he says, "that a study of the zoogeographic realm of the invertebrates living at high altitudes will throw much light on the history of these regions. As far as it is possible to judge at present, the rather large number of species endemic to these elevated regions argues against any wholesale glaciation of the region."

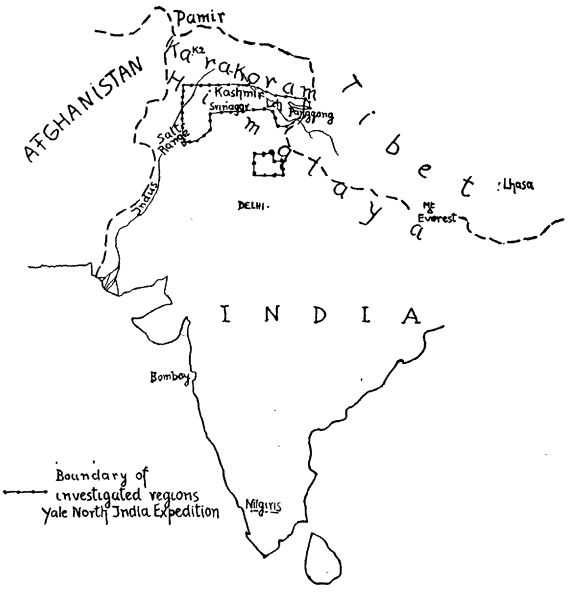
The expedition returned from Ladakh to Srinagar, Kashmir, on October 2.

### VARIOUS ACTIVITIES OF THE EXPEDITION UNTIL JANUARY, 1933

During the last five months the various expedition members were busy in Kashmir, the Punjab, Calcutta and the Nilgiri Hills of southern India. Although the latter region was out of the general field of our studies Hutchinson was anxious to get some zoogeographical data on the fauna of the Nilgiris in relation to the "pluvial relict" hypothesis.

Mr. Lewis, who had started back in June to the more promising fields of the Siwalik formations, collected in Bilaspur State in the Simla Hills and adjacent portions of the Punjab. He also worked in the Siwalik Hills proper, from the Sutlej River to the Kaluwala Rao near Dehra Dun (United Provinces). He reports about his results as follows, "An abundance of excellent material was collected in the time available, and in addition to the large vertebrate fauna numerous invertebrates and paleobotanical specimens were secured; all of which will be added to the collections of the Peabody Museum of Natural History of Yale University."

My field work in Kashmir continued until November 23 and was then transferred partly back to the Salt Range and partly to the Siwalik foothills in the Rawalpindi district. The last excursion to the southwestern Salt Range undertaken for the sake of the tilted Pleistocene strata made me come across a prehistoric site. This was discovered first by Mr. Hutchinson, who had done biological work on the salt lake Kalakahar. A second locality was found near-by on an ancient lake terrace with three layers of implementiferous soil containing coup de poing, scrapers and rejects of presumably early paleolithic age. A human skull was found in between the upper two




layers. With the kind permission of the director of the Indian Archeological Survey I was able to collect these traces of what appears to be the earliest settlement of prehistoric man in India.

Around the middle of January, 1933, the field work of the expedition was terminated and the members left India shortly after. The scientific collections have safely arrived at New Haven and shall be worked upon by the members of the expedition and with the aid of scientific experts.

As this undertaking was being carried out in countries which offer many natural hindrances to scientific exploration, the success of the expedition was due in great part to the help of the Government of India and various Indian scientific institutions. I greatly appreciate all the support that has been so generously extended toward us by British-Indian government officials.

H. DE TERRA

YALE UNIVERSITY

# A HISTORY OF THE NATIONAL RESEARCH COUNCIL 1919–1933

## III. DIVISION OF ENGINEERING AND INDUSTRIAL RESEARCH[1]

By Professor DUGALD C. JACKSON

CHAIRMAN

THE Division of Engineering was established as one of the Council's divisions in 1919 for the purpose of organizing and coordinating engineering research in industry. Its membership consists of representatives

[1] This is the third of a series of ten articles prepared to describe briefly the nature of the activities with which the National Research Council has been engaged during the past fourteen years.

from the national engineering societies and certain members-at-large.

The following persons have served as chairmen, beginning with the period immediately before the formation of the division from a committee of the Council:

1918– —Henry M. Howe
1919–1921—Comfort A. Adams
1921–1923—Alfred D. Flinn
1923–1927—Frank B. Jewett
1927–1930—Elmer A. Sperry
1930–1933—Dugald C. Jackson

During the first period of its life, from 1919 to 1923 inclusive, the principal object of the division was regarded as getting more and better research done in the engineering field, avoiding the rôle of dictatorship or of assuming credit for work which it encouraged others to do. The division headquarters were established in the United Engineering Societies Building in New York City on invitation of the Engineering Foundation and the four Founders Engineering Societies, for the purpose of intimate association with the national engineering societies.

The second period of the division, from 1923 to 1927, was one of transition. Numerous research projects which had their roots in wartime requirements were completed, and their committees were discharged to clear the decks for project activities to meet current needs.

After the Division of Research Extension was merged with the Division of Engineering in 1924, an attempt was made to balance the activities of the division between research projects *per se* and promotional efforts. The organization then was quite unique. It was a pioneering effort, with few precedents. A director and a secretary of the division were selected to guide the work of the division under the supervision of the chairman and executive committee.

In the period 1927–1933, the third of division life, research projects already started have been continued. A variety of new ways has been found for increasing effectiveness in bringing to the attention of the public, and of specialists like industrialists and bankers, the value and benefits of research in the industries. A change in the character of the promotional activities of the division from "why" to "how" do research during this period is also significant.

The major work of the division can be classified best under two main headings: (1) research projects and (2) promotion of research.

The gradual evolution of a research-project policy and the development of procedure in the administration of research projects undertaken for study has been indicated. In the conduct of several of these projects the division has been fortunate in the cooperation of other divisions of the Council. In others its quasi-governmental standing has stood it in good stead in securing the cooperation of governmental departments. It has always had the whole-hearted support and cooperation of the interested engineering societies.

It obviously would be impossible in the space allotted to this report to describe even in brief detail each of the more than fifty research projects which have been completed during the past fourteen years or which are now under way. Two examples (one, the marine piling investigation from the list of completed projects; and the other the Highway Research Board, from current work) are therefore here selected to illustrate project policy, method of conducting project work, and the significance of results obtained.

A section of the San Francisco Bay contained many large and valuable structures, which had been erected on unprotected wooden piles over a period of several decades. In 1914 it was found that a species of shipworm previously unknown in those waters had attacked the dikes at the entrance of Mare Island Navy Yard and other structures in the bay. In 1917 signs of serious damage appeared in the dikes. Within the next four years practically every timber structure in the vicinity was damaged, with losses estimated at $15,000,000.

The National Research Council was requested to organize a study on a nation-wide scale. A national committee was formed to study the preservation of wooden structures from the attack of marine borers, and to conduct an investigation into the value and proper use of various substitutes for timber. Cooperation was secured on a comprehensive scale. Among the governmental agencies assisting were: United States Coast Guard, Navy Department, War Department, Forest Products Laboratory, Bureau of Lighthouses, Bureau of Fisheries, Coast and Geodetic Survey and Chemical Warfare Service. Other cooperating organizations included the American Railway Engineering Association, American Association of Port Authorities, Harvard University, Massachusetts Institute of Technology, University of California, American Museum of Natural History and the Smithsonian Institution. Funds amounting to more than $50,000 were contributed by twenty-eight railroads, steamship lines and industrial companies. In addition to the organizations already mentioned, agencies of state and municipal governments, industries and harbor property owners over the world furnished services and materials. Two other divisions of the Council assisted in this work, namely, those of biology and agriculture, and chemistry and chemical technology.

As a consequence of this coordinated investigation, accurate knowledge is now available of conditions existing in all our ports on the Atlantic, Gulf and Pacific Coasts, including Alaska and our insular possessions. We know the habits of these borers, their life cycle, their breeding seasons, how to prevent their attack, how to preserve structures and also how to counter-attack. The completed report occupies a book of 534 printed pages and was widely distributed and used throughout the world as a reference book.

The Highway Research Board was organized in 1920 to assist in outlining a comprehensive program of highway research and to coordinate activities thereunder, to organize specific projects of highway investigation, and to act in a general advisory capacity.

The value of quasi-governmental standing of the Council is exemplified by the work of this board. The executive order of the President of the United States permits the Department of Agriculture to support and assist this project to a degree which would be impossible were it sponsored under other auspices. In this particular case total cash contributions from various sources have been more than $200,000. The wide-spread affiliations of the board are indicated by the fact that it has direct representation from every state highway department and many of the leading engineering colleges.

Time will not permit the review of other research projects completed or under way, such as those in heat transmission, electric and gas welding, molding sands and fatigue of metals under repeated stress. One special project quite different in character from the foregoing, the World Engineering Congress, is worthy of mention on account of its international character. The congress of 1929 was held in Japan under the auspices of the Kogakkai (Engineering Society of Japan) during the months of October and November. The purpose of these congresses, which are held at intervals of several years, is to advance and diffuse knowledge by presentation of papers and discussions on engineering subjects, to interchange views on various phases of professional engineering work, to promote international cooperation in the application of engineering science, and to cultivate a feeling of fellowship among engineers of the world.

The Division of Engineering and Industrial Research was selected by representatives of the American engineering societies to act as a sponsor body and to initiate activities on behalf of American engineers. Eighty papers by invited American authorities were prepared for the congress under this sponsorship, representing a cross-section of engineering developments in this country. The congress was personally attended by a large delegation from the United States, whose eminence in the profession reflected credit on American engineering and added to international friendships.

The promotional efforts of the division have been adapted in character and purpose to the state of industry. At the outset special attention was given to an exposition of the value of research in the industries. Activities at the present moment include, in addition to the above, special emphasis on "how to do research," on the promotion of research within trade associations for the benefit of their respective fields of industry and trade, and on fuller recognition of the university as a seat for the conduct of research in cooperation with industry.

Two domestic inspection tours of representative research laboratories have been sponsored and arranged for groups of industrial executives and bankers related to various fields of industry and from different geographical areas.

Eighty-five executives, including chairmen of boards, presidents, vice-presidents and general managers of industrial corporations and financial institutions, participated in the first one (1930). The general plan of organization, the type of problems selected for the research laboratory and methods used in their solution were studied. The importance and benefits to the particular industry derived from each laboratory were also discussed. These laboratories were mostly those maintained by large individual companies, but the tour program included the U. S. Bureau of Standards and the laboratory of a trade association.

The second tour of research laboratories was patterned after the first, but emphasized the significant feature that industrial research is not an affair exclusively for large companies. Under the critical financial conditions prevailing in the autumn of 1931, it is significant that nearly sixty representative industrial executives and bankers participated in this tour. While the number was not so large as in the previous tour, the geographical representation from as far west as the Pacific Coast and as far south as New Orleans demonstrated appreciation of the opportunities afforded by these tours.

Encouragement of research by trade associations has included the presentation of suitable addresses before association meetings, arrangement for key executives and research committees to visit successful research laboratories, suggestions as to the formation of research committees, the type of problems to be selected for study, the financing of the research projects, and the selection of laboratory facilities. Such assistance has been rendered to the textile, fisheries, brick and clay, glass-container, motion-pic-

ture, porcelain-enamel, steel-construction and aviation industries. A great deal of work remains to be done in this field.

Recognizing the need for promotional efforts designed to demonstrate "how to do research," the division sponsored the preparation of a book entitled, "Profitable Practice in Industrial Research." Fourteen distinguished men in science and in scientific research collaborated in the preparation of this volume, thus making available their experience and achievement in the development of a technique in industrial research.

In order to carry out effectively its promotional efforts, the division has found it necessary to keep at hand various types of information which may be useful to those who are considering the establishment of research laboratories or their proper administration. Examples of these are: bibliographies, surveys, plans for laboratory layouts and the book, "Profitable Practice in Industrial Research."

# SCIENTIFIC EVENTS

## THE INDUSTRIAL FELLOWSHIPS OF MELLON INSTITUTE DURING 1932–33

THE past fiscal year of Mellon Institute, ended February 28, 1933, covered a period of commercial dullness throughout the country. Notwithstanding the severe depression, however, the industrial fellowship activities in the institution were just as extensive and important as in 1931–32.

During 1932–33, 67 fellowships—18 multiple and 49 individual fellowships—were in operation, on which the services of 109 fellows and 28 assistants were required. At the close of the year 55 fellowships—14 multiple and 41 individual fellowships—were active, and 83 fellows and 15 assistants held positions thereon. Twenty-six fellowships have been at work for five years or more, and of this number 14 have concluded 10 years of research and nine fellowships have been operating for 15 years or longer.

In the last fiscal year $616,360 was received by the institute from fellowship donors to defray the cost of scientific investigations carried on for these companies and associations. The money appropriated by donors to the institute during the past twenty-two years amounts to $8,893,378.

Nine new fellowships began operation during 1932–1933, and 12 fellowships concluded their investigational programs in that year. During the calendar year 1932, 2 bulletins, 40 research reports, and 27 other papers were contributed to the literature by members of the institute. Forty U. S. patents and 62 foreign patents were issued to fellows. The total publications for the twenty-two years ended December 31, 1932, have been as follows: 18 books, 107 bulletins, 653 research reports, 961 other articles and 485 U. S. patents.

Many notable advances were made by the fellowships of 1932–33, and releasable facts regarding this investigational progress are presented in the twentieth annual report of the director, Dr. E. R. Weidlein, to the institute's trustees. Especially noteworthy were the research accomplishments of the industrial fellowships on air pollution, coke, commodity standards, food varieties, organic synthesis, packaging, petroleum production, protected metals, shoes and sugar. A large number of new products were developed and many of them were introduced commercially by fellowship donors. The urgent necessity for reviving business has been spurring many manufacturers to try through scientific investigation to evolve novel commodities as well as to improve their plant and merchandising practises. Throughout 1932–33 the very enthusiastic cooperation of donors in need of research results has expedited the work of their fellowships.

In addition to the numerous strictly technologic investigations of its fellowships and the constantly productive activities of its department of research in pure chemistry, the institute is studying the economic and social aspects of industrial research. Staff members of the organization are also aiding unemployed scientific men and engineers in securing professional posts, and are advising and encouraging the many companies that appeal to the institution for technical assistance.

The construction of the institute's new building is being continued despite prevailing business conditions. By the end of 1932 about 80 per cent. of the limestone had been set in place in the exterior, and during the subsequent two months practically all this work was completed. So far 235,000 cu. ft. of limestone and 22,000 cu. ft. of granite have been used, and only a very small amount of stone remains to be placed at the four corners of the edifice. The interior mechanical work is progressing, and it is thought now that the institute can occupy the building in the summer of 1934.—W. A. HAMOR.

## THE MORRIS ARBORETUM OF THE UNIVERSITY OF PENNSYLVANIA

THE Morris Arboretum in Chestnut Hill, which was bequeathed to the University of Pennsylvania by the late Miss Lydia Thompson Morris, will be