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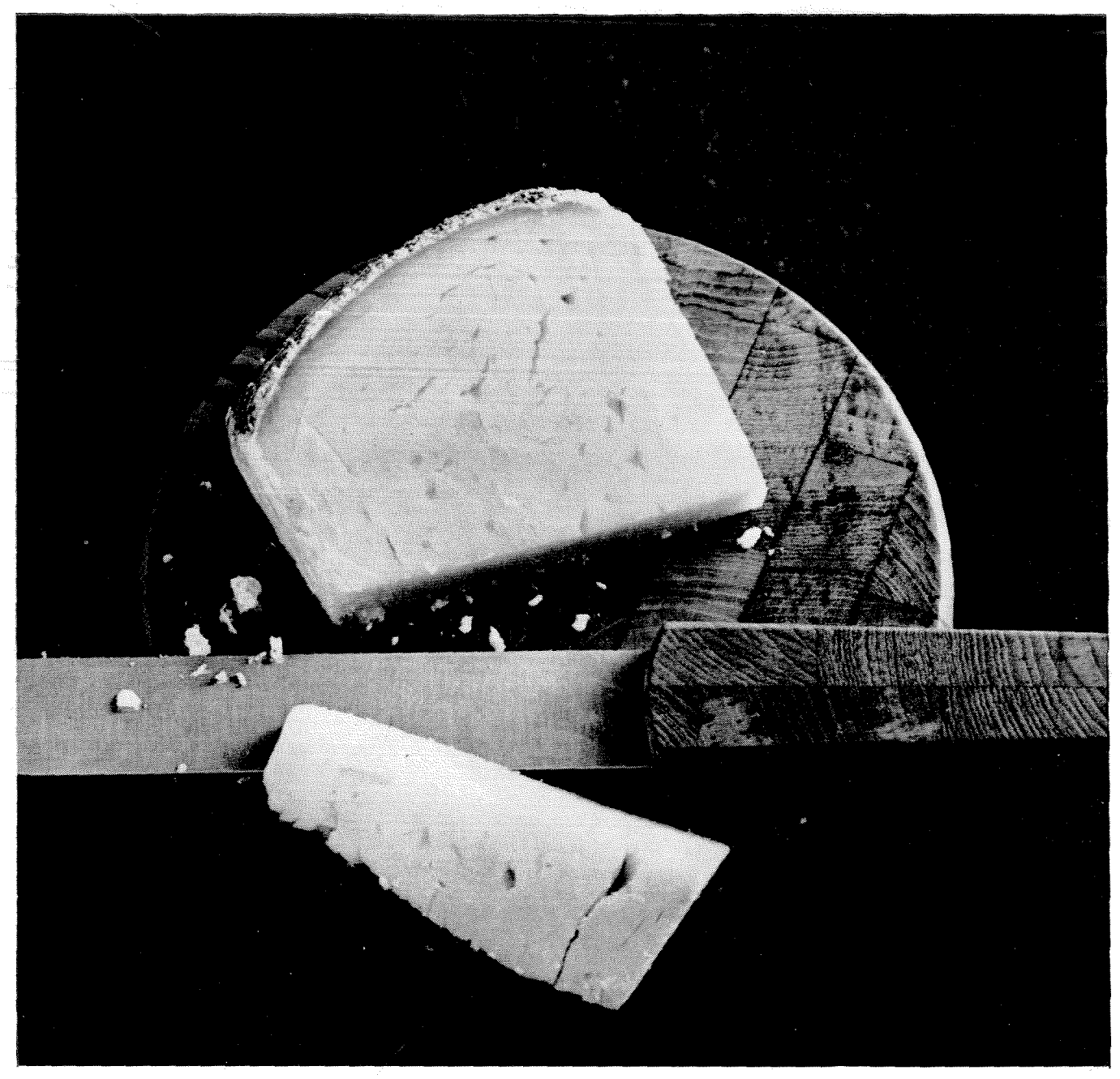

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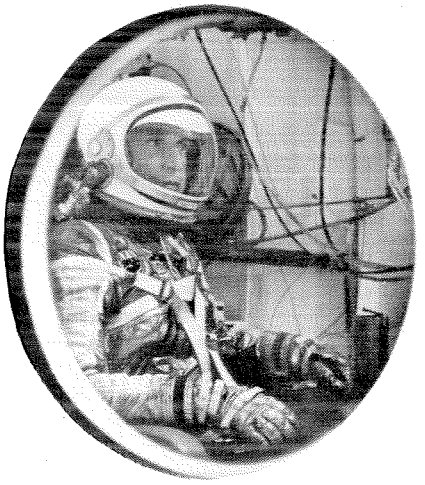

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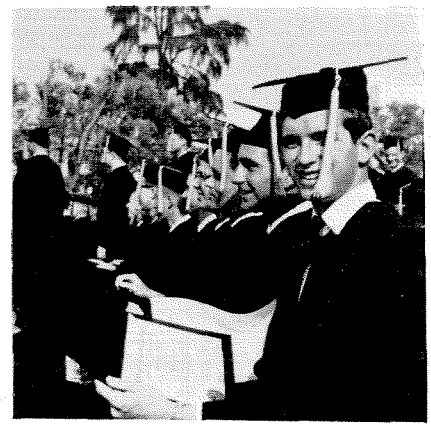


On Our Cover

Walter Kendall Brown, '65, expresses satisfaction over the diploma that has been his for a matter of minutes. For more pictures of this year's commencement — page 9.

Allan Sandage,

staff member of the Mount Wilson and Palomar Observatories, has discovered a new class of astronomical objects that may very well make it possible within a short time to determine the structure of the universe. This, and Dr. Maarten Schmidt's recent (*E & S* — May 1965) breakthrough in determining cosmological distances, has astronomers calling this the most exciting month in astronomy since the development of the telescope. The story of the new Sandage discovery is on page 7.

George S. Hammond,

Arthur Amos Noyes Professor of Chemistry at Caltech, rises to the defense of his colleagues in a response to "the hue and cry about making professors stay home, and making them keep their minds on teaching," in "The Faculty *Is* Teaching" on page 16.

Books

The New Priesthood — the Scientific Elite and the Uses of Power.

by Ralph E. Lapp

Harper & Row $4.95

Reviewed by J. N. Franklin, professor of applied science

Dr. Ralph Lapp got his PhD from the University of Chicago in 1945. Since then he has been assistant director of the Argonne National Laboratory, consulting scientist for the Bikini bomb tests, and science adviser on the War Department general staff. In 1947 he became head of the nuclear physics branch of the Office of Naval Research. More recently he has been an author of books on science and society, such as *Nuclear Radiation Physics; The New Force; Atoms and People; Radiation — What It Is and How It Affects You; Man and Space; The Voyage of the Lucky Dragon;* and *Kill and Overkill.*

These are the main points he makes in *The New Priesthood:*

1. "Democracy faces its most severe test in preserving its traditions in an age of scientific revolution."
2. "Scientists in advisory positions wield enormous power."
3. "The danger is that the new priesthood of scientists may usurp the traditional roles of democratic decision-making."
4. The new economy will be a "PhD-based economy."
5. The present system of advice by scientists to Congress and the Executive is unreliable, unrepresentative, and inefficient.
6. There should be a Department of Science in the President's cabinet. This department would, among other functions, replace the National Science Foundation and the Atomic Energy Commission.
7. "The full impact of the new world of technology is yet to be felt; it lies in the field of computers and data processing machines."
8. In 1980 around $25 billion will be spent for non-defense research and development.
9. Financial support should be shifted, relatively, from the physical to the biological sciences as support for each is increased.

More specifically, Dr. Lapp, in Chapter 2 ("University, Laboratory, 'Think' Factory"), talks about the dangers to universities which come from "big science" and "team science." For example, "academic carpetbaggers" are alleged to obtain advancement by bringing in large government contracts. The government-supported program in high energy physics is criticized as a "tour de force in pure science" of dubious practical value. "Think" factories are: Aerospace, MITRE, IDA, RAND, SDC. Lapp criticizes them for the high salaries of their officers and for the seclusiveness of their research.

After a discussion of the atomic effort and the roles of science and the military in World War II, the author deals, in Chapter 5 ("The Merging of the Cults"), with the defeat of the May-Johnson bill, which would have put atomic energy under military control. Oppenheimer, Conant, and Vannevar Bush testified *for* military control. (Oppenheimer is described as speaking with a "mixture of slang and over-humility.") Harold Urey spoke very effectively against military control. Eventually, Senator Brian McMahon led the fight to defeat the May-Johnson bill. By the way, that's not Lyndon, but Edwin Johnson.

A chapter on "Scientist Citizens" talks about the fallout problem, and includes some colorful invective against Lewis Strauss, attributed to a "highly placed AEC official": "If you disagree with Lewis about anything, he assumes you're just a fool at first. But if you go on disagreeing with him, he concludes you must be a traitor."

"The Public Response" discusses Pauling's famous petition and Teller's theory of underground nuclear testing. Lapp agrees with Churchill that there is danger in "peace through mutual terror," and he states that it is the responsibility of experts to speak out, and of laymen to make their own interpretations.

A chapter on "Science and Congress" recommends the creation of a full-time, central Congressional Research Institute to advise Congress on research and development. Lapp repeatedly criticizes the National Academy of Sciences and the National Science Foundation for doing too little, and further criticizes the Space Board of the National Academy for containing only "space enthusiasts."

Chapter 9, "Scientists and Politics," on the "new breed of scientist-politician," contains a fine analysis of the difference in attitude between politicians and scientists. The scientist is an innovator; the politician prefers the tried and true. "The trick in politics is not to have ideas but to implement them."

Chapter 10, "Scientists and the Executive," is very critical of the President's Science Advisory Committee. (Caltech readers will note that R. F. Bacher and H. P. Robertson were on the first President's Science Advisory Committee. This book is full of references to other Caltech celebrities, including Beckman, Pauling, Harrison Brown, DuBridge, C. C. Lauritsen, Frank Goddard, and others. There are, in addition, nine direct references to Caltech.)

Chapter 11, "The Tyranny of Technology," predicts and characterizes the great future growth and influence of science and engineering.

In the opinion of this reviewer, *The New Priesthood* will reinforce the latent public fear of science and scientists. As we in science and technology know, our only power in government is to frustrate or to abet the research projects of our colleagues. We simply do not, with our computers, make *decisions* about Vietnam or the Dominican Republic. As experts, we should and do make recommendations pertaining to our special fields. As individual citizens in a democracy we share the public duty to commit ourselves to our beliefs. The title of *The New Priesthood*, its chapter headings, and its style are anxious and exaggerated. While we in science and technology may be mildly amused or annoyed by Dr. Lapp's many criticisms of our most honored institutions, the public may be confused, dismayed, and misled. Today, when the public regard of science and technology is at a new height, when the scientific contribution to the national defense and to the public welfare is of a new magnitude, Dr. Lapp's book is a step backward into the dark ages of estrangement of science and the people.

Alumni Books

Mechanics of Incremental Deformations

by Maurice A. Biot, PhD '32

John Wiley and Sons, Inc. $17.50

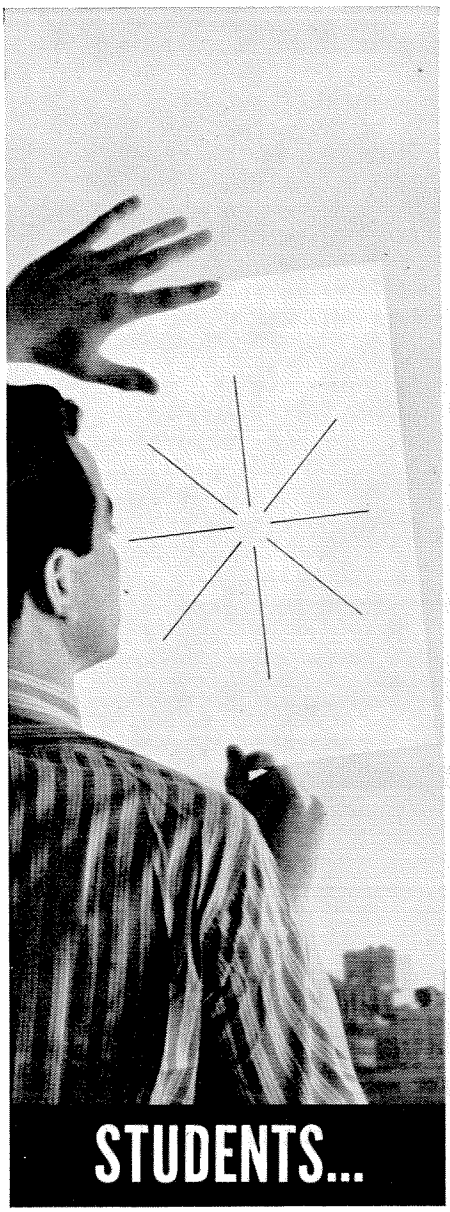
A collection of papers on the theory of elasticity and viscoelasticity of initially stressed solids and fluids, including thermodynamic foundations and applications to finite strain.

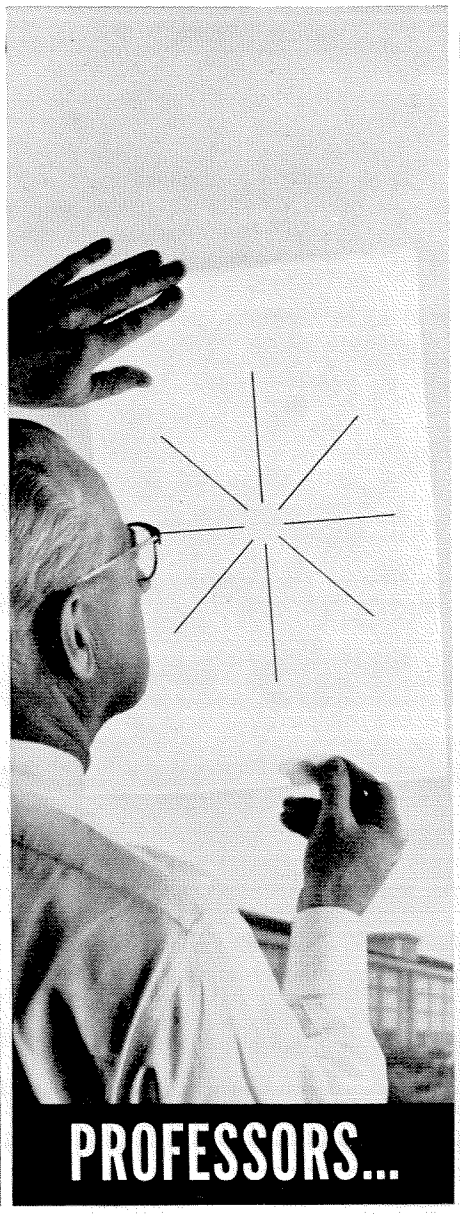
Fundamentals of Microwave Electronics

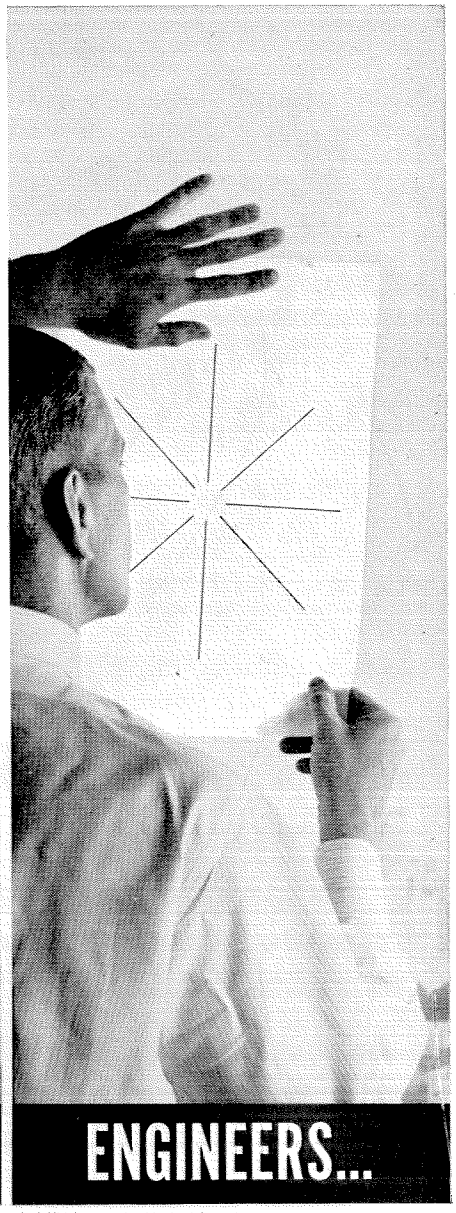
by Martin Chodorow and Charles Susskind '48

McGraw-Hill $12.50

A graduate textbook on microwave-tube design, both for the experienced reader and for the beginner.







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June 1965, Vol. XXVIII, No. 9

INTERLOPERS IN SPACE

New findings may make it possible to determine the structure of the universe

Allan Sandage, staff member of the Mount Wilson and Palomar Observatories, has discovered a new class of astronomical objects that may make it possible, within a short time, to determine the structure of the universe.

For the past 20 years many of these objects were thought to be blue stars in the outer regions of our Milky Way Galaxy. Now they are suspected of being very distant super-bright galaxies reaching more than halfway to the horizon of the universe. Dr. Sandage has tentatively named them "quasi-stellar blue galaxies." Although they are related to the quasi-stellar radio sources, they do not emit radio energy. They may represent the next evolutionary step after the quasi-stellar radio sources. They may also be galaxies in the process of being born.

The new objects are like the quasi-stellar radio sources in that they appear to be up to 100 times brighter than an ordinary galaxy. But they are 500 times more numerous than the radio sources. There are probably more than 100,000 of them down to 19th apparent magnitude, which is the limit of the magnitude at which objects can be seen by the Schmidt telescope at Palomar. (The 200-inch telescope sees objects 40 times fainter.)

The major significance of the Sandage discovery is that astronomers now have a powerful new tool which can probe enormous distances into the cosmos to test the "big bang" versus the steady state model of the universe.

The "big bang" theory holds that some 12 billion years ago all the matter in the universe was in one place and was ejected outward in every direction by a gigantic explosion. The matter, now condensed into stars and galaxies, continues to move along the same paths. According to the steady state theory, matter is continually being formed and the universe has no beginning and no ending.

"The quasi-stellar galaxies appear to be so numerous and reach so far into space," says Dr. Sandage, "that we should be able to determine the effects of space curvature and the slowing down of the expansion of the universe within the next few years."

Clues to the true model of the universe already are emerging from the studies made by Dr. Maarten Schmidt and Dr. Sandage of the much less numerous quasi-stellar radio sources ("Extending the Frontiers of Space" – *E & S, May 1965*).

The clues suggest that our universe is a finite, closed system which originated in a "big bang," that the expanding universe is slowing down, and that it probably pulsates perhaps once every 82 billion years. The evidence is inconsistent with the steady

Allan R. Sandage

state theory. However, there is not yet enough evidence for conclusive determination of the true model of the universe. The existing evidence is based on the red shifts and light measurements of only nine quasi-stellar radio sources, and the light measurements of a few quasi-stellar blue galaxies.

"With these sources we already are looking out slightly less than halfway to the observable horizon on the model of the universe which is emerging from the data," says Dr. Sandage.

"We have every belief that with the much greater red shifts which we expect to obtain, we will see more than 60 percent of the distance to the horizon. Such a distance would encompass one-third of the volume of the visible universe."

Evolution of galaxies

In addition to their importance in solving the long-standing cosmological problem of space curvature and the age of the cosmos, the new class of objects is expected to shed light on the process of formation and evolution of the galaxies themselves. While the discovery is still too new to explain their role in the birth processes of the stellar systems, first indications suggest that astronomers may be seeing galaxies in the very early phases of their life.

Drs. Sandage and Schmidt have obtained spectral red shifts for three of the quasi-stellar blue galaxies, using the spectral line pattern search method developed by Dr. Schmidt for the quasi-stellar radio sources. The red shift for one of the quasi-stellar blue galaxies, named BSO No. 1 (BSO for blue stellar objects), indicates a recession rate of 125,000 miles per second. This makes it the second most distant object known — second only to the quasi-stellar radio source 3C-9, which has a recession rate of 149,000 miles a second.

The red shifts of the two other quasi-stellar blue galaxies indicate that their recession rates are 16,000 miles a second and 24,000 miles a second.

The astronomers found spectral lines of carbon III and IV in BSO No. 1. These are ionized carbon atoms and their spectral fingerprints had been detected previously only in the most distant of the quasi-stellar radio sources. In the two nearer quasi-stellar blue galaxies were found spectral emission lines of oxygen II and III, neon III and V, plus several hydrogen lines.

The red shifts were determined after Dr. Sandage had predicted that the objects would be extragalactic. He and Philippe Veron, a research student from France, located some of the first members of the class while making a survey at Palomar for quasi-stellar radio sources. The two astronomers photographed several faint blue objects that, like quasi-stellar radio sources, emitted much light in the ultraviolet, but which, unlike them, had no radio emission. Dr. Sandage called the objects "interlopers." Recent observations showed the interlopers to be the first members of the new class.

Dr. Sandage found that the brightest of the blue objects — those brighter than 14.5 magnitude — were distributed in depth about as expected for normal stars in our galaxy. Most of these objects are stars. However, the blue objects that were fainter than 14.5 were distributed in a different way. They increased in depth much more rapidly than the brighter objects, suggesting that they were extragalactic.

A second difference between the bright and the faint objects was in the measured ultraviolet energy. Precise measurements of colors showed that the faint objects emitted much energy in the ultraviolet. This is contrary to stars but similar to the quasi-stellar radio sources. It also suggests that the faint objects are extragalactic, and this was later proved by the red shift measurements.

Dr. Sandage found that the fainter of the objects with less than a 14.5 magnitude did not increase in number quite as fast as did the less faint ones per volume of space. He explained this as evidence of the predicted curvature of space and the effect of the red shift in the received light. The influence of the gravitational field of all the matter in the universe is believed to cause space to curve.

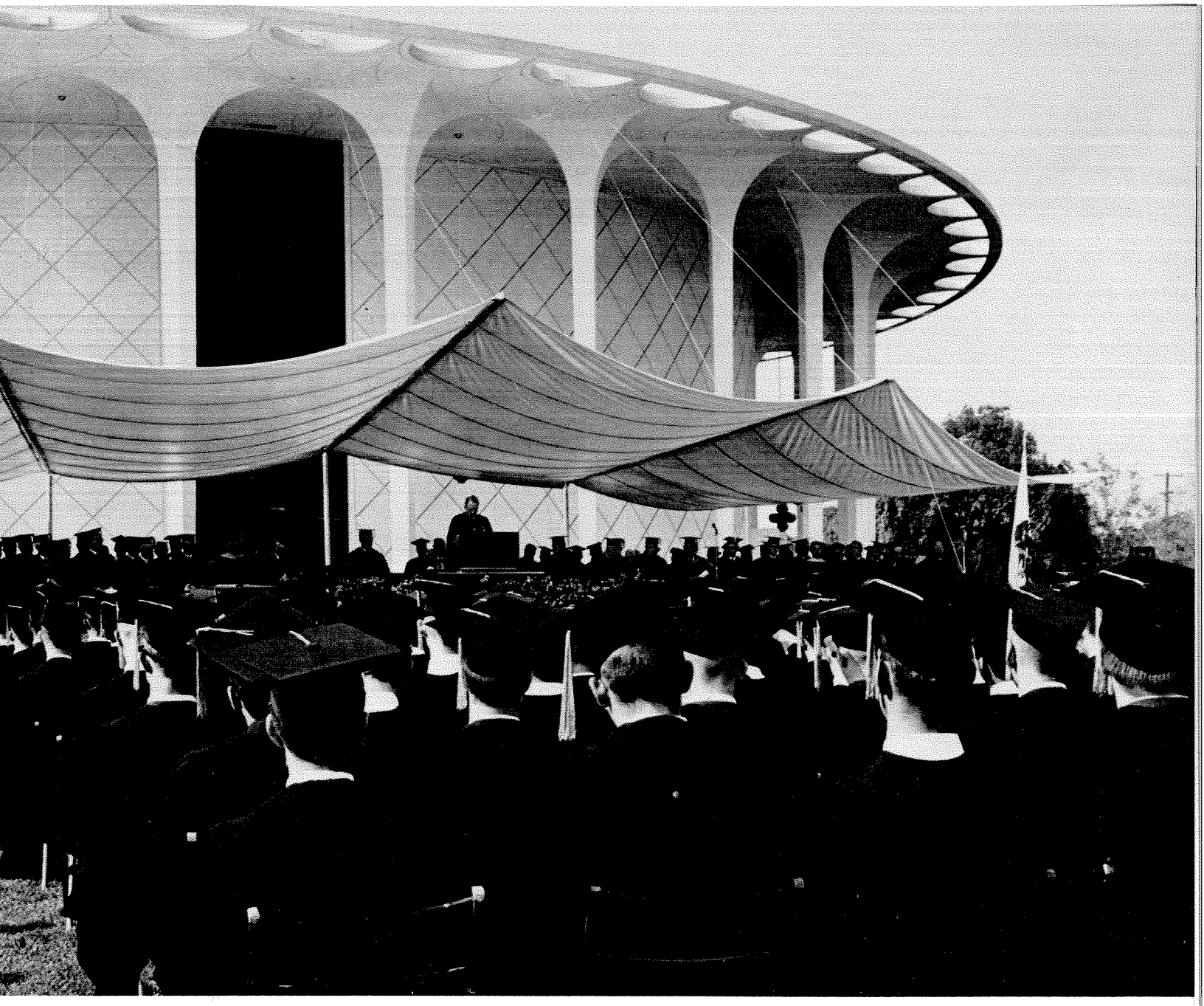
Life span of the quasi-stellar blue galaxies

Dr. Sandage believes that some quasi-stellar blue galaxies may still be being born. He calculates that they live for some 500,000,000 years. The figure is based on the estimated age of 1,000,000 years for quasi-stellar radio sources, and on a comparison of their frequency with that of the quasi-stellar blue galaxies.

The new objects are scattered throughout the universe, with the nearest of them about 20 million light years from the earth, which is nearby in cosmological terms.

These objects and the quasi-stellar radio sources appear to be distributed so far away that they should enable the 200-inch telescope to look back 93 percent of the time since the birth of the universe.

"If we can go back far enough we will get back to the time of the birth of the normal galaxies," says Dr. Sandage. "And perhaps we can get back to what is known as the particle horizon where matter had not yet had time to congregate into such structures as clouds, quasi-stellars, stars, or galaxies."



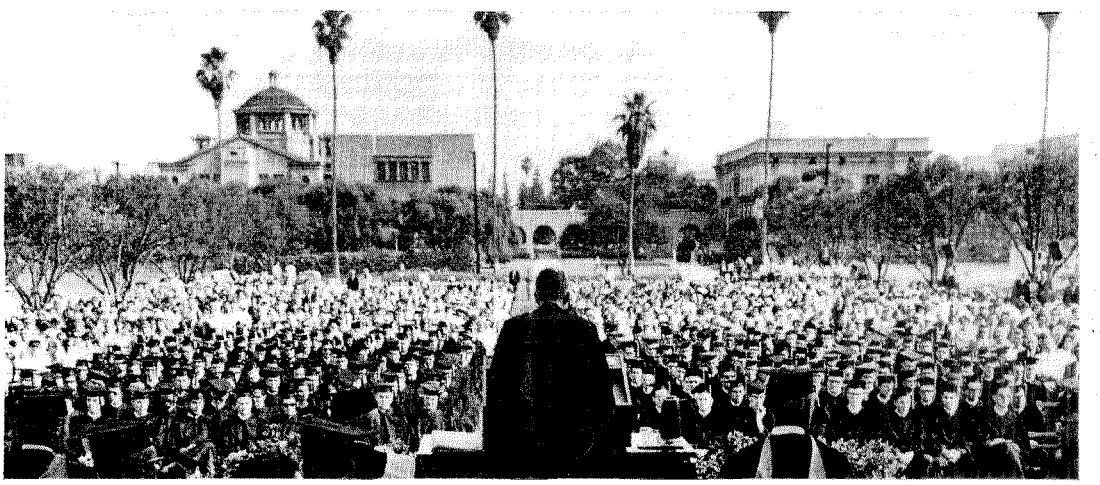
COMMENCEMENT 1965

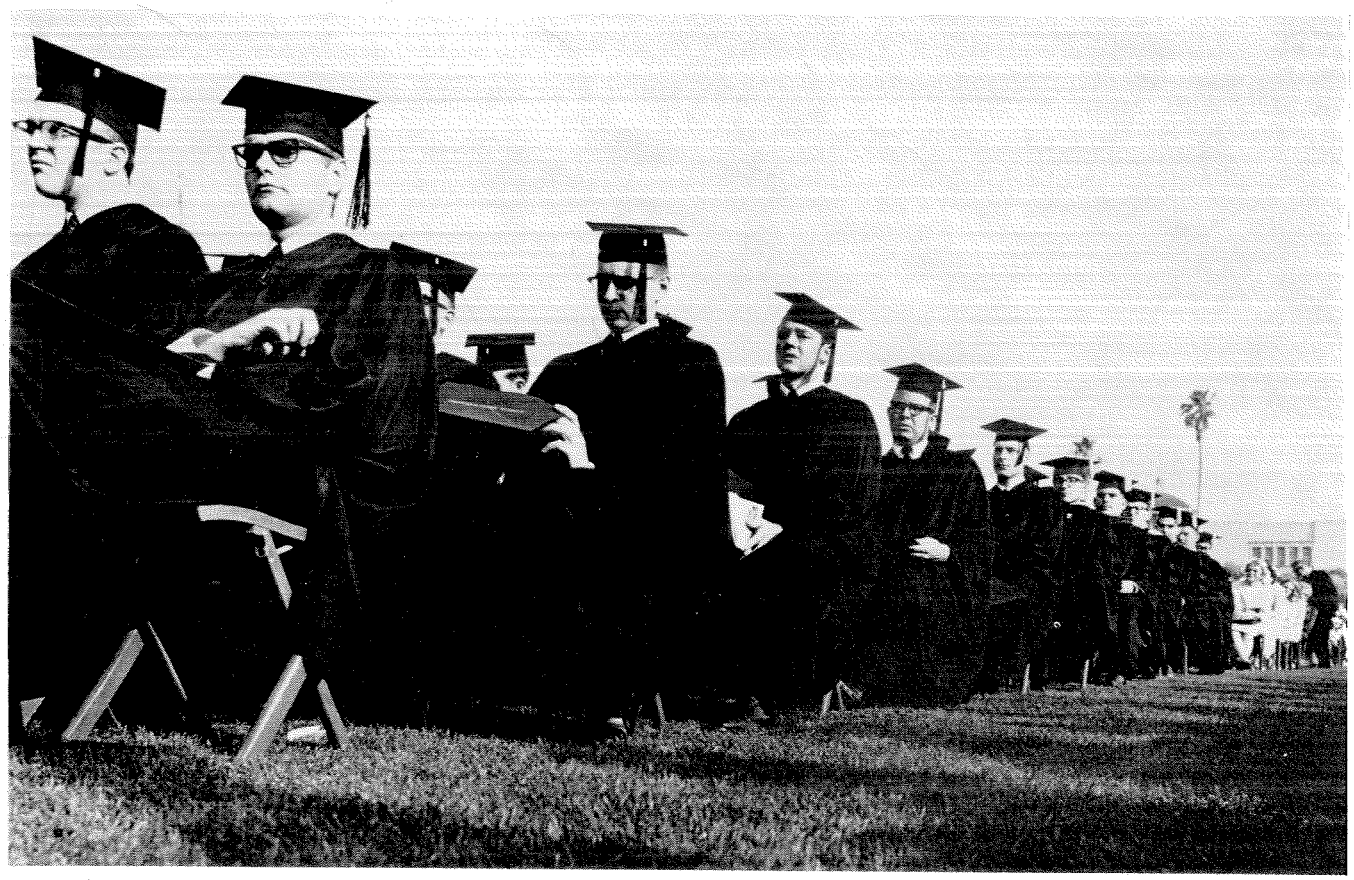
At Caltech's 71st annual commencement on June 11, a total of 388 students received degrees — 150 Bachelors of Science, 132 Masters of Science, 98 Doctors of Philosophy, and 8 Engineers. One-third of the graduating seniors — 51 men — were honor students who maintained a B-plus average throughout their four years at Caltech.

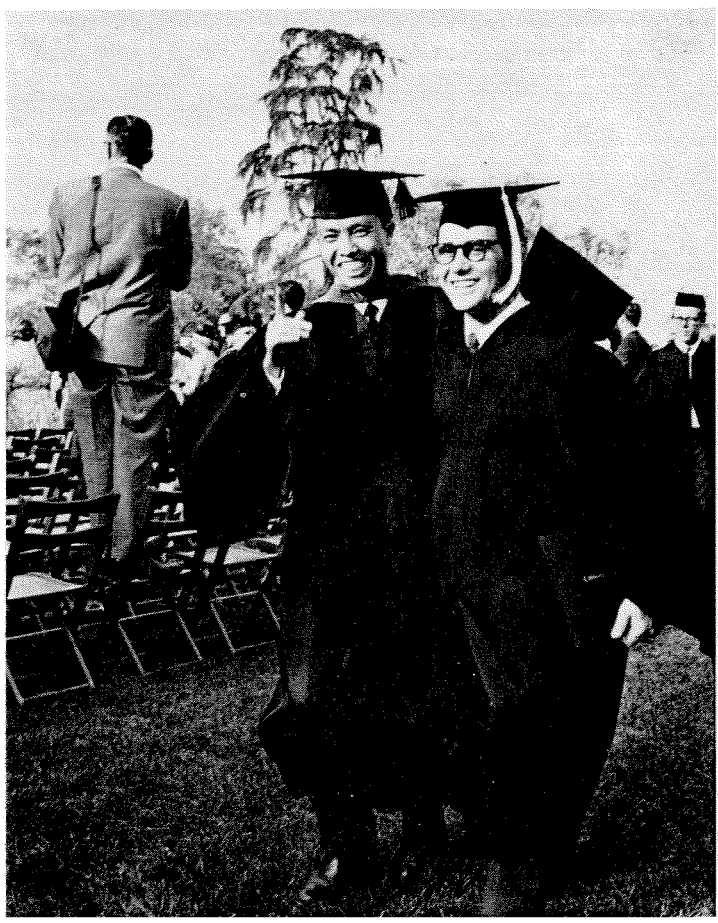
Frank Stanton, president of the Columbia Broadcasting System, delivered the commencement address, "Scientific Progress and the Democratic Process."

Commencement

. . . continued





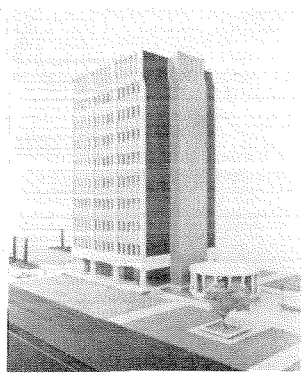


Groundbreaking ceremonies in the eucalyptus grove which is the site of the new Millikan Library.

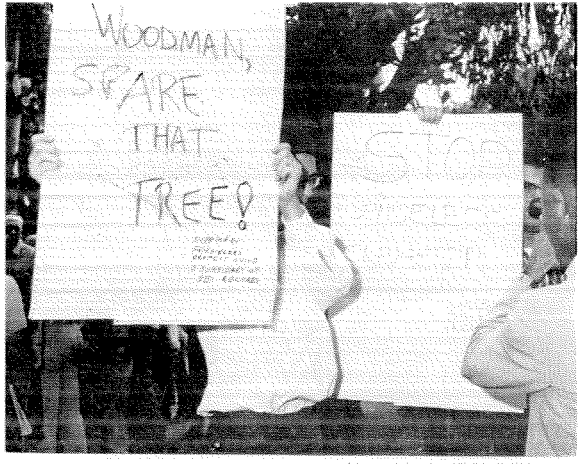
Groundbreakers — President DuBridge; Seeley G. Mudd, whose gift makes the library possible; Arnold O. Beckman, chairman of the Caltech board of trustees.

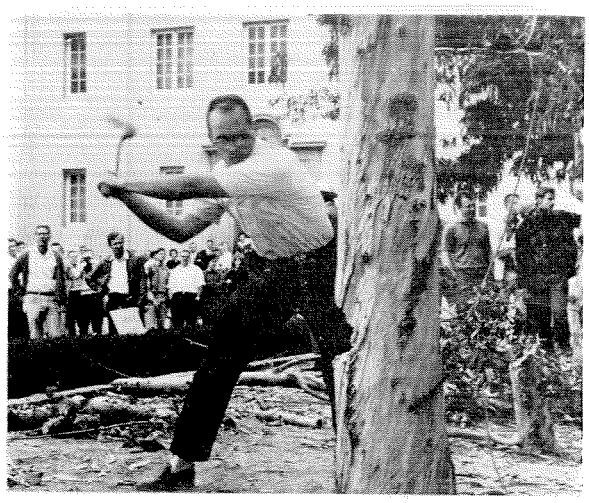
Caltech's New Millikan Library

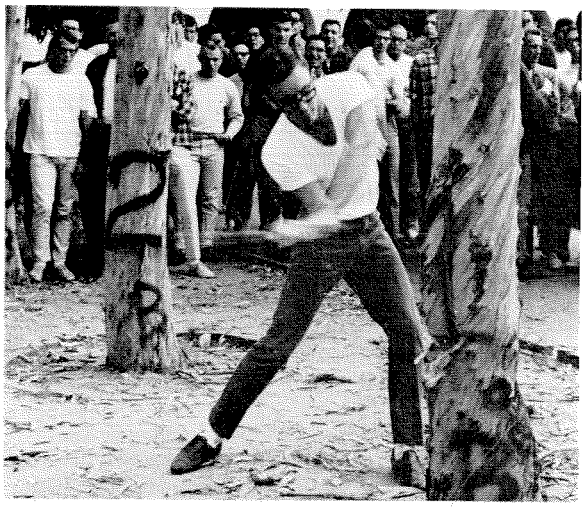
The official groundbreaking for Caltech's R. A. Millikan Memorial Library took place at a spring open house for the Institute Associates on May 26. The library site is west of Throop Hall, in the eucalyptus grove between the present general library and the Crellin chemistry laboratory.

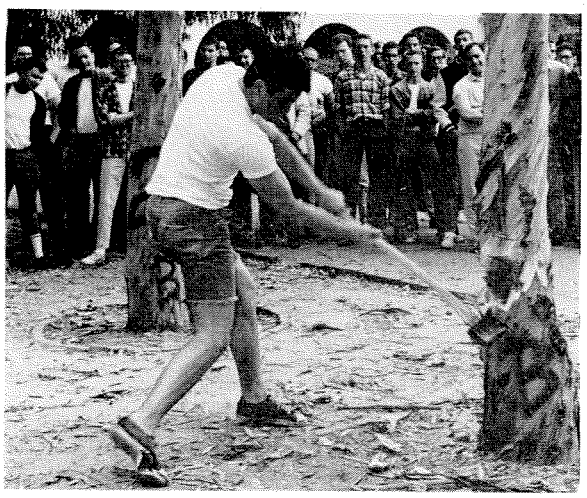


A model of the new library on display at the Associates' spring open house.



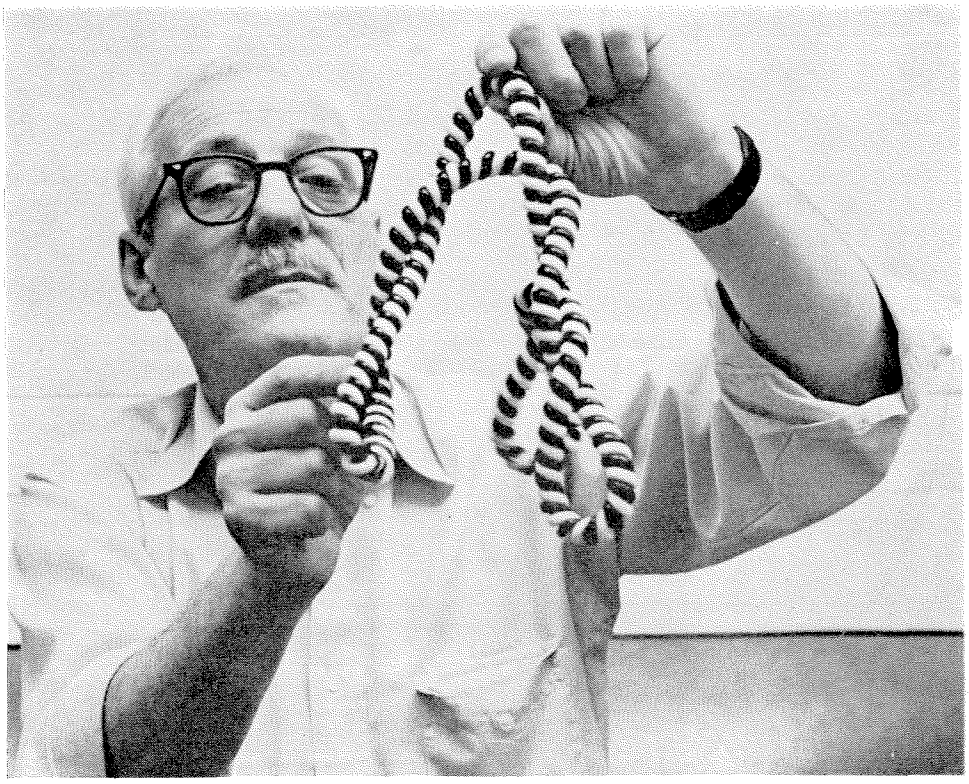






Destruction Sets In

Destruction ceremonies followed the official groundbreaking by one day as undergraduates organized the First Annual Eucalyptus Decimation Contest to help clear the ground for the library. Dabney House won this spirited interhouse competition with a mean time of 104.2 seconds on a tree with a circumference of 30 inches, for a total score of 115.7 millifungs.



Jerome Vinograd, Caltech associate in chemistry and biology, with a model of a double-stranded helix arranged to form a twisted circular structure like that found in the DNA from polyoma virus.

DNA — Structure and Superstructure

Jerome Vinograd, research associate in chemistry and biology, and his collaborators at Caltech, have succeeded in isolating the most highly organized DNA molecule that has yet been found. This is the DNA of the polyoma virus which causes cancer in some rodents.

Like other DNA molecules, the DNA of the polyoma virus consists of long, double strands of atoms, the strands being intertwined in a helix. In addition, Caltech research workers had found that each of the two strands is joined at the ends, forming a circle of two, continuous strands wrapped around each other in 500 right-handed turns.

Now the Caltech group has discovered that the circle forms an additional superstructure by twisting to the left upon itself five or more times. Thus, five or more smaller loops are formed by the twistings of the larger circle.

The detailed picture of this complex DNA molecule — a circle only one fifty-thousandth of an inch in diameter — was accomplished in enzymatic and chemical studies, with ultracentrifuge techniques developed by Dr. Vinograd, and with electron microphotographs.

This is the first evidence of a higher organization of an isolated DNA molecule. As with protein molecules, it may now be said that DNA has a tertiary structure. There are indications, from the work of others, that the DNAs of three other viruses may have a similar structure. These viruses are SV-40 and the human and rabbit papillomas.

To replicate, a virus must invade a living cell and must use the cell's building materials. But viral DNA cannot replicate in the super-twisted form in which polyoma DNA is found. It must somehow open up, and in doing so loses the twisted structure. After the twisted viral DNA invades a cell, at least one break in either of the two DNA strands must occur for the two strands to separate and form two daughter molecules.

It is not known what causes the strand break in nature. Presumably an enzyme is responsible. In the laboratory, Dr. Vinograd and his associates have unlocked the super-twisted configuration with an enzyme named pancreatic DNAase.

Associated with Dr. Vinograd in the research are Dr. Jacob Lebowitz, research fellow in chemistry; Roger J. Radloff, graduate student in biology; Robert Watson, research assistant in chemistry; and Philip Laipis, undergraduate student in chemistry. The work is supported by the U.S. Public Health Service.

The Month at Caltech

Scientists of the Year

Maarten Schmidt and Jesse L. Greenstein, staff members of the Mount Wilson and Palomar Observatories, have been named 1965 California Scientists of the Year by the California Museum of Science and Industry for their roles in the discovery of quasi-stellar radio sources.

The award, made by the museum and the California Museum Foundation to provide public recognition to individuals who have made the most noteworthy contributions to the advancement of knowledge, has been given annually since 1958. Dr. Greenstein, professor of astrophysics, and Maarten Schmidt, professor of astronomy, are the third and fourth Caltech faculty members to receive the award. William A. Fowler and Frank Press are former winners.

State Advisors

Clarence R. Allen, professor of geology and geophysics, and interim director of Caltech's Seismological Laboratory, and George W. Housner, professor of civil engineering and applied mechanics, have been named to head two committees of scientists and engineers to advise the state government on geological hazards in California.

Dr. Allen's 11-man committee will advise on methods of collecting scientific data and of initiating investigations to cope with threats of earthquakes, landslides, and floods.

Dr. Housner's 10-man committee is to advise on the internal organization necessary to conduct worthwhile earth sciences programs, to recommend on budgeting problems, and to define the proper balance of responsibilities between state and local agencies in protecting the population from natural hazards.

Development Officers

Lyman G. Bonner, rocket propellant expert and development director of the Hercules Powder Company's explosives department, will become director of foundation relations, associated with Caltech's Development Office, on July 1. Dr. Bonner, a Caltech alumnus (PhD '35), is a brother of James Bonner, professor of biology here. He will assist faculty members in identifying foundations interested in their fields of endeavor and will assist President DuBridge in seeking general foundation support.

Dr. Bonner received the U.S. Navy's highest civilian award — The Distinguished Public Service Award — for developing new propellants for rockets and guided missiles during World War II. Before joining the Hercules Powder Company 20 years ago, he was a fellow of the National Research Council at Princeton University; a research assistant at both the U.S. Rubber Company in Passaic, New Jersey, and the Geophysical Laboratory in Washington, D.C.; and assistant professor of physics at Duke University in Durham, North Carolina.

E. Curzon Fager, Jr. has been appointed director of corporate relations of Caltech's Development Office. He will be liaison between the Institute and the corporate community, working to stimulate interest between the two, and to obtain corporation support for research projects. Mr. Fager has been associate director of development since 1958.

David E. Dangler, formerly assistant to the general manager of the Vegetable Oil Products Company in Wilmington, California, (now Foremost Dairies, Inc.) has joined the Development Office as associate director of corporate relations. Mr. Dangler received his BS degree from Yale University in 1942.

Theodore C. Combs, Caltech alumnus (1927) engaged in property development and management, will act as associate director of corporate relations in the Development Office on a limited-time basis. Mr. Combs is a member of the board of directors of the Alumni Association, and has held various other offices in the association, including that of president in 1940.

William C. Cassell has been appointed director of income trusts for the Development Office. He is responsible for the organization and administration of the program of deferred giving and bequests. Mr. Cassell has been serving as assistant to the treasurer of the Claremont Colleges in Pomona. He is a graduate of Pomona College and was formerly with Hornblower and Weeks, members of the New York Stock Exchange.

THE FACULTY IS TEACHING

A professor invites the critics to think again

by George S. Hammond

The American press is currently playing a new dirge concerning education in this country. This year's theme concerns the plight of students deserted by professors, who have turned from the classroom to research or to missions in Washington. Editorial writers, columnists, and authors of popular magazine articles are unanimous in their judgment that faculties have ceased teaching.

For the past 17 years I have been professoring, first at Iowa State University and now at Caltech. Like most people who have spent more than six months at the same job, I consider myself something of an expert in the field.

The hue and cry about making professors stay home, and making them keep their minds on teaching instead of research when they are at home, is largely a red herring. Most professors go to Washington only as part of an occasional family vacation, and most of them do little or no consulting. Research is a different matter and there is, undeniably, an increasing emphasis on research and other forms of creative scholarship. (I believe that such increased activity is indispensable to the nation's changing social, political, and economic climate, but this is not the time to defend that position.)

One critic (John Fischer, in "Is There a Teacher on the Faculty," in *Harper's Magazine*, February 1965) has said: "So long as research alone pays off, in cash and fame, the temptation to scamp on teaching is almost irresistible."

This allegation is an unfounded slander. By the same reasoning, our lives should be so full of "almost irresistible" temptations that we would all be utterly depraved. There is no indication that the professorial clan is more than normally susceptible to temptation. The rewards of research may make it possible for a few very good men to abandon teaching if they choose to do so, but most members of this tiny group do not stop teaching, and some are brilliant teachers.

The best course I ever attended was taught by Paul Bartlett, who was, and still is, one of the world's foremost innovators in the field of physical organic chemistry. He still teaches the same course at Harvard, although the course content is almost unrecognizable after 20 years of progress in the field. At the present time, one of the key undergraduate courses in the chemistry department at Caltech is taught by John D. Roberts, who not only maintains a preeminent position as a research chemist but also finds time to be chairman of the Division of Chemistry and Chemical Engineering and to serve on national advisory committees.

Men like these are largely responsible for the current popular image of the itinerant university professor. Actually, their only problem is that they are too valuable in everything that they do! To put the lid on them by doubling their teaching loads and keeping them home to meet all their classes would damage other important parts of our national effort. Society always asks its most able men to carve themselves into little pieces, then complains because the whole man cannot be found in every piece.

Not all professors are Bartletts or Roberts's. There are always too few men of such caliber. However, I believe that there are a remarkably large number of college and university faculty members who do a variety of jobs reasonably well. Not all are success-

ful, and some end up doing a poor job in teaching, research, or both. But usually such men are replaced before they acquire tenure, if a more promising candidate can be found.

A popular bit of mythology is the belief that only research accomplishment counts toward promotion to tenure. At both Iowa State and Caltech there are tenure faculty members whose contributions are almost exclusively in the teaching program. At both institutions there are full professors whose principal claim to fame is successful research; they do little or no teaching. In each of these schools the research group is the larger of the two, but the two groups *together* form only a minority of the faculties.

These examples seem to be typical of the country's major institutions. Award of a tenure appointment on the basis of either teaching or research alone is a luxury that no institution can afford very often. To earn such an appointment on the basis of research alone, a young man must be extraordinarily productive and his work must be of genuinely high quality; volume alone is not enough. To obtain tenure on the basis of teaching alone requires equally brilliant classroom performance.

The mechanics of the academic system

Most people are ignorant of the mechanics of the academic system, and general misconception has probably been increased by a recent article ("President Under the Gun," *Life*, January 15, 1965) implying that college presidents play a leading role in judging faculty performance. In most first-class institutions, recommendations concerning new appointments and promotions originate with the tenured members of departments and are relayed by way of the department chairmen and higher administrative officials to the governing body of the institution. Presidents and deans seldom raise objections based upon their own evaluation of the competence of candidates. The administration may raise questions concerning the man's performance in teaching and research or may question the wisdom of very rapid promotion, but such questions are usually intended as guidelines to general institutional policy and are intended to serve as a subtle brake on departments that might otherwise plan unlimited expansion.

Thus, the prinicpal responsibility for recommending promotion lies with those who are in the best position to judge both a man's research and his teaching. Such judgment is certainly fallible because it can be influenced by personal feelings; and to some extent it should be. A man must be an extraordinarily good teacher or researcher if he is to be an over-all asset to a department in which he is an outstandingly poor citizen. Moreover, most of us don't pretend to understand the work of all our colleagues thoroughly and one is often forced to make educated guesses concerning the real value of either their research or their teaching. Since even a man's departmental colleagues may have some doubt in their evaluation, they are likely to seize upon any facet of performance that seems to be clearly definitive. If a man has no published work to show for five or six years of research the decision is easy, and a *superficial* account of the action will indicate that only research was taken into consideration.

No university department will knowingly abandon its teaching functions. The image of a department is created not only by research publications but also by the professional performance of students from that department. A good departmental image is precious since it largely determines the caliber of incoming graduate students, helps lure strong new faculty members, and lends strength to requests for research funds from external sources. Furthermore, the status of the department within the university community rests, in part, on the caliber of instruction provided for students majoring in other departments. In the long run, any department that is notably remiss in general instruction will suffer. Finally, since professors are usually people who take pride in their work, the desire to do a decent job of teaching provides strong motivation, regardless of current criticism.

Teaching performance

Thus teaching performance receives more than casual attention in discussions concerning appointments and promotions. After all, the discussants realize that if they recommend promotion of a miserable teacher, they will have to assume correspondingly greater teaching responsibility themselves. Careful weighing of important, and sometimes conflicting, factors usually leads to as wise a decision as could be expected under any system. This is likely to be true even in departments where the members can seldom reach a consensus on any other subject. Academic perquisites, although often criticized by the general public, carry with them grave responsibilities that are generally taken seriously by faculty members. Over-all, I believe that faculty evaluation of the job done by younger colleagues within the department is usually severe but reasonably just.

Understanding the mechanics of promotion is important since about the only member of the aca-

demic community who now enjoys public sympathy is the struggling *young* Mr. Chips who gets the sack because he has no time for research ("A Teacher Sweats It Out," *Life*, January 22, 1965). Careful scrutiny usually shows that the unfortunate young instructor is a fine fellow, a good but not truly inspired teacher, and a man who has ideas about research that never quite come to fruition. The senior members of the department hate to let him go, but after long debate they decide that he does not have as much promise as one of the several dozen other young men looking for instructorships in the department. If he were a brilliant teacher and had produced a modicum of good research, he would probably have been promoted, as was his peer who is only a tolerable teacher with a sensational research record. Currently, there is a tendency to weigh research performance a little more heavily than teaching in the difficult borderline case of a man who teaches fairly well, and does fairly good research. This bias is partly faddism, but it also makes sense for other reasons. Acceptable teaching requires less creativity than acceptable research, although superlative performance in either field demands outstanding originality.

Many outsiders fear that when a faculty member receives tenure he will become lazy and incompetent. There may be such cases, but I personally have never seen one and have heard of only a very few. Certainly the entrenched loafer is not a major menace to higher education. Some men who have pushed hard to obtain tenure subsequently appear to have fired most of their creative ammunition in the big assault. Such men are seldom lazy, or they would never have made the grade in the first place, and sometimes, as the fervor for research wanes, they become real teaching stalwarts of their departments. They may also, sooner or later, undertake administrative work with the same kind of vigor displayed in research during their earlier years as instructors and assistant professors.

The panaceas

The sidewalk academicians are forever discovering new gimmicks that would surely cure educational maladies, if only the academic community were not too conservative to accept innovation. Unfortunately, most of the panaceas are as old as the hills and have either been found to have limited usefulness or to be impractical for widespread application.

One of the "new" academic procedures frequently recommended is the establishment of student-rating systems. Such schemes have been cropping up for years on many campuses, and I have been rated as a teacher by extensive student-rating forms at both Iowa State and Caltech—the first time at least ten years ago. The results have always been interesting. One member of a class of home economics students found my lectures quite lively but was disturbed by the rip in the back of my brown sports jacket. The one clear conclusion that I have drawn from the critical surveys is that classes are collections of individuals. Methods that are pleasing to some will bore others. A discussion that seems crystal clear to one will seem obscure to another. On the whole, student ratings are helpful, but they provide no magic formulas for success.

With respect to actual teaching procedures and curriculum content, professors are cut to no set pattern. Some are hopelessly conservative and others are recklessly liberal. Here at Caltech, a hotbed of research prize winners and honorary citizens of Washington, academic instruction is a continual subject for conversation and changes constantly appear. This year, after weeks of study and debate, the faculty voted to try giving freshmen only *pass* and *fail* grades in a two-year experiment. Simultaneously a new system for advising freshmen was instituted; consequently 16 senior faculty members are now advising small groups (10-20) of freshmen.

Recently Richard Feynman, one of the world's best theoretical physicists, spent two years of intensive work in redoing the freshman and sophomore physics courses. Some students found the product brilliant while others considered it terrible. However, they all had the experience of seeing Feynman in action and none considered him dull or the course conservative.

External examiners

I was especially amused by a suggestion of John Fischer's in his *Harper's* editorial. He has heard that Swarthmore augments its honors programs by using external examiners, and he accuses the academic fraternity of cowardice for not making general use of this means of indirect self-examination.

The principal barrier to widespread implementation of such a plan is neither money nor academic conservatism; it is the *demand on the time and efforts of the external examiners.* Consider the number of man-hours that would be required to conduct an oral examination with an external examiner for every graduating college senior in the country. The examinations would necessarily be spread over several months and would involve thousands of people. The amount of travel by professors to Washington would be dwarfed by comparison with the annual

migratory movements of academic examiners.

To carp and quibble is easier than to make fruitful suggestions for the solution of difficult problems. The real stimulus to write is found in the blatant attempt of critics to stir the supporting public to rebellion. Taxpayers, private donors, parents and students are encouraged to revolt. A revolution may be needed but the one advocated may do serious damage to American education. The most talented members of the academic community, those who are spread too thin, are the very ones who are in the best position to say, "To hell with it!" and forsake the academic world entirely. Although academic salaries have risen sharply in recent years, the top men in the field can still gain financially by moving to non-academic positions. Any significant number of desertions in this direction would create a new and terrifying status symbol for young academicians. Fortunately, the threat of desertion has been with us for a long time and still the academic community has survived and flourished.

Surprisingly, the current caricature of professors may be a welcome change from the bizarre images held up to the public over the past few decades. It is a relief to be cast as a conscienceless entrepreneur rather than as an ineffectual idiot. At least, the modern-day professor is credited with doing something; he may not be teaching but he is doing research and traveling to Washington.

I have seen many good teachers and much fine teaching. I have also encountered mediocre teaching and poor teaching. In fact, I have dispensed all three brands of pedagogy myself. There have been days when I felt certain that what I have said to my classes has seldom been said better and there have been other days when I have known full well that both I and my students should have stayed in bed. Furthermore, some of the best-received lectures have been among the poorest, since it is relatively easy to give a smooth recitation of cut-and-dried material.

The professor's problem

Performance seems to be necessarily uneven if it is ever to be really good. A professor is presented with an almost unmanageable problem. If he stops to examine a point in real detail, and especially if he concludes that the matter cannot be settled on the spot, he may give a few students real insight into a working field of scholarship. On the other hand, to most of the students in any class it will be evident that: (a) the professor doesn't know all (any?) answers, and (b) the class isn't covering "ground" very rapidly (this being important because one of the chief purposes of most students in attending class is preparation for the next examination).

I do not indict students. Students have neither the time nor the intellectual stamina to make every class a great educational experience. What a student needs is fine, introspective lectures for just those times when he is in exactly the right mood to receive them. The rest of the time he really needs facts and generalizations in neat little packages.

A successful educational program in a college or university demands a great deal from teachers and asks even more from students. Consequently, most students will have really done very well if each year they enjoy a major learning experience in one or two courses. If they have also done their chores well enough in other courses to earn respectable grades on examinations, they will be the university's premium products.

Facing the facts

The facts are straightforward, but faculty, students, parents, and editors find them hard to swallow. Students and faculty are especially vulnerable because their personal ambitions are thwarted. A student who has once experienced real satisfaction in listening to a lecture usually feels shortchanged because all others do not appear to be of like quality. A professor who has seen one student blossom under his tutelage is frustrated because all of the others do not respond similarly. A natural protective reaction is for each party to blame the incompetence of the other, and nothing is easier since both students and faculty are in situations requiring continued demonstration of both competence and incompetence.

Higher education in the United States is in a state of turmoil and many of us feel that we are presenting an enormously complex play before a terrifyingly large audience. Since the action is not scheduled, we must often perform without rehearsal. I am pleased that the audience is watching so closely, because I believe that they will get their money's worth. I only hope that they will see enough of the stage to appreciate the magnificence of the action while tolerating some of the bumbling.

Our system of higher education is typically American, a young giant, often awkward and often wrong, but possessing marvelous strength and vitality. Perhaps its greatest deficiency is a lack of grace and self assurance, but even these qualities can be found if one searches hard enough. At the present accounting, the system has a prodigious record of accomplishment in both extending knowledge and transferring it to new generations.

Alumni News

Alumni Seminar

To its participants, comprising some 1300 alumni, their families and guests, Caltech's Alumni Seminar is a day of outstanding lectures, exhibits, campus tours, and nostalgic visiting. May 8, 1965, was no exception.

Beckman Auditorium, the latest in demonstration lecture halls, was in constant use beginning with James Bonner's lecture on "The New, New Biology." Simultaneously, three other lectures were presented to sizable audiences: "The White Dwarfs" by Jesse L. Greenstein, "Better Safe than Solid" by Heinz Ellersieck, and "Sensors in Space" by R. V. Meghreblian. Each gave a repeat performance during the day, as did all other lecturers, to permit a scrambling of attendees.

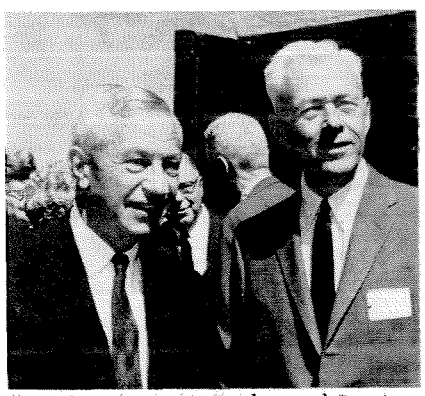
Alumnus John Rubel '42, vice president and director of technical planning at Litton Industries, addressed the entire body just before noon. His talk, "Breaking the Poverty Barrier," was an impartial discussion of President Johnson's poverty program.

Six other lectures were given during the day: "Man and His Machines" by Dino A. Morelli; "Some Matters of Considerable Gravity" by Thane H. McCulloh; "Light on the Dark Continent" by Thayer Scudder; "Solar Flares and Interplanetary Storms" by Harold Zirin; "Nature's Versatile Molecular Architecture" by John H. Richards; and "Fresh Fields in Aviation" by Peter B. S. Lissaman. A number of these lectures will be published in future issues of *Engineering and Science*.

The evening social hour, banquet, and talks were held at the Huntington-Sheraton Hotel, where the ballroom was filled to capacity. Ted Combs '27, Seminar chairman, presided. Dr. Arnold Beckman '28, chairman of the board of trustees, spoke briefly of the cost of educating an undergraduate and of the small percentage actually borne by the student, or even by his scholarship. The financial obligation of alumni to their alma mater was stressed.

President Lee A. DuBridge told of his surprise that no one during the day had asked him about the current student "rebellions," then proceeded to diagnose the many reasons for college student insurgence and quickly pointed out that none of these exist in serious proportions at Caltech, where, thanks to the wisdom of Dr. Robert A. Millikan and other early leaders, a balance of interests and controls has flourished.

Chairman Combs was assisted by other Seminar officials: Robert M. Lehman '31, assistant general chairman; Craig T. Elliott '58, chairman of program committee; Donald H. Loughridge '23, assistant chairman of program committee; H. M. O'Haver '29, chairman of arrangements committee; Robert G. Smith '31, assistant chairman of arrangements committee.



President L. A. DuBridge and Seminar Chairman Theodore C. Combs.

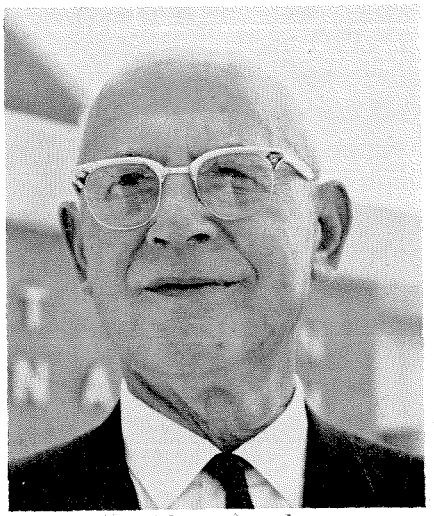
Clark Scholarship

Donald S. Clark, professor of physical metallurgy, director of placements, and secretary of the Alumni Association, is to be honored for a lifetime devoted to teaching and research and service to the Alumni Association. At the annual alumni meeting on June 9, Richard P. Schuster, Jr., president of the Association, proposed that a Donald S. Clark Alumni Scholarship be endowed by alumni and friends to pay tribute to Dr. Clark for a lively Caltech career spanning 40 years since his enrollment as an undergraduate in 1925. Specific details of the Donald S. Clark Alumni Scholarship will be determined later this month. A first-year goal of $25,000 has been established, however, and contributions are already being accepted.

Alumni Honors

William N. Lacey, professor emeritus of chemical engineering, and Harold Z. Musselman, administrative advisor in physical education, were awarded honorary memberships in the Caltech Alumni Association at the annual alumni meeting and reunion held in Los Angeles on June 9.

Dr. Lacey came to Caltech in 1916, and Musselman—who served for many years as athletic director of the Institute—came here in 1921. The two men join five other living honorary members of the association: Lee A. DuBridge, George R. MacMinn, Charles M. Schwieso, Jr., Royal W. Sorensen, and J. E. Wallace Sterling.



Harold Z. Musselman

Also, at the annual meeting, 50-year certificates were awarded to 18 alumni who graduated from Caltech 50 or more years ago: Kirk W. Dyer, '02, Cromwell, Connecticut; James M. Gaylord, '02, Pasadena; Richard W. Shoemaker, '03, Grass Valley, California; Harold C. Hill, '11, San Diego; Norman E. Humphrey, '12, Long Beach; John C. Merrifield, '12, Rocky Ford, Colorado; Ray Gerhart, '13, Pasadena; Chester R. Hovey, '13, So. Pasadena; Ralph W. Parkinson, '13, Ft. Myers, Florida; Herbert S. Wood, '13, Pasadena; Virgil F. Morse, '14, Pacoima; Guy D. Young, '14, Exeter, California; Harold A. Black, '15, San Diego; Earle A. Burt, '15, Pasadena; Raymond Call, '15, Balboa; Verne D. Elliott, '15, Pasadena; Robert S. Ferguson, '15, Tallmadge, Ohio; and William M. Holmes, '15, Pasadena.

William N. Lacey

Letters

Pasadena, California

EDITOR:

Your article on the successful flight of Ranger IX (*E&S* — April '65) leaves readers with the impression that, now that JPL has provided home television viewers with pictures of Ranger's approach to the moon, it will "repeat this spectacular feat by providing home viewers with surface pictures of Mars, transmitted by the Mariner spacecraft as it approaches the planet in July."

In that it takes 8 hours and 20 minutes to transmit one picture to earth, it will be impossible to screen them for the home viewer as they are received. Actually it will take more than a week to receive all the pictures and process them. The pictures will be recorded on magnetic tape in the spacecraft as they are taken. The spacecraft will then be occulted by Mars and the tape will be played back some 10 hours after occultation. It is interesting to note that the transmission distance for the pictures will be in excess of 135,000,000 miles.

FRANK BRISTOW
Public Education, JPL

April 24, 1965
San Marino, California

GENTLEMEN:

Frederick Bedell Burt '48
April 18, 1925 — April 19, 1965

The flags are at half-mast today at the University of California, Los Angeles, where our son, Fred, was recently advanced to the newly created position of Assistant Research Professor of Surgery/ Urology.

The light was turned out on his desk where he would prepare no more brilliant medical papers. Forty years and a day seem all too short a life. However, as his colleague of a dozen years, Dr. Bruce Belt, said in tribute: "Fred was a skillful surgeon, a dedicated worker, a careful student. His research was creative and original. His discovery of a way to grow bits of human cancer in hamsters may enable us to test the ability of a wide variety of drugs to destroy a particular cancer from a particular patient. This is his immortal progeny for the benefit of all men. He was loved with faith, with loyalty, with a beautiful love."

Ulla, Eleanor and I are proud that his colleagues are establishing a Frederick Bedell Burt Medical Foundation to carry on his work. Contributions are being accepted by Dean Sherman M. Mellinkoff, School of Medicine, University of California, Los Angeles.

ROBERT C. BURT '26

Personals

1915

HAROLD A. BLACK writes that he and his wife are enjoying their new home at Wesley Palms, the Methodist retirement home in Pacific Beach, Calif. Last summer the Blacks made a 31,000-mile trip to Africa, visiting a number of missionary centers there, including Albert Schweitzer's Lambaréné.

1921

EDWARD L. CHAMPION, retired consultant for Gibbs & Hill, Inc., consulting engineers of New York City, died May 1 in Pasadena. He was vice president of the company from 1940 until his retirement in 1960, coming to the West Coast to direct the company's western activities in 1950. He is survived by his wife, Evelyn; a son, Edward, of Temple City; a daughter, Mrs. Dorothy Willis of Fresno; and four grandchildren.

1924

HOWARD M. WINEGARDEN, MS '27, PhD '31, has retired after 40 years at the Cutter Laboratories in Berkeley, where he was in charge of the research division.

1925

EDGAR M. DeREMER, vice president of La Jolla Properties, Inc., died early last month in La Jolla following a short illness. He had been a project engineer for the Fluor Construction Company, and also had worked with the Southern California Gas Company.

1928

DOUGLAS G. KINGMAN, MS '29, has retired to his avocado grove in Poway, Calif., after 34 years with the Mobil Oil Co. and its predecessor, the General Petroleum Corp.

1932

WILLIAM C. ROCKEFELLER, MS '34, is vice president of SoniCo, Inc., a subsidiary of the Shell Oil Co. in San Diego, engaged in research and development on various phases of sonic devices. The company's principal product at this time is a sonic pile driver invented by ALBERT G. BODINE, '36.

1933

TED S. MITCHEL writes that he has now fully recovered from a mild coronary suffered last fall and has returned to his job as manager of technical recruitment, covering the eastern United States for the Shell Companies, with headquarters in New York City.

1935

ARTHUR N. ETZ, general engineering contractor, is currently engaged in resort development and subdivision work. He is chairman of a 4-County Development Committee appointed by the supervisors of Kern, Los Angeles, San Bernardino, and Inyo counties. The Etz's live in Palmdale, California.

1936

PAUL J. SCHNEIDER, MD, is now chief of plastic surgery at the Herrick, Merritt, and Children's hospitals in the San Francisco area.

E. MORTON HOLLAND writes; "As far as I know I am the only alumnus to have gone so far astray as to become a representative with a New York Stock Exchange member firm (A. G. Edwards & Sons)."

1937

JOHN HOWARD BLUE, Lieutenant Colonel, U.S. Marine Corps (Retired), was a candidate last month for his MS degree from Rollins College in Winter Park, Florida.

1938

SAMUEL E. WATSON, JR., senior geologist with the Iranian Oil Exploration and Producing Company in Tehran, has been transferred by his home company, Tex-

aco, Inc., to "parts unknown," after eight years in Iran.

1939

CHARLES H. TOWNES, PhD, provost and professor of physics at MIT, and winner of the 1964 Nobel Prize in physics, was elected a trustee of the Carnegie Institution last month. Dr. Townes, who is developer of the laser-maser principle, is also serving as consultant to the National Bureau of Standards and the Brookhaven National Laboratories.

1940

JAMES E. LuVALLE, PhD, director of basic research for the Fairchild Space and Defense Systems division of the Fairchild Camera and Instrument Corporation in Syosset, New York, received an award last month for the best scientific paper published in the journal of the Society of Photographic Scientists and Engineers during 1964. The paper described research work on the chemical and spectral sensitization of silver halides. LuValle directs the operations of a Fairchild laboratory, which he was instrumental in establishing, for basic research on the interaction of light with solid state material.

ROY E. MARQUARDT, MS '42, chairman of the board of the Marquardt Corporation in Van Nuys, received the Gold Knight of Management Award last month at the 17th annual conference of the southern California area council of the National Management Association in Los Angeles. Known as the "father of the American ramjet engine," Marquardt rediscovered the basic principles of this propulsion system in 1942 when he was engineer in charge of naval research at Northrop Aircraft in Los Angeles. He established an aeronautical research laboratory at USC in 1943, with a Navy contract to develop a ramjet engine.

1942

S. KENDALL GOLD, assistant manager of the engineering and construction department of the California Texas Oil Corp. in New York City, writes that his family have become ski enthusiasts and have built a ski chalet at Stratton Mt., Vt.

1944

RICHARD E. KUHNS has completed 19 years with the Los Angeles County Engineer Department. His duties with the sanitation division now include waste water reclamation research and development.

HARRISON W. SIGWORTH is assistant to the president of the Standard Oil Company of California, Western Operations, in San Francisco. He reports that he occasionally sees TONY SPAULDING '44, LAWSON JONES '43, JOHNNY NELSON '44, KEN POWLESLAND '43, GLENN BILLMAN '41, and BOB BOWLES '41.

ROBERT G. McANLIS sends word that he has been at Rocketdyne Edwards Field Laboratory in California for 18 months, and is now the safety engineer there. He was formerly with the Johns-Mansville Company in New Jersey.

1945

THEODORE B. TAYLOR is one of five U.S. nuclear scientists who received the Atomic Energy Commission's E. O. Lawrence Memorial Award in April at the National Academy of Sciences in Washington, D.C., for his "outstanding contributions to the design of nuclear weapons and for his significant role in the development of the TRIGA research reactor." Dr. Taylor, who is with the Defense Atomic Support Agency, was senior research advisor at the General Dynamics Corporation's General Atomic Division from 1956 to 1964.

1946

DONALD B. HICKS has been transferred from his position as resident sales engineer with the Kaiser Steel Corp. in Fresno to senior sales engineer at Kaiser Center in Oakland.

HOWARD E. JESSEN, assistant director of research and development of the Ceco Corporation in Chicago, has now been appointed manager of the firm's market research department.

ROBERT C. SIEGEL, president of Palomar Theaters, Inc., was made president of the Robjohn Corp. in January. He is also secretary of Siegel Bros. Inc., and of Margo Operating Co. — all Oceanside, Calif., corporations.

1948

ANDREW P. ROLLINS, JR., MS, formerly a colonel in the U.S. Army, has been appointed to the rank of temporary brigadier general by President Johnson, and named deputy director of military construction and special assistant to the chief of engineers for support of NASA.

BENOIT MANDELBROT, MS, AE '49, staff member of the IBM Research Center in Yorktown Heights, New York, was visiting professor of applied mathematics at Harvard University in 1963-64, and of economics in 1962-63.

1949

MALCOLM C. McQUARRIE, MS, patent attorney for the Kaiser Aluminum & Chemical Corp. in Oakland, was graduated from Georgetown University Law School in Washington, D.C. in 1963, and was admitted to the California Bar last year.

ROLF M. SINCLAIR and his wife announce the birth of their second child — first son — Andrew Caisley, on April 23. Rolf is on the research staff of the plasma physics laboratory at Princeton University.

PATRICK D. DOHERTY writes that he and DONALD P. MERRIFIELD '50, and ROBERT J. ARENZ, PhD '64, will be ordained Jesuit priests this month. Doherty and Merrifield began their studies for the priesthood after leaving Caltech, Doherty receiving his PhD degree at St. Louis University in Missouri, and Merrifield at MIT. Arenz, who entered the Jesuit Order before beginning his graduate work at Caltech, has been a research fellow on the aeronautics staff at the Institute for the past two years, directing research in photoviscoelasticity and investigating analytically the dynamics of solid propellant rocket materials. He also is a consultant on spacecraft structures for the Lockheed Missiles and Space Company.

1950

ROY P. CRAIG, MS, visiting lecturer at the University of Colorado in Boulder since 1961, has been appointed associate professor of physical science there. He has been a chemist with the Dow Chemical Co. near Boulder for eight years.

1951

ROBERT G. ALDER has been doing graduate work in chemistry at the University of California at Riverside this past year on a National Defense Education Act fellowship. He expects to be doing research in the field of carborane and boron hydride chemistry. He was formerly a senior chemist with the American Potash and Chemical Corp.

JAMES A. IBERS, PhD '54, writes that he recently left the Brookhaven National Laboratory to become professor of chemistry at Northwestern University in Evanston, Illinois.

ALBERT E. VAN HISE, MS '52, sends this report of his activities: "Two years ago I gave up my rather lucrative profession at building war machines to start over — back down at the bottom — as an instructor at the Polytechnic Institute of Brooklyn, where I hope I am doing a little more 'good' in the world. I am now studying part time here toward a PhD in systems science. I don't make much money anymore, but I will be taking my third European vacation (3½ months) this summer."

1952

RICHARD R. DICKINSON writes that, after five years and five transfers, he has returned to Texaco's refinery in Long

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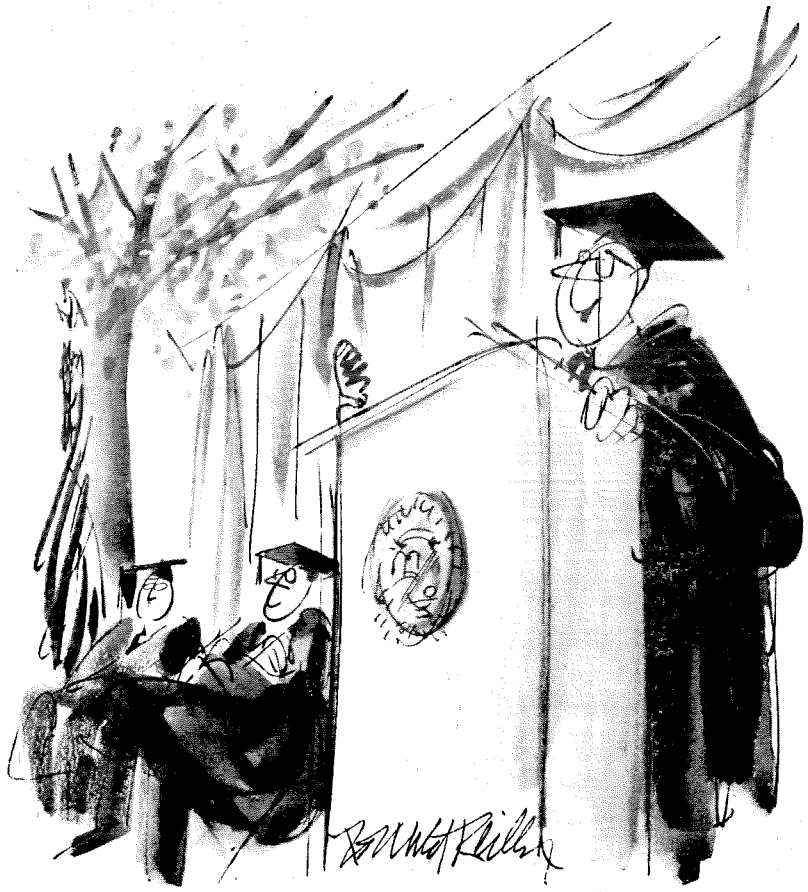

Drawing by Donald Reilly;
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". . . and now we, your teachers and mentors, wish you Godspeed, and may each and every one of you make a bundle."

Beach, California, where he is chief process engineer.

1953

DAVID J. MacDONALD, JR., MS '54, assistant professor of chemistry at the University of Nevada in Reno, writes that since leaving Caltech he has taken up skiing, mountain climbing, and the study of inorganic substitution reactions in chromium and nickel complexes. After receiving his PhD at UCLA in 1960, he was research chemist with the California Research Corporation for three years. He was married in 1962 and has two children.

THOMAS F. TALBOT, MS, is joining the faculty of Vanderbilt University in Nashville, Tennessee, as associate professor of materials science and mechanical design. He received his PhD in mechanical engineering from the Georgia Institute of Technology in Atlanta in June 1964.

1954

JOHN T. F. KUO, MS, geophysicist and associate professor of mining at the Henry Krumb School of Mines at Columbia University, is studying the earth's gravity from each of the 102 floors of the Empire State Building. He works from 7 p.m. to 3 a.m., when the building is quiet, with his gravimeter, an apparatus that is sensitive to weight differences of one one-billionth of a pound. He says that extrapolations from his figures might help in the design of instruments measuring the gravitational acceleration on space vehicles. Kuo has been at Columbia since 1960.

1955

WILLARD V. T. RUSCH, MS, PhD '59, associate professor of electrical engineering at USC, is one of six USC professors to receive an award for excellence of teaching this year. Before joining the USC faculty in 1960, Rusch was a Fulbright scholar on electromagnetic theory in Aachen, Germany. A consultant to Caltech's JPL, he measured the temperature of the moon by radar during the December 1964 lunar eclipse.

1958

JAY B. CLEARWATERS, senior engineer at the missile components plant of the Aeronutronics Division of the Philco Corp., at Newport Beach, Calif., was killed May 29 when a twin-engine Beechcraft, of which he was copilot, crashed and burned a few minutes after takeoff from the Orange County Airport. Clearwaters worked at Caltech's JPL before going to Aeronutronics in 1961.

1959

FRANK W. CHILDS III, project engineer at the Aerojet-General Corp. in Sacramento, is engaged in propellant development for liquid rocket engines in the advanced technology division. He was designing propellant pressurization for Aerojet in Azusa before going to Sacramento in 1963.

1960

ERICK L. LINDMAN, JR., is now assistant professor of physics at the University of Texas in Austin. He received his PhD degree from UCLA, is married, and has a daughter.

1961

ROBERT D. NASON is working on his PhD degree at the Scripps Institution of Oceanography in La Jolla. He married Louise Bowen of Pasadena in September 1963.

1962

MATTHEW M. COUCH, associate scientist with a Caltech research group, died on May 6 on the campus. He had been working with Alexander Goetz, Caltech professor of physics, on an atmospheric

Personals . . . *continued*

physics research project supported by a U.S. Public Health Service grant. After his graduation from Caltech he was a graduate student at Yale in the Sterling Chemistry Laboratory. He is survived by his parents, Mr. and Mrs. George M. Couch and a brother, Michael, of Pasadena.

JAMES BROWN IFFT, PhD, is assistant professor of chemistry at the University of Redlands.

LESTER INGHER, graduate student at the University of California at San Diego studied nuclear physics at the Niels Bohr Institute in Denmark last summer. He has started a Karate school and club at UCSD, and writes, "true to form, have broken another bone – left big toe."

1963

HAROLD R. HARRISON is a second-year graduate student in physics at Columbia University.

ROBERT W. SCHMIEDER and his wife have a daughter, born May 22. Schmieder received his MS degree in January from Columbia University and is working for his PhD degree there.

HARRY E. KELLER, graduate student in chemistry at Columbia University, was married on May 7 to Jayne Emily Schmidt. The Kellers are living at 35 S. Broadway, Irvington-on-Hudson, N.Y.

NICHOLAS J. TURRO, JR., PhD, is instructor of chemistry at Columbia University.

1964

GEORGE R. CANNON, JR. is on a two-year Mormon mission in Chile. He plans to enter graduate school in the U.S. upon completion of the mission.

JOHN C. SWONSON, JR., First Lieutenant in the U.S. Air Force, is a member of the first aircrews flying the Air Transport Service's new C-141 Starlifter in operational use from Travis AFB in California.

1965

MICHAEL J. COSGROVE is now a second lieutenant in the U.S. Air Force assigned to Chanute AFB in Illinois for training as a missile launch officer.

WERNER MUKATIS has joined the research laboratories of Rohm and Hass Company in Bristol, Pennsylvania.

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holography . . . optimism about fine temperature differences . . . color vision instead of brain strain

Photography by Fourier

Holography is done with a He-Ne laser, a mirror or two, and a photographic plate.

Holography is peculiar photography, where the photographic record is quite invisible to the naked eye and doesn't really depend on silver density. The photograph, if you want to call it that, is merely a representation of all the phases and amplitudes in a scene or collection of separate scenes. In the reconstruction, which is astonishingly simple and direct, you get a choice between a three-dimensional virtual image or a series of real images in different planes. You can read all about it in *J.O.S.A. 53*, 1377 (1963) and *54*, 1295 (1964) and accept it intellectually, but it wouldn't hurt to convince your own eyes. Looking at one of these plates, you recall wondering at an early stage in your career what kind of a dance is being executed by a molecule of air in your ear while listening to a full orchestra and chorus. Baron Fourier sure was ahead of his time.

Just because we are giving holography a little shove here, don't assume we offer the perfect photographic material to do it on. The early holographers have been using KODAK Spectroscopic Plates, Type 649-F, a red-sensitized product with the same capacity for detail as KODAK High Resolution Plates.[1] When they tell us they don't need all the super-resolution this type of emulsion can provide and would like to trade some of it off for a little more speed, we suggest KODAK Spectroscopic Plates, Type V-F. If this should all turn into more than a *succès d'estime*, it is most unlikely that either of these emulsions would remain the best choice.

If anybody is interested in speeding the advent of such a new and best choice, he had better keep in touch with Eastman Kodak Company, Special Sensitized Products Division, Rochester, N. Y. 14650.

The possible dawn of the cholesterol age

D.C.B., a chemist of ours and an extremely busy man, took a day off. Mrs. B., a clever girl enjoying a fine run of good fortune on a nationally televised contest, had reached the stage of competing for a substantial prize in Florida real estate. He kept her company to New York for the shot at the big one. But to make good use of his hour aloft, he took along *Scientific American* to catch up on science as an aspect of modern culture. There, in the August 1964 issue, he found an article on the cholesteric state of matter. Suddenly a question answered itself. Suddenly he understood why our Eastman Organic Chemicals Department had been getting inquiries lately for the esters of cholesterol.

A corporation no less respected than Kodak was permitting one of its scientists to disclose in the magazine certain exciting physical properties of the esters of that greasy stuff which has lately become familiar by name to middle-aged males who live well. The new-found properties offer little apparent cause for worry. On the contrary, the author winds up on a broadly optimistic note hinting at forthcoming discoveries that might assign cholesterol a central role in the sensory mechanism of the vertebrates. The optimism is generated by a remarkable sensitivity to fine temperature differences and to traces of various vapors that is seen in the color of the light reflected by layers of the esters. Though cholesteryl esters are old stuff, as are the nematic, smectic, and cholesteric interregna between the liquid and solid states of matter, new visions arise of salves that show the physician epidermal temperature anomalies difficult at best to find with complex instruments,[2] of simple nondestructive test methods that reveal structural unsoundness through singularities in heat flow.

So it came to pass that Mrs. B., calmed and comforted by a husband beside her engrossed in his *Scientific American*, went on and won the big house and lot in Florida. Further did it come to pass that we can now offer *3-Chlorocholest-5-ene* (EASTMAN 9562, "Cholesteryl Chloride"), *Cholesteryl Acetate* (EASTMAN 2391), *Cholesteryl Myristate* (EASTMAN 9693), *Cholesteryl p-Nitrobenzoate* (EASTMAN 9697), *Cholesteryl Nonanoate* (EASTMAN 9669), and *Cholesteryl Propionate* (EASTMAN 4742). Orders may be placed with Distillation Products Industries, Rochester, N. Y. 14603 (Division of Eastman Kodak Company).

Now where do you get directions for the use of these esters? You don't. At least not yet. Finding the directions for use we assume to be what your employer might be paying you to do. Least of all do we offer assurance of success. You and the firm we avoided mentioning are up against a hard fact of life. That the author got clearance to yield to the blandishments of *Scientific American* is no accident. The big company, even as our own, has to publish enough to make itself attractive to the scientific community, whence will come its future strength. Yet the old sense of property, the basis of the firm's very existence, inhibits it from tossing to the four winds those few nuggets of practical information for which much gold has been traded.

Meanwhile we keep thinking of more and more cholesteryl esters and wondering whose move is next.

When many channels vex the mind

Avoid brain strain. Why waste high-powered deductive reasoning on tasks just as well accomplished through mere color vision? Primates like you generally have use of color vision free of charge. We (Instrumentation Products Division, Eastman Kodak Company, Rochester, N. Y. 14650) can supply name of nearby dealer who now accepts orders for KODAK LINAGRAPH 705 Paper. Comes in widths 3⅝-in. to 12-in., lengths to 400 feet.

Blue light, as through a KODAK WRATTEN Filter No. 34, falling on this paper leaves a red trace; green light, as through WRATTEN No. 12, a blue-green trace; white light (or an overlap of the blue and green light), a nearly neutral black one—after running the paper through an oscillogram processor wherein the four regular baths have been replaced from a KODAK LINAGRAPH 705 Processing Kit that you had better order from the dealer while you are at it.

With many channels overlapping often, the untangling of them can tax the mind to distraction if they're all black all over. KODAK LINAGRAPH 705 Paper is so sensitive you can draw a red line on it at 4,000 feet per second. Oscillography may even be farthest from your thoughts.

[1] This has little to do with holography and more with detail rendition for microelectronics production, but KODAK High Resolution Plates now have an emulsion that is about 6μ thick before processing and 4μ after (hitherto 9μ and 6μ, respectively).

[2] *The Journal of Investigative Dermatology, 43*, 89.

This is another advertisement where Eastman Kodak Company probes at random for mutual interests and occasionally a little revenue from those whose work has something to do with science