

CALIFORNIA INSTITUTE OF TECHNOLOGY
PASADENA

NORMAN BRIDGE LABORATORY OF PHYSICS

November 8, 1930

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Dr. R. A. Spoehr,
Rockefeller Foundation,
61 Broadway,
New York City.

Dear Dr. Spoehr:

Upon receipt of your request for more detailed information regarding the application of the California Institute, I sent requests to Dr. Noyes, Dr. Morgan, Dr. Buwalda, and Dr. Bell to go more into detail in the statement of their needs and plans, and I am today sending you, without any attempt at editing, a copy of the original document and attached to it these subsidiary documents, with the idea that each division of the Institute will state its own case better than I would state it for them.

In all the foregoing I have limited the picture to the pure science departments, although the needs of the engineering departments are large and funds must be obtained for their adequate development. I am assuming, however, that this is not the direction in which the interests of the Rockefeller Foundation lie.

I have ^{also} asked Dr. Munro to prepare a brief statement about the work in the humanities merely to keep before the officers of the Rockefeller Foundation the fact that from an educational point of view the most unique and in my opinion the most important advance which the Institute has made lies in its attempt to train effective scientists who have, nevertheless, had very much larger opportunities than scientists usually have to understand somewhat the big human problems which are perhaps even more vital to our progress than the scientific ones. The work in history, economics, government, literature, and ethics is now being handled by men quite as outstanding as the men in the sciences.

Sincerely yours,

Robert A. Millikan

RAM:IH

(ind) 20512
California Institute of
Technology

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928
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B I O L O G Y

Thomas Hunt Morgan.

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The following statement covers the present financial condition of the biological groups for the current year, the expected increases in salaries for the coming year, and the anticipated expenses for the three following years.

I wish to emphasize the fact that there has been no extension of the program outlined from the beginning; in fact, two subjects that it was hoped might be profitably developed here in connection with the biological work, viz.: physiological psychology, and bacteriology from the biological and genetic point of view, have been given up for want of sufficient funds to support them.

It would not have been possible to equip the groups now on hand without using the unexpended interest on the original amount given for buildings and equipment. Since only one building of the three has so far been erected, the interest on the remaining seven hundred thousand dollars has made it possible to supply the necessary apparatus. But the present building is now full, and not entirely suitable for the physiological work. It will be necessary, therefore, soon to proceed to the erection of at least one new building, which will deprive us of part of our present income, and its upkeep and equipment will exhaust the remaining interest on the remaining capital.

By way of illustrating what has been accomplished while the department has been building up, without encroaching on the capital sum originally granted, the following progress may be reported: (a) a farm of ten acres for experimental work on plant genetics has been bought (\$30,000); (b) a greenhouse, potting shed and heating plant (\$6,000) erected; (c) a marine station has been bought at Corona del Mar for investigations on marine animals and plant in conjunction with the work at the Institute. The building and lot cost \$50,000, and the alterations about \$5,000; (d) a plot of land across the street from the Institute has been purchased (\$12,000), on which a small laboratory for plant physiology (including two vaults insulated for temperature and moisture conditions) has just been completed (\$10,000) for Doctor Dolk; six rooms for biochemistry have been equipped at a cost of about \$6,000. Three men (Borsook, Winegarden and Thimann) are now actively at work in this field; Doctor Robert Emerson and two assistants in biophysics have just joined us to work on the physiology of chlorophyll. The equipment has cost us about \$5,000.

Physiological work has proven more expensive than anticipated, and in order to maintain the types of work already started and in addition to properly support the groups in physiology there is need, in the immediate future, for a minimum of fifty thousand dollars a year, over our present budget of one hundred thousand, to be distributed about as follows:

Our original program will not be complete without a group in General Physiology. It is proposed to start such a group as soon as a first rate man to head it can be found. The support of this work will call for about twenty-five thousand dollars.

The biochemistry group when complete, including promotions, will call for about \$8,000 additional; that in biophysics about \$7,000; that in plant physiology about \$7,000, and that in experimental embryology, including the marine stations, at least \$10,000. It is not proposed to increase the genetic group beyond its present status.

|| Total needed increases then amount to \$25,000 + \$8,000 +
\$7,000 + \$7,000 + \$10,000 = \$57,000. = 60%

Budget 1929-1930: Salaries \$42,266.67; Fellows \$5,000; Maintenance,
Field and Marine Laboratories \$47,133.33

= 94,400.00
\$

C H E M I S T R Y

A.A. Noyes

A. PROPOSED DEVELOPMENT OF THE WORK IN CHEMISTRY

During the past five years there has come about naturally a large growth in the research activities of the Division of Chemistry. Thus at the present time the men who are devoting their time largely or wholly to research may be classified as follows:

Professors and Assistant Professors (mainly in research)	6
Professors and Assistant Professors (in research and teaching)	6
National Research Fellows (only in research)	4
Ph.D. candidates (in research and graduate study)	17

The research activity of the Division is further illustrated by the fact that its staff has published since 1925 two extensive research monographs and 240 scientific articles.

Budget, 1929-1930: Salaries \$53,816.67; Fellows \$13,680; Maintenance and Shop \$22,001.80. - *89,498.47*

The foregoing research development, which is almost wholly in the fields of theoretical and inorganic chemistry, has resulted in crowding the Gates Chemical Laboratory to such an extent that there is literally no space for another research man, and many of those now here are working under seriously congested conditions. Moreover, the funds available have made it increasingly difficult to provide adequately for the salaries of the research men and for the instruments required in their investigations.

In order to provide satisfactorily for the continuation of the graduate work and research in the fields of theoretical and inorganic chemistry, which thus far have alone been extensively cultivated, and in order to provide for development of the important field of organic chemistry (discussed in Section C of this report) it is necessary to make available additional laboratories (by extending the Gates Chemical Laboratory) and to supply new funds for its maintenance and for the salaries of its staff. An itemized statement of the estimated expenditures which such development might involve constitutes Section B of this report.

B. COST ESTIMATE FOR THE DEVELOPMENT OF THE WORK IN CHEMISTRY

CONSTRUCTION AND EQUIPMENT OF GATES CHEMICAL LABORATORY

<u>Construction of West Unit (400,000 cu. ft.)</u>	\$250,000
Building, plumbing, heating, architect's fee	\$200,000
Electric wiring and fittings	50,000
<u>Equipment of West Unit</u>	85,000
Chemical desks, sinks, furniture, machinery	50,000
Instruments	20,000
Library: new books	15,000
<u>Reconstruction of East Unit (80,000 cu. ft. extra)</u>	45,000
Reconstruction of third story	30,000
Alterations in lower stories	5,000
Equipment: chemical desks, etc.	10,000
<u>Landscaping of North Garden</u>	<u>20,000</u>
<u>Total for construction and equipment</u>	\$400,000

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ENDOWMENT FOR NEW SALARIES, SUPPLIES, AND MAINTENANCE

<u>Provision for \$50,000 new income for developing organic chemistry</u>	\$ 1,000,000
<u>Provision for \$20,000 extra income for inorganic and physical chemistry</u>	400,000
<u>Provision for extension and maintenance of library</u>	<u>100,000</u>
<u>Total endowment for new salaries, supplies, maintenance</u>	<u>1,500,000</u>
GRAND TOTAL	\$1,900,000

Present Budget: 89,498.47

Requested Increase: 70,000 or 78%

C. PROPOSED DEVELOPMENT OF ORGANIC CHEMISTRY

It has been the policy of this Institute to attempt to develop new fields of graduate study and research only when there become available investigators that are thoroughly competent and funds and facilities that are fully adequate to ensure the creation of an outstanding research group in the new branch of science. A further feature of this policy has been to concentrate initially on those lines of science which are most closely associated with the fields of research already developed.

In pursuance of these policies the chemistry department at this Institute has thus far provided fully for graduate study and research only in the directions of inorganic, physical, and subatomic chemistry - fields which have closest relations with the researches in modern physics of the Norman Bridge Laboratory and with those in astrophysics of the Mount Wilson Observatory. It has, nevertheless, been long recognized that a similar intensive development of organic chemistry is highly desirable. This would be especially true if the work in that science were built up in directions germane to the research developments at the Institute in physical chemistry and subatomic physics, and in biochemistry and biophysics. And as opportunity offered, beginnings have been made in these directions. Thus, on the biochemical side, with the aid of a fund supplied by Dr. Bernhardt Smith of Los Angeles and of a grant from the Carnegie Corporation, Professor J. J. Abel was invited to the Gates Chemical Laboratory; and he initiated here with the aid of two of our unusually competent graduates (Drs. G. R. Alles and A. L. Raymond) the researches on insulin which he later consummated with such brilliant success. On the theoretical side, Professor H. J. Lucas of our permanent staff, has studied through a series of years the behavior of unsaturated compounds in relation to electronic hypotheses as to their molecular structures.

Lack of funds and of laboratory space and facilities has, however, prevented any adequate permanent provision for organic chemical work; but recent growth in related directions now makes it important that such provision be made as soon as possible. Specifically, it seems very desirable that graduate study and research be developed here in the two following branches of organic chemistry. One of these is theoretical in a fundamental sense, in that it concerns itself with the interpretation of the molecular structure of carbon compounds and of the occurrence and rate of organic reactions, from the viewpoints of modern physics and subatomic chemistry. The other is biological in its bearing, in that it concerns itself with the study of those substances and reactions that are of special interest to the animal or plant physiologist. These two lines of work are selected: first, because they seem likely to be of most importance to the future development of the science of organic chemistry; and secondly, because there are already in the Institute departments of chemistry and biology many investigators whose cooperation in the suggestion and solution of problems would be of great value. Thus, in theoretical

chemistry there are Professors Pauling and Badger (working on the electronic structure of molecules), professors Tolman and Ramsperger (studying the factors determining the rate of chemical reactions - perhaps the most vital problem of organic chemistry), and Professors Dickinson and Beckman (investigating the effect of radiations on chemical reactions). And in biology, there are Professor Borsook and his associates (studying protein hydrolysis and synthesis with the aid of physicochemical methods), Professors Robert Emerson (studying chlorophyll photosynthesis), and Professor Dolk (studying the effect of hormones on growth in plants). On the other hand, it is not proposed to specialize in synthetic work of the usual type for the reason that this field, because of its importance to chemical industry, is already well provided for in the laboratories of many other universities and chemical corporations.

In carrying out this development of organic chemistry it is proposed to pursue the plan which has been followed in the sections of inorganic and physical chemistry and in other departments of the Institute; namely, that of gradually appointing to the staff a group of relatively young men who have already demonstrated their research ability, giving to each man independent charge of his own general field of research, and assigning to him such graduate students and fellows as are interested in his work; building up at the same time the graduate group by the award of scholarships and fellowships.

PHYSICS

IMMEDIATE NEEDS

R. A. Millikan

The Department of Physics presents at this moment the following situation:

A	Professors and Assistant Professors Millikan, Epstein, Tolman (1/2), Houston, Bowen, Zwicky, Goetz, Watson, Smythe, Lauritsen, Oppenheimer (1/2)	10
B	Fellows (all having the Ph.D. or its equivalent) International Research Fellows (3), National Research Fellows (6), Institute Fellows (7), Visiting Professors on research problems (4)	20
C	Ph.D. Candidates	43
D	Published major papers last year, 59; books 2	
E	Budget 1929-1930: Salaries \$53,500; Fellows \$16,140; Maintenance and Shop (this shop serves many Institute Departments) \$39,139.91. = 108,779.91	

Four of the foregoing staff (Houston, Bowen, Goetz, and Lauritsen) all exceptionally brilliant and productive men, whose present salaries range from \$3,000 to \$4,500, have within the year refused offers yielding salaries aggregating \$16,500 more than these four men have in toto been receiving. They have preferred to remain because of the better opportunity for scientific work afforded by the Institute, but their joint salaries should be increased by not less than a total of \$12,000.

On account of the very large number of researches going on in the Norman Bridge Laboratory, the budgeted funds for the equipment accounts were last year overdrawn by about \$8,000, so that $\$12,000 + \$8,000 = \$20,000$ of additional funds are needed to maintain the department at its present rate of productivity.

18.5%

M A T H E M A T I C S

E. T. Bell

The Department of Mathematics has at present the following

- A Professor and Assistant Professors
Bateman, Bell, Van Buskirk, Michal, Wear, Ward, Wolfe
- B Fellows with Ph.D. degree pursuing research
Carlitz, Dorroh, Lehmer, Pall
- C Visiting Professors on the same standing as (B)
Damsgard, Schlichter
- D Candidates for Ph.D. degree, 7
- E Budget for 1929-1930: Salaries \$29,950; Fellows \$7,700; Books \$2,500.

Advanced work in mathematics of grade comparable to that in the sciences at the Institute was organized in 1926. Last year there were 4 National Research Fellows (American), 1 International Research Fellow. Last year 35 papers were published in leading American and foreign journals; a complete list is not available for this year, but will be more extensive. This does not overlap mathematical physics.

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To make possible a continued reasonable development in mathematics the following items (1) and (2), are indispensable:

(1) A mathematical library (principally sets of mathematical journals): cost, \$50,000. This estimate is a carefully considered minimum, arrived at after consultation with the leading experts of the United States on mathematical libraries. To maintain the library when once acquired by current purchases, \$3,000 a year is necessary. This estimate is reached as before. The last capitalizes at 5% to \$60,000. Total for library, \$110,000, of which \$50,000 is for immediate purchases, \$60,000 capitalization to keep the library up to date. It should be mentioned that delay in purchasing available sets of journals greatly increases the cost, as the supplies are limited and competition by purchasers is keen.

(2) Two professors, total salaries \$12,000, to care for work in Modern Geometry and Modern Analysis. Without these, students trained exclusively at the Institute will be forced to go elsewhere for part of their fundamental training. Thus far only advanced students from other institutions, where such training is given, have come here to take their Ph.D.

ADDITIONAL FUNDS NEEDED IN IMMEDIATE FUTURE FOR NORMAL DEVELOPMENT
IN TEACHING AND RESEARCH

DIVISION OF GEOLOGY AND PALEONTOLOGY

John P. Buwalda

Budget 1929-1930: Salaries \$25,900; Fellows \$7,300; Maintenance and explorations, \$35,450. = 68,650

The staff of the Division of Geology and Paleontology consists at present of four professors and one instructor, aided by five teaching fellows. The number of graduate students has ranged, during the past three years, from about fifteen to over twenty, and the number of undergraduates specializing in geology and paleontology has averaged about fourteen. Two introductory courses for other students in the Institute have enrolled about 120 each.

Researches are being vigorously prosecuted, in the fields of vertebrate paleontology, seismology, economic geology, and structural geology, by members of the staff, and graduate students are engaged in field investigations at various localities scattered from eastern Oregon to Mexico.

The members of the staff are also contributing in an important way to the solution of problems involving the supply or utilization of the economic resources of the Southern California region, particularly water, petroleum, and clay deposits. The outstanding example at present is perhaps the geologic investigation of the various projected routes for the 250-mile Colorado River aqueduct.

The number of graduate students and undergraduates specializing in this field, and the high scholarly type of these men, makes it exceedingly desirable that a sufficient number of additional appointments to the staff be made to provide instruction and guidance in research in those fields which are not adequately represented at present, so as to give graduate students as full and well-rounded a training as they should have to meet modern professional standards. Two admirable buildings are being provided and will shortly be constructed; utilizing them will involve certain added operation expenses over the restricted quarters now occupied. In addition certain research projects require additional funds.

The following are items of expense in the immediate future for which no permanent provision has been made:

Professor of Seismology	\$7,000
Field assistance in Vertebrate Paleontology	4,200.
Professor of Petrography, salary	6,000
Instructor in General Geology and Petrology	1,500
Professor of Physiography and Geomorphology, salary	4,000
Professor of Invertebrate Paleontology, salary	6,000
Seismology Laboratory, operation	17,000
General equipment and books, additional	4,000
Additional explorations in Vertebrate Paleontology	<u>11,000</u>
	\$60,700

88% increase

HUMANITIES

Wm. B. Munro

The California Institute has fully recognized the desirability of making a place in its undergraduate curriculum for a generous amount of instruction in the humanistic studies. The faculty of the Institute, in sympathy with this objective, has cooperated by eliminating some of the more specialized technical courses which are ordinarily required in schools of engineering. As a result of this the California Institute now requires every student to take, in each of his four undergraduate years (and in the fifth year as well) one or more courses of a humanistic character. These courses, given by the Division of the Humanities, cover the more important branches of Literature, History, Philosophy and Economics. Eighteen members of the Institute's teaching staff (exclusive of assistants and readers) are engaged in this work. A fine new building, one of the best on the campus, known as the Dabney Hall of the Humanities, is utilized for this instruction.

The principles which are being followed in building up this side of the curriculum may be briefly summarized:

- (a) Concentration on a few important humanistic studies, with no electives until the senior year and then a very limited number.
- (b) Instruction in small groups, never exceeding twenty students.
- (c) Scholastic standards in the humanities to be maintained on exactly the same plane as in the natural sciences.
- (d) Utilization of the outstanding scholars who come from time to time to the Huntington Library for research. Every year some of these scholars give instruction at the Institute.
- (e) All additional resources obtained for the humanistic studies to be devoted to improving the quality of the instruction rather than increasing its quantity.