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Facts about CALTECH

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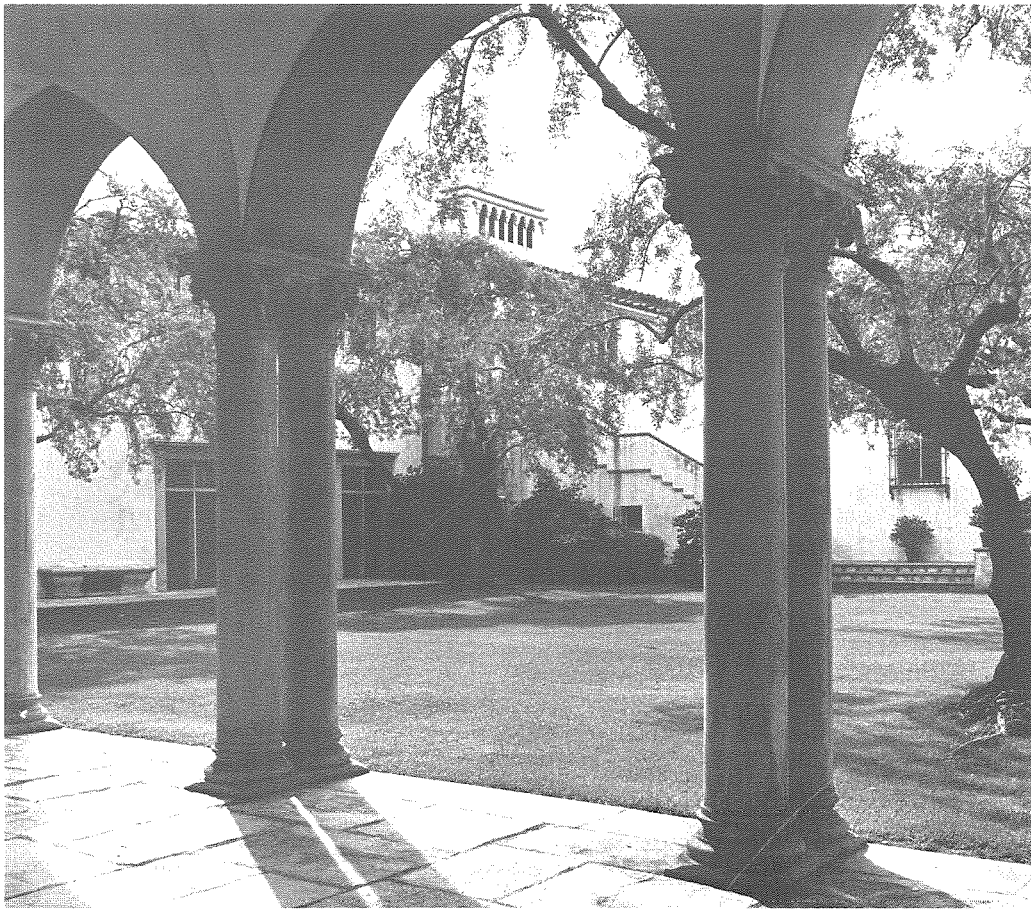
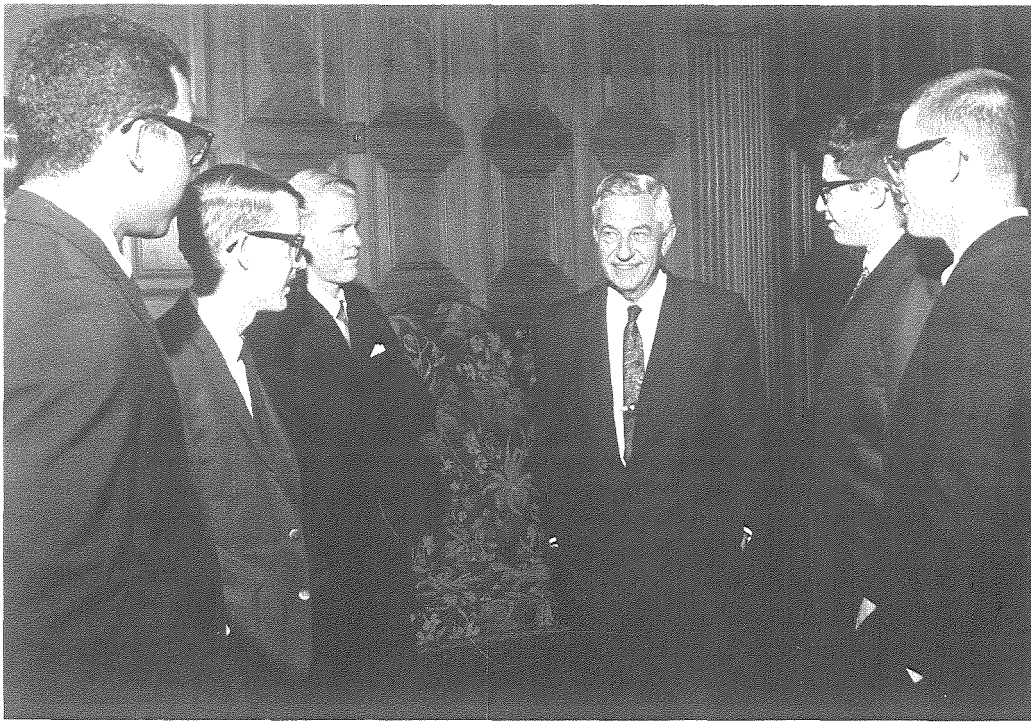


Facts about Caltech

CALIFORNIA INSTITUTE OF TECHNOLOGY

PASADENA, CALIFORNIA



"What we want in our student body is, first and foremost, men of the highest intellectual caliber. But we also want these men to be well-rounded human beings—men with spirit, with imagination, with health, with character. Of course we want, and the world sorely needs, the occasional genius who may lack some social graces. But we also need the man whose intellectual power is combined with the spark of leadership and human understanding. Our present student body is great because it contains so many young men with just these qualities."

—*From a speech made by* DR. LEE A. DUBRIDGE, *President of the California Institute of Technology.*

To the reader

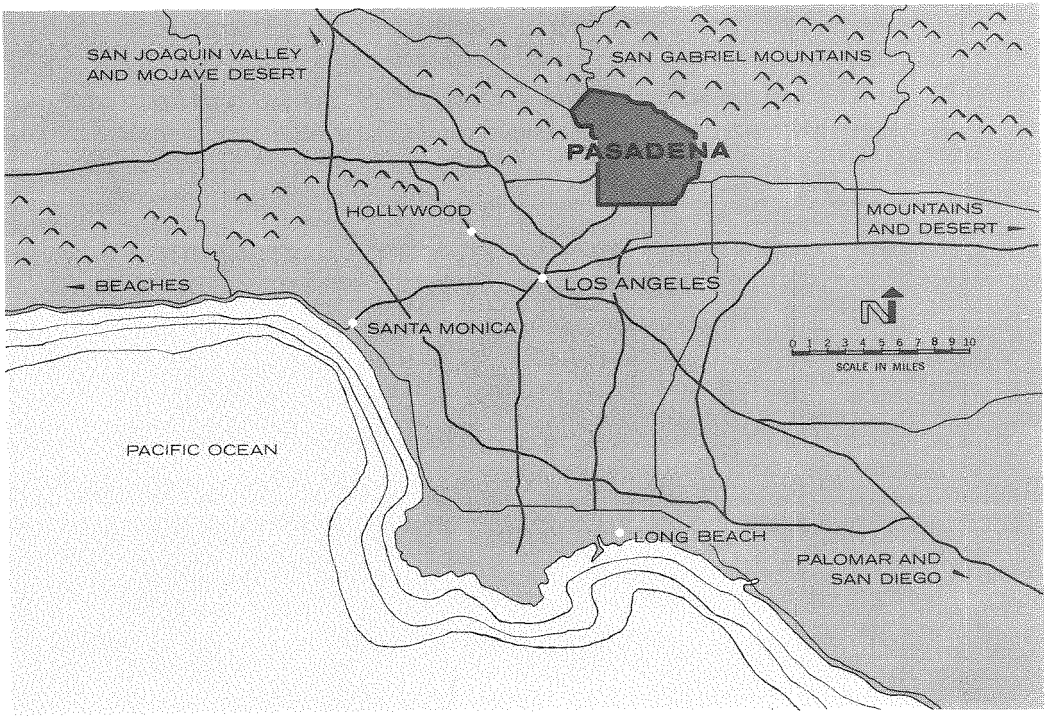
THE DECISION *to go to college is a big one. A college education represents a major investment of time and money, and hence one should exercise great care in choosing a college or university well suited to his particular interests and abilities.*

This booklet is intended for you, the reader who has some general interest in science and engineering and who would like to know how subjects in these fields are taught and studied at the California Institute of Technology.

We need not tell you much here about science or engineering as a career, or as a way of life. We only remind you that each really *is* a way of life, and not just an assemblage of courses in a college catalog. We try to avoid vague phrases about the value of education and the aims of science, because we assume that you already know about these things and are interested mainly in what the California Institute of Technology does about them.

Finally, we assume that you are less concerned with broad generalities about the Institute than with those factual yardsticks that are commonly accepted as offering an objective measurement of the kind and quality of teaching that is to be found in an American college. We hope to give you a concrete and realistic picture of the teaching you can find at the California Institute of Technology, and of the life you can expect to lead here.

Pasadena is at the foot of the San Gabriel Mountains, twenty-five miles from the Pacific Ocean. Caltech's campus is shown above.



Facts and principles

SCIENCE and engineering are taught and studied at a great many institutions. Each of these institutions differs from the others in ways that range from geographic location, size, and athletic prowess, to the principles on which it bases its educational philosophy. A student, to select the one institution that most nearly meets his own set of requirements, needs some knowledge of both facts and principles. Here, then, are some facts about the California Institute of Technology.

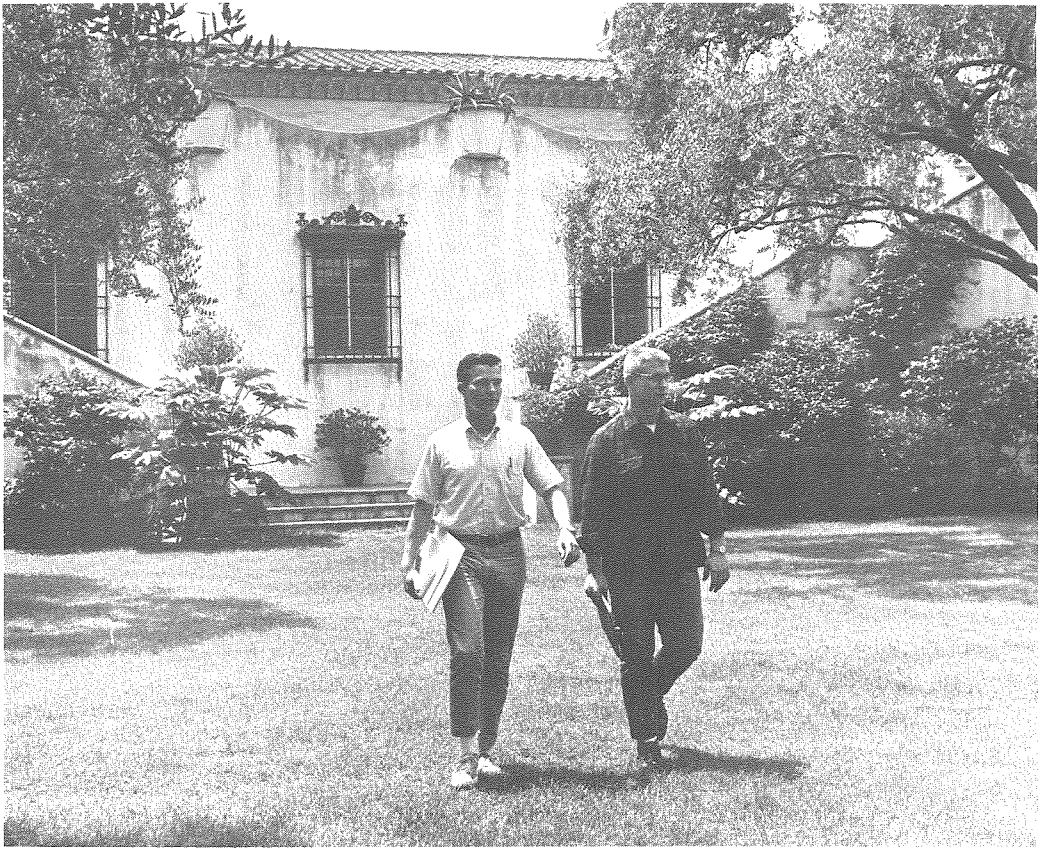
The California Institute of Technology is in Pasadena, California, four miles from the San Gabriel Mountains, twenty-five miles from the Pacific Ocean, and about a fifteen-minute drive from downtown Los Angeles.

The Institute is an independent, privately endowed institution, like the Massachusetts Institute of Technology, Harvard, Stanford, or Yale. It is not connected with any other college or university.

The Institute is young. It took its present form less than fifty years ago, but it has grown to be one of the leading centers of learning and research in the world.

The Institute is small. It has about 700 undergraduate students, 750 graduate students, and 550 faculty members, of whom 250 are engaged in instruction. The optimum size of the freshman class is 180 men.

The California Institute of Technology is not easy—no college of science and engineering is. But Caltech students are carefully chosen for academic prowess, for general all-around interests, and for healthy social adjustment. Every student admitted to the Institute has the ability—mental and physical—to complete the prescribed courses and earn his degree. Those students who do drop out generally lack the deep and genuine interest necessary to become an engineer or scientist. It takes strong motivation to carry a man successfully



through the hard work of a professional career. There is much to be taught in science and engineering, and the more carefully a college selects its students the more it can demand of the students in mastering the ever-increasing body of scientific and technical knowledge. Caltech offers a challenge of hard work and high standards. For those who meet this challenge, the record of its graduates indicates that the rewards are great.

While it is true that Caltech is not easy, it is equally true that the students enjoy a well-rounded life. More than a third of them participate in intercollegiate athletics. Nearly ninety percent take part in some form of extracurricular campus activity, as compared with approximately fifty percent at a typical state university.

Here is a further set of facts that may help to explain the character of the California Institute of Technology:

The Institute's faculty publishes each year nearly 1,000 original articles, books, and technical reports on new research. It is, in other words, an extraordinarily creative group.

Six out of seven of the Institute's seniors go on to graduate school. They, too, become creative men.

Many classes are held in small seminar rooms.

Creative may be the best single word to use in explaining the Institute. It is, in fact, the key word in the statement of policies laid down by the Institute trustees in 1921. The undergraduate school, said that statement, must

> . . . provide a collegiate education which will best train the creative type of scientist or engineer.

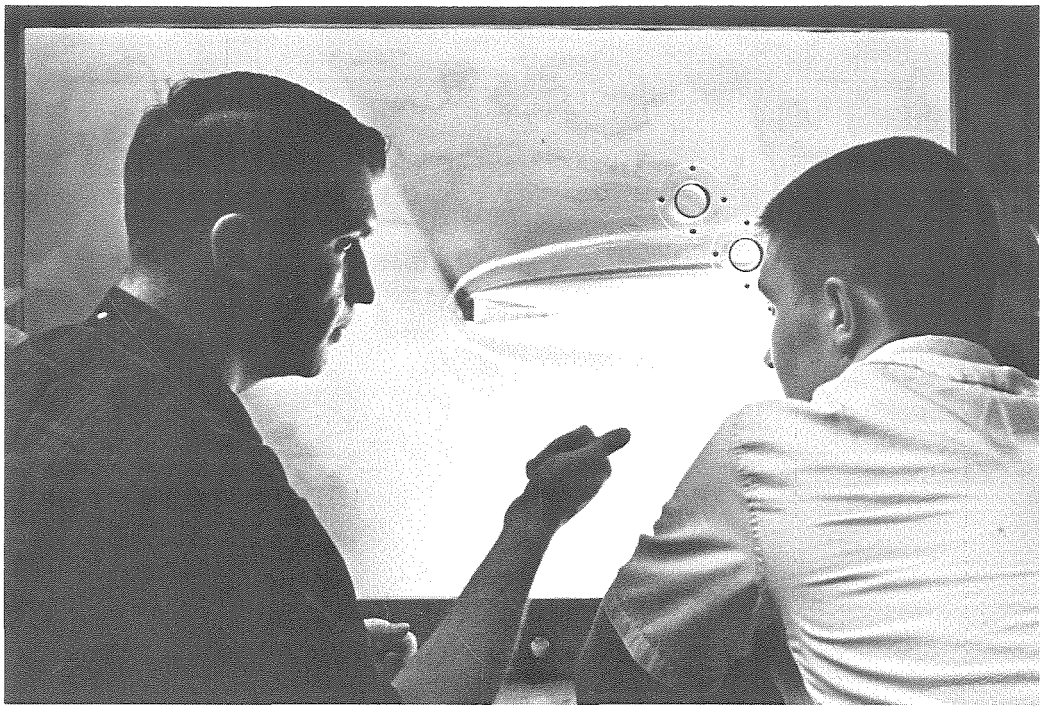
"Creative scientists and engineers," as the phrase is used here, means simply men who work more by reason than by rote; who do not depend too much on handbook or textbook; and who, faced with new problems, are generally able to work out their own paths. These are the men most likely to lead in research, and to assume leadership in other kinds of activities as well.

This creativity springs, not from any simple set of facts, but from the five principles that guide the Institute:

1. Teach fundamentals first. The Institute believes that no scientist or engineer is worth his salt today unless he has a broad knowledge of the fundamental sciences—mathematics, physics, and chemistry. The lines that divide the three are getting more and more difficult to define, and good men must be able to cross them freely. So Institute students, whether they are to be engineers, biochemists, or astronomers, study the fundamentals first. All freshmen take the same science courses. Specialization enters and increases as the student progresses, but there is no exclusive concentration on one small field. All told, there are five basic courses—in physics, mathematics, and chemistry—that every Caltech student takes.

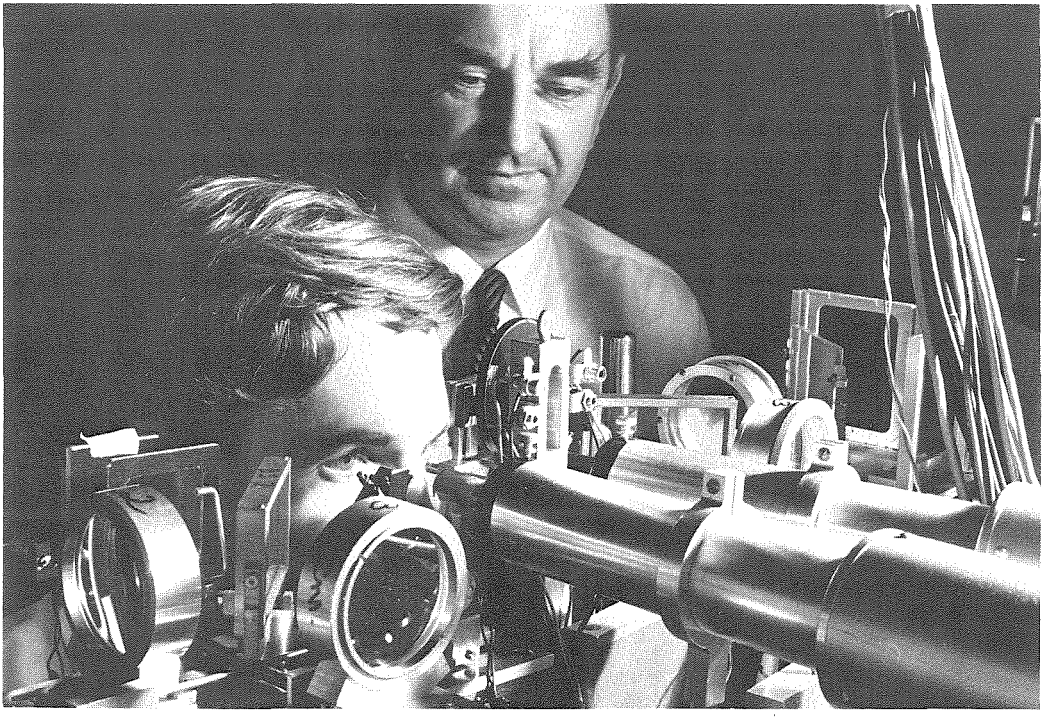
2. Teach the humanities as well as science and technology. It is a working rule at the Institute that every student shall devote about one-quarter of his class time to the arts, letters, and social sciences. Here again, as in the physical sciences, the emphasis is on the fundamentals—of history, economics, literature, and philosophy.

3. Teach small groups of students. This principle is built into the very walls at Caltech, most of whose classrooms will hold only about



A graduate research assistant describes the nature of the flow in the high-speed water tunnel to a freshman who is doing honors research.

Studies of the human eye in Caltech's Computing Center reveal that the constant movement of the eyes is necessary for sharp vision.



twenty students each. Class size varies after the freshman year, depending on the courses chosen by the upperclassmen.

4. Teach in an atmosphere of research. At the Institute, every building where teaching goes on is a place where research goes on, too. From the beginning, students are instructed by men who are themselves working on new problems in engineering and science. Through the Freshman Honors program, freshmen are actively encouraged to become involved in the research being done by the faculty. By the time students are seniors, they are often able to begin work on original research, although even then much attention still is given to increasing their background of fundamental knowledge.

5. Teach in an atmosphere of freedom. Both faculty and students at the Institute are given a great deal more freedom than at many other colleges. Individual faculty members are free to select and pursue their own research projects. New methods of teaching are constantly being tested and, when proven, are adopted. The student at Caltech lives by an Honor System which takes the place of many rules and regulations. Examinations are not proctored; in fact, many are of the take-home variety. There is no compulsory regulation of the student's free hours; there are no curfews. Great latitude is granted students in the selection of elective courses, and capable students are encouraged to pursue their own research. In 1964 comparative freshman grading was eliminated. Term-end grades are limited to "Pass" or "Fail" in freshman courses.

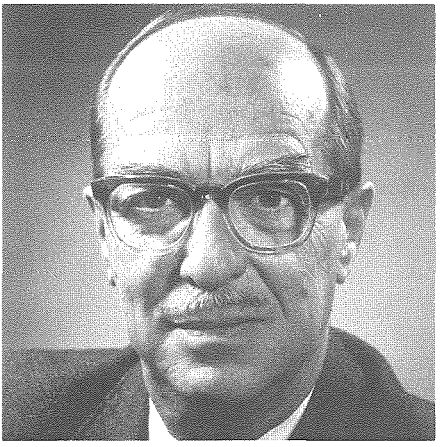
The principles are clear. They would be of little use without a group of men capable of putting them into practice. Fortunately, the principles themselves have attracted to Caltech a faculty whose members are outstanding as scientists and as educators. The results of their own training and research activities are passed on to the students.

The provost and the deans

DR. ROBERT F. BACHER, *Provost*

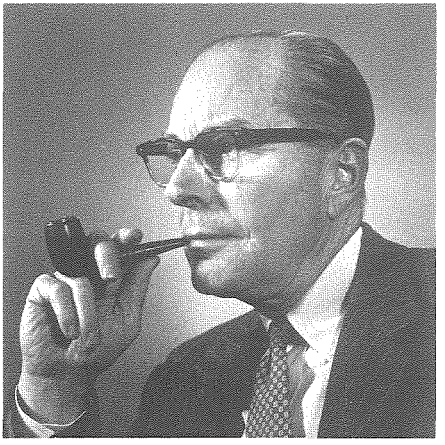
DR. H. F. BOHNENBLUST,
Dean of Graduate Studies

FOSTER STRONG, *Dean of Freshmen*



PAUL C. EATON, *Dean of Students*

L. W. JONES, *Dean of Admissions*



The men who teach

A GOOD faculty consists of men who are leaders in their fields and who are able to communicate both knowledge and enthusiasm for learning to their students. The California Institute of Technology has such a faculty.

The most famous of the Institute's scientists was Robert A. Millikan, who headed the Institute from 1921 to his retirement in 1945. Dr. Millikan, together with George Ellery Hale, Thomas Hunt Morgan, William B. Munro, and Arthur A. Noyes, led the California Institute of Technology to eminence in the twenties and thirties. Today the faculty has a new group of leaders.

President Lee A. DuBridge, research physicist, came to the Institute in 1946 from the position of Professor of Physics and Dean of the Faculty at the University of Rochester. During World War II, as head of the Radiation Laboratory set up by the Office of Scientific Research and Development at the Massachusetts Institute of Technology, he guided the development of the radar systems that had such an important effect on the war's progress.

Dr. Robert F. Bacher, former chairman of the Division of Physics, Mathematics and Astronomy, holds the office of Provost. This post links the administration, the faculty, and the board of trustees, and increases the effectiveness of the Institute in the development and improvement of Caltech's academic program. A key member of the Los Alamos Atomic Energy Laboratory during the war, Dr. Bacher has also served on the President's Science Advisory Committee.

In the Division of Chemistry and Chemical Engineering, made famous by A. A. Noyes, Dr. John D. Roberts now heads a nationally known group that is investigating many important aspects of modern chemistry. Dr. Roberts works on small-ring organic compounds

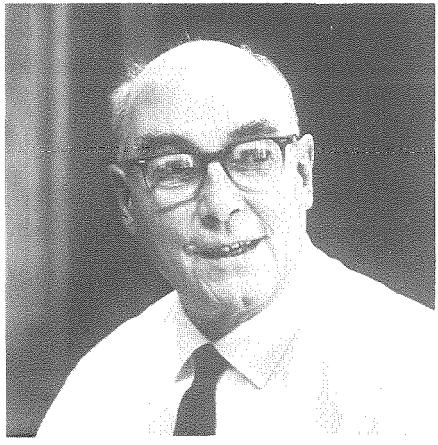
The chairmen

DR. RAY D. OWEN, *Chairman, Division of Biology*

DR. ROBERT P. SHARP, *Chairman, Division of Geological Sciences*

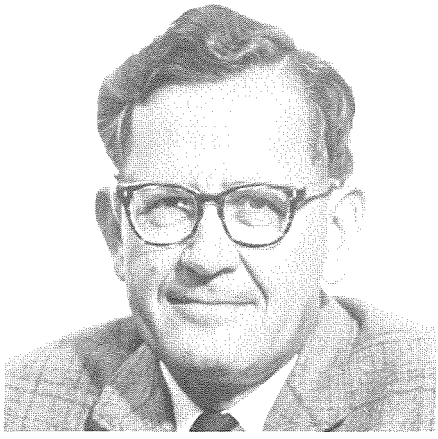
DR. HALLETT D. SMITH, *Chairman, Division of the Humanities and Social Sciences*

DR. CARL D. ANDERSON, *Chairman, Division of Physics, Mathematics and Astronomy*



DR. F. C. LINDVALL, *Chairman, Division of Engineering and Applied Science*

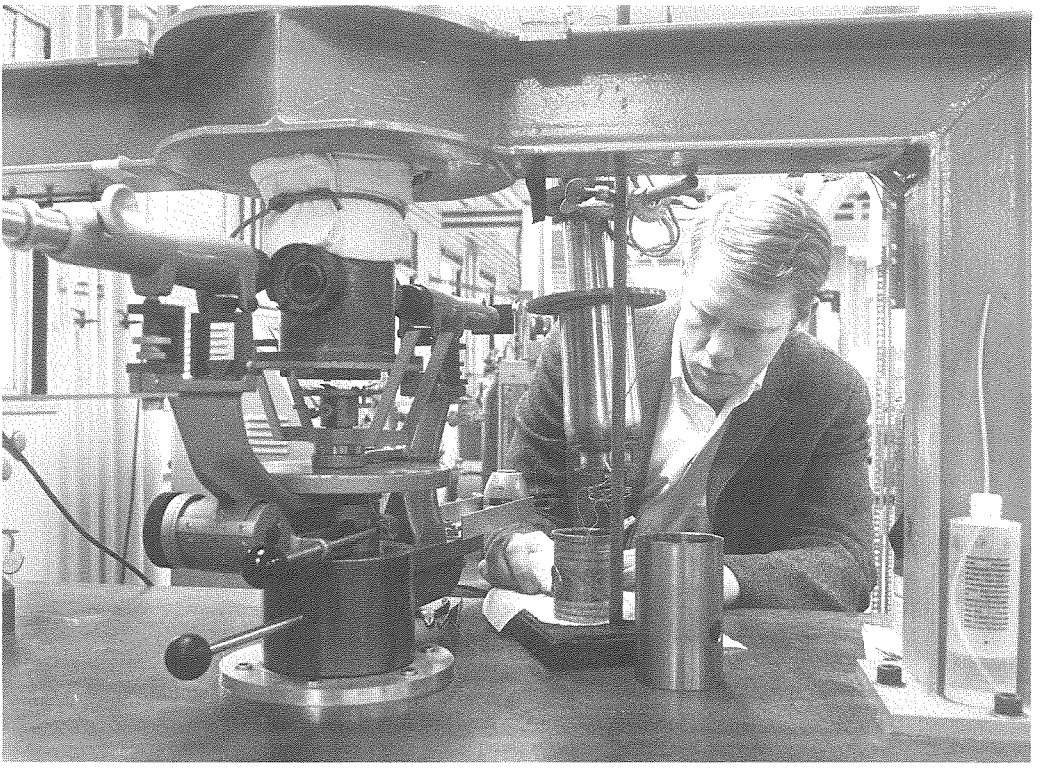
DR. JOHN D. ROBERTS, *Chairman, Division of Chemistry and Chemical Engineering*



and applications of nuclear magnetic resonance spectroscopy to problems in organic chemistry. Dr. Aron Kuppermann is making exciting progress toward understanding the basic characteristics of chemical reactions through studies of reactions occurring in collisions involving crossed molecular and atomic beams. Drs. George S. Hammond and G. W. Robinson are studying how energy is transferred between molecules, and Drs. Norman Davidson and Jerome Vinograd are working out the properties of DNA. Dr. Harry B. Gray is designing and studying new molecular arrangements containing transition metal and rare earth ions.

Research with interdisciplinary emphasis continues to develop in chemical engineering. Studies of fluid mechanics with special attention to systems in which chemical reactions occur are being conducted by Drs. B. H. Sage and G. R. Gavalas. Biomedical engineering studies on material and momentum transport in the blood and across interfaces to the blood are of current interest to Drs. S. K. Friedlander and G. R. Cokelet. Fundamentals of liquid and solid systems are being considered by Dr. C. J. Pings, and Dr. N. W. Tschoegl is investigating polymers from both the molecular and engineering points of view. Chemical and physical changes in plasmas at moderate and high temperature are of current concern to Drs. W. H. Corcoran and F. H. Shair.

The Division of Biology, under the chairmanship of Dr. Ray Owen, is largely devoted to two active modern areas of teaching and research: molecular biology and the biology of nervous systems. The molecular biology program ranges widely, using the techniques and concepts of biophysics and biochemistry to investigate basic attributes of living systems and extending to such challenging problems as how the genetic materials program the development of complex organisms. Studies of nervous systems include neurophysiology and biosystems analysis (in a program with strong interdisciplinary ties with Electrical Engineering and the Computing Center) and investigations in the field of psychobiology under the direction of Dr. Roger W. Sperry, famous for his development and use of "split-brain" techniques and for studies of specificity in the nervous system.



Student in laboratory in Chemical Engineering.

Dr. Carl D. Anderson, chairman of the Division of Physics, Mathematics and Astronomy, was the first of six Caltech graduates to win a Nobel Prize. His discovery of the positron earned him this distinction. Dr. Anderson and his colleagues are investigating cosmic ray phenomena. Dr. Richard Feynman, winner of the 1965 Nobel Prize, has recently made important new progress toward unifying our gravitational and electrodynamic field theories. Dr. Murray Gell-Mann and a group of active young theorists are making exciting advances in fitting together the sub-nuclear particles into an ordered system. Experimental nuclear research, from low energy up to more than a billion electron-volts, is carried out on the campus, and Dr. W. A. Fowler and his colleagues attempt to apply the knowledge gained in the nuclear physics laboratory to problems in astrophysics and stellar evolution.

The Division of Engineering and Applied Science is headed by the well-known electrical and mechanical engineer Dr. Frederick C. Lindvall. In the engineering laboratories, Caltech engineers are concerned with such diverse subjects as fluid mechanics, cavitation theory, physical properties of metals, basic studies of alloys, jet propulsion, reaction kinetics, soil mechanics, waste water recovery, earthquake engineering, structural analysis, heat transfer, plasmas, solid state physics, and radio propagation. In the Aeronautical Laboratories, one of the nation's earliest large wind tunnels and several modern supersonic tunnels and shock tubes serve as tools for study of basic aerodynamic and fluid mechanics problems. Aircraft and aerospace structures are also an important part of the work of the Aeronautical Laboratories. In the Computing Center, which is available to any campus research project, Caltech engineers and scientists attack a variety of complex physics and mathematical problems, do research on computer systems and languages, and develop systems for improving man-machine interaction. For the division as a whole, much of the study and research might well be described as applied science, particularly applied physics.

Heading the Division of the Geological Sciences is Dr. Robert P. Sharp, whose research interests center on glaciers and arid-region processes. Other division staff members do work in isotopic geochemistry, age-dating, crystal physics, paleontology, areal and structural geology, meteorites, astrogeology, petrology, and the planetary sciences. The Seismological Laboratory, a world-famous center of earthquake and earth interior research, is part of this division.

Dr. Horace W. Babcock heads the group of astronomers and astrophysicists that operates the Mount Wilson and Palomar Observatories, whose facilities include the 100-inch Hooker and the 200-inch Hale telescopes. The work being done by these scientists includes fundamental studies on the nature, origin, and age of the universe.

The chairman of the important Division of the Humanities and Social Sciences is Dr. Hallett D. Smith, outstanding scholar of Elizabethan literature. This division comprises a distinguished group of scholars and teachers in English literature, foreign languages, phi-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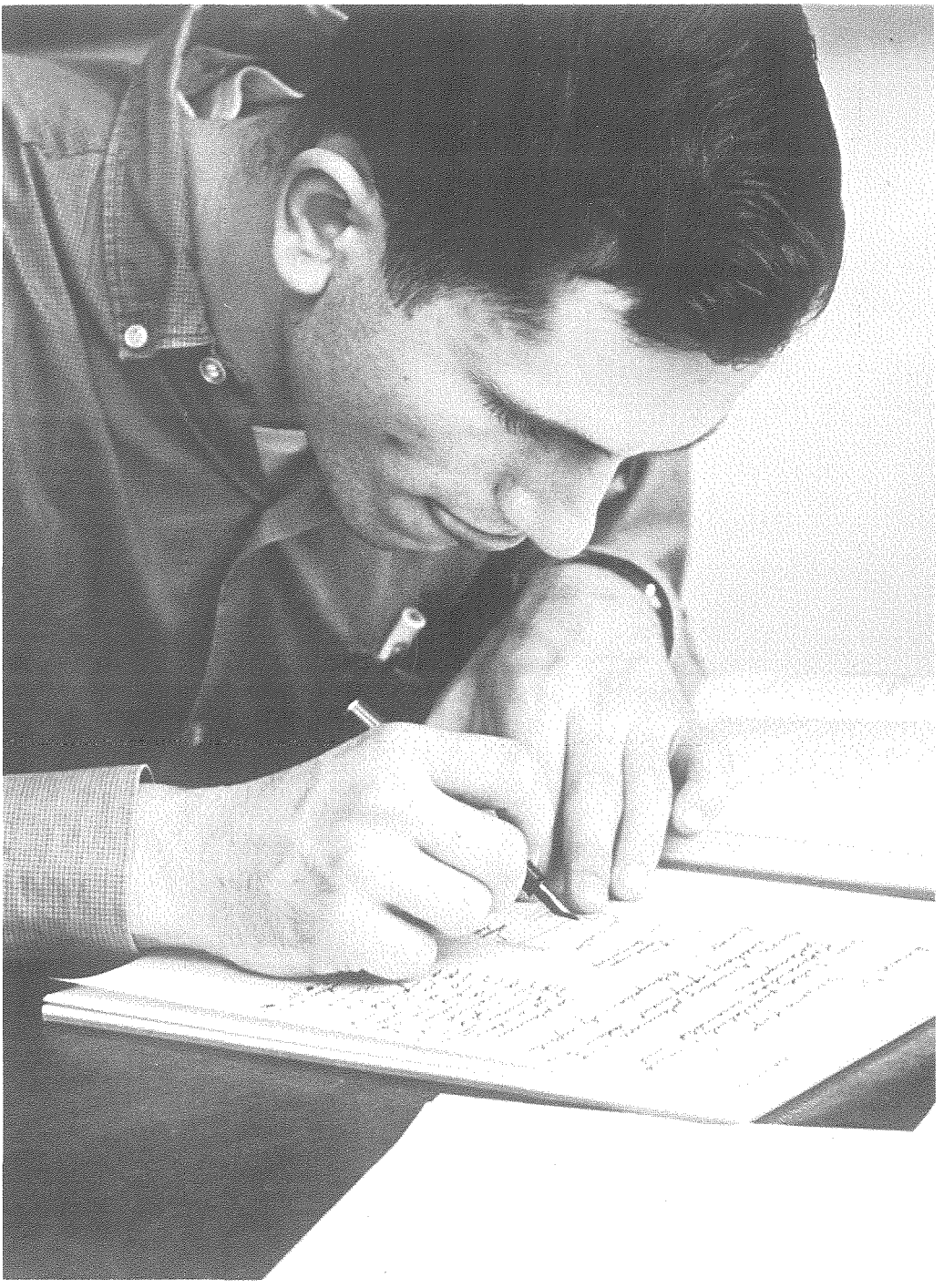
losophy, history, economics, government, and related fields.

The Division of the Humanities and Social Sciences offers options (majors) in English, in history, and in economics. Students concentrating in one of these fields have a much more solid grounding in science, mathematics, and engineering than liberal arts students ordinarily have, and can bring these scientific disciplines to bear upon their humanities specialty. The curriculum in each of these fields in the division provides excellent preparation for advanced work in graduate school, law school, business administration, or government. Special emphasis is laid at Caltech on problems of science and government policy, the effects of technological change upon developing and highly developed societies, and the social, cultural, political, and economic aspects of the relationship between science and man. These problems are approached in an interdisciplinary spirit, with contributions from psychology, history, anthropology, geography, and political science as well as from science and engineering.

The Institute requirements in the humanities and social sciences for all undergraduates are broad but flexible. One hundred and twenty units are required, of which only 27 units are specified—in English. The rest may be selected from offerings in history, philosophy, economics, political science, geography, foreign area studies, literature in a foreign language or in English, fine arts, and music. These requirements are spread over the four years of college, so that a student who is specializing in some field of science or engineering continues to study human and social problems. Many Caltech students concentrating in technical fields elect to take more than the required 120 units in the humanities and social sciences.

A faculty noted for its contributions to science would be of little interest to a student unless the student could expect some contact with the men of that faculty. At Caltech there are about 550 faculty members and 1,450 undergraduate and graduate students. While only half of these faculty members are engaged primarily in teaching (the others concentrate on research), the favorable faculty-student ratio contributes to a much closer relationship between student and teacher than can be found at most other colleges and universities.

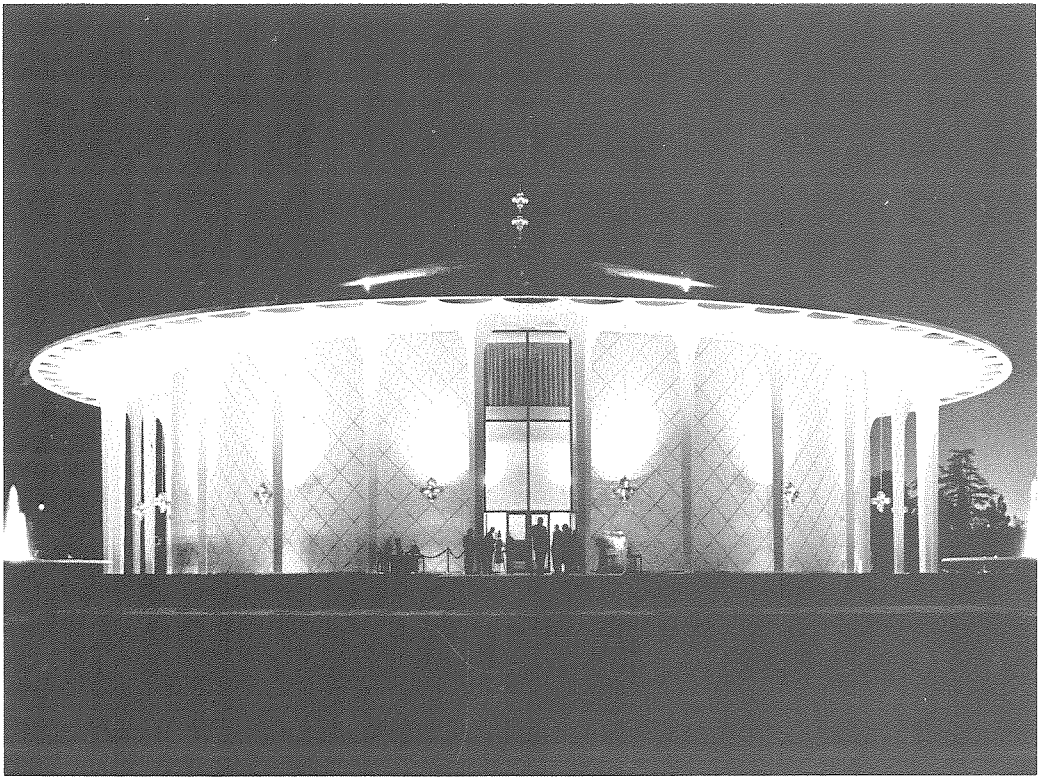


The men who study

BECAUSE it takes both brains and hard work to become a scientist or an engineer, and because the California Institute of Technology demands a generous amount of each, it would be reasonable to expect Institute students to be entirely devoted to their studies. Caltech exercises a high degree of selection among its applicants, but the Admissions Committee looks for many achievements in addition to high grades. There may be good reasons why a student is not straight-A; for example, he may have spent part of his time in high school on worthwhile extracurricular activities, or he may have had to work to earn money. If these do not mean that he has neglected his studies, he may be considered a more desirable applicant for having had these experiences.

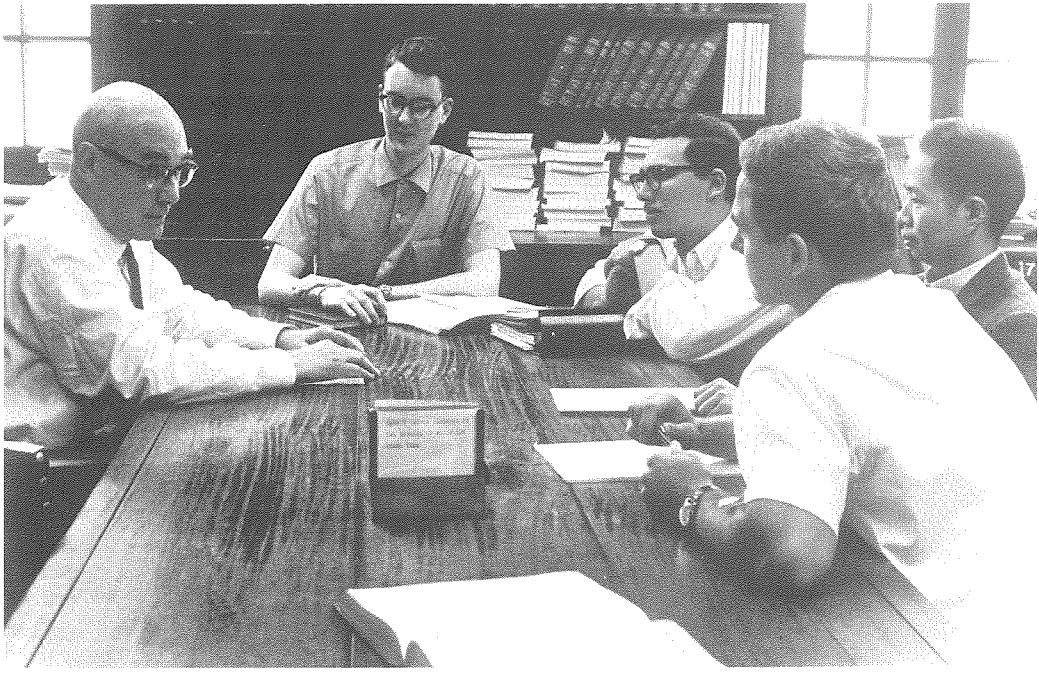
And so, not surprisingly, it turns out that the students who come to the Institute not only get into extracurricular activities and athletics and social affairs, but they get into them more than most college students. This, of course, is but one of the many phases of an education at Caltech.

What remains is to show the kind of life that the students lead at the Institute—because it is, after all, the life as a whole that counts more than facts or principles or faculty or classmates. What follows is a once-over-lightly account of undergraduate life at Caltech.



Beckman Auditorium is the scene of student assemblies and social activities.

Dr. Carl Anderson, Nobel Laureate, meets with physics students.



ACADEMIC LIFE

THE ACADEMIC year is divided into three terms: late September through December; January through late March; and late March through mid-June.

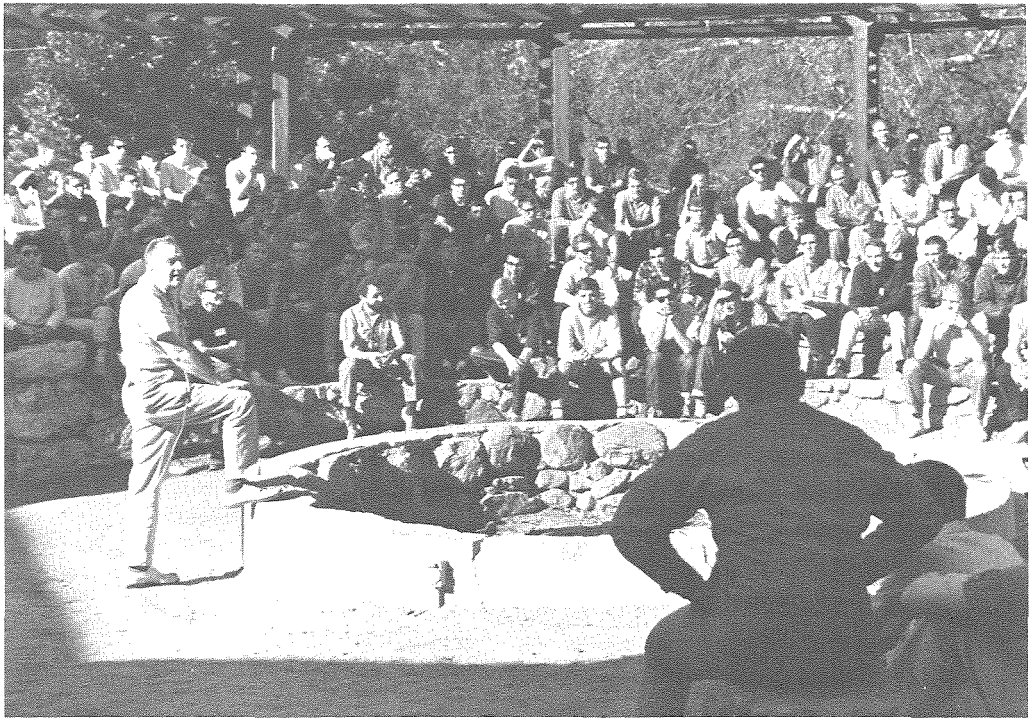
In order to succeed at Caltech, the student must spend much of his time studying, because the course-load at Caltech is not light. Actually, the average student spends about 50 to 60 hours a week in class and studying, which still leaves plenty of time for him to engage in extracurricular activities.

All freshmen at Caltech take the same science courses, and there is advanced placement for those who qualify. The schedule for freshmen consists of courses in physics, chemistry, mathematics, English or history, and physical education. During his sophomore year, the student is required to take courses in physics, mathematics, humanities, and physical education. By the time he is a sophomore, the student has selected his option (the Caltech equivalent of a major), so he may start to specialize in it—or he may continue broadening his education by taking some of the survey courses which are offered by practically all departments. During his junior and senior years, the student takes most of his courses in his option.

During his four years at Caltech, the student lives under the Honor System, which was established and is enforced by the students. Its main precept is that no Caltech student may do anything which takes unfair advantage of another member of the Caltech community.

For those students whose academic interests go beyond the normal requirements of their courses, Caltech offers a number of opportunities for additional study in some field of particular interest. Many freshmen participate in honors work. Usually this takes the form of being a member of one of the numerous research groups on campus. Research jobs are also open to interested students.

Lectures and seminars are given regularly by members of the faculty and visitors. These lectures detail the results of research being done at Caltech and other campuses, and they give the student an opportunity to broaden his knowledge in many areas and to learn about current research in his own field.



At Student Camp, freshmen meet faculty, upperclassmen, and President DuBridge.

For the more culturally inclined, concerts and dramas are performed at Caltech's Beckman Auditorium throughout the year, and the cultural opportunities open to the student in a metropolitan area as large as that of Los Angeles are limited only by the student's interest, imagination—and access to transportation.

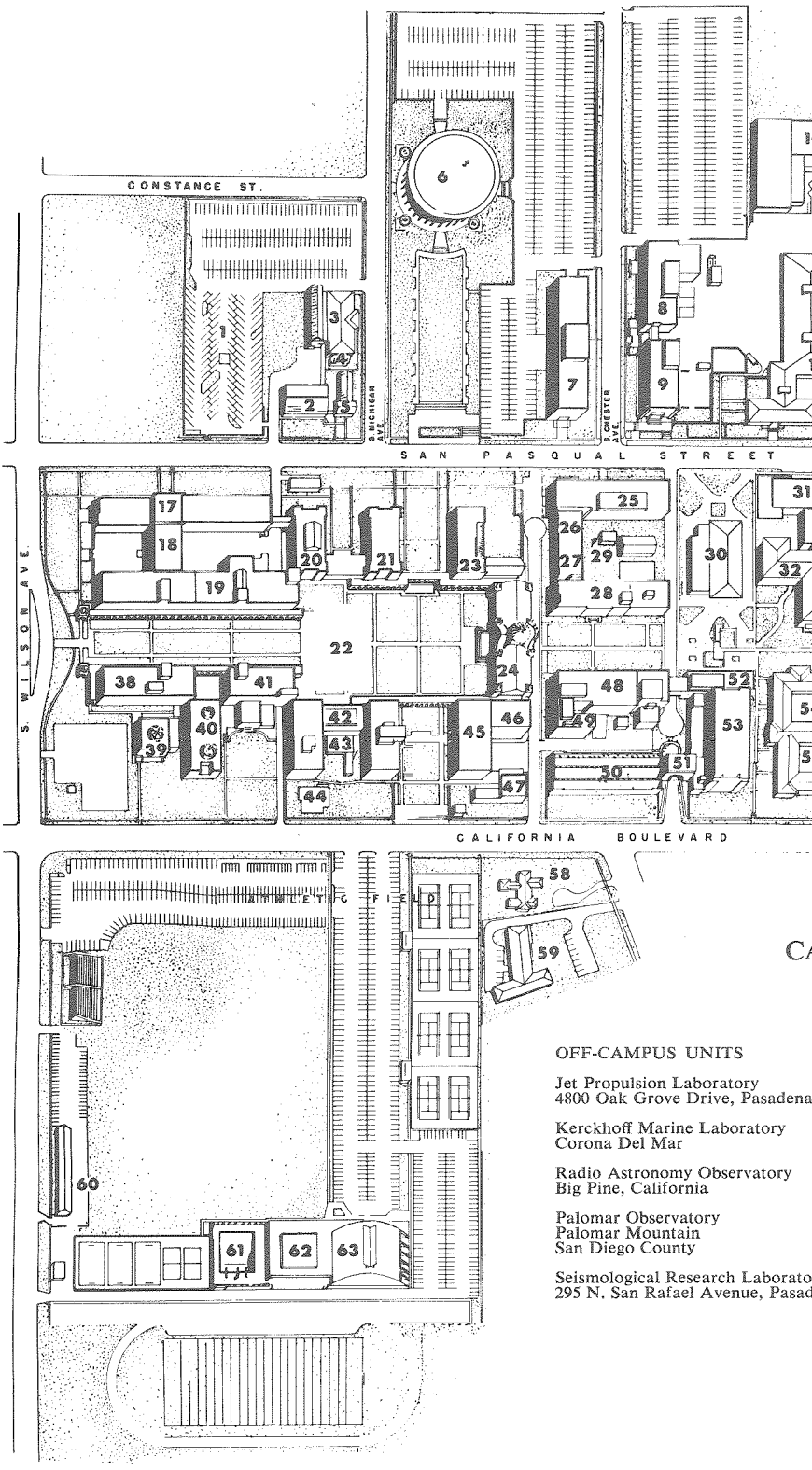
STUDENT LIFE

MOST students at Caltech live in the student houses. In each of the seven houses—Blacker, Dabney, Fleming, Lloyd, Page, Ricketts, and Ruddock—there are about 80 undergraduates.

By the time he arrives at Caltech, the entering freshman has already been assigned to live in one of the seven houses. Before classes start, freshmen spend the weekend at frosh camp in the San Bernardino Mountains. At camp, the frosh meet upperclassmen and faculty members, and they are given lectures on what Caltech is like and what Caltech expects of them. During the first term of school, freshmen live in the student houses to which they have been assigned. By Thanksgiving they may either choose to stay where they are or take part in a week of rotation to consider moving to another house. During rotation, the freshmen have an opportunity to meet the members of other houses by eating lunch and dinner at a different house each day. At the start of second term, the frosh move into their new homes.

Each house is a single unit, and each has its own dining room, lounge, and patio. Meals are served by student waiters, and coat and tie is the usual dress for the evening meal. All the houses have elected officers, and the rules of each house are enforced by a committee of students elected or appointed within the house. The rules are liberal, and the student may come and go as he chooses.

Each house has its own social program, which the student may participate in to any degree that he desires. A typical program for one term would consist of several exchange dances with neighboring colleges, a barn dance, parties of various kinds, and one big event such as a dinner party. In addition, the social chairmen, who have contacts at neighboring schools, are able to arrange dates for the members of the houses.



OFF-CAMPUS UNITS

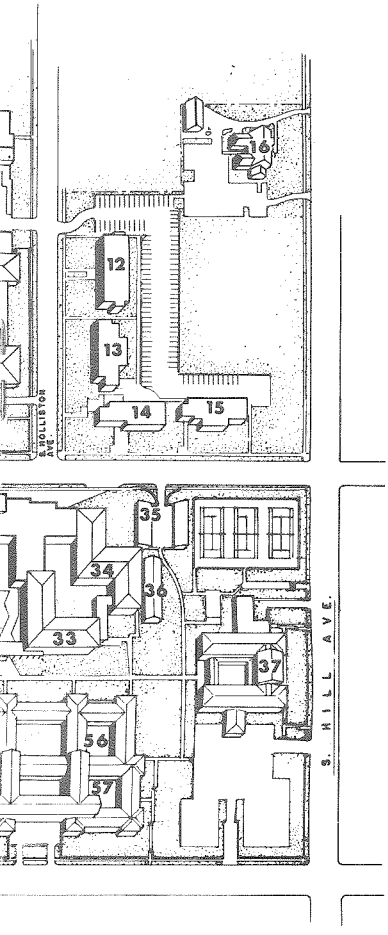
Jet Propulsion Laboratory
4800 Oak Grove Drive, Pasadena

Kerckhoff Marine Laboratory
Corona Del Mar

Radio Astronomy Observatory
Big Pine, California

Palomar Observatory
Palomar Mountain
San Diego County

Seismological Research Laborato
295 N. San Rafael Avenue, Pasad



MPUS MAP

1. Chemical Physics Laboratory (Under Construction)
2. Campbell Laboratory (Plant Research)
3. Earhart Laboratory (Plant Research)
4. Clark Laboratory (Plant Research)
5. Dolk Laboratory (Plant Research)
6. Beckman Auditorium
7. Keck Laboratories (Engineering)
8. Steele Laboratory (Electrical Sciences)
9. Booth Computing Center
10. Central Engineering Services
11. Physical Plant (Administration and Shops)
12. Keck House
13. Mosher-Jorgensen House
14. Braun House
15. Marks House
16. Industrial Relations Center
17. Church Laboratory (Chemical Biology)
18. Alles Laboratory (Molecular Biology)
19. Kerckhoff Laboratory (Biological Sciences)
20. Crellin Laboratory (Chemistry)
21. Gates Laboratory (Chemistry)
22. Millikan Library
23. Dabney Hall (Humanities and Social Sciences)
24. Throop Hall (Administration)
25. Spalding Laboratory (Chemical Engineering)
26. Chemical Engineering Laboratory
27. Heating Plant
28. Thomas Engineering Laboratory
29. Nuclear Engineering Laboratory
30. Winnett Student Center
31. Chandler Dining Hall
32. Page House
33. Lloyd House
34. Ruddock House
35. Residence & Dining Halls Office
36. Building T-4
37. Athenaeum (Faculty Club)
38. Mudd Laboratory (Geological Sciences)
39. Culbertson Hall (Auditorium)
40. Robinson Laboratory (Astrophysics)
41. Arms Laboratory (Geological Sciences)
42. Bridge Laboratory (Physics)
43. Cosmic Ray Laboratory
44. Isotope Handling Laboratory
45. Sloan Laboratory (Mathematics and Physics)
46. Kellogg Radiation Laboratory (Nuclear Physics)
47. Graphic Arts and Safety Office
48. Guggenheim Aeronautical Laboratory
49. Karman Laboratory (Fluid Mechanics and Jet Propulsion)
50. High Energy Physics (Future)
51. Merrill Wind Tunnel
52. Firestone Laboratory (Flight Sciences)
53. Synchrotron Laboratory
54. Fleming House
55. Dabney House
56. Ricketts House
57. Blacker House
58. Arden House
59. Young Health Center
60. Building T-1 (Air Force ROTC)
61. Alumni Swimming Pool
62. Locker Rooms
63. Scott Brown Gymnasium
64. Central Plant (Under Construction)
65. Business Services (Future)

Seven Student Houses provide on-campus housing for undergraduates. Each of the Houses has its own patio.

There is stiff athletic competition between the seven student houses during the whole school year. There are seven Interhouse sports: softball and swimming during the first term; tennis, track and field, and volleyball during second term; and basketball and touch football in third term. Interest in these sports and pressure on the players are often greater than in intercollegiate competition. The prestige of each house is at stake. There is also a challenge system called Discobolus, for which the houses respectively challenge each other every week.

After the freshman year, students are not required to live in the student houses, and some students move off campus to nearby apartments. But even those who move usually keep their membership in the house in order to participate in the social and athletic programs.

ACTIVITIES

EVERY undergraduate automatically becomes a member of the student body corporation, The Associated Students of the California Institute of Technology (ASCIT). Through ASCIT the student has the opportunity to become involved in activities and services which make Caltech life more than just "classes."

ASCIT publishes a yearbook, *The Big T*; a weekly student newspaper, *The California Tech*; a student handbook, *The Little t*; and a literary magazine, *Totem*.

The ASCIT vice president and nine others make up the Board of Control, which is responsible for investigating the rare violations of the Honor System.

ASCIT also sponsors occasional assemblies and concerts, provides funds for special-interest clubs, and runs the Caltech Coffeehouse—a place where students, faculty, and their guests can gather for late-evening talk, music, and food.

Student paper, the "California Tech," reports weekly on campus activities.

Winnett Student Center patio is the scene of a YMCA-sponsored address by Senator Charles Percy and of an ASCIT-sponsored twilight dinner for 800 people.

The other major student organization is the Caltech YMCA. Y membership is free and open to all students. Activities head in just about any direction that student participation wants to go. Some traditional directions have been public affairs, religion, and the arts.

The Y Leaders of America program brings guests of national prominence to campus, giving students the rare opportunity to personally encounter such people as author Paul Goodman, civil rights leader Martin Luther King, and philosopher Abraham Kaplan.

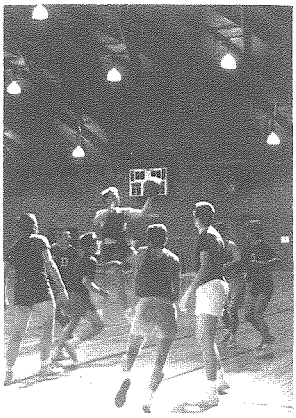
Through the Y Tutoring Program, Caltech students tutor students from other schools who seek help at all levels from elementary school through junior college. This has proved to be an educational experience for both the tutors and the tutored.

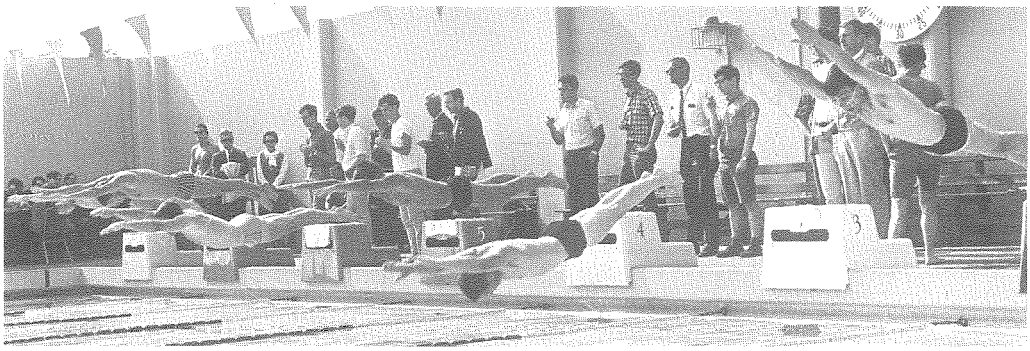
Another Y program brings theology students to live on the campus for a week—an attempt to stimulate a meaningful exchange of perspectives between theological and scientific communities.

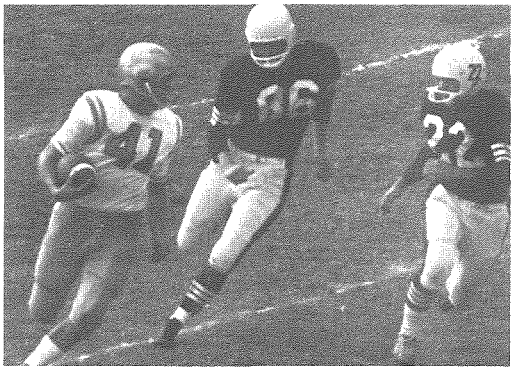
The important thing to realize about all the ASCIT and YMCA activities is that, in addition to being run *for* students, they are run *by* students.

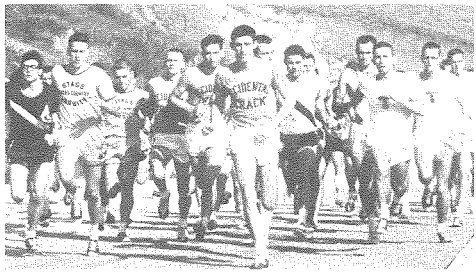
There are also a number of clubs which come and go, with student interest and effort again the determining factor for their existence. Some of the current ones:

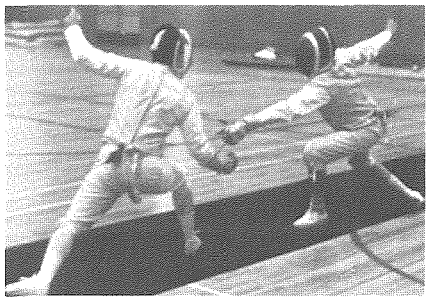
Caltech Band	Math Club
Glee Club	Physics Club
Debate Team	Geology Club
Musicale (Record Library)	Drama Club
Young Democrats	Photography Club
Young Republicans	Ham Radio Club
Karate Club	Student Shop
Sailing Club	Alpine Club (mountain climbers)
Newman Club	Flying Club
Computer Club	Caltech Christian Fellowship

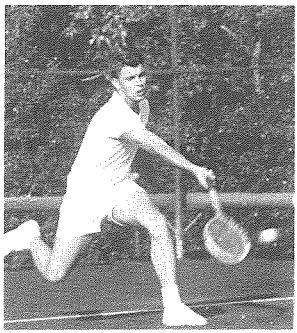












SPORTS

CALTECH offers an excellent opportunity for those interested in athletics, for a great variety of sports, both intercollegiate and intramural, is offered. The emphasis in sports at Caltech is on the enjoyment the student receives from the program.

Caltech belongs to the NCAA and the NAIA, and the major sports are played within the Southern California Intercollegiate Athletic Conference (consisting of Caltech, Claremont-Harvey Mudd, Occidental, Pomona, Redlands, and Whittier).

Caltech's excellent athletic facilities include the Scott Brown Gymnasium, the Alumni Swimming Pool, a fully equipped quarter-mile track, two baseball diamonds, a football field, a soccer field, two volleyball courts, and eight well-kept tennis courts. More than a dozen full- and part-time coaches work with the teams.

Football, the first sport of the school year, is perhaps most important, although it is certainly not one of Caltech's strengths. Practice starts several weeks before the opening of school. Freshmen have played on the varsity team for the past few years, and several have been stars in their first year.

Soccer, which has become an undergraduate sport only in the last few years, is rapidly growing. The Caltech team has made impressive progress in turning completely inexperienced players into competent kickers. There is also an open team consisting of graduate students, faculty, and employees.

Most students have never played water polo before coming to Caltech, but the team, which works very hard to get into condition, usually does well in league competition. Those who prefer a less confining arena than a swimming pool are welcome on the cross-country team, which trains arduously through sometimes-wet fall weather.

Basketball, though a second-term sport, starts in November. Both the varsity and junior varsity teams meet stiff competition in the SCIAC, but have had some overwhelming victories recently in non-league games.

Many beaches are about an hour's drive from the Caltech campus.

The wrestling team is new and has been composed primarily of freshmen, who show promise for the future. Fencing, Caltech's newest intercollegiate sport, has caught on rapidly. The team made a very respectable showing in 1967 regional competition.

The rugby team, though not officially recognized, is excellent. Any member of the Caltech community is eligible to play. Because the season is during the winter, it provides a great opportunity for football and soccer players to stay in shape.

Track season begins in second term and continues into May. Caltech times and distances are usually not spectacular, but the team generally has the greatest depth of any Caltech team, and for this reason it does reasonably well.

Baseball competes with track for participation and usually comes out the loser. The combined varsity and frosh team usually has about 15 men on it. Practice starts early to try to make up for the lack of players. Caltech also fields both varsity and frosh tennis teams.

The swimming team has done remarkably well in the past years. Several outstanding swimmers have been developed by the extensive training program, and Caltech students have set several conference records.

The golf team does not get much publicity, but there is enough interest from the students to provide plenty of players. During the spring and summer months the Caltech Cricket Club provides anglophiles with exercise, and several Caltech students also participate on a local lacrosse team.

At Caltech almost any student who really wants to, even with little or no previous experience, can participate in intercollegiate athletics. Those who enjoy competitive athletics but who do not want to compete at that level can take part in the lively intramural program in the student houses.

The results

ONE final aspect of the California Institute of Technology remains to be explained. What happens to its graduates?

It has been found that more of them, proportionately, go on to win Ph.D.'s in science than do students of any other educational institution in the country. Also, a significant number go on to graduate work in medicine, business, or even law.

This same pattern is also the modern trend in engineering. For most students, graduate study in a specialized branch of engineering will be the goal. For others, immediate industrial work is the objective, and ultimately administration. Each year many companies, including nearly all of the major ones, send recruiting teams to the Institute, and consistently find the graduates to be the type of men they are seeking.

And how do the men get along in industry?

Caltech alumni are young (half of them are under 40), but a poll has shown that the average income of Institute graduates is more than $6,000 higher than that of all other U.S. college graduates. One in every five is a top executive, and four out of five have managerial or supervisory positions.

Caltech graduates, then, become *leaders* in industry.

The reason for the success of California Institute of Technology graduates lies in the Institute's educational philosophy. Long before he graduates, the Caltech student knows the feeling of having faced a problem that no formula fits. He has not just learned the

answers to problems that others have already solved. He has learned to recognize and to solve new types of problems. He is provided, as far as is possible, with the most general and far-reaching modes of problem-analysis known to man, and in the process of learning he has been stimulated by constant contact with equally able classmates.

And, of course, there is the other side. The most brilliant scientific genius of the age could not succeed today unless he also knew something about people and how to get along with them. The Institute's philosophy is aimed at turning out graduates who can lead effective lives as men and as citizens of the community.

Every year a large number of secondary-school students make up their minds to join this group. The following appendix tells those interested in attending the California Institute of Technology how to proceed.

". . . to provide a collegiate education which will best train the creative type of scientist or engineer . . ."

Appendix

1. Freshman Admission Procedures

EACH YEAR the freshman class is selected from the group of applicants by an Admissions Committee made up of faculty members all of whom teach undergraduates and most of whom teach at least one freshman course. In judging men for admission the Committee uses three sources of information: secondary-school records and recommendations, entrance examinations, and personal interviews whenever possible.

Any of you who are interested in admission should first make sure that by the end of your last year of secondary school you will have met all of the following requirements:

English	3 years
Mathematics	4 years
Physics	1 year
Chemistry	1 year
United States History	1 year

You will then have 10 secondary-school units. A total of 15 units is required; the remaining 5 units may be made up from any of the subjects in the following list:

Foreign languages, additional English, history, geology, biology or other laboratory science, drawing, shop, commercial subjects.

The four-year program in mathematics should include the principal topics of algebra, geometry, analytic trigonometry, and the elementary concepts of analytic geometry and probability in a way which displays the underlying relationships between these branches of mathematics. The program should emphasize the principles of logical analysis and deductive reasoning, and provide applications of mathematics to concrete problems. The three-year English requirement is minimum, and four years are strongly recommended.

A foreign language is not required for admission, but it is a very valuable addition to anyone's educational background. Students interested in technical fields sometimes pay little attention to the humanities subjects such as English and history. At the Institute it is very important that you have learned to write clearly and concisely, and that you know how to read with reasonable speed and retain and organize what you have read. These accomplishments are just as important in technical work as they are anywhere else, and about one-quarter of your study time at the Institute will be spent in the humanities.

Just as important as the subjects required for admission are the grades earned in these subjects. An applicant's grades should be well within the range that his secondary school considers good enough to justify recommending him to colleges. Grades in mathematics, physics, and chemistry should be mostly A or its equivalent.

If your subjects and grades are in order, your next step is to arrange to take the College Entrance Examination Board tests. The tests to be taken for admission to the Institute are (1) the morning program called the Scholastic Aptitude Test, which is a three-hour test of mathematical aptitude and of the ability to use words and to read with understanding and discrimination; and (2) the afternoon program consisting of the Level II Achievement Test in Mathematics and any two of the following: Physics, Chemistry, English Composition. The Level II Mathematics Test is designed for students who have completed three and one-half years of a mathematics program of the type outlined above. The Level II test does not presuppose an advanced placement course in mathematics. Note that the Scholastic Apti-

tude and the Level II mathematics tests must be taken,[1] and that the choice lies only among physics, chemistry, and English, of which two must be taken. No substitution of other tests can be permitted.

The Scholastic Aptitude and Achievement Tests are offered as a combined one-day program in December, January, March, May, and July of each year. You should consult your counselor or write to the College Entrance Examination Board at the appropriate address given below for the exact dates of the tests and the deadline for applying to take them.[2]

Tests may be taken on any date on which they are offered, *but in order to be considered, an applicant must take the Scholastic Aptitude Test and Achievement Tests no later than January of the year in which admission is desired.*[3] No exception is made to this rule and no substitution of tests other than those specified is permitted.

Arrangements to take the tests can usually be made through your school authorities or you can write directly to the College Entrance Examination Board at either of the following addresses: P.O. Box 592, Princeton, New Jersey 08540; or P.O. Box 1025, Berkeley, California 94701. The Board will send you full information with regard to the tests, which are a part of the admission requirements not only at the California Institute of Technology but at many other colleges as well. *Completed applications to take the tests should reach the appropriate Board office at least four weeks in advance of the examination dates.* Applicants living in foreign countries must file applications even earlier.

No later than the middle of January you must also write to the Dean of Admissions, California Institute of Technology, Pasadena, California, requesting an admission application blank. When you receive the blank, fill it out and return it as soon as possible together with $10 to cover the application fee. This fee is not refundable whether or not the applicant is admitted, but it is applied on the first-term bills of those who are admitted and who register here in September. *The deadline for receipt of admission applications is February 15, and no application will be considered unless accompanied by the $10 application fee.* You must also make sure that a transcript of your secondary-school record is sent to the Dean of Admissions as soon as the grades for the work of the first semester of your last school year are available. *The deadline for receipt of transcripts is March 1.*

When you have arranged to take the examinations and have seen to it that your application and transcript have been forwarded to the Dean of Admissions, you have no further responsibility with regard to admission except to do a good job on the tests.

By February 15 or earlier, recommendation forms are sent out for each applicant for admission who has an application blank on file. These forms are sent directly to the principal or headmaster of the school which the applicant is attending, with the request that they be filled out and returned directly to us.

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1. Very occasionally the applications of those who have taken the Level I instead of the Level II Mathematics Test will be considered. It should be pointed out, however, that the Institute feels it can better judge the qualifications of an applicant who has taken the Level II test, and those who have not taken it will be handicapped in the competition for admission.

2. 1967-68 Dates for Admission to C.I.T. in September 1968:

Tests	*Apply to C.E.E.B. by*
December 2, 1967	October 28, 1967
January 13, 1968	December 9, 1967

Students taking the tests in foreign countries should apply to the C.E.E.B. four weeks earlier than the above dates.

3. A student who has just begun physics or chemistry the preceding September should probably not attempt the College Board test in that subject even in January. He would be better advised to take the test in the science (physics or chemistry) he took in his junior year. A student in his junior year might well consider taking in May of that year the test in the science (physics or chemistry) which he is currently studying.

Personal interviews with those who have done well on the College Board tests are held whenever possible at the schools. *It is not possible to visit all of the schools involved but if a personal interview cannot be held, this in no way prejudices an applicant's chances of admission. The applicant has no responsibility with regard to the personal interview unless and until he receives a notice giving the time and date when a representative will visit his school.* These visits occur in the latter half of March and early April.

When the results of the College Board tests are known and interviews have been completed, the Admissions Committee meets and chooses the 180 men to form the freshman class. The Committee judges each applicant on the basis of his secondary-school records, his examination grades, and on the information gained from the recommendation forms and from interviews when these have been held. This information includes the opinion of the school authorities regarding the applicant's general qualifications as a creative person and a good citizen. All applicants are notified of admission or rejection by April 20.

2. Early Decision Plan

THE INSTITUTE will consider a few outstanding candidates who wish to make the California Institute their first choice under an early decision plan. Such a candidate must have taken the required College Board tests by the end of his junior year, or at the following July administration (note that May is the last series at which an early-decision candidate may take the Level II mathematics test), must have an excellent school record, and must have the thorough backing of his high school.

An applicant for admission under the early decision plan must have his credentials on file by October 15 of his senior year. He will be notified by December 15 whether he has been accepted. An accepted applicant is then expected to withdraw all applications to other colleges. An applicant who is not accepted under the early decision plan will be considered without prejudice for admission at the regular time in April, unless he receives notice of final rejection in December.

3. Advanced Placement

A NUMBER of high schools and preparatory schools offer selected students the opportunity to accelerate and to take in the senior year one or more subjects which are taught at the college level and cover the material of a college course. The College Entrance Examination Board gives in May of each year a set of Advanced Placement examinations. covering this advanced work.

Advanced placement is possible at the Institute in chemistry and mathematics. As currently organized, the required freshman course in physics contains so little that duplicates advanced placement work that students are rarely allowed to skip it. Although all freshmen must take a humanities course, no one specific course is required; advanced placement in the humanities is thus not applicable.

Advanced placement comes in different forms in different subjects: it may take the shape of enrollment in sophomore courses or in special freshman courses, or of excuse from part or all of a required freshman course, depending entirely on the student's background. Advanced placement is worked out between each interested student and the department concerned; each student who desires advanced placement is therefore urged to report to the Institute two or three days before Registration in order to make the proper arrangements.

It is usually necessary for a student to score a 5 or a 4 on his Advanced Placement Test in order to be considered for advanced placement at the Institute. Stu-

dents who have not done this well—and students who have not taken the Advanced Placement tests but have covered advanced work—may be granted advanced placement on demonstration of their readiness for it. This demonstration will frequently take the form of a satisfactory score on one of the Institute transfer tests given in special administration before Registration.

4. Transfer Admission Procedures

IF YOU are an applicant who has attended college elsewhere, you should, as your initial step in applying for admission with advanced standing, send to the Dean of Admissions a transcript of your college work; the transcript should include a list of subjects to be completed before transfer. If you have not had the equivalent of at least the first-year mathematics, physics, and chemistry courses listed on page 46, you will be considered as a freshman and must follow the procedures outlined in Section 1 above.

If you are eligible for transfer into the sophomore or junior classes, you will take transfer examinations in mathematics, physics, and English. If you expect to major in either chemistry or chemical engineering, you will take in addition an examination in chemistry. The examinations cover the work in these subjects at the Institute at the level for which the applicant is requesting credit. The tests will be given in the middle of May, and *the deadline for filing transfer applications is April 1. Deadline for those living in foreign countries: March 1.* The tests may be taken either at the Institute or at the college the applicant is attending. In the latter case, the tests must be taken under the supervision of a member of the college faculty who will agree in writing to supervise the examinations. In general only those who have college grades of A or B or their equivalents will be permitted to take the tests. Credit for subjects other than those covered by examination is arranged after the applicant's admission, in consultation with the departments concerned. A preliminary estimate of credit may, however, be obtained from the Dean of Admissions if a transcript or a list of subjects has been sent in for evaluation. Transfer applicants are notified of admission or rejection about June 20.

5. Costs

EXPENSES at the California Institute of Technology for one academic year can be estimated as follows:

Tuition	$2,100
Room and Board (on campus)	1,100
Dues and Fees	98
Books and Supplies	130
	$3,428
Personal	400
	$3,828

In addition, a freshman or a new transfer student pays a $10 registration fee and a breakage deposit of $25, any unused portion of which is refunded to him when he leaves the Institute.

6. Scholarships

A NUMBER of highly desirable applicants are unable to meet these expenses without placing an undue burden on themselves or their parents. Every effort is made to take care of these men through scholarships, which are awarded almost entirely on the basis of need. On the average, somewhat over 65 percent of a freshman class holds scholarship grants in various amounts, depending on need as estimated by the College Scholarship Service (see below). A number of freshman scholarships are awarded for all four years, providing the student maintains a satisfactory record. Those who receive one-year scholarships are en-

titled to apply for renewal in subsequent years, providing their financial need continues and they are in good standing academically. For the past several years Caltech has been able to offer financial assistance to all those in the freshman year and beyond who have demonstrated need. It is hoped that economic conditions will continue to make this possible.

Anyone who really wants to attend a particular college, but who is doubtful about his ability to meet the cost, should make application for admission and for a scholarship, and base his final judgment of whether or not he can afford to attend on the size of the scholarship, if any, which the college offers him.

If you are applying as a freshman and if you will need scholarship assistance, you should have your parents (or guardian) fill out a Parents' Confidential Statement, which is a form put out by the College Scholarship Service. It should be returned to the Service according to the instructions on the form. The Statement may be obtained from your school counselor or by writing to the College Scholarship Service at one of the addresses given above for the College Entrance Examination Board. It is not necessary to file more than one Statement with the College Scholarship Service. A space is provided in the Statement for you to name the colleges to which you want copies sent, and if the Institute's name appears in this space, we will receive a copy from the Service. An applicant must file the Statement with the Service no later than February 15.

No other form (except, of course, the admission application blank mentioned in Section 1 above) is required in order to make a scholarship application at the Institute, and it is not necessary to apply for any specific scholarship by name. An applicant who has asked that a copy of the Statement be sent to us will be considered for the best scholarship to which his need and other qualifications entitle him.

The foregoing provisions apply also to the Opportunity Grants offered by the Federal Government under the Higher Education Act of 1965.

Candidates for freshman scholarships are urged to make exhaustive inquiry of their school advisors and to watch their school bulletin boards for announcements of scholarship contests, the winners of which may use the awards at the college of their choice. The State of California, for example, awards such scholarships annually to residents of the state who wish to attend a college within the state. Residents of the State of California who request financial aid will be penalized in consideration for scholarship grants if they do not apply for California state scholarships, provided their test scores indicate that they would have won a state award had they applied. Among the nationwide awards are the National Merit Scholarships and the Westinghouse Talent Search Awards. Applicants in need of financial assistance should enter any such contest for which they are eligible in addition to applying for California Institute scholarship grants. While duplicate awards will not be given beyond the actual extent of need, the more sources to which a candidate applies, the greater are his chances of receiving scholarship assistance.

A transfer student may apply for a scholarship on a special form which should be requested at the time he submits his transcript to us. This form is to be returned *directly to the Institute* not later than April 1.

7. Loans

LOANS are available to members of all undergraduate classes including entering freshmen. They are made upon application subject to the approval of the Faculty Committee on Scholarships and Financial Aid and the extent of the available funds. There are two sources of loan funds, and the conditions governing each are described below.

California Institute loan funds are available in amounts not to exceed $750 in any one year and a maximum of $3,000 during undergraduate residence. No interest is charged and no repayment of principal is required during undergraduate residence as long as residence is continuous (the term "residence" includes the usual vacation periods). For those who do not go on to graduate school repayment commences after the graduation of the class of which the borrower has been a member and is at the rate of $50 a month, including simple interest at 4 percent per annum on the unpaid balance. For those who go on to graduate school at Caltech or elsewhere no later than the fall following their class's graduation, interest is charged at the rate of 3 percent per annum but no repayment on principal is required until the final advanced degree is earned, provided that the borrower remains in continuous residence. After the final degree has been earned, repayment commences at the rate of $50 a month including interest at 4 percent on the unpaid balance. If the borrower withdraws from undergraduate or graduate registration at any time before receiving the degree for which he has been working, the total amount owed the Institute becomes due and payable at once unless the Committee on Scholarships and Financial Aid agrees to some exception to this rule.

Federal loans under the National Defense Education Act are available in amounts not to exceed $1,000 for any individual in a single year up to a total of $5,000. The borrower must demonstrate financial need, must be an above average student, and must be willing to sign a loyalty oath. No interest is charged on these loans nor is any repayment of principal required until one year after the final degree has been earned. At that time repayment commences, and interest is charged at the rate of 3 percent per annum on the unpaid balance.

Funds are also available under the Federal Guaranteed Loan program. For families with adjusted incomes below $15,000 a year the terms of guaranteed loans are similar to those of the NDEA program mentioned above. There is no need qualification for guaranteed loans, but families with incomes above $15,000 pay 6 percent from the date of borrowing.

Students who wish to borrow and who meet the stipulated requirements will be given their choice of the foregoing sources of loans to the extent of available funds.

It is inadvisable for foreign students from countries with seriously adverse rates of exchange to borrow more than they can repay from savings (after taxes) out of salaries earned in the United States. The Federal Government grants a maximum extension of only 18 months on student visas for holders who engage in full-time commercial employment after they take their degrees. For practical purposes this means that total indebtedness may not exceed $1,000.

8. Deferred Payment Plan

IN ADDITION to loans there is available a plan under which any student in good standing may defer up to $1,300 of his college bills each year to a total of $5,200 and may pay the deferred portion in installments after the graduation of his class. The sum of $3.90 per $100 of loan principal is added each year to the deferred portion and represents the premiums on a life insurance policy in the amount of any balance due the Institute under this plan. The insurance policy covers the life of the student for the duration of the obligation, and during the four undergraduate years it covers, in addition, the life of the parent or guardian responsible for the student's support. Interest on the amount deferred is charged at the rate of 6½ percent per annum payable quarterly. The interest

is the only payment made on this plan during the undergraduate years. For a student who defers $1,000 a year for four years, the interest payments would be as follows: freshman year $46.71, sophomore year $108.99, junior year $171.27, senior year $233.55. On November 1 following his class's graduation the student commences repayment on the deferred portion at the rate of $55 a month including interest at 6½ percent on the unpaid balance. For those who go on to graduate school more favorable repayment arrangements may be made for the duration of graduate work. As in the case of loans, the total of any balance owed the Institute under this plan becomes due and payable at once if continuous residence is not maintained, unless in the opinion of the Committee on Scholarships and Financial Aid some exception to this rule should be made.

The Deferred Payment Plan and loans administered by the Institute may be used in combination, but the total that may be borrowed or deferred may not exceed $1,300 in any year.

9. Earnings

IT IS not advisable for a student to count on earning much during the first year of his attendance. After the freshman year when he has made his adjustment to college, he should have more time for outside work.

A Placement Bureau is available to help students find jobs. The Institute does not participate in the Federal Work-Study Program.

An applicant who has a financial problem should discuss the whole matter frankly in the space provided for this purpose on the admission blank, attaching an additional sheet if the space is not sufficient. In cases where personal interviews are held, the matter should be discussed thoroughly with the interviewer. It is our hope that no student who can profit from the work here shall be denied the opportunity because of lack of funds.

10. General Information

THERE is only one admission period a year: namely, in September. There are no mid-year admissions. The academic year is made up of three terms, one of twelve weeks' and two of eleven weeks' duration.

All students must be working for an Institute degree, and all must be admitted according to the regulations outlined above. The Institute does not admit special students who do not intend to complete the work for a degree.

The Institute does not offer summer courses or extension, correspondence, or night courses.

All students entering for the first time are required to submit a report of physical examination on a form supplied at the time notice of admission is sent. The report must be signed by a licensed physician (M.D.). Vaccination against smallpox and immunization or booster for tetanus (tetanus toxoid) are required at the time of the examination. A chest X-ray or a negative Mantoux skin test must have been performed within six months of matriculation and a report attached. Admission is contingent upon a satisfactory physical examination report showing that there are no defects which would substantially hinder the applicant's scholastic work or endanger his fellow students. A health fee entitling a student to medical and infirmary care is included in the total for dues and fees listed under expenses in Section 5 above.

All freshmen and sophomore students under the age of twenty-four are required to take a minimum of three hours of physical education a week. This, of course, includes any time spent in freshman or varsity athletics. For those who are unable for physical reasons to participate in the regular program, special facilities are provided.

Arrangements exist between the California Institute of Technology and certain liberal arts colleges, whereby a student enrolled in one of these colleges may follow a certain prescribed course for the first three years and then transfer into the third year of the engineering and applied science option at the Institute without further formality providing that he has the unqualified recommendation of the officials at the liberal arts college which he is attending. After satisfactorily completing in two years at the Institute all remaining work required for a bachelor's degree in engineering, he will be awarded a bachelor of arts degree by the college from which he transferred and a bachelor of science degree by the Institute. Application for admission at the freshman level under this plan should be made to the liberal arts college. The following are the colleges with which these arrangements exist: Bowdoin College, Brunswick, Maine; Grinnell College, Grinnell, Iowa; Occidental College, Los Angeles, California; Ohio Wesleyan University, Delaware, Ohio; Pomona College, Claremont, California; Reed College, Portland, Oregon; Wesleyan University, Middletown, Connecticut; and Whitman College, Walla Walla, Washington.

11. Air Force Reserve Officers Training Corps

THE California Institute of Technology unit of the Air Force Reserve Officers Training Corps (AFROTC) offers a 2-year program open to qualified juniors.

Students interested in the 2-year Professional Officer program must make application during the third term of the sophomore year. Between the sophomore and junior years the applicants must attend a six-week summer training course at an Air Force base. Successful completion of this course will qualify the student for entry into the Professional Officer program. Studies in this program are directed toward preparation for Junior Management positions in a rapidly changing, highly technical Air Force organization. Upon entry into this course, the student must agree to pursue faithfully the Institute's established courses of study leading to a degree, accept an Air Force Commission as a 2nd Lieutenant if tendered, and then serve an active duty tour of 4 years.

For interested students who qualify, a Flight Instruction Program provides 30 hours of ground school and 35 hours of actual flight training to determine the student's adaptability for further pilot training.

AFROTC graduates are normally assigned to scientific, engineering, and technological positions within the Air Force. Graduates may defer their active duty for certain valid reasons such as graduate study.

12. Courses

THE TITLES used in the following list are reasonably descriptive of the course content. A more detailed description of these subjects will be found in the Institute Catalog, which will be sent (without charge) on request made to the Office of Admissions, California Institute of Technology, Pasadena, Calif. 91109.

In addition to subject titles, the following pages give information on the number of terms the subject must be studied and the number of units required in each subject for an entire year. The term "unit," as used at the Institute, indicates the number of hours spent in a given subject per week for one term, including hours spent in class, laboratory and preparation. The units used at the Institute may be reduced to semester-hours by multiplying the Institute units by the fraction 2/9. Thus a twelve-unit course taken throughout the three terms of an academic year would total thirty-six Institute units or eight semester hours. If the course were taken for only one term, it would be the equivalent of 2⅔ semester hours.

FIRST YEAR, ALL OPTIONS

Freshman Mathematics (3 terms, 30 units)
Kinematics, Particle Mechanics, Electric Forces (3 terms, 36 units)
General and Quantitative Chemistry (3 terms, 36 units)

Literature of the Modern World
Or
An Introduction to Modern Europe
Or
Major Themes in United States History
(3 terms, 27 units)

All freshmen and sophomores are required to take Physical Education, or the equivalent, three hours a week (9 units per year).

SECOND, THIRD, AND FOURTH YEAR, ALL OPTIONS

Second, third, and fourth-year courses are listed in the tables on the following pages. There may be minor changes in or rearrangements of these courses at any time, but the general pattern will remain similar to that indicated here.

All elective courses as shown on the following pages are subject to approval of the student's advisor.

The Humanities electives required in the senior year in each option are selected from a wide range of offerings in European and American History, Government, Philosophy, Psychology, Anthropology, Industrial Relations, Foreign Area Studies, Literature in English, French, or German, and an Introduction to the Visual Arts.

ASTRONOMY

second year

Sophomore Mathematics (3 terms, 36 units)
Electricity, Fields, and Atomic Structure (3 terms, 36 units)
Humanities Electives (3 terms, 27 units)
Introduction to Astronomy (1 term, 9 units)
Electives (3 terms, 27-33 units)

third year

Quantum Mechanics (3 terms, 27 units)
Topics in Classical Physics (3 terms, 27 units)
General Astronomy (3 terms, 27 units)
Humanities Electives (3 terms, 27 units)
Electives (3 terms, 27-42 units)

fourth year

Astronomy and Physics Electives (3 terms, at least 54 units)
Humanities Electives (sufficient to complete requirements)
Electives (3 terms, at least 42 units)

BIOLOGY

second year

Sophomore Mathematics
(3 terms, 36 units)
Electricity, Fields,and Atomic Structure
(3 terms, 36 units)
Humanities Electives (3 terms, 27 units)
Science or Engineering Electives
(3 terms, 51 units)

third year

Humanities Electives (3 terms, 27 units)
Physical Chemistry (3 terms, 27 units)
Organismic Biology (1 term, 22 units)
Biochemistry (1 term, 22 units)
Genetics (1 term, 12 units)
Electives (3 terms, 28-46 units)

fourth year

Humanities Electives (3 terms, 39 units)
General Physiology (1 term, 10 units)
Electives (3 terms, 138-153 units)

CHEMISTRY

second year

Sophomore Mathematics
(3 terms, 36 units)
Electricity, Fields, and Atomic Structure
(3 terms, 36 units)
Chemistry of Covalent Compounds
(3 terms, 27 units)
Experimental Methods of Covalent Chemistry
(3 terms, 18 units; may be taken in the
third year)
Electives (3 terms, 33 units)

third year

Economic Principles and Problems
(2 terms, 12 units)
Elementary German (3 terms, 30 units)
Physical Chemistry (3 terms, 27 units)
Physical Chemistry Laboratory
(2 terms, 16 units)
Quantitative Analysis (1 term, 10 units)
Oral Presentation (1 term, 2 units)
Electives (3 terms, 20-32 units)
Humanities Electives (3 terms, 33 units)

fourth year

Humanities Electives (3 terms, 42 units)
Electives (3 terms, 108-120 units)

CHEMICAL ENGINEERING

second year

Sophomore Mathematics
(3 terms, 36 units)
Electricity, Fields, and Atomic Structure
(3 terms, 36 units)
Chemistry of Covalent Compounds
(3 terms, 27 units)
Electives in Science and /or Engineering
(3 terms, 27 units)
Electives (3 terms, 18 units)

third year

Chemical Engineering Thermodynamics
(3 terms, 21 units)
Physical Chemistry (3 terms, 27 units)
Engineering Mathematics (3 terms, 36 units)
Quantitative Analysis (1 term, 4 units)
Economic Principles and Problems
(2 terms, 12 units)
Electives (3 terms, 45-54 units)

fourth year

Transport Phenomena (3 terms, 27 units)
Optimal Design of Chemical Systems
(3 terms, 36 units)
Chemical Engineering Laboratory
(2 terms, 18 units)
Physical Chemistry Laboratory
(1 term, 8 units)
Electives (3 terms, 54-63 units)

ECONOMICS

second year

Sophomore Mathematics
(3 terms, 36 units)
Electricity, Fields, and Atomic Structure
(3 terms, 36 units)
Science or Engineering Electives
(3 terms, 27 units)
Economic Principles and Problems
(2 terms, 12 units)
Electives (3 terms, 24 units)

third year

Money, Income and Growth
(2 terms, 18 units)
International Economic Relations
(1 term, 9 units)
Electives** (3 terms, 105 units)

fourth year

Price Theory* (1 term, 9 units)
Econometrics* (1 term, 9 units)
Electives to be chosen from specified
Economics courses (3 terms, 27 units)
Electives** (3 terms, 96 units)

*These courses may be taken in the third year instead of the fourth year.

**60 units of science or engineering electives are to be taken in the third and fourth years. For students in the economics option, this should include 21 units in mathematics.

ENGINEERING

second year

Sophomore Mathematics
(3 terms, 36 units)
Electricity, Fields, and Atomic Structure
(3 terms, 36 units)
Engineering and Science Electives*
(3 terms, 45-63 units)
Humanities Electives (3 terms, 27 units)

third year

Advanced Mathematics Elective
(3 terms, 36 units)
Engineering and Science Electives*
(3 terms, 75-93 units)
Humanities Electives (3 terms, 27 units)

fourth year

Humanities Electives (3 terms, 39 units)
Technical Presentations (3 terms, 6 units)
Engineering and Science Electives*
(3 terms, 96-114 units)

*The Division, acutely aware of the versatility expected of today's engineers, has developed a program designed to make available to undergraduate engineering students a variety of courses which include basic work in many phases of engineering and applied science. Thus a student can achieve reasonable breadth and at the same time develop in some depth in an area of special interest. The program will be administered through engineering faculty advisors whose responsibilities will be to guide and counsel the student in his choice of subjects.

ENGLISH

second year

Sophomore Mathematics
(3 terms, 36 units)
Electricity, Fields, and Atomic Structure
(3 terms, 36 units)
English Electives (3 terms, 27 units)
Science or Engineering Electives
(3 terms, 27 units)

third year

Economic Principles and Problems
(2 terms, 12 units)
English Electives (3 terms, 54 units)
Electives* (3 terms, 81 units)

fourth year

Electives to be chosen from specified
English courses (3 terms, 27 units)
Senior Seminar in English, Selected Topics
(3 terms, 27 units)
Electives* (3 terms, 87 units)

*60 units of science or engineering electives are to be taken in the third and fourth years.

GEOCHEMISTRY

second year

Sophomore Mathematics
(3 terms, 36 units)
Electricity, Fields, and Atomic Structure
(3 terms, 36 units)
Physical Geology
(1 term, 9 units)
Electives (3 terms, 64 units)

third year

Physical Chemistry (3 terms, 27 units)
Optical Mineralogy (1 term, 10 units)
Igneous Petrology and Petrography
(1 term, 10 units)
Electives (3 terms, 58 units)
Summer Field Geology (following 3rd year,
6 weeks, 30 units; 8 weeks, 40 units)
Advanced General Geology
(3 terms, 27 units)
Geological Field Training and Problems
(3 terms, 18 units)

fourth year

Humanities Electives (3 terms, 27 units)
Elementary German or Elementary Russian
(3 terms, 30 units)
Oral Presentation (1 term, 2 units)
Geology Club (3 terms, 3 units)
Quantitative Analysis (1 term, 10 units)
Physical Chemistry Laboratory
(2 terms, 16 units)
Metamorphic Petrology and Petrography
(1 term, 10 units)
Electives (3 terms, 46 units)

GEOLOGY

second year

Sophomore Mathematics
(3 terms, 36 units)
Electricity, Fields, and Atomic Structure
(3 terms, 36 units)
Physical Geology (1 term, 9 units)
Electives (3 terms, 64 units)

third year

Elements of Physical Chemistry
(2 terms, 18 units)
Optical Mineralogy (1 term, 10 units)
Igneous Petrology and Petrography
(1 term, 10 units)
Electives (3 terms, 67 units)
Summer Field Geology (following 3rd year,
6 weeks, 30 units; 8 weeks, 40 units)
Advanced General Geology
(3 terms, 27 units)
Geological Field Training and Problems
(3 terms, 18 units)

fourth year

Humanities Electives (3 terms, 27 units)
Elementary German or Elementary Russian
(3 terms, 30 units)
Oral Presentation (1 term, 2 units)
Geology Club (3 terms, 3 units)
Advanced Field Geology (3 terms, 30 units)
Geology and other Science Electives
(3 terms, 58 units)

GEOPHYSICS

second year

Sophomore Mathematics
(3 terms, 36 units)
Electricity, Fields, and Atomic Structure
(3 terms, 36 units)
Physical Geology (1 term, 9 units)
Electives (3 terms, 64 units)

third year

Topics in Classical Physics
(3 terms, 27 units)
Electives (3 terms, 42 units)
Advanced General Geology
(3 terms, 27 units)
Engineering Mathematics (3 terms, 36 units)
Geological Field Training and Problems
(3 terms, 18 units)

fourth year

Humanities Electives (3 terms, 27 units)
Elementary German or Elementary Russian
(3 terms, 30 units)
Oral Presentation (1 term, 2 units)
Geology Club (3 terms, 3 units)
Physics and Mathematics Electives
(3 terms, 54 units)
Geology or Geophysics Electives
(3 terms, 33 units)

HISTORY

second year

Sophomore Mathematics
(3 terms, 36 units)
Electricity, Fields, and Atomic Structure
(3 terms, 36 units)
Science and Engineering Electives
(3 terms, 27 units)
History (Advanced Subjects)
(3 terms, 27 units)
Electives (2 terms, 18 units)

third year

Economic Principles and Problems
(2 terms, 12 units)
Electives* (3 terms, 120 units)

fourth year

History (Tutorial), open only to History
majors (3 terms, 27 units)
Electives* (3 terms, 114 units)

*In the second, third, and fourth years a total of at least 81 units are to be selected from specified History courses. These must include at least 9 units in each of three major areas of historical study: early European, modern European, and American History.

MATHEMATICS

second year

Sophomore Mathematics
(3 terms, 36 units)
Electricity, Fields, and Atomic Structure
(3 terms, 36 units)
Introduction to Abstract Algebra
(3 terms, 27 units)
Electives in Science or Engineering, outside of Mathematics (3 terms, 27 units)
Humanities Electives (3 terms, 27 units)

third year

Economic Principles and Problems
(2 terms, 12 units)
Advanced Calculus (3 terms, 36 units)
Selected Courses in Mathematics
(3 terms, at least 27 units)
Electives (3 terms, at least 27 units)
Humanities Electives (3 terms, 27 units)

fourth year

Humanities Electives (3 terms, 39 units)
Selected Courses in Mathematics
(3 terms, at least 27 units)
Electives (3 terms, at least 24 units)

PHYSICS

second year

Sophomore Mathematics
(3 terms, 36 units)
Electricity, Fields, and Atomic Structure
(3 terms, 36 units)
Electives (3 terms, 63-75 units)

third year

Topics in Classical Physics
(3 terms, 27 units)
Quantum Mechanics (3 terms, 27 units)
Electives (at least 69 units)

fourth year

Humanities Electives (3 terms, 33 units)
Economic Principles and Problems
(2 terms, 12 units)
Experimental Physics Laboratory
(2 terms, 12 units)
Physics Electives (3 terms, 54 units)
Electives (3 terms, 27 units)

THIS booklet is intended to give a general picture of the California Institute of Technology. It provides the information needed by anyone interested in applying for admission. Those who want more detailed information, especially on courses and requirements for graduate study, may obtain a copy of the Institute Catalog by writing to the Office of Admissions, California Institute of Technology, Pasadena, California 91109.


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