SCIENCE

VOL. 78 FRIDAY, DECEMBER 8, 1933 No. 2032

SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal

Lancaster, Pa. Garrison, N. Y.

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

THE NATIONAL ACADEMY OF SCIENCES

ADDRESS OF WELCOME[1]

By Dr. KARL T. COMPTON

PRESIDENT OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

IT is no common honor and privilege which I have this morning in welcoming the most distinguished scientific body of America to Cambridge as the guests of the Massachusetts Institute of Technology. Pleasant and stimulating as these meetings are, and appropriate as is this old New England center of intellectual progress for meetings of this type, it is natural that the academy can meet in the Boston region only at intervals of a number of years; and when it does meet in this region, the Massachusetts Institute of Technology will have to take its turn with its sister institution up the river in the privilege of acting as host. While on this particular occasion you have done us the honor of accepting our invitation, I wish to emphasize the fact that in a very real way Harvard University is also your host, since several Harvard members of the academy have cooperated as members of our local committee and are participating in the entertainment of our guests. I wish, therefore, to speak not only for the Massachusetts Institute of Technology, but also for the entire academy group in this region, in welcoming you to these meetings.

The mention of the cooperation of our Harvard colleagues on this occasion leads me to say a few words about an important aspect of the relations between our two institutions. Each has a position of eminence in its own field. At various points these fields of interest overlap. I do not believe that many people outside of these institutions realize the extent to which real cooperation between them is an accomplished fact, whereby graduate students and staff in the overlapping fields may take advantage of the special opportunities and facilities in both institutions. While each institution tries to do its own work in the most effective possible way, our ideal is to offer to the more advanced students the combined advantages of both institutions in so far as this is possible by cooperation.

[1] Address at the opening session, Massachusetts Institute of Technology, Cambridge, November 20, 1933.

I therefore extend this welcome to you in a sense as a representative of both institutions, although the Massachusetts Institute of Technology has undertaken the primary responsibility on this particular occasion.

It would be fitting on this occasion, I think, to review very briefly certain outstanding events in the history of the National Academy of Sciences, with particular reference to a new aspect of these activities which gives promise of further extending the prestige of the academy and its service to the public in a significant way.

When it is recalled that the charter of the National Academy of Sciences was given in the administration of President Lincoln and that that very active arm of the academy, the National Research Council, was created by executive order of President Wilson, it is evident that the significant steps in the organization of the academy have occurred during times of national emergency. It is this same principle which has applied in the creation of the Science Advisory Board as an agency of the National Academy and the National Research Council to assist the government during the present emergency.

The executive order of President Roosevelt, dated July 31, 1933, reads:

ESTABLISHMENT OF SCIENCE ADVISORY BOARD UNDER THE NATIONAL RESEARCH COUNCIL

The National Research Council was created at the request of President Wilson in 1916 and perpetuated by Executive Order No. 2859, signed by President Wilson on May 11, 1918. In order to carry out to the fullest extent the intent of the above Executive Order there is hereby created a Science Advisory Board with authority, acting through the machinery and under the jurisdiction of the National Academy of Sciences and the National Research Council, to appoint committees to deal with specific problems in the various departments.

The Science Advisory Board of the National Research Council will consist of the following members who are hereby appointed for a period of two years:

Karl T. Compton, *chairman,* president, Massachusetts Institute of Technology, Cambridge, Massachusetts.

W. W. Campbell, president, National Academy of Sciences, Washington, D. C.

Isaiah Bowman, chairman, National Research Council; director, American Geographical Society, New York City.

Gano Dunn, president, J. G. White Engineering Corporation, New York City.

Frank B. Jewett, vice-president, American Telephone and Telegraph Company; president, Bell Telephone Laboratories, Incorporated, New York City.

Charles F. Kettering, vice-president, General Motors Corporation; president, General Motors Research Corporation, Detroit, Michigan.

C. K. Leith, professor of geology, University of Wisconsin, Madison, Wisconsin.

John C. Merriam, president, Carnegie Institution of Washington, Washington, D. C.

R. A. Millikan, director, Norman Bridge Laboratory of Physics, and chairman of the Executive Council, California Institute of Technology, Pasadena, California.

FRANKLIN D. ROOSEVELT

The White House,
July 31, 1933.

(No. 6238)

Whatever may have been the arguments pro or con for setting up an organization of this type (and I can speak of this quite objectively, because I had no knowledge that any such step was even contemplated until the executive order had been published), the fact remains that the situation has developed in such a way that through this board the Academy and the National Research Council are being given an opportunity to assist the government to an extent which has never before been equalled in the history of the Academy, with the exception of the critical period during the last war. The reasons for this, I think, are twofold.

In the first place, the change of administration and the economic crisis of the country and the tremendous program upon which the government has embarked to pull us through this crisis have all raised an unusual number of problems which have important bearing on the organization and program of scientific work of the government or of agencies over which it has some jurisdiction. At the same time, the responsible officers of the government are burdened with such a load of added responsibilities in connection with the recovery program that they must of necessity look for expert advice on these problems. Our experience thus far has been that when this advice is sound and clear-cut, it is welcomed and acted upon as effectively as conditions permit.

In the second place, the basis of any assistance to the officers of the government must be absolute confidence of these officers in the competency and disinterestedness of the group offering the advice. I wish here to pay a tribute to the tact, resourcefulness and energy with which the new chairman of the National Research Council has dealt with the situation and has gained the personal confidence and respect of those government officers for whom these problems are being handled. In a reciprocal way I can bear witness in all sincerity to our conviction, based on contact with these government officers, that they are above all anxious to discharge their duties for the best interests of the country, without fear or favor.

Let me go on now to mention very briefly, by way of illustration, a few of the problems which the Science Advisory Board has undertaken during the past three months.

The Weather Bureau: The Secretary of Agriculture asked the Science Advisory Board to submit recommendations for improving the service of the Weather Bureau. To assemble the facts and formulate tentative recommendations for consideration by the board, a committee was formed, consisting of R. A. Millikan, *chairman,* Isaiah Bowman, Charles Dana Reed and Karl T. Compton. This committee called into consultation leading members of the staff of the Weather Bureau and of the meteorological services of the Army, the Navy, the California Institute of Technology and the Massachusetts Institute of Technology, and also technical experts attached to the Aeronautics Division of the Department of Commerce. It gave consideration to a recent report on the Weather Bureau by a committee of the American Society of Civil Engineers. It discussed its tentative proposals with high administrative officers of the Weather Bureau, the Department of Commerce, the Army and the Navy. As a result of these efforts the Science Advisory Board submitted last week to the Secretary of Agriculture a preliminary report on the service of the Weather Bureau, with recommendations for reorganizing this service in several important respects to take advantage of improved techniques and new opportunities for increasing the accuracy and probably the range of forecasting, and it was able to report that these recommendations have received the unanimous approval of all experts consulted and the agreement of the administrative officers in all departments of the government which are concerned, to cooperate in making the proposed reorganization successful and economical.

The United States Geological Survey and the Bureau of Mines: The Secretary of the Interior submitted to the Science Advisory Board several questions in regard to the organization of the U. S. Geological Survey, the Bureau of Mines and the Division of Mineral Resources of the Department of Foreign and Domestic Commerce. These matters were referred for study and tentative recommendations to a committee, consisting of Charles K. Leith, F. P. Beckett and Frank de Wolf. Because of the urgency of certain questions, this committee has submitted two preliminary reports and will soon be ready to submit its final report to the secretary. It is not going too far to say that the preliminary reports already submitted have done much to clarify and settle a peculiarly difficult problem which confronted these services, particularly in consideration of the greatly increased importance of these services in a planned economy in which accurate knowledge of minerals and mineral resources is necessary for intelligent planning.

The Railroads: At the request of the Federal Coordinator of Transportation, the Science Advisory Board has set up a committee on research for the railroads, comprising men who have had outstanding success as directors of industrial research laboratories or who have, in one way or another, a background which would make them of peculiar assistance to the railroads in the formulation of a plan which will more effectively bring science to the service of the railroads, in the interests of improved service to the public and an improvement in their financial situation. This committee consists of F. B. Jewett, *chairman,* Maurice Holland, director, C. F. Kettering, John Johnston, Francis Frary, E. K. Bolton, A. A. Potter, Dugald C. Jackson, H. G. Moulton, of the Brookings Institution, and R. L. Lockwood, of the office of the Federal Coordinator. This committee is to cooperate with a committee of high railway executives to study the railway situation, formulate recommendations, and advise in putting the plans into effect.

Perhaps twenty other illustrations could be given of the work of specific committees or of cases in which a better coordination has been introduced into new activities of the government through the Science Advisory Board but time does not permit their enumeration.

There are, however, two further aspects of the work of the Science Advisory Board to which I would call particular attention, since these have to do not with the meeting of present problems or emergencies but with the formulation of permanent policies through which science and the government may better serve the public. One of these involves cooperation with representatives of the social sciences to insure joint action with them on the problems of the present emergency as well as of future policies, in order that actions may be taken with the best possible knowledge of all aspects and implications of the problems. The other involves the formulation of a permanent policy of the government with respect to scientific research. This is particularly important in this time of flux of policies and institutions. The discussions which centered around the word "technocracy" have raised some important problems but have at the same time unduly shaken public confidence in the basic services of science to society. It is important that the government's policy should not be in the direction of curtailing the development of science and its application to human welfare, but rather in the direction of coordinating these developments with the necessary social and economic adjustments in order that benefits may be made a maximum and the difficulties of readjustment be minimized. It is within the scope of the assignment of the Science Advisory Board to make positive recommendations to the President along these lines, and to this end two excellent committees have

been formed to give preliminary consideration to these more permanent aspects of the board's work, with the expectation that these should become the major responsibilities of the board as soon as the more pressing problems associated with the present emergency have been disposed of.

Many of these activities have already called upon the resources of the National Research Council, and it is evident that this new arm of the academy will result in an increased effectiveness of the academy and the National Research Council as public servants.

PAPERS PRESENTED AT THE CAMBRIDGE MEETING

AT the autumn meeting of the National Academy of Sciences, held in Cambridge, Mass., on November 20, 21 and 22, the following papers were presented:

Relation between positron electron pairs and single positives resulting from gamma ray collisions with atomic nuclei: CARL ANDERSON and SETH NEDDERMEYER (introduced by Robert A. Millikan).

Cosmic ray fluctuations and their interpretations: ROBLEY EVANS, ROBERT A. MILLIKAN and VICTOR NEHER.

Evolution of the expanding universe: G. LEMAITRE (introduced by Harlow Shapley).

The physical background of relativistic cosmology: H. P. ROBERTSON (introduced by Harlow Shapley).

The terrestrial abundance of the permanent gases: HENRY NORRIS RUSSELL and DONALD H. MENZEL. There is a fairly general agreement of cosmic and terrestrial abundances of metallic elements, but a large discrepancy in the abundances of the permanent gases, in particular hydrogen, helium, nitrogen and neon. The obvious inference is that the earth has lost most of these gases initially present, as the moon has lost its atmosphere. An examination of the conditions of escape shows that this could have occurred only if the original temperature of the earth were very high, 5000° C. or greater. The cooling would have been very rapid, and the conclusion seems unavoidable that most of the loss occurred during the first few years if not the first few days of the planet's independent existence, with the loss of hydrogen practically immediate. For substances such as water and carbon dioxide, which may enter into the composition of molten magma, no difficulty arises. Under present conditions no atom could escape if purely thermodynamic conditions prevailed. Collisions of the second kind with excited metastable oxygen atoms could, however, impart to hydrogen and helium atoms velocities sufficient to enable them to escape. That such excited atoms are present is shown by the occurrence of the auroral lines.

Radial stellar pulsations of appreciable amplitude: T. E. STERNE (introduced by Harlow Shapley).

Discussion of magnitudes and colors from the Harvard photographic photometry: CECILIA H. PAYNE (introduced by Harlow Shapley).

The necessity for the existence of magnetic fields associated with sun-spot vortices: D. H. MENZEL and T. E. STERNE (introduced by Harlow Shapley).

Polarization of sun's rays reflected by the moon: F. E. WRIGHT. The percentage of polarization in sunlight reflected by different areas of the moon and at different phases was measured during the lunation, September 1 to October 19, 1933, by a visual method and also by means of a thermoelement and rotatable analyzer. In the visual method a special eyepiece was employed with which the percentage polarization can be ascertained under favorable conditions, to one tenth of one per cent. In this eyepiece a tiltable, plane parallel plate of thin celluloid compensates the plane polarization of the incoming light; a bi-quartz plate serves to rotate the plane of vibration plus 45° in the one half and minus 45° in the second half and to produce a photometric field; a second tiltable plate of thin celluloid is used to introduce a small amount of plane polarized light and thereby to increase the accuracy of the setting, following the practise of B. Lyot; a Savart plate with Nicol or Wollaston prism is employed to detect the presence of polarized light in the compensated beam. The eyepiece was used on the 6-inch refracting telescope of Mt. Wilson Observatory and functioned exceedingly well. The results obtained are shown in a series of tables and graphs. Discussion of the data of measurement, together with a comparison of the results of measurements on terrestrial materials, indicates, in agreement with previous work, that the lunar surface materials are of the nature of volcanic ashes and pumice.

Sun-spots and weather: CHARLES G. ABBOT. In the year 1908, Dr. George E. Hale at Mount Wilson Observatory discovered magnetism in sun-spots. He soon found that magnetic polarities are opposite in adjacent spots. Following up the investigation, it was disclosed that the order of the two polarities is opposite in the north and south solar hemispheres and that the order continues unchanged through each eleven-year sun-spot period, but reverses at the beginning of the next period. Thus it requires two eleven-year periods to bring the sun through a full cycle of magnetic changes. In 1931, the author discovered periodicities of approximately 7, 8, 11, 21, 25, 45 and 68 months in the variation of solar emission of radiation. Indications were found that these periodicities are reflected in terrestrial temperatures. Since November, 1932, assisted by Mrs. A. M. Bond, he has studied these periodicities in the departures from normal temperature at Bismarck, N. Dak. Although they are clearly present, changes of phase and amplitude occur in long ranges of time which hinder their usefulness for forecasting purposes. He has discovered that these changes of phase and amplitude in these periodicities of variation from normal temperatures at Bismarck, N. Dak., are functions of the numbers of sun-spots prevailing. The times of maximum in some periods are set forward by as much as half a period in passing from sun-spot minimum to sun-spot maximum. He attempted with some success to forecast temperature departures by combining periodicity and sun-spot data, but a better