's Atlantic Division in Frederick, Md. He has been with Aerojet since 1956 and was formerly manager of contracts at the Downey plant.

Edwin S. Gould is now a chemist in the petroleum chemistry department at the Shell Development Company's Emeryville Research Center.

Alan R. Stearns has been elected a vice president of Marshall Industries in San Marino. He was formerly manager of special projects and will continue his work in the fields of acquisitions, new products research, and marketing. The Stearns' have two children—Laura, 9, and Ralph, 6.

1947

William F. Ballhaus, PhD, has been appointed executive vice president of the Northrop Corporation in Los Angeles. He has been vice president of Northrop and general manager of its Nortronics division since August 1957, and has been with the company since 1953.

Howard J. Teas, PhD, is now head of the recently-created agricultural biosciences division of the Puerto Rico nuclear center at the University of Puerto Rico at Mayaguez. He was formerly associate professor of botany at the University of Florida's agricultural experiment station in Gainesville.

1948

Paul S. Rogell, MS, EE, now heads Rogell Associates, in Norwalk, Conn., a company appointed by the Espey Manufacturing and Electronics Corporation as representatives to sell technical electronic products in New York, Connecticut, Long Island, Westchester County, and Northern New Jersey. Paul was formerly sales manager of the electron tube department of the Columbia Broadcasting System.

C. Craig Paul, ID, vice president of Harley Earl Associates in Warren, Mich., is senior member of the three-man team which designed the U.S. section at the Italia '61 exposition in Turin, Italy, now in progress.

continued on page 36

N. John Beck, MS, is now vice president of research at the Cummins Engine Company, Inc., in Columbus, Indiana. He joined the company in 1959, and has recently been serving as director of advanced design and development in the company's research division.

1949

William M. McCardell, MS, is now coordinator of long-range planning at the Humble Oil and Refining Company in Houston, Texas.

1950

Richard Buck, MS '51, is now principal research chemist at the Bell & Howell Research Center of the Consolidated Electrodynamics Corporation in Pasadena. He was formerly research chemist at the California Research Corporation in San Francisco.

Lt. Col. William B. Higgins writes from Stanford that "after three years postgraduate work – two years at the Naval Postgraduate School – for a BS in aeronautical engineering, and a year and a summer here at Stanford for the Degree of Engineer, to be awarded in January, we are heading southward to Point Mugu. To make things merrier, two children were added to the family in the last two years – one a ready-made, and last June, one of our own, making our total three.

"At Point Mugu, I will have a project job on the F4H and its missile system. The bone-creaking and other deteriorations associated with middle age have not gotten so far out of hand as to keep me from flying jets up to now – and I hope they hold off a little longer."

1951

Douglas Calley writes that he is teaching math and physics to grades 9-12 at the Verde Valley School in Sedona, Arizona. He was married to Louise Nelson in 1959 and they now have a son, John, born on January 26, 1961. Doug is currently building a small mountain cabin north of Flagstaff.

Leo Baggerly, MS '52, PhD '56, assistant professor of physics at Texas Christian University in Fort Worth, received a silver cup last spring from Alpha Chi, national scholastic honor fraternity, as "the professor who has contributed the most to the intellectual growth of TCU during the past year."

Jim T. Luscombe, president of the Luscombe Engineering Corporation in San Marino, is now also vice president of the Pacific Division of the Valve & Primer Corporation in Pasadena.

Robert E. Covey, MS '52, is still chief of wind tunnel operations and environmental test facilities at Caltech's Jet Propulsion Laboratories.

John W. Bjerklie, manager of the research and development section of Sunstrand Aviation in Denver, Colorado, writes that his main work interest is space conversion systems and torpedo propulsion engines. The Bjerklies have three children: John J. E., 8, David, 6, and Kirsten, 1.

Ernest Dzendolet, BS '55 Bio., is an assistant professor in the psychology department of the University of Massachusetts at Amherst. His interest is in sensory psychology – primarily electrical phenoma of the eye.

George C. Dacey, PhD, is now vice president of research at the Sandia Corporation in Albuquerque, N.M. He was formerly director of solid state electronics research at the Bell Telephone Laboratories in Murray Hill, N.J. The Daceys have two children; Donna and John.

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1952

Donald E. Stewart, MS '53, is now a chemical engineer in the advanced power systems division of Electro-Optical Systems, Inc., in Pasadena. He was formerly technical director for the Industrial Hard Chrome Plating Corporation in Emeryville, Calif.

Howard M. Robbins, PhD, is senior engineer on the technical staff of the manager of advanced systems research at the IBM Federal Systems Division Space Guidance Center in Owego, N.Y. He has been with the company since 1960.

1953

Artur Mager, PhD, is now assistant director of spacecraft sciences at the Aerospace Corporation in Los Angeles. He was formerly director of sciences at the National Engineering and Science Company in Pasadena.

Major Kenneth M. Hatch, MS, completed the regular course at the U.S. Army Command and General Staff College in Fort Leavenworth, Kansas, last spring, and is now assigned to the Kansas City District Engineers Office in Kansas City, Mo.

Gilbert E. Stegall, MS, supervising climatologist at the Weather Records Processing Center in Kansas City, Mo., recently received an award of $200 in recognition of extremely competent performance at his job from the U.S. Department of Commerce Weather Bureau in Washington. The citation read: "Under your capable leadership, and with the complete cooperation and confidence of the personnel under your supervision, a complex program is being carried out in an exceptional manner in your Center. The high degree of leadership, initiative, and resourcefulness you have displayed together with your fine personal performance in the program you manage, are most commendable and typify the contributions on which your award is based."

Donald O. Emerson is now assistant professor and chairman of the rapidly expanding department of geological sciences at the Davis campus of the University of California. Since he left Caltech, Don has received an MS and PhD from Penn State.

1954

Major Francis G. Gosling, Jr., MS, completed the regular course at the U.S. Army Command and General Staff College at Fort Leavenworth, Kansas, in June, and is now stationed at the Department of Tactics, U.S. Military Academy, West Point, N.Y.

1956

Major Mark C. Carrigan, MS, completed a 38-week course at the U.S. Army Command and General Staff College in Fort Leavenworth, Kansas, in June and is now assigned to San Juan, Puerto Rico.

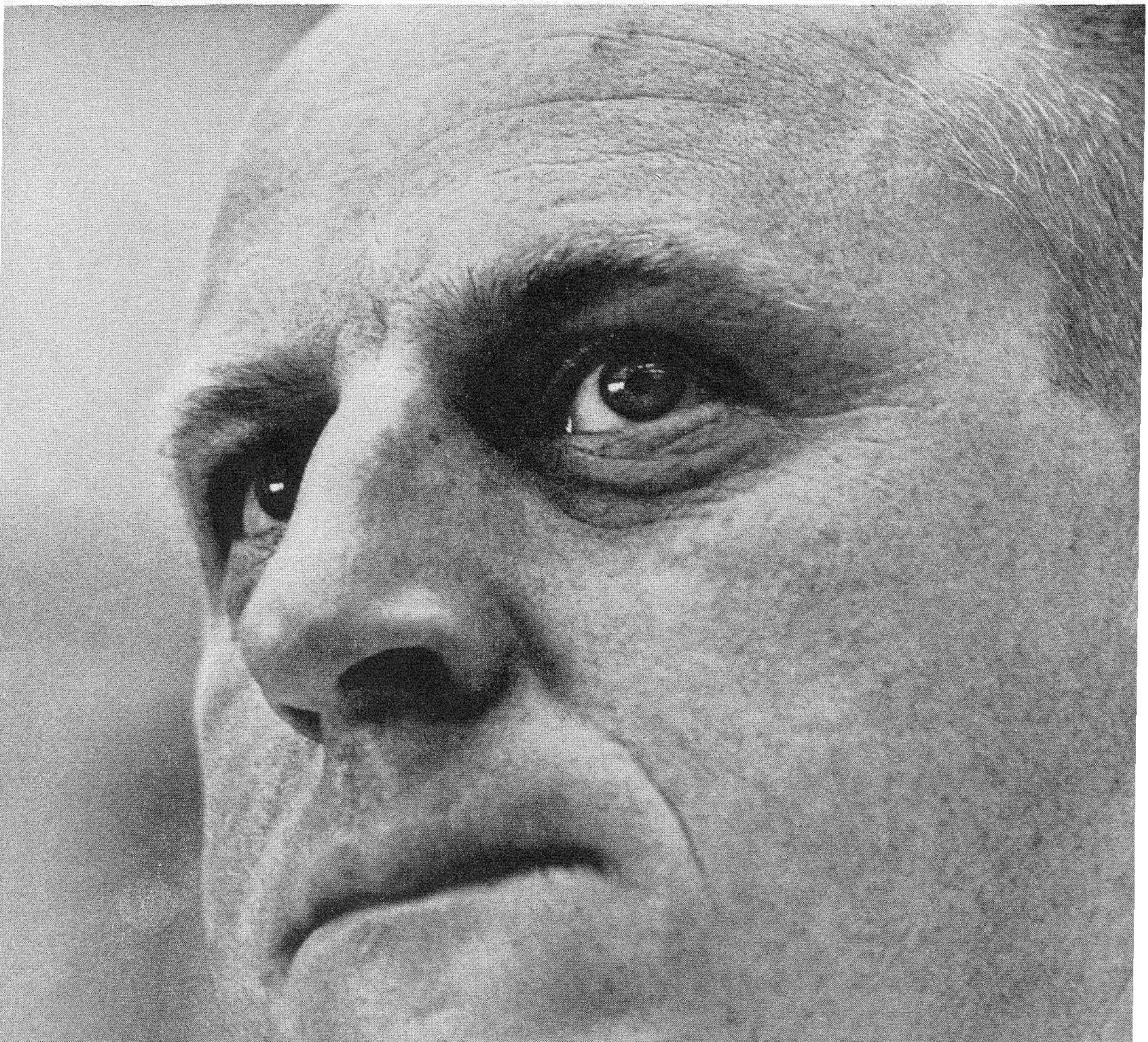
1957

Don M. Pinkerton writes that he is working for the electro-mechanical staff of the Federal Aviation Agency, engaged in the design and inspection of electrical power systems for new air traffic control facilities in the 11 western states.

Capt. Harry M. Roper, Jr., MS, completed a 38-week course at the U.S. Army Command and General Staff College at Fort Leavenworth, Kansas, in June and is now stationed at Headquarters, Third U.S. Army, in Fort McPherson, Ga.

Oak St. School
Inglewood, Calif.

Do you share his driving determination to know?



An unsolved problem is a nagging challenge to him. The word "impossible" is an impertinence.

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Lost Alumni

The Institute has no record of the present addresses of these alumni. If you know the current address of any of these men, please contact the Alumni Office, Caltech.

1906
Norton, Frank E.

1911
Lewis, Stanley M.

1915
Soyster, Charles J.

1918
Lavagnino, John F.

1921
Arnold, Jesse

1922
Cox, Edwin P.
Rose, Edwin L.

1923
Hickey, George I.
Skinner, Richmond H.

1924
Goldsmith, Morris
Tracy, Willard H.

1925
Waller, Conrad J.

1926
Chang, Hung-Yuan
Maechtlen, Lawrence G.
McCarter, Kenneth C.
Yang, K. J.

1927
Evjen, Haakon M.
Moore, Bernard N.
Riggs, Eugene H.

1928
Chou, P'ei-Yuan
Martin, Francis C.
Morgan, Stanley C.
Wingfield, Baker

1929
Briggs, Thomas H., Jr.
Burns, Martin C.
Muskat, Morris
Nelson, Julius
Robinson, True W.
Wolfe, Karl M.

1930
Allison, Donald K.
Chao, Chung-Yao
Douglass, Paul W., Sr.
Janssen, Philip
Shields, John C.
White, Dudley

1931
Ho, Tsien-Loh
Voak, Alfred S.
West, William T.
Woo, Sho-Chow
Yoshoka, Carl K.

1932
Brass, P. D.
Bruderlin, Henry H.
Patterson, J. W.
Shockley, William
Wright, Lowell J.

1933
Applegate, Lindsay M.
Downie, Arthur J.
Hsu, Chuen Chang
Koch, A. Arthur
Larsen, William A.
Lockhart, E. Ray
Michal, Edwin B.
Murdock, Keith A.
Rice, Winston R.
Shappell, Maple D.
Smith, Warren H.

1934
Harshberger, John D.
Liu, Yuan Pu

1935
Becker, Leon
Bertram, Edward A.
Huang, Fun-Chang
McNeal, Don

1936
Chu, Djen-Yuen
Creal, Albert
Dunn, Clarence L.
Kelch, Maxwell
Nelson, Loyal E.
Ohashi, George Y.
Van Riper, Dale H.

1937
Burnight, Thomas R.
Cheng, Ju-Yung
Easton, Anthony
Fan, Hsu Tsi
Jones, Paul F.
Lotzkar, Harry
Maginnis, Jack
Moore, Charles K.
Munier, Alfred E.
Nojima, Noble
Penn, William L., Jr.
Rechif, Frank A.
Servet, Abdurahim
Shaw, Thomas N.

1938
Gershzohn, Morris
Goodman, Hyman D.
Gross, Arthur G.
Kanemitsu, Sunao
Li, Yuan-Chuen
Lowe, Frank C.
Porter, Edwin J.
Rhett, William
Tilker, Paul O.
Tsao, Chi-Cheng
Wang, Tsun Kuei
Watson, James W.
Woodbury, William W.

1939
Asakawa, George
Brown, William Lowe
Gombotz, Joseph J.
Liang, C. Chia-Chang
Robertson, Francis A.
Tsien, Hsue-shen
Weinstein, Joseph
Wilson, Harry D.

1940
Batu, Buhtar
Gentner, William E.
Gibson, Arville C.
Green, William J.
Hsu, Chang-Pen
Karubian, Ruhollah Y.
Menis, Luigi
Paul, Ralph G.
Tajima, Yuji A.
Tao, Shih Chen
Torrey, Preston C.

1941
Clark, Morris R.
Dieter, Darrell W.
Easley, Samuel J.
Geitz, Robert C.
Harvey, Donald L.
Hubbard, Jack M.
Kuo, I. Cheng
Levitt, Leo C.
Noland, Robert L.
Robinson, Frederick G.
Standridge, Clyde T.
Taylor, D. Francis
Tiemann, Cordes F.
Waigand, LeRoy G.
Wolfe, Samuel

1942
Bebe, Mehmet F.
Callaway, William F.
Chastain, Alexander
Devault, Robert T.
Emre, Orhan M.
Go, Chong-Hu
Hughes, Vernon W.
Johnston, William C.
Levin, Daniel
MacKenzie, Robert E.
Martinez, Victor H.

Caltech Varsity Game Scores

Football

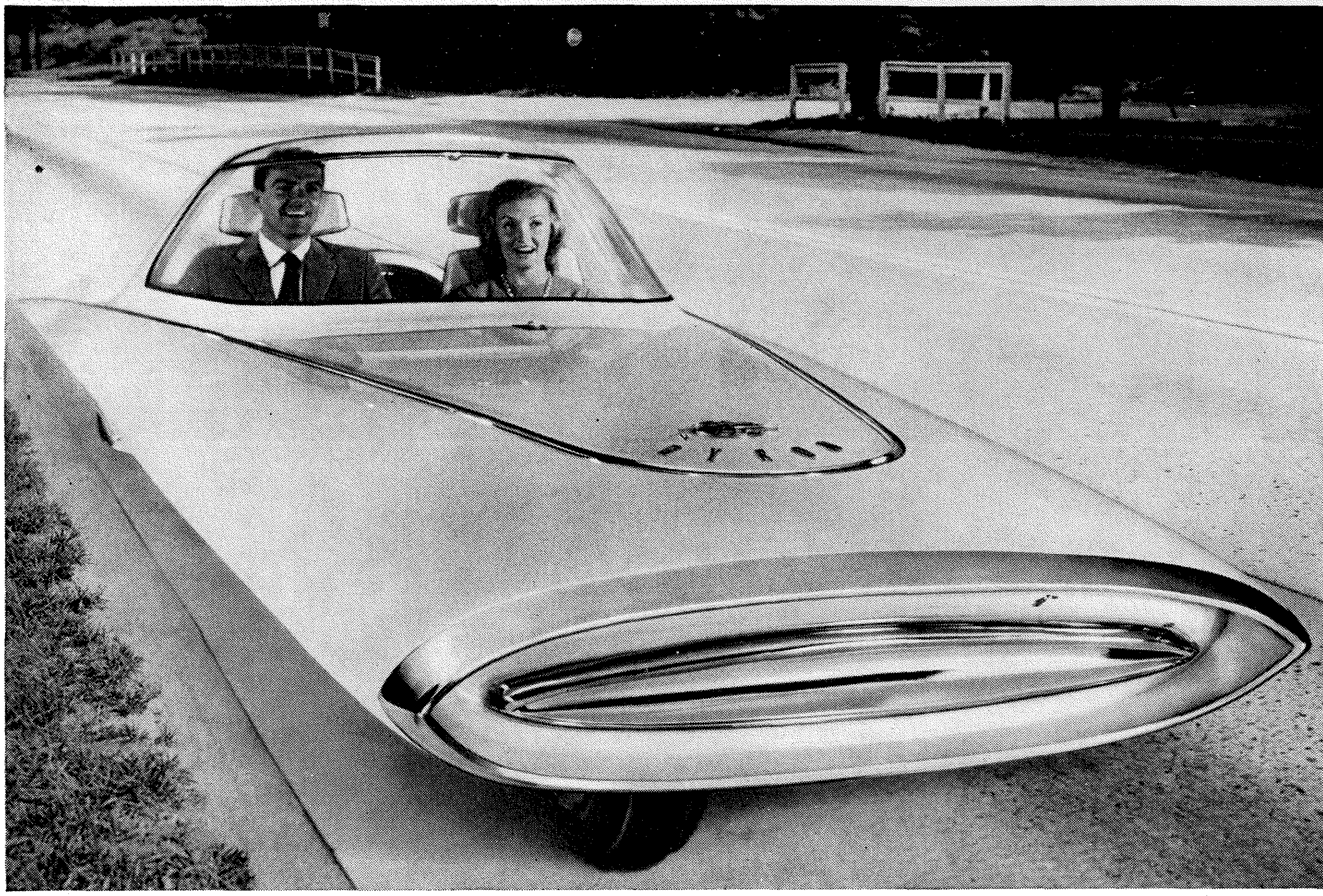
October 7	Azusa College	43	Caltech	14
October 14	Pomona	53	Caltech	7
October 21	Le Verne	29	Caltech	0

Water Polo

October 3	Caltech	9	San Fernando State	8
October 6	Caltech	15	Pasadena City Coll.	10
October 10	L.A. State	17	Caltech	4
October 13	UCLA	17	Caltech	3
October 17	Caltech	14	Claremont-H. Mudd	6
October 20	Pomona	11	Caltech	6
October 24	Caltech	16	Mt. SAC	7

Soccer

October 7	Caltech	2 (tie)	Biola	2
October 14	Caltech	5	UC Riverside	4
October 21	Caltech	3	Caltech	1



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The engineer is vitally concerned with design—inside and outside—whether it's an advanced new car or a nuclear-powered ship. With Nickel, or one of the many metals containing Nickel, he has a material that can meet the demands of a wide range of service conditions—providing an excellent choice for the equipment of today and the designs of the future.

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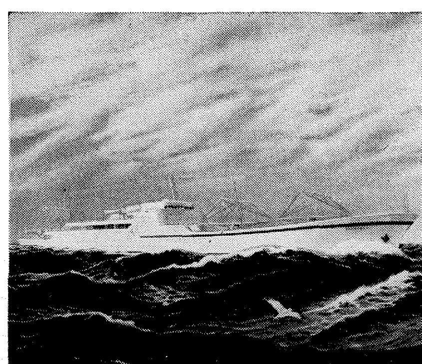
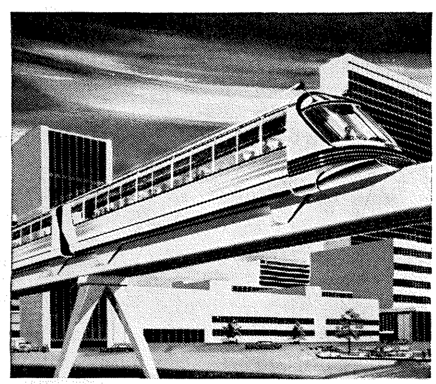


The Nuclear Ship Savannah is capable of sailing 350,000 nautical miles without refueling. Her uranium oxide fuel is packaged in tubes of Nickel Stainless Steel, more than 5,000 of them. Engineers specified 200,000 pounds of Nickel Stainless Steel for use in the ship's reactor to meet critical service demands.



Monorail "Airtrain"—a compact, high-speed transportation system that will be automatic, almost noiseless. Development is being explored by leading U.S. cities. Lightweight Monorail design demands strong weight-saving metals. Logical choice: Nickel alloys to take advantage of newest engineering concepts.

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Lost Alumni . . . *continued*

1943
Angel, Edgar P.
Bethel, Horace L.
Bridgland, Edgar P.
Brown, Glenn H., Jr.
Brown, James M.
Bryant, Eschol A.
Burlington, William J.
Carlson, Arthur V.
Colvin, James H.
Daniels, Glenn E.
Hamilton, William M.
Hillyard, Roy L.
Hilsenrod, Arthur
King, Edward G.
Koch, Robert H.
Kong, Robert W.
LaForge, Gene R.
Lee, Edwin S., Jr.
Leeds, William L.
Ling, Shih-Sang
Lobban, William A.
Lundquist, Roland E.
Mampell, Klaus
Mixsell, Joseph W.
Mowery, Irl H., Jr.
Nesley, William L.
Neuschwander, Leo Z.
Newton, Everett C.
O'Brien, Robert E.
Patterson, Charles M.
Pearson, John E.
Rambo, Lewis
Rivers, Nairn E.
Roberts, Fred B.
Rupert, James W., Jr.
Scholz, Dan R.
Shannon, Leslie A.
Smitherman, Thomas B.
Tindle, Albert W., Jr.
Vicente, Ernesto
Walsh, Joseph R.
Washburn, Courtland L.
Weis, William T.
Wood, Stanley G.

1944
Alpan, Rasit H.
Baranowski, John J.
Barriga, Francisco D.
Bell, William E.
Benjamin, Donald G.
Berkant, Mehmet N.
Birlik, Ertugrul
Burch, Joseph E.
Burke, William G.
Cebeci, Ahmed
Cooke, Charles M.
De Medeiros, Carlos A.
Fu, Ch'eng Yi
Harrison, Charles P.
Hu, Ning
Johnson, William M.
Labanauskas, Paul J.
Leenerts, Lester O.
Lin, Chia-Chiao
Marshall, John W.
Mattinson, Carl O.
Onstad, Merrill E.
Osborne, Louis S.
Pi, Te-Hsien
Pischel, Eugene F.
Rasof, Bernard
Ridlehuber, Jim M.
Shults, Mayo G.
Stanford, Harry W.
Stein, Roberto L.
Sullivan, Richard B.
Trimble, William M.
Unayral, Nustafa A.
Wadsworth, Joseph F., Jr.
Wight, D. Roger
Williams, Robert S.
Wolf, Paul L.
Writt, John J.
Yik, George

1945
Ari, Victor A.
Budney, George S.
Bunze, Harry F.
Fanz, Martin C.
Fox, Harrison W.
Gibson, Charles E.
Jenkins, Robert P.
Knapp, Norman E.
Kuo, Yung-Huai
Levy, Charles N.
Rice, Jonathan F.
Tseu, Payson S.
Turkbas, Necat
Yank, Frank A.

1946
Allison, Charles W., Jr.
Barber, John H.
Behroon, Khosrow
Bowen, Mark E.
Burger, Glenn W.
Chen, Ke-Yuan
Childers, Kenan C., Jr.
Dethier, Bernard
Dyson, Jerome P.
Esner, David R.
Foster, R. Bruce
Halvorson, George C.
Hayne, Benjamin S., III
Hoffman, Charles C.
Huestis, Gerald S.
Ingram, Wilbur A.
KeYuan, Chen
Lewis, Frederick J.
Lowery, Robert H.
Maxwell, Frederick W.
Olsen, Leslie R.
Parker, James F.
Prasad, K. V. Krishna
Simmons, George F.
Sledge, Edward C.
Smith, Harvey F.
Tung, Yu-Sin
Webb, Milton G.
Weldon, Thomas F.
Winson, Jonathan

1947
Asher, Rolland S.
Atencio, Adolfo J.
Clarke, Fredric B.
Clements, Robert E.
Dagnall, Brian D.
Darling, Donald A.
Hammerle, William G.
Hsu, Chi-Nan
Huang, Ea-Qua
Lane, James F.
Leo, Fiorello R.
Lim, Vincente H., Jr.
MacAlister, Robert S.
Manoukian, John
McClellan, Thomas R.
Miller, Curtis E.
Molloy, Michael K.
Moorehead, Basil E. A.
Olson, Raymond L.
Orr, John L.
Ramaswamy, Guruvayur S.
Ray, Kamalesh
Rust, Clayton A.
Sanders, Lewis B.
Sappington, Merrill H.
Torgeson, Warren S.
Wan, Pao Kang
Wellman, Alonzo H., Jr.
Wimberly, Clifford M.
Winters, Edward B., Jr.
Ying, Lai-Chao

1948
Agnew, Haddon W.
Bunce, James A.
Collins, Burgess F.
Cotton, Mitchell L.
Crawford, William D.
Hager, James Ward
Hsieh, Chia Lin
Hsiao, Chien
Latson, Harvey H., Jr.
Leavenworth, Cameron D.
Mason, Herman A.
Morehouse, Gilbert G.
Oliver, Edward D.
Rhynard, Wayne E.
Stein, Paul G.
Swain, John Sabin
Swank, Robert K.
Voelker, William H.
Winniford, Robert S.
Woods, Marion C.
Wray, Robert M.
Yanak, Joseph D.

1949
Barker, Edwin F., Jr.
Bauman, John L., Jr.
Baumann, Laurence I.
Bottenberg, William R.
Bryan, Wharton W.
Burkholder, Joseph F.
Clancy, Albert H., Jr.
Clendening, Herbert C.
Cooper, Harold D.
Felt, Gaelen L.
Foster, Francis C.
Galstan, Robert H.
Heiman, Jarvin R.
Hurley, Neal L.
Krasin, Fred E.
Lowrey, Richard O.
MacKinnon, Neil A.
McElligott, Richard H.
Merrell, Richard L.
Parker, Dan M.
Petty, Charles C.
Rinehart, Marion C.
Ringness, William M.
Stappler, Robert F.
Weiss, Mitchell
Wilkening, John W.
Yu, Sien-Chiue

1950
Bryan, William C.
Edelstein, Leonard
Gimpel, Donald J.
Li, Chung Hsien
McDaniel, Edward F.
McMillan, Robert
Merrifield, Donald P.
Montemezzi, Marco A.
Pao, W. K.
Paulson, Robert W.
Petzold, Robert F.
Roberts, Morton S.
Scherer, Lee R., Jr.
Soldate, Albert M.
Whitehill, Norris D.

1951
Arosemena, Ricardo M.
Chong, Kwok-Ying
Davison, Walter F.
Denton, James Q.
Hawk, Riddell L.
Lafdjian, Jacob P.
Li, Cheng-Wu Li
Padgett, Joseph E., Jr.
Palmer, John M., Jr.
Pfeiffer, Walter F.
St. Amand, Pierre
Summers, Allen J.
Van Hise, Albert E.

1952
Abbott, John R.
Arcoulis, Elias G.
Gerington, Thomas E.
Harrison, Marvin E.
Helmuth, James G.
Loftus, Joseph F.
Long, Ralph F.
Lunday, Adrian C.
O'Brien, Joseph
Primbs, Charles L.
Robieux, Jean
Schaufele, Roger D.
Shelly, Thomas L.
Sutton, Donald E.
Wiberg, Edgar
Wilson, Howard E.
Woods, Joseph F.
Zacha, Richard B.

1953
Lennox, Stuart G.
McCormick, William D.
Ritter, Darrell L.
Schroeder, Norman M.
Vidal, Jean L.
Wilburn, Norman P.

1954
Coughlin, John T.
Feuchtwang, Thomas E.
Handen, Ralph D.
Mertz, Charles III
Rogers, Berdine H.

1955
Barman, Mervyn L.
Campbell, Douglas D.
Crowe, Thomas H.
Lim, Macrobio
Negrete, Marco R.
Wolfe, John H.

1956
Edwards, Robert W.
Feige, Jacques
Garnault, Andre F.
McAllister, Don F.
Romaneski, Albert L.
Spence, William N.
Tang, Chung-Liang

1957
Howie, Archibald
Leader, Elliot
Lee, Wonyong
Rapaport, Seymour A.
Stuteville, Joseph E.
Wong, Chi-hsiang

1958
Marin, Jean Francois
Rieunier, Jacques M.
Schumann, Thomas G.

1959
Bodine, Alan G.
Byun, Chai B.
Guillemet, Michel P.
Idriss, Izzat M.
Ko, William
Monroe, Louis L.

1960
Lindquist, David M. W.

1961
Loussararian, Serge
Steinberg, Charles M.

LAST OF THE BIG SPENDERS

"Hullo? . . . Oh, George? . . . oh . . . Boy, are you persistent! I thought we settled everything last month . . . Didn't you get my letter? Well, for gosh sake. Wait a minute—

"Miss Johnson! Will you come in here for a minute? . . . Didn't you mail my letter to Mr. Sternmeyer? . . . On the tenth? Let's see—that was last Friday!

"Hey, George. My secretary mailed it Friday. You should have gotten it by—

"What'd it *say*? Well, it said I was convinced everybody should give to the Fund and I enclosed my check to prove it. Now you can't ask for more than that, can you?

"O.K. Apologies accepted. I mean when I say I'll give, I mean I'll—

"How large was the check? Oh, I guess it was about 2¼ by 3¼. Most of them are about that size . . . All you do is take it down to the warehouse and present it to them and they'll give you the picture. Now if it's damaged or anything it's insure—

"That's what I *did* say—picture. P-I-C-T- Well, it's not worth a *lot,* but I think it would look kind of nice in Dabney Lounge. Auntie was from a very fine old Pasadena family.

"George? George, you still there? George?"

THE ALUMNI FUND WOULD MUCH PREFER MONEY, M-O-N-E-Y
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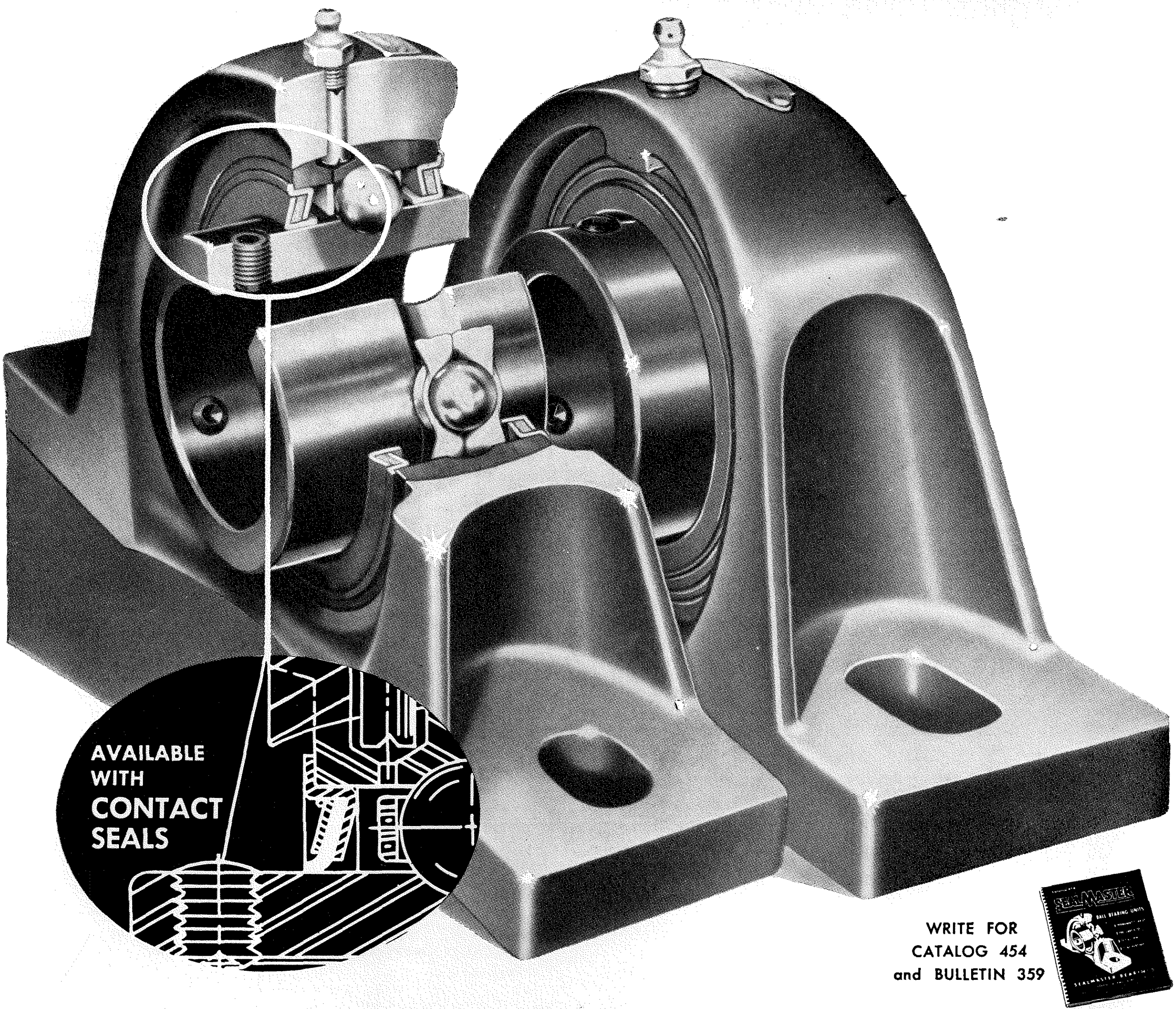

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CATALOG 454
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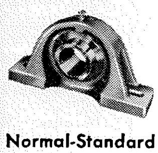
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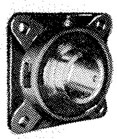
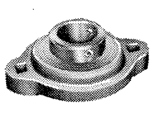
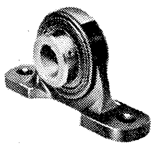
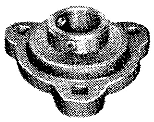
Medium Duty
PILLOW BLOCKS


Standard
Medium Duty
FLANGE UNITS


LFT
FLANGE UNIT


LP
PILLOW BLOCK


LF
FLANGE UNIT

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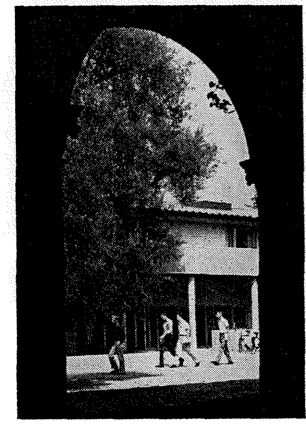

ALUMNI EVENTS

January	Winter Dinner Meeting
March 3	Annual Dinner Dance

ATHLETIC SCHEDULE

Water Polo

November 14
Redlands at Caltech
November 17
Occidental at Caltech

Cross Country

November 14
Pasadena College and Claremont-H. Mudd at Caltech
November 21
Pacific Lutheran at Caltech
December 2
All-Conference at Mt. Sac

Soccer

November 11
Biola at Caltech
November 18
UC Riverside at Caltech
November 21
Redlands at Redlands
December 2
Pomona at Pomona

Football

November 18
Claremont-H. Mudd at Rose Bowl

FRIDAY EVENING DEMONSTRATION LECTURES

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

November 10
Waste Water Reclamation
—Jack McKee
November 17
Sounds of the Earth
—Stewart W. Smith
December 1
Computers—How They Think
—Gilbert McCann

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Holley B. Dickinson, '36

SECRETARY
Donald S. Clark, '29

VICE-PRESIDENT
William L. Holladay, '24

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John R. Fee, '51

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Vice-President Lee A. Henderson, '54
Weld Rite Company, Oakland
Secretary-Treasurer Edwin P. Schlinger, '52
Scott-Buttner Electric Co., Inc., Mountain View
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Informal luncheons every Thursday

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Evanston, Illinois
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Division of Highways, State of California
Vice-President G. Donald Meixner, Jr., '46
Dept. of Water Resources, State of California
Secretary-Treasurer John Ritter, '35
Division of Highways, State of California
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Luncheon first Friday of each month
Visiting alumni cordially invited—no reservation

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3040 Udal Street
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Astronautics Div., Convair
Program Chairman Herman S. Englander, '39
U. S. Navy Electronics Laboratory

Kodak beyond the snapshot...

(random notes)

A little x-ray news

More precious than rubies is confidence in the importance of what one does for a living. One thing we do for a living is to manufacture x-ray film. Unkind words are rarely spoken about society's need for x-ray film. Now we have news about x-ray film and need to make it seem important. Easy.

The first piece of news has it that Kodak x-ray film of high contrast and fine grain is now obtainable with emulsion on one side only. Ties in to the current push for great structural strength in small mass. Load-bearing members are now getting so thin that putative flaws on their radiographs have to be checked out with a microscope. Since a microscope can focus on only one side of the film at a time, it's better to have the other side blank. Simple, yes; trivial, no. Manufacturing and distribution problems on our scale are rarely trivial.

The second piece of news much exceeds the first in importance. You have been given estimates by various authorities of how much radiation you and your children can expect to soak up, barring disaster. You have been told how much to figure for medical and dental radiological examination over a lifetime. Meanwhile we have been quietly goofing up the statistics! We have been upping the response of the films. With the latest step, the same amount of examination requires half or a third as much radiation as before. Just privately rejoice a little at how the deal has been sweetened a bit for you, statistically.

To John!

We are not alone in polypropylene. Seven other large and reputable companies are known to be playing in the game against each other and us. All we players must be very brave, hide our nervousness, and raise our glasses high in a toast to the memory of Senator John Sherman, who believed in the great public good that comes of free and untrammeled competition.

(Other nations have ambitious polypropylene plans of their own and are outproducing the U.S. in polypropylene right now in the aggregate. The peoples of the earth had better start making their artifacts out of polypropylene—and fast!)

As the game gets under way, we hold certain strong cards. Our Tenite polypropylene

- Can be polymerized from propylene by two completely different processes of our own devising, both free and clear of the U.S. patents of others.
- Comes in many flow rates.
- Comes in the widest variety of reproducible colors.
- Is exceedingly well fortified by our own antioxidants against oxidative deterioration.
- Has "built-in hinge," i.e. tremendous fatigue resistance under flexure.
- Weathers very well when extruded in monofilament for webbing and cordage, because of our own ultraviolet inhibitors.
- Has high-enough softening temperature so that when it is extruded as sheet you can cook in it and yet on a yield basis it costs less than cellophane.

A familiar force

Here is a picture of the basic amplifier

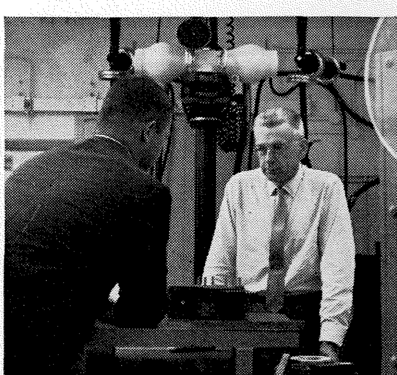
used in photography. This amplifier can provide a gain of 10^9. There is a genie in the bottle. Familiarity with him breeds not contempt but admiration.

Once upon a time, it was customary to summon the genie by retiring to a little darkroom and pouring him out of his bottle into a white enameled tray. No longer does he demand such ceremonious treatment.

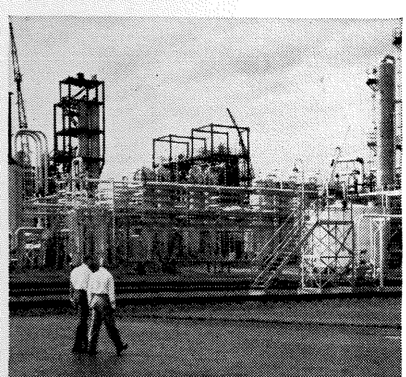
Our wet friend now works unseen inside a box, responding to push buttons. His very fluidity has been replaced by a kind of viscosity which need little concern the client, who merely inserts a probe into a disposable cartridge. When the work is done, the genie uses his private exit to the sewer.

This newly announced Eastman Viscomat Processor does 36 feet of 16mm film per minute. Not entirely by coincidence, this happens to be the rate at which film runs through a projector. The film spends about one minute in the processor. It emerges processed to standard commercial quality, ready to project. It can be stopped for seconds or days and restarted without loss of quality. Were we not so touchy about processing quality, the gadget would have been on the market long before.

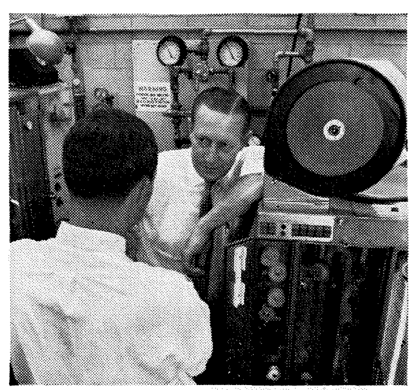
Note: Whether you work for us or not, photography in some form will probably have a part in your work as years go on. Now or later, feel free to ask for Kodak literature or help on anything photographic.



X-RAY FILM NEEDS GOOD PEOPLE



POLYPROPYLENE NEEDS GOOD PEOPLE



SOPHISTICATED PHOTOGRAPHIC ENGINEERING NEEDS GOOD PEOPLE

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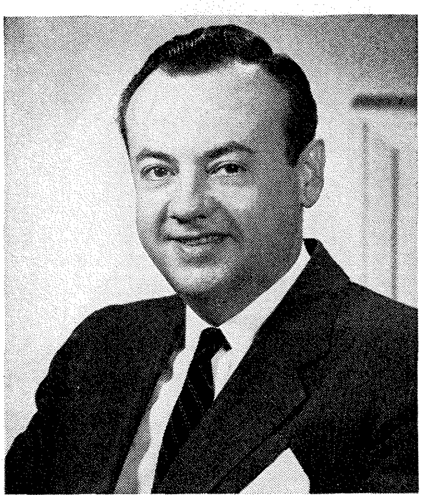
Interview with General Electric's Dr. J. H. Hollomon
Manager—General Engineering Laboratory



Society Has New Needs and Wants—Plan Your Career Accordingly

DR. HOLLOMON is responsible for General Electric's centralized, advanced engineering activities. He is also an adjunct professor of metallurgy at RPI, serves in advisory posts for four universities, and is a member of the Technical Assistance panel of President Kennedy's Scientific Advisory Committee. Long interested in emphasizing new areas of opportunity for engineers and scientists, the following highlights some of Dr. Hollomon's opinions.

Q. Dr. Hollomon, what characterizes the new needs and wants of society?

A. There are four significant changes in recent times that characterize these needs and wants.

1. The increases in the number of people who live in cities: the accompanying need is for adequate control of air pollution, elimination of transportation bottlenecks, slum clearance, and adequate water resources.
2. The shift in our economy from agriculture and manufacturing to "services": today less than half our working population produces the food and goods for the remainder. Education, health, and recreation are new needs. They require a new information technology to eliminate the drudgery of routine mental tasks as our electrical technology eliminated routine physical drudgery.
3. The continued need for national defense and for arms reduction: the majority of our technical resources is concerned with research and development for military purposes. But increasingly, we must look to new technical means for detection and control.
4. The arising expectations of the peoples of the newly developing nations: here the "haves" of our society must provide the industry and the tools for the "have-nots" of the new countries if they are to share the advantages of modern technology. It is now clearly recognized by all that Western technology is capable of furnishing the material goods of modern life to the billions of people of the world rather than only to the millions in the West.

We see in these new wants, prospects for General Electric's future growth and contribution.

Q. Could you give us some examples?

A. We are investigating techniques for the control and measurement of air and water pollution which will be applicable not only to cities, but to individual households. We have developed, for example, new methods of purifying salt water and specific techniques for determining impurities in polluted air. General Electric is increasing its international business by furnishing power generating and transportation equipment for Africa, South America, and Southern Asia.

We are looking for other products that would be helpful to these areas to develop their economy and to improve their way of life. We can develop new information systems, new ways of storing and retrieving information, or handling it in computers. We can design new devices that do some of the thinking functions of men, that will make education more effective and perhaps contribute substantially to reducing the cost of medical treatment. We can design new devices for more efficient "paper handling" in the service industries.

Q. If I want to be a part of this new activity, how should I plan my career?

A. First of all, recognize that the meeting of needs and wants of society with products and services is most important and satisfying work. Today this activity requires not only knowledge of science and technology but also of economics, sociology and the best of the past as learned from the liberal arts. To do the engineering involved requires, at least for young men, the most varied experience possible. This means working at a number of different jobs involving different science and technology and different products. This kind of experience for engineers is one of the best means of learning how to conceive and design—how to be able to meet the changing requirements of the times.

For scientists, look to those new fields in biology, biophysics, information, and power generation that afford the most challenge in understanding the world in which we live.

But above all else, the science explosion of the last several decades means that the tools you will use as an engineer or as a scientist and the knowledge involved will change during your lifetime. Thus, you must be in a position to continue your education, either on your own or in courses at universities or in special courses sponsored by the company for which you work.

Q. Does General Electric offer these advantages to a young scientist or engineer?

A. General Electric is a large diversified company in which young men have the opportunity of working on a variety of problems with experienced people at the forefront of science and technology. There are a number of laboratories where research and advanced development is and has been traditional. The Company offers incentives for graduate studies, as well as a number of educational programs with expert and experienced teachers. Talk to your placement officers and members of your faculty. I hope you will plan to meet our representative when he visits the campus.

A recent address by Dr. Hollomon entitled "Engineering's Great Challenge — the 1960's," will be of interest to most Juniors, Seniors, and Graduate Students. It's available by addressing your request to: Dr. J. H. Hollomon, Section 699-2, General Electric Company, Schenectady 5, N.Y.

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All applicants will receive consideration for employment without regard to race, creed, color, or national origin.