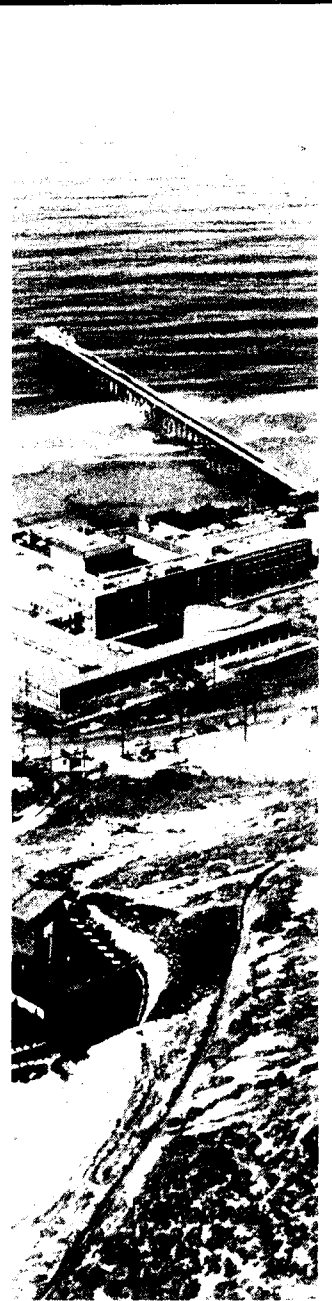
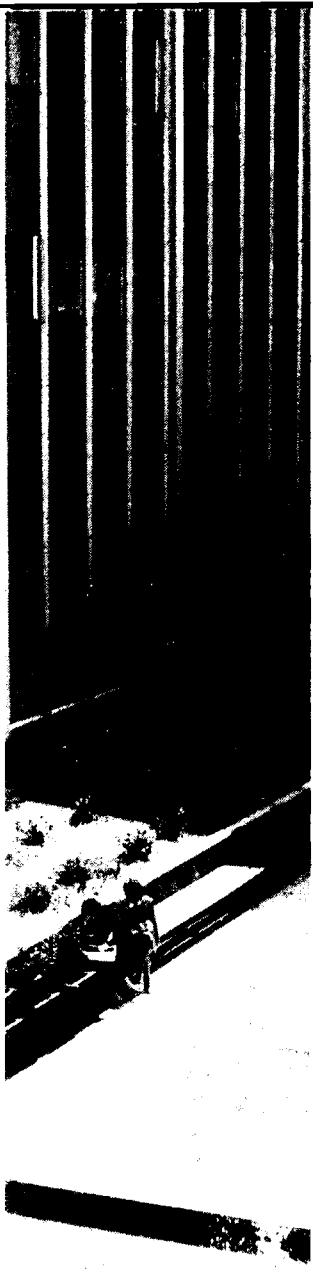


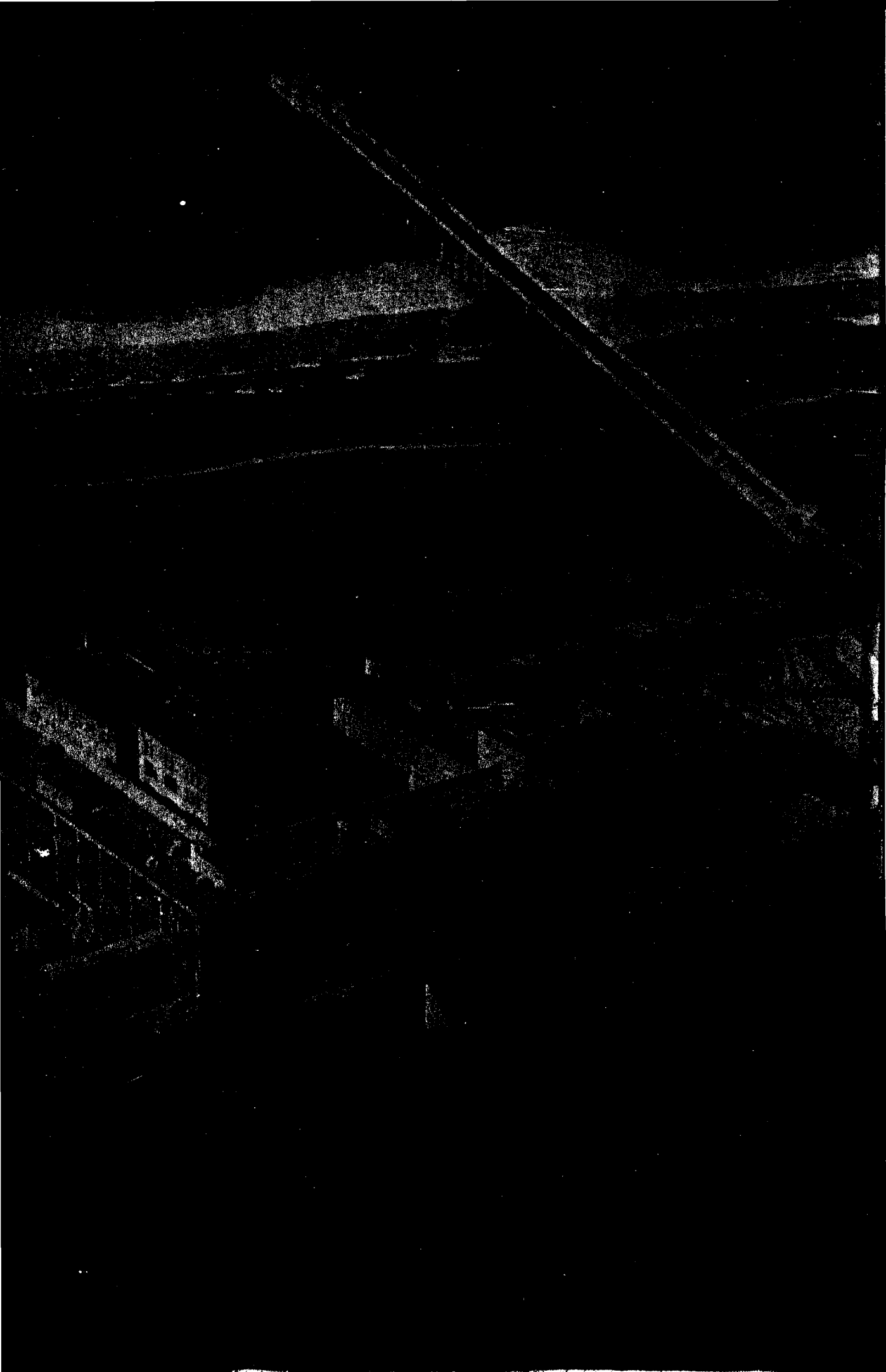
GENERAL CATALOG



UNIVERSITY OF CALIFORNIA, SAN DIEGO

SCHOOL OF SCIENCE AND ENGINEERING

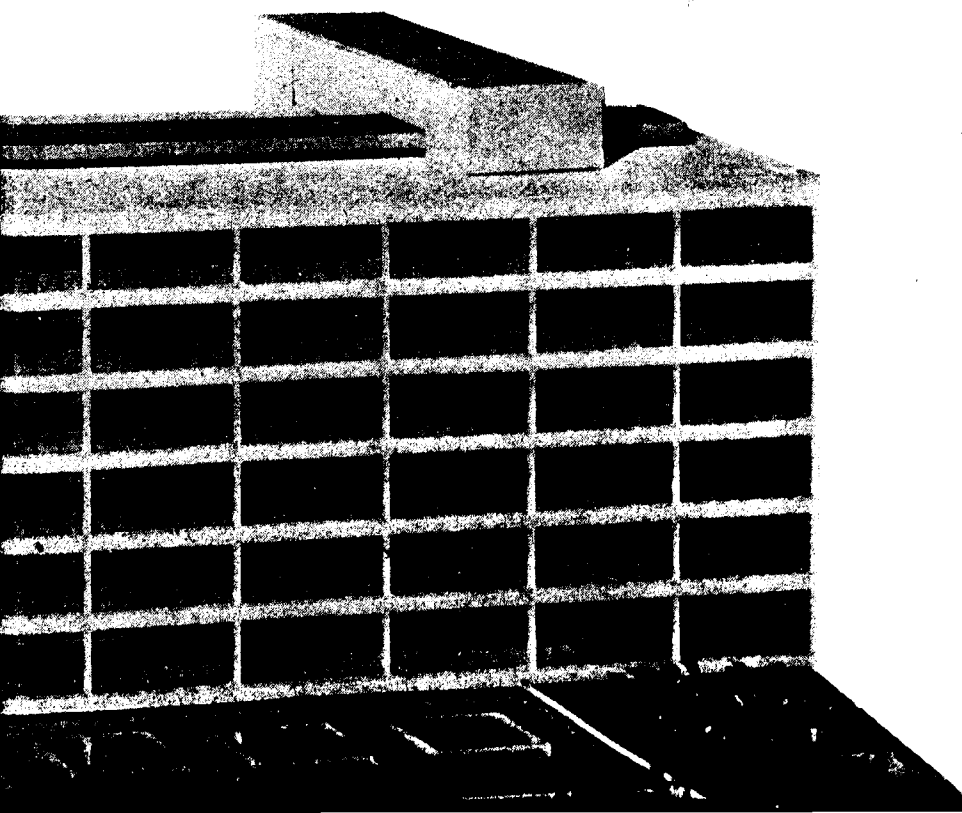
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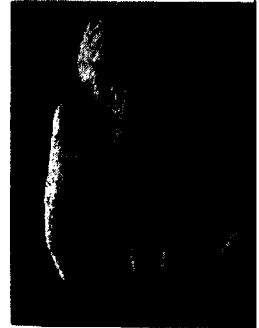
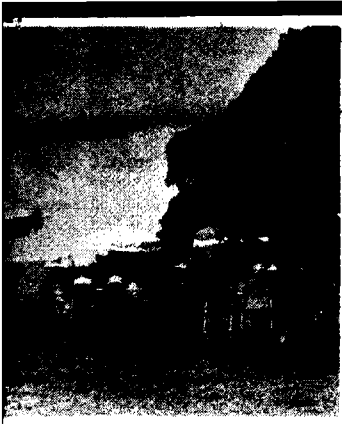
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# CALENDAR, 1961-1962

5

## FALL SEMESTER, 1961-62

- 1961** Aug. 1, Tuesday Last day for filing new applications for admission (accompanied by official transcripts in duplicate), as well as renewal of applications previously submitted.
- Aug. 15, Tuesday Last day for filing applications for readmission after an absence.
- Sept. 6, Wednesday Examination in English for foreign students.
- Sept. 11, Monday Fall semester begins.
- Sept. 11, Monday, to Sept. 14, Thursday Registration Week. For details, see Registration Circular and official bulletin boards.
- Sept. 18, Monday Instruction begins.
- Sept. 29, Friday Last day to file registration packets or to change study lists without fee.
- Oct. 2, Monday Last day for filing applications for advancement to candidacy for the master's degrees to be conferred in January, 1962.
- Oct. 19, Thursday Last day for filing applications for foreign language screening tests to be given Nov. 3.
- Nov. 3, Friday Foreign language screening tests. For time and place, see Registration Circular and official bulletin boards.
- Nov. 11, Saturday End of mid-term period.
- \*Nov. 23, Thursday, to  
\*Nov. 25, Saturday Thanksgiving Holiday.
- Nov. 23, Thursday, to  
Nov. 25, Saturday Fall Recess.
- Nov. 27, Monday Last day for graduate students to add courses to study list and/or to drop courses without penalty of F.
- Dec. 1, Friday Last day for filing in final form with the committee in charge theses for the doctor's degrees to be conferred in January, 1962.
- Dec. 7, Thursday Last day for filing applications for foreign language screening tests to be given Dec. 15.

*Dec. 15, Friday*

Foreign language screening tests. For time and place, see Registration Circular and official bulletin boards.

*Dec. 15, Friday*

Last day for filing new applications for admission (accompanied by official transcripts in duplicate), as well as renewal of applications previously submitted.

*Dec. 18, Monday, to  
Jan. 1, Monday*

Christmas Recess.

*\*Dec. 22, Friday, to*

Christmas Holiday.

*\*Dec. 25, Monday*

*\*Dec. 29, Friday, to*

New Year's Holiday.

*\*Jan. 1, Monday*

**1962** *Jan. 2, Tuesday  
Jan. 2, Tuesday*

Classes resume after Christmas Recess.

Last day for filing in final form with the committee in charge theses for the master's degrees to be conferred in January, 1962.

*Jan. 13, Saturday*

Instruction ends.

*Jan. 15, Monday, to  
Jan. 24, Wednesday*

Final examinations.

*Jan. 24, Wednesday*

Last day for filing with the Dean of the Graduate Division completed copies of theses for the master's and doctor's degrees to be conferred in January, 1962.

*Jan. 24, Wednesday*

Fall semester ends.

### SPRING SEMESTER, 1962

**1962** *Jan. 2, Tuesday*

Last day for filing applications for readmission after an absence.

*Jan. 24, Wednesday*

Examination in English for foreign students.

*Jan. 29, Monday*

Spring semester begins.

*Jan. 29, Monday, to  
Feb. 1, Thursday*

Registration Week. For details, see Registration Circular and official bulletin boards.

*Feb. 5, Monday*

Instruction begins.

*\*Feb. 12, Monday*

Lincoln's Birthday.

*\*Academic and administrative holiday*



- Feb. 13, Tuesday* Last day for filing applications for advancement to candidacy for the master's degrees to be conferred in June or August, 1962.
- Feb. 16, Friday* Last day to file registration packets or to change study lists without fee.
- Feb. 23, Friday* Last day for filing applications for foreign language screening tests to be given Mar. 2.
- Mar. 2, Friday* Foreign language screening tests. For time and place, see Registration Circular and official bulletin boards.
- Apr. 9, Monday, to  
Apr. 14, Saturday* Spring Recess.
- Apr. 21, Saturday* End of the mid-term period.
- Apr. 27, Friday* Last day for graduate students to add courses to study list and/or to drop courses without penalty of F.
- Apr. 30, Monday* Last day for filing in final form with the committee in charge theses for the master's degrees to be conferred in June, 1962.
- May 10, Thursday* Last day for filing applications for foreign language screening tests to be given May 18.
- May 11, Friday* Last day for filing in final form with the committee in charge theses for the doctor's degrees to be conferred in June, 1962.
- May 18, Friday* Foreign language screening test. For time and place, see Registration Circular and bulletin boards.
- May 26, Saturday* Instruction ends.
- May 28, Monday* Last day for filing with the Dean of the Graduate Division completed copies of theses for master's and doctor's degrees to be conferred in June, 1962.
- \*May 30, Wednesday* Memorial Day.
- May 28, Monday, to  
June 7, Thursday* Final examinations.
- June 7, Thursday* Spring semester ends.



*GENERAL INFORMATION*

## THE UNIVERSITY OF CALIFORNIA

Founded in 1868, the University of California is composed of academic colleges, professional schools, divisions, departments of instruction, museums, libraries, research institutes, bureaus and foundations, and the University of California Press, situated on seven campuses throughout the State, namely: Berkeley, Davis, San Diego, Los Angeles, Riverside, San Francisco, and Santa Barbara.

The Regents of the University, by authority vested in them by the State Constitution, created an academic body called the Academic Senate. The Senate, subject to the approval of The Regents, determines the conditions for admission, for certificates, for degrees. It authorizes and supervises all courses of instruction in the academic and professional colleges and schools except the School of Law. It recommends to The Regents all candidates for degrees and has general supervision of the discipline of students.

The Graduate Division of the University is divided into the Northern Section and the Southern Section. The latter embraces all graduate activities on the four southern campuses, Los Angeles, Santa Barbara, Riverside, and San Diego.

## THE SAN DIEGO CAMPUS

The name, "University of California, San Diego" has been chosen by The Regents to designate what will eventually become a full-fledged University offering graduate and undergraduate work in the many fields of learning, with chief emphasis during the coming few years on building up a strong curriculum in the physical and natural sciences. At present, however, only graduate work is offered.

The campus originally consisted of 158 acres designated as a "pueblo lot" (a heritage of early Mexican rule in California) of the City of San Diego on the coast two miles north of La Jolla and about sixteen miles north of the center of San Diego. In 1960, the City of San Diego, with the authorization of the electorate, formally transferred 60 acres of adjacent lands to be used for the School of Science and Engineering. In addition, the City of San Diego is ceding to the University 450 acres adjacent to the original campus, and it is expected that within another year several hundred acres more will be added from other sources.

Twenty acres of marshland in Mission Bay belonging to the University

constitute a wildlife refuge. It is planned to use some of this land for experimental purposes. Docking facilities for the eight ships of the Scripps Institution, as well as 49,000 square feet of floor space in fifteen buildings for laboratories, offices, shops, and storerooms, have been provided by the U. S. Navy Electronics Laboratory at Point Loma, about fifteen miles from the campus.

Several units of the University are represented on the San Diego campus:

*The Scripps Institution of Oceanography*

The Institution is an outgrowth of the program of field investigations on the animal life of the Pacific Ocean begun in 1892 by the Department of Zoology of the University of California under the leadership of Professor W. E. Ritter. A summer field station was established each year at a locality along the California coast. At first, financial support came in small sums from numerous persons interested in the work, from alumni of the University, and to some extent from the University itself. The interest of Miss E. B. Scripps and Mr. E. W. Scripps began in 1903 when the field station was moved from San Pedro to San Diego. Most of the funds for the physical development of the San Diego campus and for support of the scientific work during the early years were given by the Scripps family. With the growth of the Institution, the State of California and the Federal Government have borne an increasing proportion of the total cost.

For several years, the enterprise was carried on as the Marine Biological Association of San Diego, a corporation which had no official connection with the University of California, though such a relation was looked forward to and provided for in the articles of incorporation. The Institution became an integral part of the University in 1912, when the property and management were transferred to The Regents of the University, the name of the foundation being then changed to the Scripps Institution for Biological Research. The scope and character of the research program ultimately focused on all aspects of the study of the sea and this fact was formally recognized on October 13, 1925, when the name was changed by The Regents to the Scripps Institution of Oceanography.

The purpose of the Institution is primarily research, but it has always offered opportunities for advanced graduate work and for many years functioned as a graduate department in the Southern Section of the Graduate Division. Its first Ph.D. degree in Oceanography was awarded in 1935 and the first degrees of Master of Science in 1948.

### *The School of Science and Engineering*

In July, 1958, The Regents established on the San Diego campus an Institute of Technology and Engineering "to provide graduate instruction and research in mathematics, physics, chemistry, the earth and biological sciences and engineering." Looking forward to the further expansion of the University in the San Diego area, The Regents specified that "the faculty should be appointed with the expectation that they will eventually carry a full teaching load and will engage in undergraduate instruction, as the need arises."

During 1959, the name of the new Institute was changed to the School of Science and Engineering. It is temporarily housed in buildings recently constructed but originally planned for the Scripps Institution. New quarters are now being erected, however. The School of Science and Engineering will eventually include several departments of instruction and research, of which the Departments of Physics, Chemistry, and Earth Sciences have already been established. These departments accept students as candidates for graduate degrees in their respective fields, and the student body of the School will eventually include undergraduates as well.

### *The Institute of Marine Resources*

This University-wide institute, devoted to fostering research and investigation of the resources of the sea, has its headquarters on the San Diego campus, and its activities offer many opportunities to graduate students.

### *The Institute of Geophysics and Planetary Physics*

This branch of the University-wide Institute of Geophysics was established in 1960 and, although it offers no instruction, it will eventually involve many graduate students in its research activities.

### *Associated Laboratories*

The headquarters laboratory of the U. S. Bureau of Commercial Fisheries, Biological Laboratory, La Jolla, is housed on the campus, and at the Point Loma annex to the campus are located the headquarters laboratories of the Inter-American Tropical Tuna Commission and the U. S. Bureau of Commercial Fisheries, Biological Laboratory, San Diego.



*REQUIREMENTS FOR ADMISSION*

## **NEW STUDENTS**

Students on this campus must be admitted to the Graduate Division of the University. Prior to 1960, the responsibility for all formal matters pertaining to the granting of degrees was retained at the Office of the Graduate Division on the Los Angeles campus. In 1960, however, in accordance with the general movement toward decentralization of the University, this campus was given almost complete responsibility for admission and registration of students and the administration of its graduate degrees. Many of the functions of the Dean of the Graduate Division were delegated to an Associate Dean in charge of graduate affairs. At present, all student activities, admission, registration, counseling, veterans affairs and selective service, fellowships, assistantships, and loans, are centralized in the Office of the Dean on this campus.

Each student seeking admission to the Graduate Division must file a formal application and an official transcript of his record in duplicate from each college and university he has attended, not later than August 1 for the fall semester, and not later than January 2 for the spring semester. One set of the official records is retained permanently in the Office of Admissions. These records may not be withdrawn. The duplicate set of records will be sent to the student's major department. The application must be accompanied by a money order or bank draft for \$5 in payment of the application fee. Payment by check, draft, or money order is acceptable. Any payment must be drawn for the exact amount of the fees, and should be made payable to The Regents of the University of California. Because of the time required to process an application and to prepare the registration forms, applications and/or transcripts received after the deadline date will be considered only as time permits and in the order received. Late applicants are advised, therefore, also to seek admission elsewhere if circumstances require immediate registration in graduate work. The blank for application may be obtained from the Office of Admissions, University of California, San Diego, Box 109, La Jolla, California.

Applications for admission in graduate status will be received from graduates of recognized colleges and universities. The basis of selection is promise of success in the work proposed, which is judged largely on the previous college record.

Holders of the bachelor's degree from institutions of acceptable standing are accorded admission to the Graduate Division subject to the fol-

lowing qualifications: (1) that the standards of the degree in question are equivalent to those maintained at the University of California; (2) that the record of scholarship is satisfactory; and (3) that the student can be accommodated in the field in which he wishes to study. These provisions affect all applicants whether from colleges or schools in the University of California or outside it.

An applicant who has taken the Graduate Record Examination should submit with his application a copy of the results of the examination; this will be especially helpful for a student whose grade-point average is near the minimum requirement for admission in regular graduate status.

Students who do not register in the semester for which they were admitted and who later wish to attend a regular session must file a renewal of application for admission to graduate status. If they have attended other institutions or University Extension in the interval they must file supplementary transcripts covering such work.

### *READMISSION*

An application for readmission is required of persons formerly registered in a regular session as graduate students who wish to return after not having formally registered in the University for a semester or more. Enrollment in courses in University Extension does not constitute registration in regular session. The form for readmission is obtainable from the Registrar. Readmission is subject to the recommendation of the chairman of the student's major department and the approval of the Dean of the Graduate Division. Transcripts of record (in duplicate) must be submitted with the readmission application form for work taken subsequent to the date of last attendance on this campus. No fee is charged. Each applicant, however, is required to file a vaccination certificate.

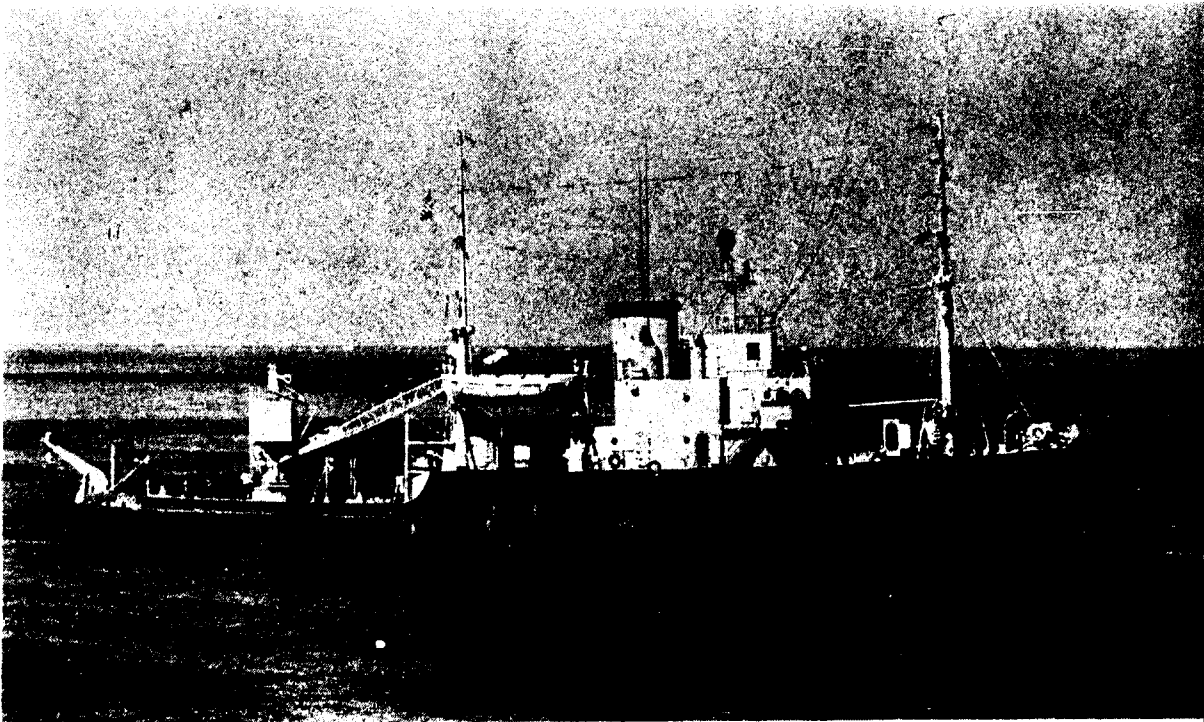
### *FOREIGN STUDENTS*

Foreign students may apply for admission in a letter addressed to the Office of Admissions, University of California, San Diego, Box 109, La Jolla, California, U.S.A. The formal application form may be filed and the application fee paid by the student upon his arrival at the University. The letter of application must be signed by the applicant and must include the following information:

1. Applicant's full legal name (using no abbreviations).
2. Address to which reply should be mailed.



3. Applicant's birth place (city and country).
4. Date of applicant's birth (month, day, year).
5. Name of country of which applicant is now a citizen.
6. Name under which applicant plans to register.
7. Subject in which applicant proposes to specialize.
8. Whether or not applicant proposes to become a candidate for a higher degree. If so, what degree.
9. Whether or not applicant has previously attended the University of California. If so, on which campus.
10. Names of all secondary schools and colleges attended by applicant, in chronological order, giving the location of each, the month and year entered, the month and year of withdrawal, the total number of years of attendance, and the degree or degrees received.
11. The estimated amount (in United States dollars) of funds available during the applicant's period of study in the United States.
12. The language the applicant first learned to speak and the language or languages which were the medium of instruction in the schools attended.
13. Semester in which the applicant would like to begin studies.



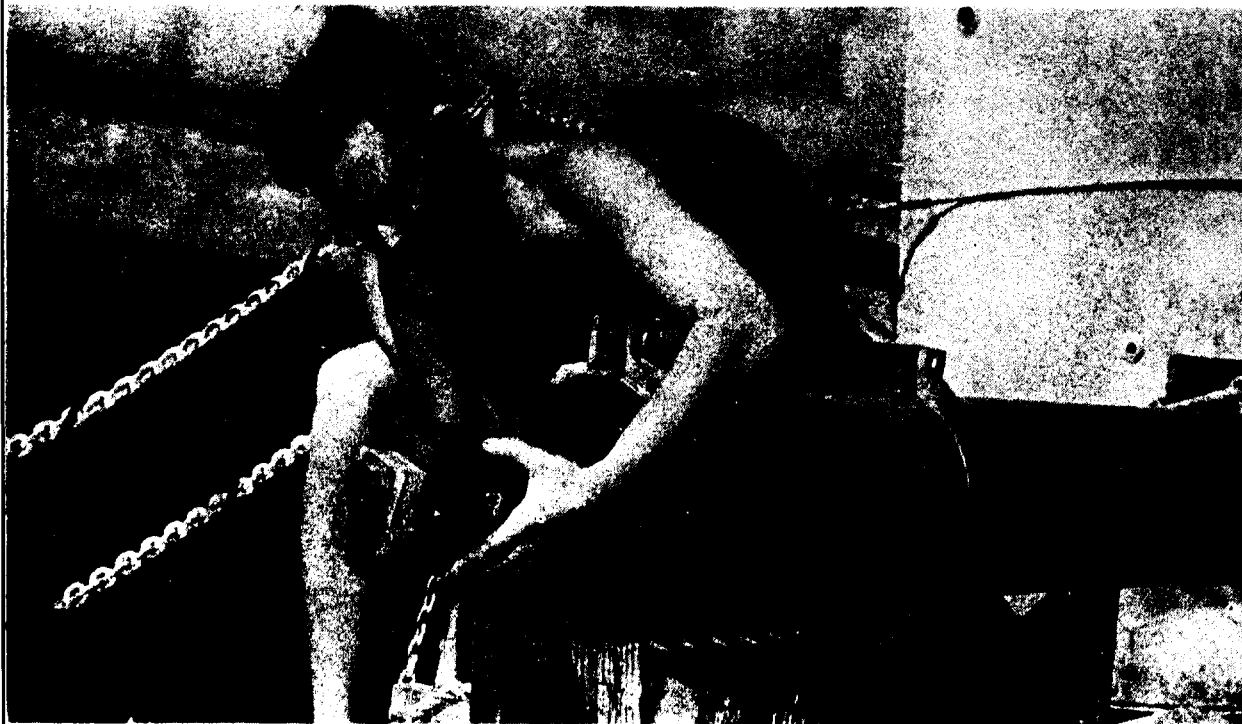
The letter of application must be accompanied by official transcripts of record in duplicate of all previous secondary school and university and college work.

Transcripts of record and all official credentials are permanently retained in the files of the Office of Admissions and are not returnable under any circumstances if the student is accepted for admission to graduate status.

At the time of his entrance physical examination each applicant must present to the Student Health Service an official certificate showing successful vaccination against smallpox. (See following section on Physical Examination.)

The letter of application and all official records must reach the Office of Admissions not later than four months before the date of registration for the semester for which the applicant is seeking admission.

Every foreign student is required to take the University's Examination in English for Foreign Students. The purpose of the examination is to determine whether the student has a sufficient command of English to enable him to profit by University work. If the applicant fails to pass the examination, he will not be allowed to register until he has completed



further work in English. The examination is given twice a year, usually on Wednesday of the week preceding registration for each semester.

Upon arrival on the campus, students from other countries shall call at the Office of the Dean of the Graduate Division to complete admissions procedures. Foreign students who need advice on visas, immigration and other related problems should confer with the Foreign Student Adviser in the Office of the Dean.

Further information will be found in a circular, *INFORMATION FOR PROSPECTIVE STUDENTS FROM OTHER COUNTRIES*. Copies of this circular will be sent upon request to the Office of Admissions.

### *PHYSICAL EXAMINATION*

Before he may register in the University, each new graduate student must appear at the Student Health Service and pass a physical examination; each re-entrant graduate student and old undergraduate student entering graduate status for the first time must report to Student Health Service for clearance of health record and recheck of certain items in the physical examination.

Each new applicant and each applicant for readmission will be given with his application a form for certification of his successful vaccination against smallpox within the last seven years. This form must be signed by a licensed physician or registered nurse and must be presented to the Student Health Service by the applicant at the time of his entrance physical examination. In lieu of such certification, vaccination may be secured at the Student Health Service at the time of taking the physical examination.

The Student Health Service provides medical and other care.

### *DEFINITION OF ACADEMIC RESIDENCE*

Every graduate student must register for, attend, and complete upper division courses (courses in the 100 series) and graduate courses (200 series), amounting to at least 4 units for each semester or 2 units for each Summer Session, in order to satisfy the minimum residence requirement in candidacy for any higher degree issued by the University. Each six- or eight-week Summer Session counts as one-half of one semester of residence.

### *STUDY-LIST LIMITS*

In order to counteract the tendency to accumulate credits by sacrificing thoroughness and the high scholarly attainment which comes only through

intense application, the University restricts the number of units in which a student may enroll.

A graduate student in a regular session is limited to 16 units when he takes only undergraduate courses, to 12 units when he takes only graduate courses, and to a total made up in the proper proportion of 12 to 16 – as for example, 6 graduate and 8 undergraduate – when he takes both undergraduate and graduate courses.

Research assistants and others employed approximately on half-time are limited to three-fourths of these totals. Students engaged full-time in other occupations are limited to 6 units of graduate and/or upper division courses.

Study lists exceeding these limits may be accepted only with the approval of the Dean of the Graduate Division.

Every graduate student is required to file with the Office of the Dean of the Graduate Division by a specified date a study list containing his program of courses which has been approved by the adviser in the department of his major subject. Study lists not signed by a departmental adviser will not be accepted. Instructions for filing registration packets and a list of graduate advisers are issued to all students at the time of registration. Changes in study lists may not be made after the tenth week of classes.

### *DISQUALIFICATION FROM GRADUATE STATUS*

A regular graduate student is normally required to maintain a grade B average in all work taken subsequent to his admission to regular graduate status, and is subject to dismissal if his grade-point average falls below that level at any time. He is also subject to dismissal if his work in any two consecutive semesters falls below a grade B average.

### *FOREIGN LANGUAGE EXAMINATIONS*

The examinations in foreign language required by all departments are conducted by an examiner under the supervision of a committee of the Graduate Council. Each examination will be in writing and will consist of three parts: (1) a preliminary screening examination to determine whether the student is reasonably prepared; (2) a translation, without the aid of a dictionary, of a passage selected from at least 50 pages of material which the student has prepared and which he has chosen with the approval of his adviser; (3) a translation, with the aid of a dictionary, of a passage selected from material recommended by the department of the

student's major. The reading examinations are graded on the basis of both quantity and quality, their purpose being to demonstrate the student's ability to read, with reasonable accuracy and speed, material which properly falls within his field of interest.

The screening examinations will be given twice each semester, on the dates announced in the Calendar. Applications for these examinations must be filed by the date announced in the Calendar. The reading examinations may be taken thereafter, by appointment with the examiner, by those who pass the screening test.

A student may be excused from taking the foreign language screening examination provided he has:

1. Completed the 1G (Graduate Reading) course in a foreign language and is recommended by the instructor as having done satisfactory work.
2. Completed two years of the language at the college level in the four-year period just prior to the petition with grades of C or better. Each student must petition and in his request must state the number, title, unit value, grade, institution, and date taken for each language course completed.
3. Presented, by petition, convincing evidence that he has in some other way acquired a substantial knowledge of the language.

Under certain conditions a foreign student whose native language is not English may offer English as a foreign language. The foreign student accorded this privilege must be in this country on a student visa and not remaining permanently but returning to his own country. The substitution must be approved by the department of the student's major, and the department must certify to the Dean of the Graduate Division that the student has a good command of written and spoken English.



MENTS FOR DEC

## THE MASTER'S DEGREE

### *Preparation*

The candidate's preliminary training for the master's degree should be substantially the equivalent of that represented by the corresponding bachelor's degree. In the University of California, the bachelor's degree indicates eight years of systematic high-school and college work distributed according to the University's requirements for the particular college or course in which the degree is offered.

In the Departments at San Diego the degree of Master of Science is offered in the fields of physics, earth sciences, marine biology, and oceanography. It is not offered in chemistry at present.

### *Application for Advancement to Candidacy*

Advancement to candidacy must occur not later than one semester prior to the completion of requirements for the degree. Students are warned that such advancement is not automatic, but requires a formal application distinct from registration. The form for advancement to candidacy is available at the Office of the Dean of the Graduate Division. A date, approximately two weeks after the opening date, is set each semester for application for candidacy by those who hope to qualify for degrees at the close of that session.

### *Amount and Distribution of Work*

At the option of the department of his major field, a student must pursue one of the two following plans for fulfillment of the requirements for the master's degree. Under either plan all requirements for the degree must be satisfied within a calendar year from the time of completion of the course requirement.

#### *Plan I: Thesis Plan*

At least 20 semester units and a thesis are required. The units must be taken in graduate or upper division undergraduate courses, and at least 8 of the 20 must be in strictly graduate work in the major subject. No unit credit is allowed for the thesis. It is expected that the work of the graduate course, or courses, together with the thesis will not be less than half of the work presented for the degree. After these general and the special departmental requirements are met, the student may take any course in the 100 or 200 series, although he is subject to his major department's guidance in

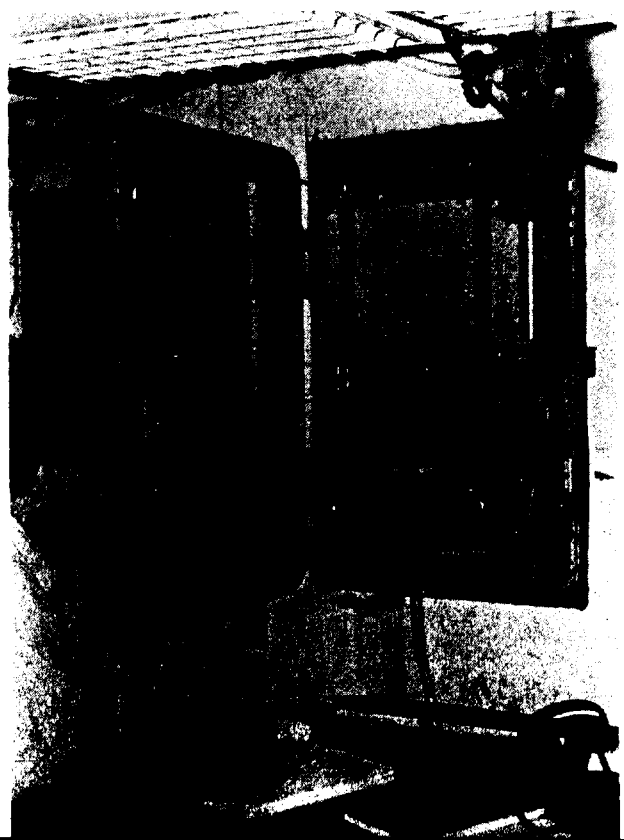
the distribution of his work among the departments. In addition, the major department may require any examination which seems necessary to test the candidate's knowledge of his field.

*Plan II: Comprehensive Examination Plan*

Twenty-four units of upper division and graduate courses are required, of which at least 12 units must be in strictly graduate courses in the major subject. After these general and the special departmental requirements are met, the student may take any course in the 100 or 200 series, although he is subject to his major department's guidance in the distribution of his work among the departments. A comprehensive final examination in the major subject, its kind and conduct to be determined by the department concerned, is taken by each candidate.

*Scholarship*

Only courses in which the student is assigned grades A, B, or C are counted in satisfaction of the requirements for the master's degree. Furthermore, the student must maintain an average of three grade points per unit in those courses and also in all others elected at any campus of the University of California subsequent to the bachelor's degree. Four grade points





for each unit of credit are given to grade A, three points to grade B, two points to grade C, one point to grade D, none to E and F.

### *Foreign Language*

A reading knowledge of one foreign language is required for the master's degree, normally French, German, or Russian. Examinations in foreign languages are conducted by an examiner under the supervision of a committee of the Graduate Council.

### *Residence*

The minimum period of academic residence required is one academic year (or two semesters), of which at least one-half must be spent at San Diego in graduate status. The requirement may be satisfied, in part, by residence on some other campuses of the University.

For degree purposes, a student is not regarded as in residence unless he is in graduate status and is actually attending regularly authorized University exercises amounting to at least 4 units of upper division or graduate work in a regular session, or 2 units in a summer session.

Ordinarily all the work for the master's degree is expected to be done in residence, but a graduate of this University or any other approved candidate may complete part of his work in absence, subject to the approval of the Graduate Council, the regulations on study in absence, and the minimum residence requirement of one year.

For regulations concerning the acceptance of graduate work completed elsewhere, credit by examination, and extension and correspondence courses, see the General Bulletin of the Graduate Division, Southern Section.

### *The Thesis*

The Librarian will check the physical format of each thesis before it is accepted and it will be the responsibility of the candidate to secure from the Librarian a memorandum of approval for submission to the Graduate Division.

The thesis must be submitted to a committee of three faculty members, one of whom must be from a department other than that of the major subject. The responsibility for placing the thesis in the hands of this committee, which is appointed by the Dean of the Graduate Division, rests with the candidate. An abstract of the thesis must be prepared separately and sub-

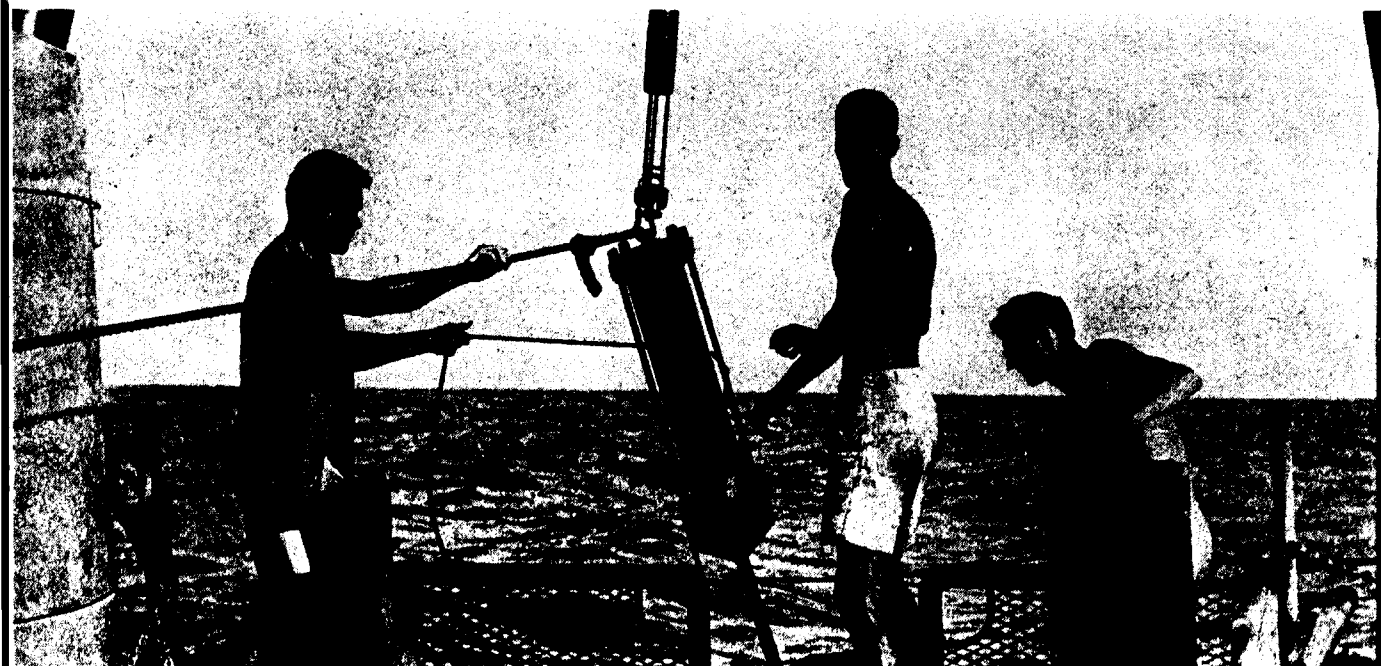
mitted with the thesis. This abstract should preferably not exceed 250 words and should be in a form suitable for publication.

After approval of the committee and the Dean of the Graduate Division, two copies of the thesis are filed with the Librarian.

### *THE DOCTOR'S DEGREE*

Students who desire to become candidates for the doctor's degree should bear in mind that the degree of Doctor of Philosophy is granted by the University of California not for the fulfillment of technical requirements alone, such as residence and the completion of fundamental courses within a chosen field, but more for the student's general grasp of the subject matter of a large field of study and his distinguished attainments within it, for his critical ability, his power to analyze problems and to coordinate and correlate the data from allied fields to serve the progress of ideas. In addition, he must demonstrate, through his dissertation, the ability to make an original contribution to the knowledge of his chosen field, and throughout his career as a graduate student must prove himself capable of working independently.

The degree of Doctor of Philosophy is offered in the fields of physics, chemistry, earth sciences, marine biology, and oceanography.



### *Preparation*

A prospective candidate for this degree must hold a bachelor's degree from one of the colleges of this University, based on a curriculum that includes the requirements for graduate status in the department of his major subject, or must have pursued successfully elsewhere an equivalent course of study.

### *Residence*

The minimum residence requirement for the doctor's degree is two academic years (or four semesters) in graduate status at the University of California, San Diego, one of which, ordinarily the second, must be spent in continuous residence. (See also Program of Study, below.)

### *Foreign Language*

Before taking the qualifying examinations for advancement to candidacy for the doctor's degree, the student must pass examinations in two foreign languages acceptable to the department of his major and the Dean of the Graduate Division. The examinations must show that he is able to read and understand the written form of these languages. These examinations are conducted by an examiner under the supervision of a committee of the Graduate Council. A student's native language will not count as satisfying one of the language requirements above.

### *Program of Study*

The student's program of study must be approved by the Graduate Council, must embrace a field of investigation previously approved by his department and must extend over the full period of study. However, recommendation for the degree is based on the attainments of the candidate rather than duration of his study, and ordinarily not less than three full years will be needed to finish the work. Departmental requirements for the degree will be found under DEPARTMENTAL ANNOUNCEMENTS.

### *Notice of Candidacy*

As early as possible, preferably at the end of the first semester of graduate study, the student should declare his intention of proceeding to candidacy for the doctor's degree. Statement of such intention should be made in duplicate, on Form 1, which is available at the Office of the Dean of the Graduate Division. One copy of the form should be filed with the department of the student's field of study, the other with the Dean.

### *Guidance Committees*

On receiving such notification, or earlier, an informal guidance committee will be appointed by the department of the student's field of study to assist the student in making out his program and in preparing him for the qualifying examinations. This committee must give its written approval to the department before the student is permitted to take these examinations and it ceases to exist as soon as he has passed the qualifying examinations.

### *Doctoral Committees*

Upon nomination of the department or interdepartment group of the student's field of study, a doctoral committee will be appointed by the Graduate Council. Nomination of the doctoral committee shall be made on Form 2, which is available at the Office of the Dean of the Graduate Division. This committee shall consist of not fewer than five members, three of whom shall be from the department of the candidate's major (one of whom shall be the principal director of the candidate's research) and two from a department or departments other than the major. The doctoral committee conducts the qualifying oral examination (in some cases also the written examinations), approves the dissertation, and conducts the final oral examination.

### *Qualifying Examinations*

Before he is admitted to candidacy, the student must pass a series of qualifying examinations, both written and oral. The written examinations may be administered by the department of the student's field of study, but the oral examination must be conducted by his doctoral committee. The qualifying oral examination is never open to the public. The report on the qualifying examinations should be made on Form 3, and must be signed by all members of the doctoral committee.

### *Advancement to Candidacy*

Upon receipt of the report on the qualifying examinations, an application form for advancement to candidacy, Form 4, will be sent to the candidate. The candidate must file his application, properly approved by the chairman of his doctoral committee, and must report in person to the Dean of the Graduate Division, who determines whether all formal requirements have been met.

A minimum period of resident study approximately equivalent to two semesters must intervene between the date of formal advancement to candidacy and the date of the final examination. The semester in which a student is advanced to candidacy will be counted as a full semester for the purpose of the residence requirement, provided advancement to candidacy occurs at or before mid-term and the student is registered for 4 or more units.

### *The Dissertation*

A dissertation on a subject chosen by the candidate and approved by his doctoral committee, bearing on his principal study and showing his ability to make independent investigation, is required of every candidate for the degree. In its preparation the candidate is guided by his doctoral committee, which also passes on the merits of the completed dissertation. The approval of this committee, as well as that of the Graduate Council, is required before he is recommended for the degree. Special emphasis is laid on this requirement. The degree is never given merely for the faithful completion of a course of study, however extensive.

The Librarian will check the physical format of each dissertation, and it will be the responsibility of the candidate to secure from the Librarian a memorandum of approval to submit to the Graduate Division. Instructions for the preparation and submission of theses may be obtained from the Office of the Dean of the Graduate Division.

The dissertation must be approved by the Dean of the Graduate Division two weeks before the proposed date of the final examination, for deposition in the University Library.

### *Final Examination*

The candidate's final examination is conducted by his doctoral committee. The examination is oral and deals primarily with the relations of the dissertation to the general field in which its subject lies. Admission to the final examination may be restricted to committee members, members of the Academic Senate, and guests of equivalent academic rank from other institutions. The report on the final examination should be made on Form 5, and must be signed by all members of the doctoral committee.



*FEES AND LIVING ACCOMMODATIONS*

## FEES

### *Application Fee*

A fee of \$5 must accompany each application for admission to the Graduate Division. This application fee is never returnable, even though the student does not enroll.

### *Tuition Fee*

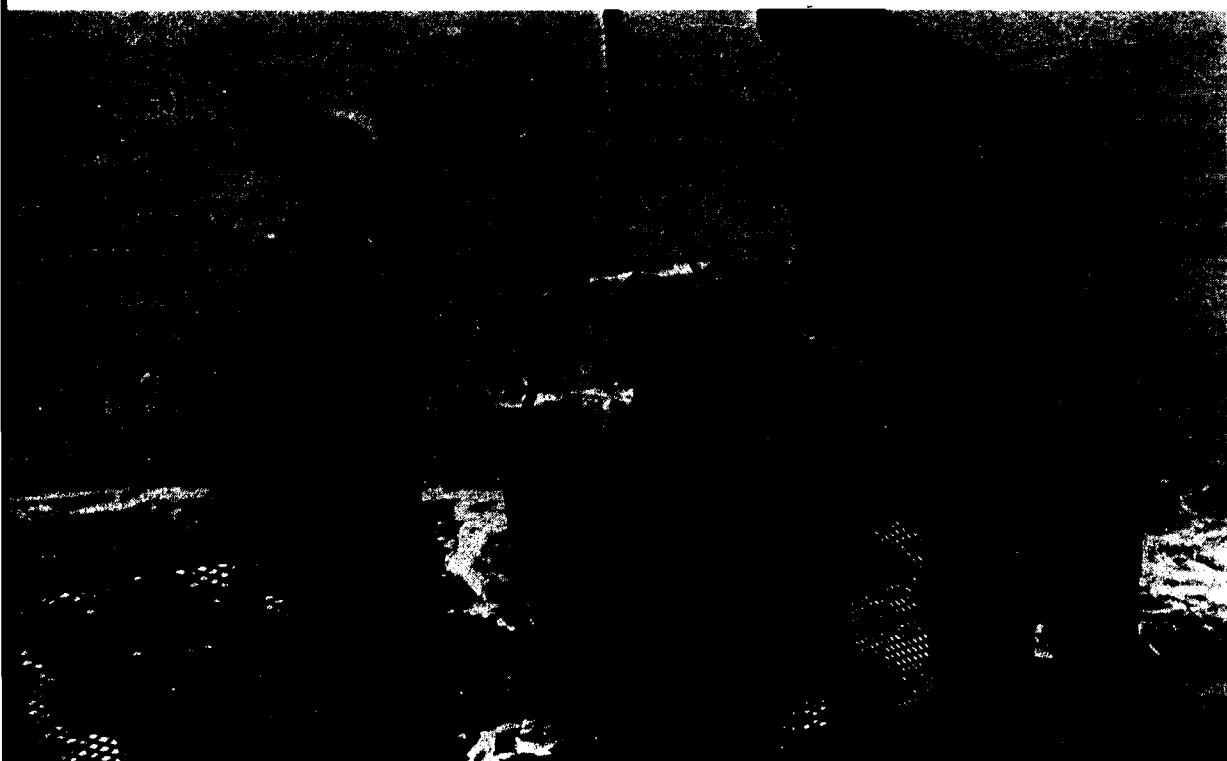
Tuition at the University of California is free to students who are classified as legal residents of the State. Upon notification of acceptance to the Graduate Division, preclassification as to residence status will be determined. However, final decisions on residence status will be made by the Attorney for The Regents in Residence Matters. All nonresidents of California, including resident aliens who have not made valid declaration of intentions to become citizens, are charged a tuition fee of \$250 a semester. Exceptions will be limited to students who are unable to devote more than half-time to academic study (1) for reasons of health as certified by the Student Health Service, or (2) for reason of full-time employment in salaried positions as certified by a statement from the employer. Where exceptions are made on the foregoing basis, the student's program will be limited to 6 units of course work, and the nonresident tuition fee will be \$125 a semester. Petition for half fee based on the above criteria must be submitted to the Office of the Dean of the Graduate Division before registration; otherwise, all students are presumed to be full-time students, irrespective of the number of units for which they are enrolled.

In exceptional cases, the tuition fee may be remitted, in whole or in part, for students in graduate status who have distinguished scholarship records and are carrying full programs of work toward higher degrees. Irrespective of how distinguished his scholarship may have been, a graduate student will not be exempted from payment of the tuition fee if he is making up subject deficiencies in his undergraduate preparation. Foreign students whose tuitions are paid by their governments are in no case eligible for remission of the nonresident fee.

The term *distinguished scholarship* in connection with the question of exemption from the payment of the tuition fee will be interpreted as follows: The scholarship standing must have been excellent throughout a period of no less than two years just preceding the time of application for

this privilege. Moreover, only students from institutions of high standing in scholarly work will be considered. Applicants for this privilege will be required to have sent to the Dean of the Graduate Division confidential letters about themselves from persons who are thoroughly acquainted with their personalities and their intellectual achievements. It should be clear from these statements, therefore, that only the decidedly exceptional student will be eligible for the privilege of exemption from the payment of tuition if he is a nonresident. Students exempted from the tuition fee pay only the incidental fee. Petitions for exemption from the nonresident tuition fee must be filed with the Dean of the Graduate Division before registration. The privilege of exemption from the nonresident tuition fee may be revoked at any time at the discretion of the Dean of the Graduate Division if in his judgment a student fails to maintain distinguished scholarship, or if he proves himself unworthy in other respects. Exemption will be granted for only one semester in advance. Students seeking exemption from this fee will be required to file a separate petition for each semester that they are classified as nonresidents.

The tuition fee for Government Contract Students is \$250 a semester.





*Incidental Fee*

The incidental fee for all undergraduate and graduate students is \$60. If a student withdraws from the University within the first five weeks from the date of his registration, a part of the fee will be refunded.

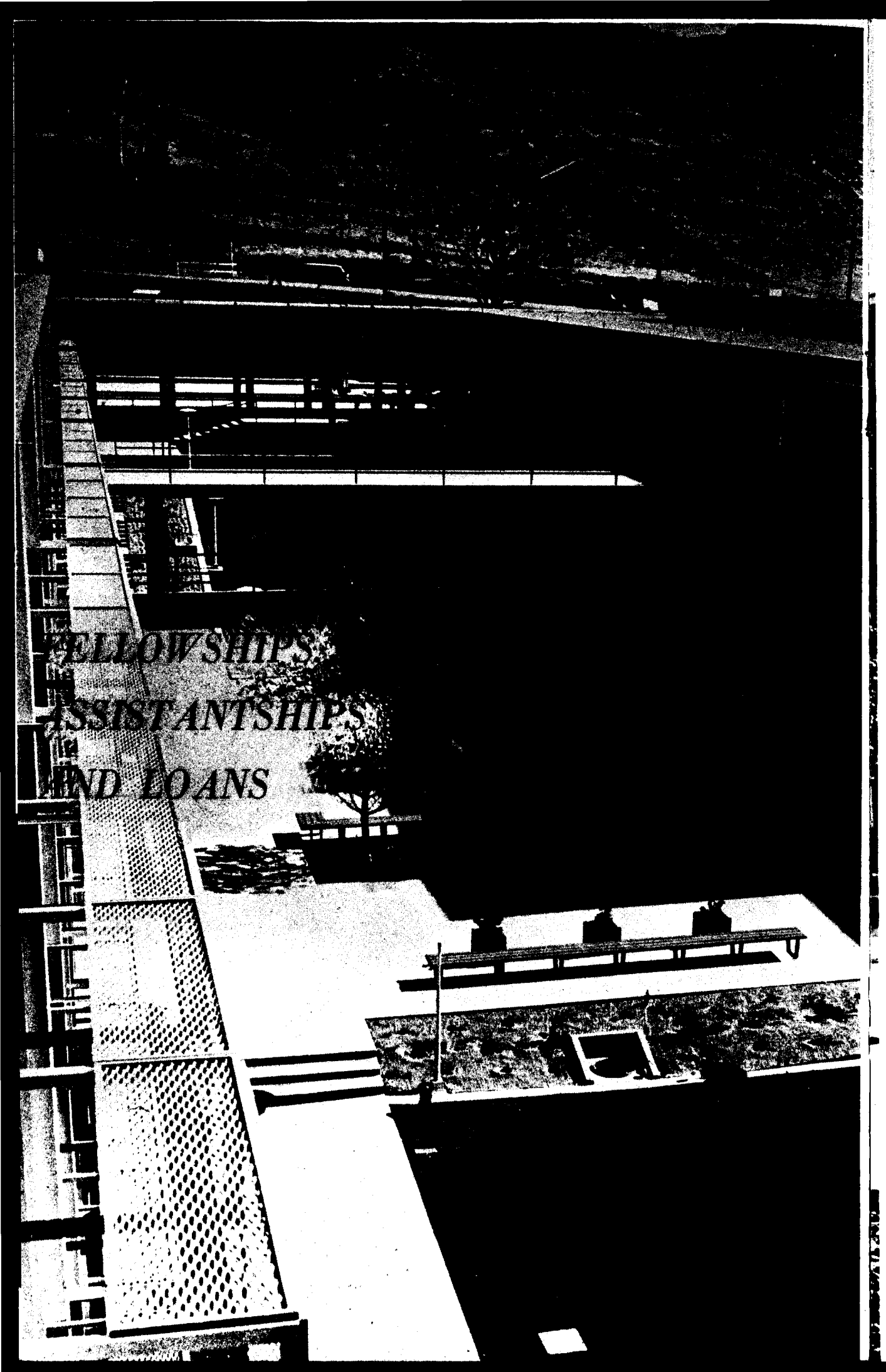
*Candidacy Fee*

Each applicant for advancement to candidacy for a doctor's degree must pay a fee of \$10 before such advancement may be granted.

**LIVING ACCOMMODATIONS**

At the present time there are no living accommodations for students on this campus, but it is expected that some may be available within the next few years. Meantime, students will find suitable accommodations in the form of rooms, apartments, or houses in the nearby communities of La Jolla, Pacific Beach or Del Mar. A Housing Office is maintained on the campus to help in this regard.





FELLOWSHIPS  
ASSISTANTSHIPS  
AND LOANS

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## FELLOWSHIPS

Graduate Fellowships are available in certain departments and will be announced from time to time.

Among these are the Sverdrup Fellowships in Oceanography. Predoctoral Sverdrup Fellowships are available to graduate students who wish to prepare themselves for careers of teaching or research in oceanography. The fellowships will carry a stipend of \$3,000 per year (including the summer months), plus required fees. Loan funds under liberal conditions, in addition to these amounts, are also available to Fellows.

Sverdrup Fellowships are on a one-year basis, but are renewable, and applicants should plan to be candidates for the doctor's degree. Applicants should have an undergraduate major in physics, chemistry, geology, one of the biological sciences, or in mathematics. Fellows may plan to specialize in any of the oceanographic sciences, including physical oceanography, submarine geology, marine chemistry, and biological oceanography.

These fellowships are designated as the Harald Ulrik Sverdrup Fellowships in memory of the third Director of the Scripps Institution, and are supported by a grant to the University by the Ford Foundation.

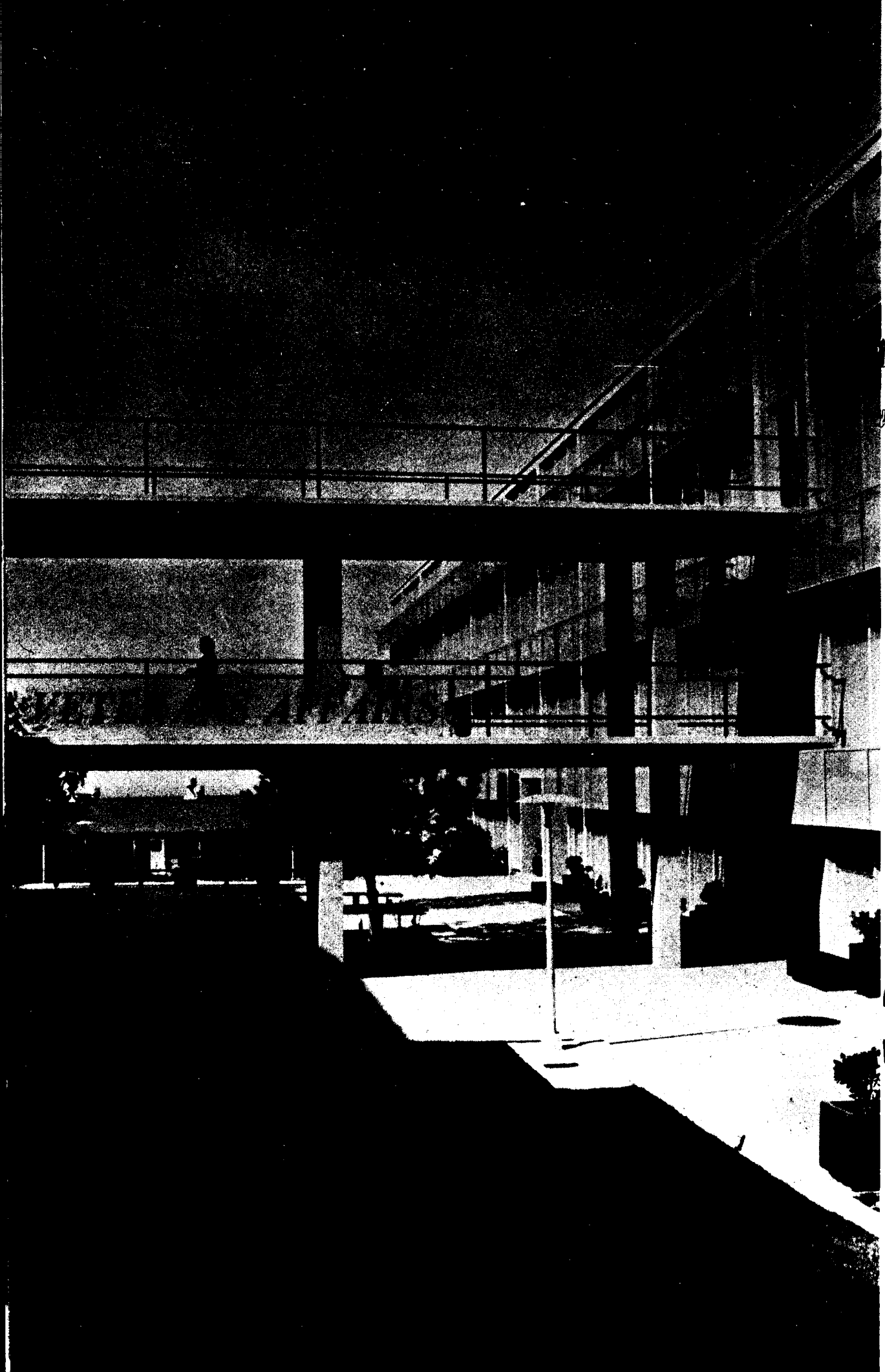
All departments on the campus encourage applications for postdoctoral appointments. Opportunities for such appointments vary from time to time. Among others are the Sverdrup Postdoctoral Fellowships in Oceanography. Postdoctoral Sverdrup Fellowships are available for oceanographic research in physical, chemical, biological oceanography, marine geology, and marine geophysics. They will carry a stipend of \$6,000 per year, including the summer months, and are renewable for a second year.

## RESEARCH ASSISTANTSHIPS

There are a limited number of Research Assistantships for properly qualified students, with stipends beginning at \$2,007 a year for half-time service to an individual or a department. An assistant must be in regular graduate status, in full-time residence, and in good scholarship standing. Application may be made to the Office of Admissions but does not constitute an application for admission, which is a separate process.

## LOANS

A limited amount of assistance in the form of loans is available to students, either on a short- or long-term basis. Applications may be made to the Office of the Dean of the Graduate Division.

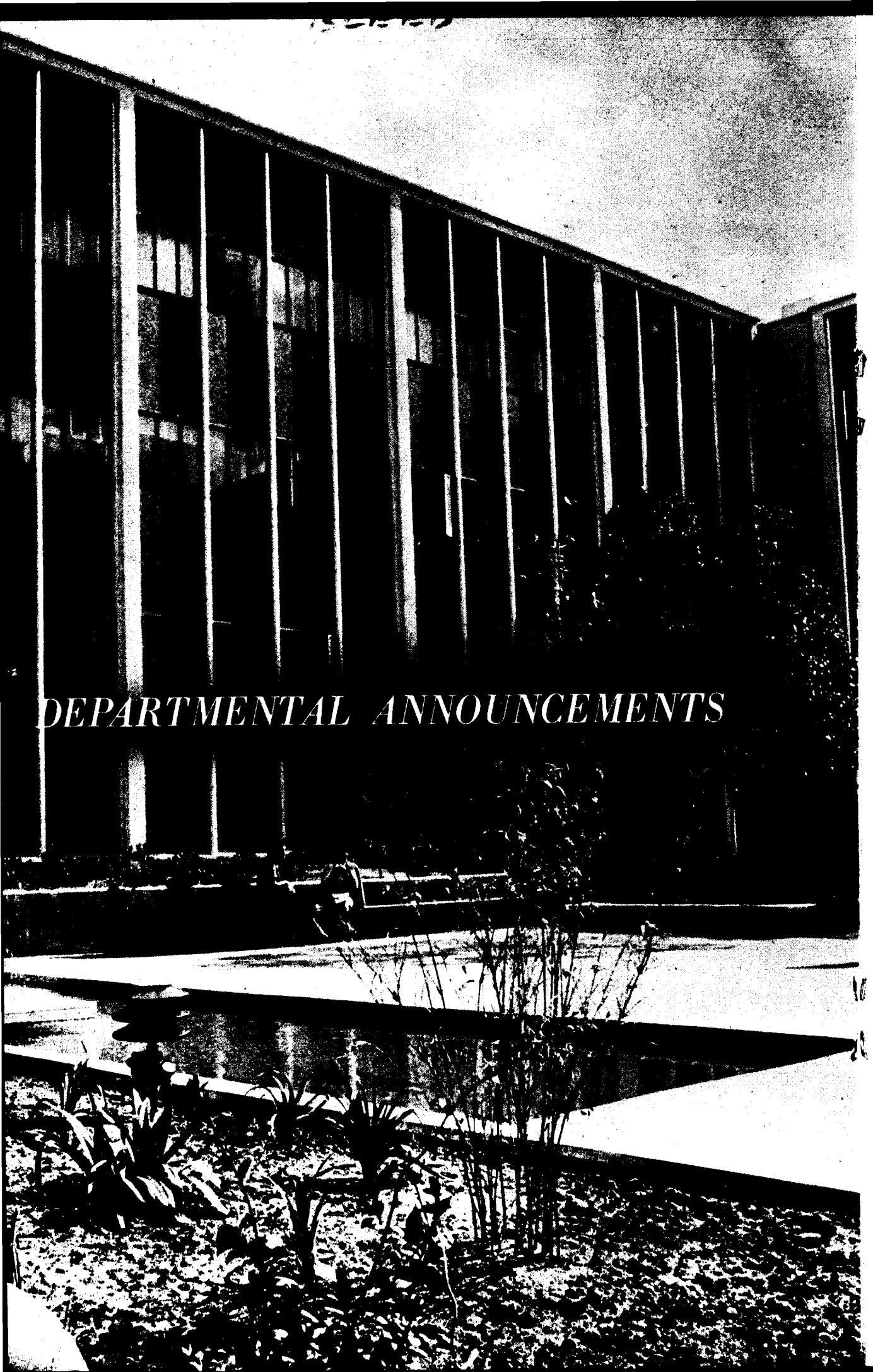


Information regarding educational benefits available from the State of California (CVEI) may be obtained from the State Department of Veterans Affairs, P. O. Box 1559, Sacramento 7, California; or by writing either to Room 225, 542 South Broadway, Los Angeles 13, California, or 515 Van Ness Avenue, San Francisco 2, California.

Veterans wishing to enroll under the provisions of Public Law 550 (Korean G. I. Bill) and students wishing to enroll under the provisions of Public Law 634 (War Orphans Education Act) should obtain from the United States Veterans Administration a Certificate for Education and Training, which should be filed with the Office of the Dean. These veterans must be prepared to pay all fees and educational costs at the time of registration as education and training allowances are paid the veterans by the Veterans Administration and the first monthly payment will normally be received 60 to 75 days after enrollment in the institution.

Information on Selective Service and draft status may be had from the Office of the Dean of the Graduate Division.





*DEPARTMENTAL ANNOUNCEMENTS*

## ABBREVIATIONS

In the following announcements, the credit value of each course in semester units is indicated by a number in parentheses after the title. A unit of registration is one hour of the student's time at the University, weekly, during one semester, in lecture or recitation, together with the time necessary in preparation therefor; or a longer time in laboratory or other exercises not requiring preparation. The session in which the course is given is shown by Roman numerals: I for the fall semester, and II for the spring semester. A course given throughout the period September to June is designated Yr. The assignment of hours is made in the Schedule of Classes to be obtained at the time of registration.

A course designated by a double number (for example, Chemistry 110A-110B) is continued through two successive semesters, ordinarily beginning in the fall semester. Each half of the course constitutes a semester's work. The first half is prerequisite to the second unless there is an explicit statement to the contrary. The instructor makes a final report on the student's work at the end of each semester. Unless otherwise noted, the student may take the first half only and receive final credit for it.

## CHEMISTRY

### *Instructional Staff*

James R. Arnold, Ph.D., Professor of Chemistry (Chairman of the Department)

Martin D. Kamen, Ph.D., Professor of Biochemistry

Joseph E. Mayer, Ph.D., Professor of Chemistry

Hans E. Suess, Ph.D., Professor of Geochemistry

Harold C. Urey, Ph.D., Professor of Chemistry-at-Large, University of California

Bruno H. Zimm, Ph.D., Professor of Chemistry

Stanley L. Miller, Ph.D., Assistant Professor of Chemistry

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E. D. Goldberg, Ph.D., Professor of Chemistry

Harmon Craig, Ph.D., Associate Professor of Geochemistry

In addition to the above listing, it is expected that the department will make one additional appointment in organic chemistry and one in biochemistry before September 1961.

The department intends at first to accept only students who wish to seek the Ph.D. The program is designed to encourage initiative on the part of the student and to develop habits of independent study. Courses in the department will be handled largely by the tutorial system, with encouragement to the student to concentrate on one or two subjects at a time under the guidance of a faculty member. Formal lectures will be kept to a minimum. Research will be started early, toward the end of the first semester in the case of a student with normal preparation. The qualifying examination for admission to candidacy will require the student to present and discuss propositions that he has prepared independently.

In order that he may participate effectively in this program, the entering graduate student will be required to have a mastery of the subjects usually presented in an undergraduate chemistry curriculum: physical, organic, analytical, and inorganic (descriptive) chemistry. Physical chemists will be expected to present the equivalent of two years of physics and of mathematics through integral calculus. The appropriate background courses in biology or geology are highly desirable for students interested in biochemistry and geochemistry, respectively, but will sometimes be taken after arrival. So that the student may be properly advised, his mastery of these undergraduate subjects will be tested by oral or written examination on his arrival.

Two foreign languages (German and either French or Russian) are required.

In the first year the student will usually take several of the courses listed below. Depending on his special interests, he may also take one or more courses in other departments. In the second year he will usually carry a very light load of formal courses, but will continue to participate in seminars and informal study groups.

The qualifying examination, so far as departmental requirements are concerned, will follow the system in use in the Department of Chemistry at Berkeley.

The candidate will present two propositions, which are to be designated as major and minor, respectively, and be prepared to discuss and defend them.

- (a) The major proposition should consist of a statement of an original research problem or scientific idea not closely connected with his doctoral thesis. He should be prepared, in the examination, to discuss the theory and the experimental techniques that may be



involved, the significance of the proposition, and its relation to previous knowledge.

- (b) The minor proposition may be similar to the major one, or it may consist of a critical survey of literature in some field of chemistry outside the field of his main interest. The purpose of this prescription is to reveal the ability of the candidate to make a critical survey and an effective, orderly presentation and also to provide him with a further incentive to broaden his understanding of chemistry.

In special circumstances the doctoral committee may modify the examination at its discretion.

According to present plans the courses to be offered by the department are as follows:

#### UPPER DIVISION COURSES

110A-110B. *Physical Chemistry* (3) Yr. *Mr. Urey and the Staff*

#### GRADUATE COURSES

201. *Chemical Thermodynamics* (3) Yr. *Mr. Arnold, Mr. Mayer,  
Mr. Urey, Mr. Zimm*

202. *Molecular Quantum Mechanics* (3) Yr. *Mr. Arnold, Mr. Mayer,  
Mr. Zimm*

203. *Statistical Mechanics of Chemical  
Systems* (3) Yr. *Mr. Mayer, Mr. Zimm*

210. *Molecular Structure* (3) Yr. *Mr. Arnold, Mr. Mayer, Mr. Urey*  
Valence theory, molecular spectra, chemical binding in solids.

221. *Physical Organic Chemistry* (3) I. *Instructor to be appointed*

232. *Special Topics in  
Physical Chemistry* (2) I, II. *Instructors to be arranged*

This course will be given from time to time by visiting or regular members of the staff on topics of special interest.

241. *Enzymes and Intermediary  
Metabolism* (3) I. *Mr. Kamen, Mr. Miller,  
and the Staff*

242. *Advanced Topics  
in Biochemistry* (2) II. *Mr. Kamen, Mr. Miller,  
and the Staff*

250. *Seminar in Chemistry* (1-4) I, II. *The Staff*

Regularly scheduled seminars will be the medium by which students are

acquainted with those important subjects that are too specialized for general courses in a small department, *e.g.*, macromolecules, chemical kinetics, advanced inorganic chemistry, nuclear chemistry, molecular spectroscopy.

299. *Research in Chemistry* (1-6) I, II. *The Staff*

Research interests of the present faculty are listed briefly below:

Arnold: Cosmic-ray produced radioactivity, meteorites, geochronology, valence theory.

Kamen: Application of biophysical chemical methods, including isotopic tracer methodology, to study of bacterial metabolism; energy storage, especially in photosynthesis.

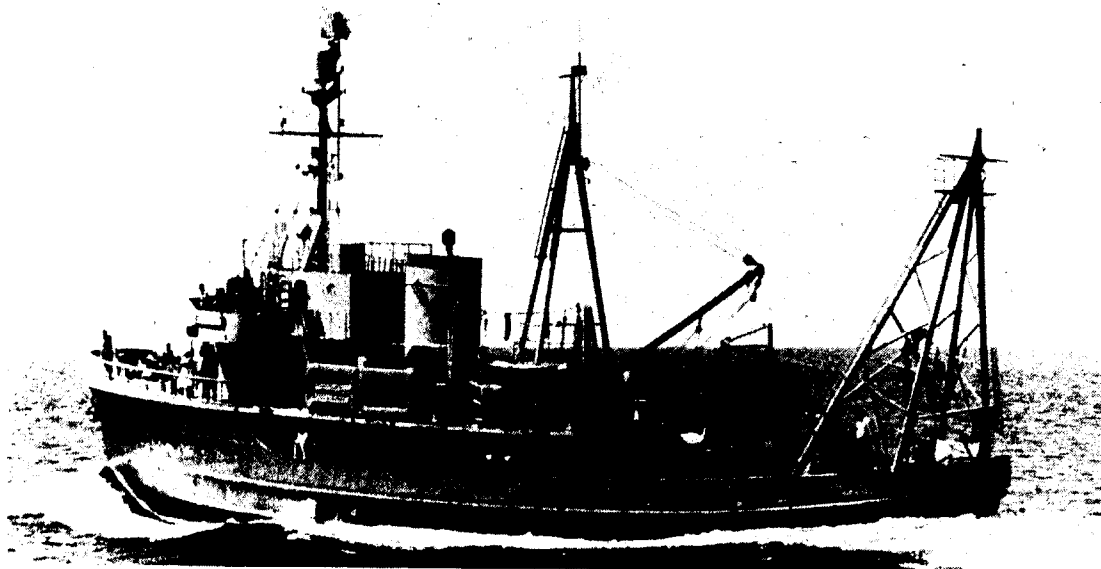
Mayer: Statistical mechanics, quantum statistics and quantum mechanics of molecules and fluids.

Miller: Synthesis of organic compounds under geologically primitive conditions, active transport in biological systems, mechanism of enzyme action.

Suess: Abundance of the elements, geochemical studies using natural and man-made radioactivity, activation analysis,  $C^{14}$  dating.

Urey: Origin of the elements and the solar system, meteorites, stable isotopes in nature.

Zimm: Experimental and theoretical physical chemistry of biological macromolecules and high polymers, statistical mechanics.



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### *Related Areas of Study*

The interdisciplinary tradition is strong at San Diego and is already well established in chemistry. It is expected that the biochemistry faculty and student body will develop close ties with the developing biology group under the leadership of Dr. David Bonner. The two departments will share a floor of Sverdrup Hall temporarily.

Three members of the chemistry faculty are strongly interested in the Earth Sciences Department. In addition to Harmon Craig and E. D. Goldberg, who are associate members of the Chemistry Department in a reciprocal arrangement, other earth scientists, for instance G. O. S. Arrhenius and A. E. J. Engel, have common research interests. The ties with oceanography, through marine chemistry and tracer studies of ocean circulation and sedimentation, are also strong. The facilities of the Scripps Institution for marine research are available to all qualified persons in the School of Science and Engineering.

Joint student programs with the Department of Physics, especially in the areas of solid state and nuclear research, will be developed as needed. This and the other collaborative programs described above will be carried on with a minimum of formal organization.



## EARTH SCIENCES

### *Instructional Staff*

Gustaf O. S. Arrhenius, D.Sc., Professor of Marine Geology

Milton N. Bramlette, Ph.D., Professor of Geology

Albert E. J. Engel, Ph.D., Professor of Geology

Edward D. Goldberg, Ph.D., Professor of Chemistry (Chairman of the Department)

Walter H. Munk, Ph.D., Professor of Geophysics

Russell W. Raitt, Ph.D., Professor of Geophysics

Roger Revelle, Ph.D., Sc.D., Professor of Oceanography

Victor Vacquier, M.A., Research Geophysicist

George E. Backus, Ph.D., Associate Professor of Geophysics

Harmon Craig, Ph.D., Associate Professor of Geochemistry

Henry W. Menard, Ph.D., Associate Professor of Geology

Richard A. Haubrich, Ph.D., Visiting Assistant Professor of Geophysics

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James R. Arnold, Ph.D., Professor of Chemistry

Hans E. Suess, Ph.D., Professor of Geochemistry

Harold C. Urey, Ph.D., Sc.D., Professor of Chemistry-at-Large

The Department of Earth Sciences offers a graduate curriculum leading to the M.S. and the Ph.D. in Earth Sciences. The program of study emphasizes the application of the analytical, experimental, and theoretical methods of physics and chemistry to fundamental problems in the terrestrial, marine, and atmospheric sciences.

### *Requirements for Admission*

A baccalaureate major in one of the physical or earth sciences, or mathematics, or engineering. The student's preparation should include:

1. General physics, equivalent to Physics 1A, 1B, 1C, 1D on the Los Angeles campus. Physics courses designed specifically for medical, biological, or agricultural students will normally not be acceptable for this requirement.

2. Two years of chemistry, including physical chemistry (advanced physics may be substituted for one year of chemistry).

3. Mathematics through differential and integral calculus. (Students intending to specialize in geophysics should also have had differential equations.)

*Requirements for the Master's Degree*

The Master of Science degree will be offered under Plan II (Comprehensive Examination) according to the general rules of the Graduate Division. All programs must include the basic curriculum of courses described under the doctoral program, and a reading knowledge of either French, German, or Russian is required.

*Requirements for the Doctor's Degree*

The curriculum for the Ph.D. is divided into two parts:

(1) A sequence of courses, the basic curriculum, intended to prepare the student for the qualifying examination for admission to candidacy for the degree. The basic curriculum includes the following courses:

- |     |                         |        |              |
|-----|-------------------------|--------|--------------|
| 120 | Mineralogy              | 215    | Tectonics    |
| 121 | Petrology               | 230A-B | Geochemistry |
| 125 | Mathematical Techniques | 240A-B | Geophysics   |
| 246 | Summer Field Course     |        |              |

Oceanography 110 – Introduction to Physical Oceanography

By the end of the second fall semester in residence the student will normally have completed the basic curriculum and one or more elective courses. If at this point he has passed reading examinations in two foreign languages (German, French, or Russian), he should be ready to take the



qualifying examination for the Ph.D. This examination will emphasize the student's ability to integrate the material covered in the above courses with his knowledge of the physical sciences for the analysis of general problems in the earth sciences. A written examination may be administered by the department; in all cases, an oral examination will be conducted by the student's doctoral committee.

(2) The remainder of the curriculum consists of advanced or specialized courses in the general options of geology, geophysics, or geochemistry, together with advanced graduate courses in physics, chemistry, or other departments, depending upon the student's area of specialization.

### *Advanced Work for the Doctor's Degree*

Advanced study and research for the doctoral thesis may be done in theoretical or experimental geophysics and geochemistry, marine and terrestrial geology, or other specialized areas of the earth sciences. Students specializing in geochemistry or geophysics will normally take some advanced courses in physics and chemistry as well as some of the departmental option courses. Other courses available are listed in the Oceanography curriculum.

#### UPPER DIVISION COURSES

120. *Mineralogy* (3) I. *Mr. Arrhenius*

Prerequisite: consent of the instructor.

Lectures and laboratory work in crystallography, X-ray, and optical mineralogy.

121. *Petrology* (3) II. *Mr. Engel*

Prerequisites: courses 120, 125, 215.

Petrology of igneous, metamorphic, and sedimentary rocks.

125. *Mathematical Techniques* (3) I. *Mr. Haubrich*

Prerequisites: differential and integral calculus.

Ordinary and partial differential equations, complex variables, vectors and tensors, Fourier and infinite series, etc., with applications to the earth sciences.

130A-130B. *Topics in Geology* (2-2) I, II. *Mr. Engel, Mr. Arrhenius*

Reading course, with preparation of written reports, dealing with basic subjects and problems in the earth sciences.

133. *Instrumental Geochemistry* (3) I. Mr. Goldberg and the Staff

Prerequisites: physical chemistry and consent of the instructor.

Lectures and laboratory work on instrumental methods with applications to geochemistry.

199. *Special Studies in Earth Sciences* (1-4) I, II. The Staff

Prerequisite: consent of the instructor.

GRADUATE COURSES

215. *Tectonics* (3) I. Mr. Menard

Prerequisite: consent of the instructor.

The large-scale structural and morphological features of the earth, crustal deformation, mountain building, permanency of continents, etc.

230A. *Geochemistry* (3) II. Mr. Goldberg

Prerequisites: physical chemistry, courses 120, 125, and Oceanography 110.

Chemistry of the lithosphere, atmosphere, and oceans; the geochemical balance; marine chemistry, geochemical cycles of major and minor elements; geochronology.

230B. *Geochemistry* (3) I. Mr. Craig

Prerequisite: course 230A.

Chemical and phase equilibria of geological importance; applications of thermodynamics to general problems in the earth sciences; geochemistry of stable and radioactive isotopes; mixing and exchange phenomena, etc.

231. *Nuclear Geochemistry* (3) II. Mr. Suess

Prerequisite: physical chemistry or atomic physics.

Radioactive and stable isotopes; stability of nuclei; radioactive decay schemes; natural radioactivities and geological applications; origin and relative abundances of the elements; fission elements and extinct natural radioactivities.

240A-240B. *Geophysics* (4-4) II, I. Mr. Raitt, Mr. Munk,  
Mr. Vacquier

Prerequisites: General physics; course 125 and Oceanography 110.

Elastic wave propagation in the ocean, the solid earth, and the atmosphere; gravity, earth magnetism; tides, and other topics in geophysics. Sequence begins in spring semester.

246. *Summer Field Course* (4) Summer Session. *Mr. Engel, Mr. Menard*

Prerequisite: consent of the instructor.

Geological mapping of land areas, and reconnaissance mapping and geophysical studies of adjacent areas of the continental shelf and slope. Field parties operate from ships, boats, and camps ashore for a period of four to six weeks. A report is prepared summarizing field studies.

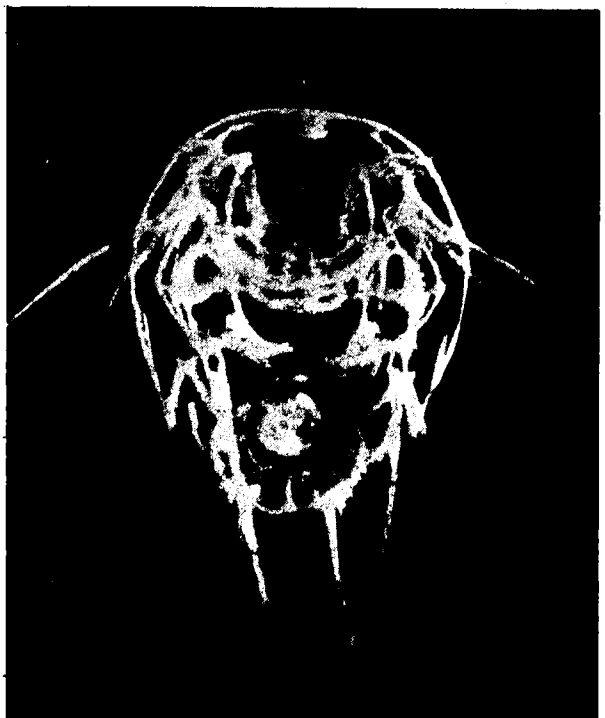
253. *Seminar in Geochemistry* (2) II. *Mr. Arrhenius and the Staff*

Prerequisite: consent of the instructor.

Oral and written reports on important topics in geochemistry. Subjects include: mineral chemistry; geochemistry of specific elements; chemical and phase equilibria; geochronology; geochemical cycles; nuclear geochemistry.

299. *Research* (1-6) I, II.

*The Staff*





LANGUAGES

*Instructional Staff*

John A. Dandliker, M.A., Lecturer in French  
 Mary J. Jennings, M.A., Lecturer in English  
 Richard H. Lawson, Ph.D., Lecturer in German  
 Leonard N. Messier, Ph.D., Lecturer in French  
 Guerard Piffard, Ph.D., Lecturer in French  
 Ernest M. Wolf, Ph.D., Lecturer in German

These courses are open to all registered students, and to certain others by permission of the instructor and the Dean of the Graduate Division. The courses in French and German are intended to prepare students for the foreign language examinations. The course in English is required of all foreign students whose grades on the entrance examination in English are unsatisfactory, and is open, by special permission, to others who wish to improve their spoken or written English.

German 1G. *Reading Course* Mr. Lawson, Mr. Wolf  
 for Graduate Students (no credit) I, II.  
 French 1G. *Reading Course* Mr. Messier, Mr. Piffard  
 for Graduate Students (no credit) I, II.  
 English 33A-33B. *English for Foreigners* (4) I, II. Miss Jennings

MARINE BIOLOGY

*Instructional Staff*

Denis L. Fox, Ph.D., Professor of Marine Biochemistry  
 Carl L. Hubbs, Ph.D., Professor of Biology  
 Per F. Scholander, M.D., Ph.D., Professor of Physiology  
 Benjamin E. Volcani, Ph.D., Professor of Microbiology  
 Claude E. ZoBell, Ph.D., Professor of Marine Microbiology  
 Francis T. Haxo, Ph.D., Associate Professor of Biology (Chairman of the  
 Division)  
 Ralph A. Lewin, Ph.D., Associate Professor of Biology  
 Beatrice M. Sweeney, Ph.D., Associate Research Biologist  
 William L. Belser, Ph.D., Assistant Research Biologist  
 Galen E. Jones, Ph.D., Assistant Research Microbiologist  
 \* \* \*  
 Martin W. Johnson, Ph.D., Professor of Marine Biology  
 Edward W. Fager, Ph.D., D. Phil., Associate Professor of Biology

The Division of Marine Biology offers a program of studies leading to the M.S. or Ph.D. in Marine Biology, emphasizing descriptive and experimental biology of marine organisms. These studies presently include systematics and life histories, genetics and evolution, microbiology, cellular and comparative physiology and biochemistry, physiological ecology and environmental biology.

Students intending to specialize in marine biology should be broadly oriented toward biology but with training in at least one specific discipline, *e.g.*, microbiology, animal or plant physiology, biochemistry, invertebrate or vertebrate zoology. Students in marine biology at San Diego are encouraged to supplement their training by course offerings in other departments of this campus, *e.g.*, oceanography, other teaching units in the biological sciences, the earth sciences and chemistry. Qualified students in marine biology may, with the approval of both departments concerned, pursue their research under the joint guidance of a member of the Division and a faculty member of another department.

Provisions are also made for certain students to pursue work toward the Ph.D. in botany, microbiology, or zoology under the supervision of UCLA faculty members in cooperation with marine biology faculty members at San Diego. Arrangements may be made for properly qualified students working under faculty members at Berkeley or other branches of the University of California to complete part of the requirements for an advanced degree at San Diego.

#### *Requirements for Admission to the Graduate Curriculum*

1. A baccalaureate degree major in one of the biological sciences or the substantial equivalent, and including:
2. Two semesters in each of the following: English, mathematics, and physics with appropriate laboratory.
3. At least 12 semester units of chemistry, including organic chemistry. Biochemistry and physical chemistry are recommended especially for students in experimental biology.
4. At least 20 semester units of biology, including basic courses in both botany and zoology.
5. Preparation is recommended in two foreign languages (one is required for the M.S. degree), chosen from the following: German, Russian, French.

### *Requirements for the Master of Science in Marine Biology*

Offered on either Plan I (20 units and thesis) or Plan II (24 units and comprehensive examination). Unit requirements may be satisfied by approved selections from courses listed in either marine biology, oceanography, or other departments, but must include Oceanography 110, 112, and 113 and a total of 12 units of graduate courses, including 2 to 4 units in a seminar course (Biology 252 or Oceanography 253). A reading knowledge of German, Russian or French is required.

### *Requirements for the Doctor of Philosophy in Marine Biology*

The required courses listed for the M.S. degree; a reading knowledge of German and either Russian or French (to be demonstrated before the end of the second year); independent study and research, with thesis, in such fields as those listed in Course 299. The student is required to pass written and oral departmental examinations, ordinarily before the end of his second year, and a qualifying examination, ordinarily before the end of his third year.

#### UPPER DIVISION COURSES

114. *Marine Vertebrates* (3) I. Mr. Hubbs

121. *Marine Microbiology* (3) II. Mr. ZoBell, Mr. Jones

Prerequisites: Oceanography 110, 112, 113. Additionally, the student should have had some course work in general bacteriology or microbiology, and some background in biochemistry is desirable.

Methods of studying bacteria and allied microorganisms, with particular reference to their importance as biochemical and geological agents in the sea.

125B. *Laboratory in Algal Physiology* (2) I. Mr. Haxo, Mrs. Sweeney

125C. *Physiology of Marine Algae* (2) I. Mr. Haxo

Prerequisite: basic courses in biology and chemistry.

Comparative physiology and biochemistry of algae with emphasis on marine problems.

126. *Microbial Genetics* (3) I. Mr. Belser

Prerequisites: general biology, microbiology, and biochemistry or their substantial equivalent.

Lectures, laboratory demonstrations, and special problems in principles and techniques of genetics, with particular reference to microorganisms.

199. *Special Studies* (1-4) I, II. *The Staff*

Prerequisite: consent of the instructor.

#### GRADUATE COURSES

\*222. *Biochromes* (2-3) II. *Mr. Fox, Mr. Haxo*

Prerequisites: course work in organic chemistry and in the biochemistry or the physiology of plants or animals.

Physical and chemical foundations of color manifestation; the chemistry, distribution, metabolism, and significance of pigments occurring in the living world.

226. *Marine and Comparative Biochemistry* (3) II. *Mr. Fox*

Prerequisites: preparation in biology and in biochemistry or physiology, or consent of the instructor. Oceanography 112 and 113 are recommended.

Chemistry of living matter; osmotic adaptations, marine colloids; comparative biochemical and physiological activities of marine organisms; biochemical cycles in the sea; animal pigments.

227. *Evolution in the Marine World* (2) II. *Mr. Hubbs*

Origin and evolution of sea and its organisms. Migration from and to the sea. Adaptation and speciation in various habitats. Experimental studies on evolution of marine forms.

252. *Seminar in Experimental and Comparative Biology* (2) I, II. *Mr. Volcani and the Staff*

260. *Seminar in Advanced Ichthyology* (2) I. *Mr. Hubbs*

285. *Laboratory in Physiology* (2-4) II. *Mr. Scholander*

Research techniques and problems in selected areas of environmental physiology.

299. *Research* (1-6) I, II. *The Staff*

Research in such biological fields as: phycology, biophysics, genetics, evolution, microbiology, vertebrate and invertebrate zoology, comparative biochemistry or physiology of marine plants and animals. Students must present evidence of satisfactory preparation for the work proposed.

The following courses in other departments will also be of interest to students in Marine Biology:

Oceanography 110, 111, 112, 113, 118A, 220, 225, 253.

Chemistry 110A-B, 135.

Earth Sciences 132.

## OCEANOGRAPHY

### *Instructional Staff*

Martin W. Johnson, Ph.D., Professor of Marine Biology

Fred B Phleger, Ph.D., Professor of Oceanography

Norris W. Rakestraw, Ph.D., Professor of Chemistry

Roger Revelle, Ph.D., Sc.D., Professor of Oceanography, and Director of the Scripps Institution of Oceanography

Francis P. Shepard, Ph.D., Professor of Submarine Geology

Fred N. Spiess, Ph.D., Research Geophysicist, Lecturer, and Director of the Marine Physical Laboratory

Robert S. Arthur, Ph.D., Associate Professor of Oceanography

Charles S. Cox, Ph.D., Associate Professor of Oceanography

Gifford C. Ewing, Ph.D., Associate Research Oceanographer, and Lecturer

Edward W. Fager, Ph.D., D. Phil., Associate Professor of Biology (Chairman of the Department)

Jeffery D. Frautschy, B.A., Associate Research Engineer, Lecturer, and Assistant Director of the Scripps Institution of Oceanography

Douglas L. Inman, Ph.D., Associate Professor of Geology

John D. Isaacs, B.S., Associate Professor of Oceanography

Philip Rudnick, Ph.D., Associate Research Physicist, and Lecturer

Tjeerd H. van Andel, Ph.D., Associate Research Geologist, and Lecturer

\*Warren S. Wooster, Ph.D., Associate Research Oceanographer, and Lecturer

John A. Knauss, Ph.D., Assistant Research Oceanographer, and Lecturer

William R. Riedel, M.S., Assistant Research Geologist, and Lecturer

Edwin L. Hamilton, Ph.D., Research Associate, and Lecturer

Milner B. Schaefer, Ph.D., Research Associate, Lecturer, and Director of Investigations, Inter-American Tropical Tuna Commission

Milton N. Bramlette, Ph.D., Professor of Geology

Carl L. Hubbs, Ph.D., Professor of Biology

\*Absent on Leave, 1961-1962.

Walter H. Munk, Ph.D., Professor of Geophysics

Francis T. Haxo, Ph.D., Associate Professor of Biology

The Department of Oceanography offers a program of studies designed to reveal the interdependence of the biological, chemical, geological, and physical processes operating in the oceans. Students are required to gain a general knowledge of all these fields. Although most students will specialize in one, the Department encourages qualified students to become competent in any appropriate combination of these fields.

Biological studies in the Department of Oceanography include systematics, life histories, and geographical distribution of zooplankton; distribution patterns, behavior, population dynamics and community relationships of marine invertebrates; ecology and population dynamics of marine fishes.

Chemical studies in the Department of Oceanography include the use of chemical techniques in the effort to understand the behavior of the ocean; the part that the ocean plays in general geochemistry; the distribution of the chemical elements; the chemical processes that go on within the ocean and in the exchange between the ocean itself and the atmosphere and the sea bottom.

Geological studies in the Department of Oceanography include marine micropaleontology; mechanics of sedimentation; petrology of sediments; and the structure and morphology of the ocean floor and the continental margins.

Physical studies in the Department of Oceanography include observation, analysis, and theoretical interpretation of problems of general circulation and the distribution and variation of properties in the ocean; interchange of kinetic and thermal energy across the ocean surfaces; propagation of sound, and light and other electromagnetic energy in the ocean; properties of ocean waves.

#### *Requirements for Admission*

1. A baccalaureate degree in one of the physical or biological sciences, which must include the following:
2. Mathematics through differential and integral calculus.
3. Physics and chemistry, one year of each with laboratory.

Students intending to specialize in physical oceanography should ordinarily have an undergraduate major in physics, including three years

of physics, and mathematics through differential equations; vector analysis is recommended.

4. An additional year of either physics or chemistry. If chemistry is selected, either quantitative analysis, physical chemistry or organic chemistry is recommended; if physics is selected, the course should stress the fundamentals of mechanics, electricity, magnetism, optics, thermodynamics, or a combination of these topics.

5. Biology, one year with laboratory.

Students intending to specialize in biological oceanography should ordinarily have an undergraduate major in biology. Courses in limnology or ecology, invertebrate zoology and general or comparative physiology are recommended.

6. Geology, one semester.

Students intending to specialize in marine geology should ordinarily have an undergraduate major in geology including courses in physical geology, historical geology, structural geology, paleontology, optical mineralogy, petrology and a field course in geology.

7. Preparation in at least one foreign language chosen from the following: French, German, Russian.

Students may be admitted with a single deficiency, other than mathematics, on condition that they make it up during their first year in residence.

Students with only a minor in their intended field of specialization may be admitted if their preparation and record are considered satisfactory by the Department.



*Requirements for the Master's Degree*

Because of limited facilities, the Department does not at the present time encourage students who wish to proceed only to the master's degree. Special arrangements can, however, be made if circumstances warrant it.

*Requirements for the Doctor's Degree*

The Department requires all students to take courses 110, 111, 112, 113 and 250 and to obtain experience at sea in a research vessel. Each student must also acquire a minimum of 21 additional graduate units, or their equivalent, in courses in oceanography and basic sciences, pass a reading examination in two of the following languages: French, German, Russian, and perform and report on independent study and research in such fields as physical oceanography, marine geology, chemical oceanography, biological oceanography, or marine physics.





UPPER DIVISION COURSES

110. *Introduction to Physical Oceanography* (3) I. Mr. Arthur

Physical description of the sea; physical properties of sea water; boundary processes including interaction between sea and atmosphere; principles of dynamics applied to motion and distribution of variables; methods of measurement with demonstration at sea.

111. *Submarine Geology* (3) I. Mr. Shepard, Mr. Inman

The topography and sediments of the ocean floor, and their recent history; sedimentary processes as they affect the shore, continental shelf, and ocean floor; comparison between recent sediments and sedimentary rocks; the development of coral reefs.

112. *Biology of the Sea* (3) I. Mr. Johnson, Mr. McGowan

An integrated survey course dealing with fundamental aspects of the biological economy of the sea; the explanation of biologically associated marine phenomena; and the interrelation of biological, chemical, and physical processes in the environment.

113. *Chemistry of Sea Water* (3) I. Mr. Rakestraw, Mr. Goldberg

Chemical composition of sea water; physical properties of sea water; biochemical activity in the oceans; marine sedimentation; thermodynamic considerations; history of the oceans; models of oceans from chemical considerations; problems of measuring composition.

\*118. *Statistics* (3) II. Mr. Fager

Methods of statistical analysis; sampling and design of experiments applicable to marine studies.

\*119. *Time Series* (3) I. Mr. Rudnick

Prerequisites: integral calculus and algebra of complex variables. Spectra; correlation functions; linear filtering; applications to geophysical time series.

199. *Special Studies* (1-4) I, II. The Staff

GRADUATE COURSES

210. *Physical Oceanography—General* (3) II. Mr. Arthur

Dynamics of ocean currents; turbulence; wind currents; atmospheric boundary layer; water masses and circulation of the ocean.

211. *Waves* (3) II. Mr. Cox

Generation and propagation of surface and internal waves; wind waves, swell and surf; wave action on beaches; methods of observation; field work.

219A. *Marine Micropaleontology* (3) II. Mr. Bramlette, Mr. Kanaya,  
Mr. Phleger, Mr. Riedel

Prerequisite: Oceanography 111 or permission of the instructors.

Introductory lectures and laboratory study of the principal groups of marine microfossils, with special emphasis on the applications to problems of oceanography, and paleoceanography.

219B. *Marine Micropaleontology* (3) I. Mr. Bramlette, Mr. Kanaya,  
Mr. Phleger, Mr. Riedel

Prerequisite: course 219A.

Advanced study of specific groups of microfossils in the marine environments, emphasizing their ecology and stratigraphic applications.

220. *Special Topics in Oceanography* (2-4) I, II. The Staff

Within the next few years the following courses will be given:

*Principles of Oceanographic Research Systems* (2) II.

*Sound and Light in the Sea* (2) I.

*Population Dynamics* (2) I.

*Zoogeography of the Sea* (2) II.

*Advanced Methods of Fisheries Research* (3) II.

*Numerical Analysis* (2) II.

\*223. *Littoral Processes* (2) II. Mr. Inman

Prerequisites: Oceanography 110, 111.

Study of the physical processes in the nearshore environment, including waves and currents and their effect on the transportation of sediments and the formation of sedimentary features.

224. *Petrography of Sediments* (3) I. Mr. van Andel, Mr. Bramlette

Prerequisite: optical mineralogy.

Lectures and laboratory. Principles of sedimentary petrology; techniques of sediment analysis; microscopic mineralogy, thin section analysis, laboratory analysis; graphical and statistical data processing.

\*225. *Marine Ecology* (3) II. Mr. Fager

Behavior, single-species population dynamics, interspecific relationships and environmental factors as they relate to the distribution and abundance of marine organisms.

229. *Advanced Sedimentary Petrogenesis* (2) II. *Mr. van Andel*

Prerequisites: sedimentary petrography and Oceanography 224 or permission of instructor.

Advanced treatment of special topics in sedimentology; selected examples of sediment research; trends of sediment research and their influence on geological thinking; application of sediment studies to stratigraphy and paleogeography.

250. *Seminar in Oceanography* (1) I, II. *The Staff*

251. *Problems in General and Physical Oceanography (Seminar)* (2) I. *The Staff*

Presentation of reports, review of literature, and discussion of current research in general oceanography and physical oceanography.

253. *Problems in Biological Oceanography (Seminar)* (2) I. *The Staff*

Presentation of reports, review of literature, and discussion of current research in biological oceanography.

255. *Problems in Marine Geology (Seminar)* (2) I. *The Staff*

Origin and structure of ocean basins and continental margins, and their physiographic features. Origin, distribution, interpretation, and methods of study of marine sediments.

299. *Research* (1-6) I, II. *The Staff*

Research in one or more of the oceanographic sciences.

## PHYSICS

### *Instructional Staff*

Keith A. Brueckner, Ph.D., Professor of Physics (Chairman of the Department)

Carl Eckart, Ph.D., Professor of Geophysics

\*Walter M. Elsasser, Ph.D., Professor of Physics

George Feher, Ph.D., Professor of Physics

Walter Kohn, Ph.D., Professor of Physics

Leonard N. Liebermann, Ph.D., Professor of Physics

Bernd T. Matthias, Ph.D., Professor of Physics

\*Absent on Leave.

Maria Goeppert Mayer, Ph.D., Professor of Physics

Oreste Piccioni, Ph.D., Professor of Physics

Marshall N. Rosenbluth, Ph.D., Professor of Physics

Harry Suhl, Ph.D., Professor of Physics

William R. Frazer, Ph.D., Assistant Professor of Physics

Sheldon Schultz, Ph.D., Assistant Professor of Physics

Robert A. Swanson, Ph.D., Assistant Professor of Physics

David Y. Wong, Ph.D., Assistant Professor of Physics

The Department of Physics in the School of Science and Engineering offers a graduate program leading to the M.S. and the Ph.D. in Physics.

The entering graduate student will be required to have a sound knowledge of undergraduate mechanics, electricity, magnetism, and optics and also to have had a senior course or its equivalent in nuclear physics and atomic physics. Provision will be made in exceptional cases to allow the graduate student to take without graduate credit courses in these subjects to supply deficiencies.

#### *Requirements for the Master's Degree*

Students who wish to be candidates for the degree of Master of Science may have the option of either Plan I or Plan II. Course requirements may be fulfilled by any of the courses offered by the Department and courses in other departments may be approved by the student's Guidance Committee. Under Plan II the comprehensive examination will be arranged by, but not necessarily conducted by, the student's Guidance Committee. A reading knowledge of one language, German, French, or Russian, will be required.

#### *Requirements for the Doctor's Degree*

The curriculum for the doctor's degree is divided into two parts.

During the first two years the student will prepare himself for the qualifying examinations both written and oral, which will normally be completed by the end of the second year. Those examinations will test the student's knowledge of basic fields of physics at the graduate level, particularly the following:

Mathematical Methods of Theoretical Physics

Hamiltonian and Lagrangian Mechanics

Electricity and Magnetism

Statistical Mechanics

## Quantum Mechanics

## Nuclear Physics

Prior to this, however, he must have passed a reading examination in two foreign languages, German, French, or Russian.

After satisfactory completion of the written examination a doctoral committee will be appointed, which will conduct the student's oral qualifying examination.

Following the qualifying examinations, a number of courses in the 230 series will be available to the student which will be taught primarily as research courses and will provide the student with specific knowledge in his research field and acquaint him with current techniques in experiment and theory.

## UPPER DIVISION COURSES

Students will be admitted to these courses to make up minor deficiencies in undergraduate training only if they are substantially able to meet graduate entrance requirements, and have had the equivalent of upper division undergraduate courses in mechanics, electricity, and magnetism.

190A-190B. *Atomic and Nuclear Physics* (3-3) I, II. Mr. Swanson

Prerequisites: introductory physics and intermediate courses in mechanics, electricity, and magnetism.

Atomic structure, spectra, the periodic table, X-rays, electron optics, nuclear systematics, radioactivity, experimental procedures, nuclear energy.

191A-191B. *Thermodynamics, Kinetic Theory, Statistical Mechanics* (3-3) I, II. Mr. Kohn

Prerequisites: introductory physics and intermediate courses in mechanics, electricity, and magnetism.

Laws of classical thermodynamics, entropy, thermodynamic potentials; applications to thermomechanical, electric, and magnetic phenomena; phase equilibria; kinetic theory of gases; introduction to statistical mechanics; applications to physical properties of solids.

## GRADUATE COURSES

200A-200B. *Methods of Theoretical Physics* (3-3) I, II. Mr. Wong,  
Mr. Frazer

Prerequisites: elementary complex variables, ordinary differential equations, vector analysis.

Develops the mathematical procedures useful in physics, including vector and tensor analysis, partial differential equations and boundary value problems, complex variables, Fourier series and transforms, matrices, integral equations. Numerical and approximate methods of solution are also discussed.

201. *Analytical Mechanics* (3) I. Mr. Schultz

Prerequisite: undergraduate mechanics, partial differential equations or advanced calculus.

Lagrangian and Hamiltonian mechanics, canonical transformations.

202. *Introductory Quantum Mechanics* (3) II. Mr. Brueckner

Prerequisites: courses 200A and 201.

Experimental and theoretical basis of quantum mechanics, operator formalism, application of Schrodinger equation, scattering theory.

203A-203B. *Electricity and Magnetism; Classical Electron Theory* (3-3) Yr. Mr. Liebermann

Prerequisite: course 200A-200B; may be taken concurrently.

Potential theory, magnetostatics, electromagnetic induction, Maxwell's equations, electromagnetic waves, special theory of relativity, motion of charged particles in electromagnetic fields; classical electron theory.

210. *Statistical Mechanics* (3) I. Mr. Kohn

Prerequisite: course 202.

Systems of weakly interacting elements; general ensemble theory; applications to systems with interactions such as imperfect gases, plasmas, liquids, order-disorder transitions; fluctuations; irreversible processes.

211. *Introduction to Solid-State Physics* (3) II. Mr. Feher

Prerequisites: courses 202 and 203A-203B.

Principles of the dynamics of ions and electrons in solids; applications to electric, magnetic, and thermal properties; point defects and dislocations.

212A-212B. *Quantum Mechanics* (3) Yr. Mr. Rosenbluth, Mr. Suhl

Prerequisite: course 202.

Operators and transformation theory, matrix mechanics, perturbation theory, angular momentum, Dirac electron theory; elements of second quantization and field theory.

213. *Theoretical Nuclear Physics* (3) I. Mr. Brueckner

Prerequisite: course 202.

Nuclear systematics, nuclear forces, two-nucleon system, statistical theory of nuclei, nuclear reactions.

214. *Theoretical Nuclear Physics* (3) II. Mrs. Mayer

Prerequisite: course 213.

Shell and collective nuclear models, beta decay, electromagnetic properties, nuclear reactions at high energy.

215. *Advanced Mechanics* (3) II. Mr. Eckart

Prerequisite: course 201.

Elasticity, hydrodynamics, shock waves, elements of magnetohydrodynamics.

230. *Advanced Solid-State Physics* (3) I. Mr. Feher, Mr. Matthias

A selection of advanced topics such as: electrical and thermal transport phenomena; cooperative magnetic phenomena; nuclear and electron magnetic resonance; many-body theory.

231. *Advanced Nuclear Theory*. (3) I. The Staff

Topics in nuclear structure and reactions.

232. *Advanced Classical Physics* (3) II. Mr. Rosenbluth

Boltzmann equation, plasma physics, magnetohydrodynamics, and topics in statistical mechanics.

233. *Quantum Field Theory* (3) I, II. The Staff

Quantum electrodynamics, pion and strange particle physics, dispersion relations.

234. *High Energy Experimental Physics* (3) I, II. Mr. Piccioni

Topics in experimental techniques and current research.



*TEACHING AND RESEARCH STAFF*



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- James R. Arnold, Ph.D., *Professor of Chemistry*  
G. O. S. Arrhenius, Ph.D., *Professor of Marine Geology*  
David M. Bonner, Ph.D., *Professor of Biology*  
Milton N. Bramlette, Ph.D., *Professor of Geology*  
Keith A. Brueckner, Ph.D., *Professor of Physics*  
Anton F. Bruun, D. Sc., *Visiting Professor of Biology*  
Carl Eckart, Ph.D., *Professor of Geophysics*  
\*Walter M. Elsasser, Ph.D., *Professor of Theoretical Physics*  
Albert E. J. Engel, Ph.D., *Professor of Geology*  
George Feher, Ph.D., *Professor of Physics*  
Denis L. Fox, Ph.D., *Professor of Marine Biochemistry*  
Edward D. Goldberg, Ph.D., *Professor of Chemistry*  
Carl L. Hubbs, Ph.D., *Professor of Biology*  
Martin W. Johnson, Ph.D., *Professor of Marine Biology*  
Walter Kohn, Ph.D., *Professor of Physics*  
Leonard N. Liebermann, Ph.D., *Professor of Physics*  
\*Bernd T. Matthias, Ph.D., *Professor of Physics*  
Joseph E. Mayer, Ph.D., *Professor of Chemistry*  
Maria Goeppert Mayer, Ph.D., *Professor of Physics*  
Walter H. Munk, *Professor of Geophysics and Associate Director, Institute of Geophysics and Planetary Physics*  
Fred B. Phleger, Ph.D., *Professor of Oceanography and Director of the Marine Foraminifera Laboratory*  
Oreste Piccioni, Ph.D., *Professor of Physics*  
Russell W. Raitt, Ph.D., *Professor of Geophysics*  
Norris W. Rakestraw, Ph.D., *Professor of Chemistry and Associate Dean of the Graduate Division*  
Roger Revelle, Ph.D., Sc.D., *Professor of Oceanography, Dean of the School of Science and Engineering, and Director of the Scripps Institution of Oceanography*  
Marshall N. Rosenbluth, Ph.D., *Professor of Physics*  
Per F. Scholander, M.D., Ph.D., *Professor of Physiology*  
Francis P. Shepard, Ph.D., *Professor of Submarine Geology*  
Hans E. Suess, Ph.D., *Professor of Geochemistry*  
Harry Suhl, Ph.D., *Professor of Physics*  
Harold C. Urey, Ph.D., *Professor of Chemistry-at-Large*  
Melvin J. Voigt, M.A., *Librarian*  
Benjamin E. Volcani, Ph.D., *Professor of Microbiology*

\* Absent on Leave, 1961-1962.

- Charles D. Wheelock, M.S., *Professor of Marine Resources and Director of the Institute of Marine Resources*
- Herbert F. York, *Professor of Physics, Chancellor of the University of California, San Diego*
- Bruno H. Zimm, Ph.D., *Professor of Chemistry*
- Claude E. ZoBell, Ph.D., *Professor of Marine Microbiology*
- George F. McEwen, Ph.D., *Professor of Physical Oceanography, Emeritus, and Curator of Physical Oceanography, Emeritus*
- Robert S. Arthur, Ph.D., *Associate Professor of Oceanography*
- George E. Backus, Ph.D., *Associate Professor of Geophysics*
- Charles S. Cox, Ph.D., *Associate Professor of Oceanography*
- Harmon Craig, Ph.D., *Associate Professor of Geochemistry*
- E. W. Fager, Ph.D., D. Phil., *Associate Professor of Biology*
- Francis T. Haxo, Ph.D., *Associate Professor of Biology*
- Douglas L. Inman, Ph.D., *Associate Professor of Geology*
- John D. Isaacs, B.S., *Associate Professor of Oceanography and Program Director of Marine Life Research*
- Ralph A. Lewin, Ph.D., *Associate Professor of Biology*
- Henry W. Menard, Jr., Ph.D., *Associate Professor of Geology*
- John A. DeMoss, Ph.D., *Assistant Professor of Biology*
- William R. Frazer, Ph.D., *Assistant Professor of Physics*
- Richard A. Haubrich, Ph.D., *Visiting Assistant Professor of Geophysics*
- Stanley L. Miller, Ph.D., *Assistant Professor of Chemistry*
- Stanley E. Mills, Ph.D., *Assistant Professor of Biology*
- Sheldon Schultz, Ph.D., *Assistant Professor of Physics*
- Robert A. Swanson, Ph.D., *Assistant Professor of Physics*
- David Y. Wong, Ph.D., *Assistant Professor of Physics*
- Victor C. Anderson, Ph.D., *Research Physicist and Assistant Director of the Marine Physical Laboratory*
- Norman F. Barber, Ph.D., *Research Geophysicist*
- Maurice Blackburn, D.Sc., *Research Biologist and Program Director of Tuna Oceanography Research*
- Seibert Q. Duntley, Ph.D., *Research Physicist and Director of the Visibility Laboratory*
- Clay L. Perry, Ph.D., *Research Mathematician*
- Philip Rudnick, Ph.D., *Research Physicist*
- James M. Snodgrass, A.B., *Research Engineer*
- F. N. Spiess, Ph.D., *Research Physicist and Director of the Marine Physical Laboratory*

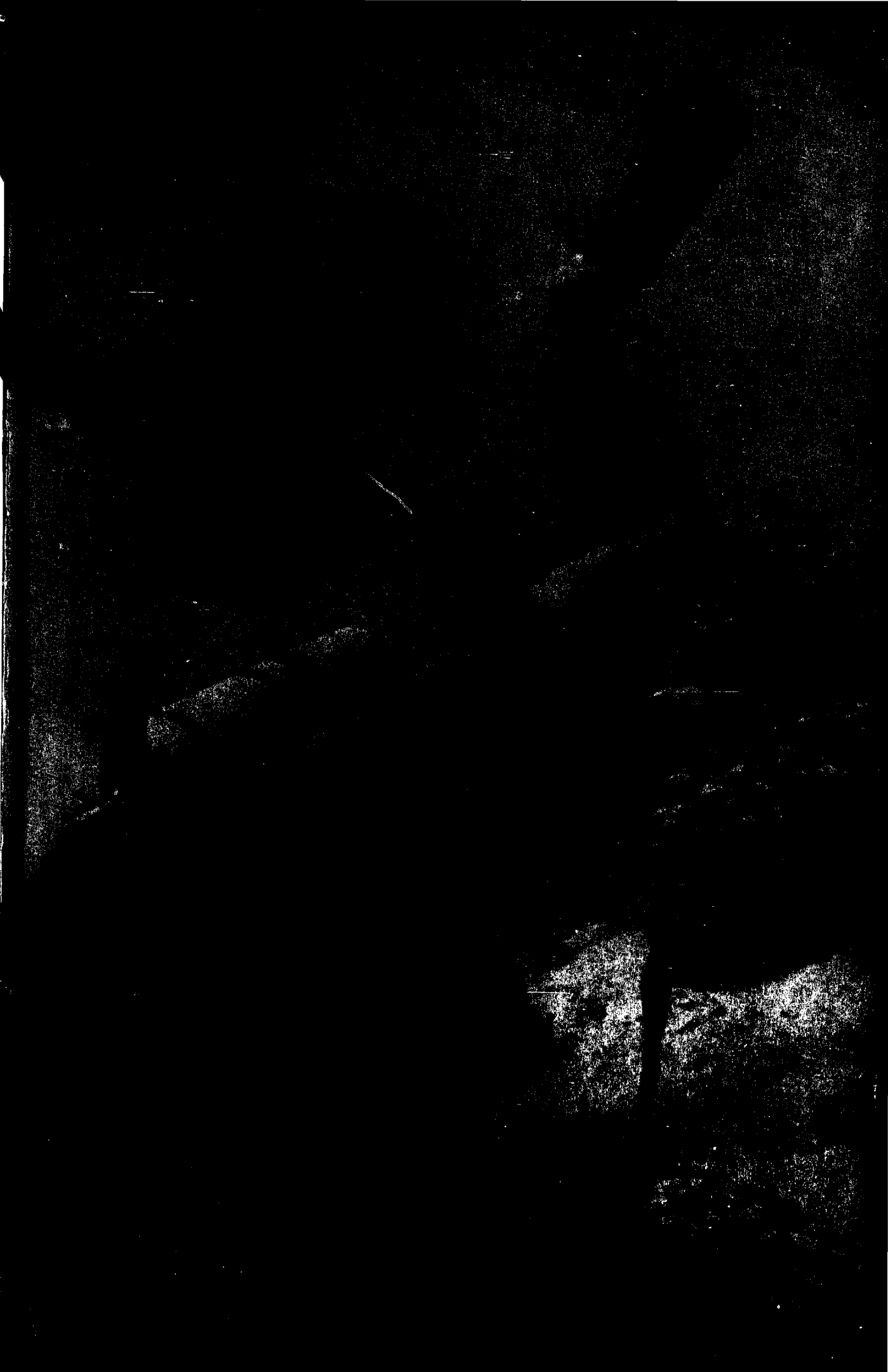
- John E. Tyler, B.S., *Research Physicist*  
Victor Vacquier, M.A., *Research Geophysicist*  
Roswell W. Austin, B.S., *Associate Research Engineer*  
Stanley C. Baker, B.S., *Associate Engineer*  
Almerian R. Boileau, M.A., *Associate Research Engineer*  
Kenneth A. Clendenning, Ph.D., *Associate Research Biologist*  
Gifford C. Ewing, Ph.D., *Associate Research Oceanographer*  
Jeffery D. Frautschy, B.A., *Associate Research Engineer and Assistant  
Director of the Scripps Institution of Oceanography*  
Charles D. Keeling, Ph.D., *Associate Research Chemist*  
Stanley H. Lai, *Associate Research Engineer*  
Frances L. Parker, M.S., *Associate Research Geologist*  
Rudolph W. Preisendorfer, Ph.D., *Associate Research Mathematician*  
George C. Shor, Jr., Ph.D., *Associate Research Geophysicist*  
Frank E. Snodgrass, M.S., *Associate Research Engineer*  
Earl D. Squier, *Associate Research Engineer*  
Beatrice M. Sweeney, Ph.D., *Associate Research Biologist*  
John H. Taylor, Ph.D., *Associate Research Psychologist*  
Tjeerd H. van Andel, Ph.D., *Associate Research Geologist*  
\*Warren S. Wooster, Ph.D., *Associate Research Oceanographer*  
Kozo Yoshida, Ph.D., *Associate Research Oceanographer*  
Marko Zalokar, Ph.D., *Associate Research Biologist*  
Mario E. Baur, Ph.D., *Assistant Research Chemist*  
William L. Belser, Ph.D., *Assistant Research Biologist*  
Leo D. Berner, Ph.D., *Assistant Research Biologist*  
George S. Bien, Ph.D., *Assistant Research Chemist*  
Brian P. Boden, Ph.D., *Assistant Research Biologist*  
Robert N. C. Bowen, Ph.D., *Assistant Research Geologist*  
Edward Brinton, Ph.D., *Assistant Research Biologist*  
Tsaihwa J. Chow, Ph.D., *Assistant Research Chemist*  
Joseph R. Curray, Ph.D., *Assistant Research Geologist*  
Jacques L. des Cloizeaux, D.d'E., *Assistant Research Physicist*  
Ian E. Efford, Ph.D., *Assistant Research Oceanographer*  
James L. Faughn, B.S., *Senior Engineer*  
Frederick H. Fisher, Ph.D., *Assistant Research Physicist*  
Robert L. Fisher, Ph.D., *Assistant Research Geologist and Program Di-  
rector, International Indian Ocean Expedition*  
Abraham Fleminger, Ph.D., *Assistant Research Biologist*

\*Absent on Leave, 1961-1962.

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- Theodore R. Folsom, Ph.D., *Senior Engineer*  
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