

prolonged period of complex volcanic eruptions.

Independence of action at neighboring volcanoes, either as to period of eruption, volume of magma erupted, explosive or quiet character of action, or relative height of lava column in conduit of volcanoes, follows from local variation in the factors entering into the process of magma eruption, such as, the volume of magma involved in each conduit extending to profound depths, the shape of the conduit, the temperature of the magma; the rate of cooling; the amount of gas diffused in any given time; the character of the surrounding rocks; and the stability of the surrounding rock masses as a complex whole. The chemical composition of the magma is also a factor involved in the activity of a particular volcano. But the composition of the magma is also a feature by which volcanoes may show independence. Differences in the composition of rocks in neighboring volcanoes is to be sought in variation in the differentiation of magmas during the course of eruption from deep-seated to surficial positions.

Among the results of such differentiation may be mentioned the production of complementary rocks, which may occur in rock bodies of various forms. A special case of local differentiation, usually associated immediately with crystallization and solidification of parts of a magma, is the production of contemporaneous veins and pegmatites. When complementary rock magmas are erupted so close to one another in space and time that they come in conjunction while still highly heated, they may diffuse into one another, or blende to such an extent as to yield hybrid rocks, or mixed dikes, sheets, etc., as observed by Harker on the Isle of Skye.

The eruption of rock magmas through solid rocks and their solidification in various positions within or upon other rocks condition the modes of occurrence of igne-

ous rocks, as those of lava streams, dikes, sheets, laccoliths, etc. And the parting or cracking of the solid rock, upon cooling, or its arrangement after fragmentation in various ways leads to distinctive structures, such as columnar, spheroidal or brecciated.

Having acquired a knowledge of the general principles applicable to all igneous rocks, it is in order to consider more specifically those occurring in all known parts of the world: first, systematically, according to some comprehensive scheme of arrangement, or classification, and then according to the groups, or associations, in which they occur in various regions, that is, according to petrographical provinces, or co-magmatic regions.

In order to describe many rocks a nomenclature is necessary, and the confusion existing in that in present use is best understood by considering the history of the growth of petrography, and the changes that have gone on in the definition and use of the oldest and commonest rock names, and descriptive terms. With this review should be associated a sketch of the development of rock classification, which has been furnished to the student in an interesting form by Cross.

A successful treatment of the subject of igneous rocks along the lines indicated would go far toward the removal of petrology from a state of distracting empiricism, and the placing of it on a more rational foundation.

JOSEPH P. IDDINGS

WASHINGTON, D. C.

#### CONDUCT OF SCIENTIFIC WORK UNDER THE UNITED STATES GOVERNMENT<sup>1</sup>

*To the Senate and House of Representatives:*

In compliance with the provisions of section 8 of the act of Congress making appropriations

<sup>1</sup>Message from the President of the United States, transmitting a report of the National Academy of Sciences relating to the conduct of the scientific work under the United States government.

for sundry civil expenses of the government for the fiscal year ending June 30, 1909, approved May 27, 1908, I transmit herewith for the consideration of the Congress the report of the National Academy of Sciences relating to the conduct of the scientific work under the United States government.

THEODORE ROOSEVELT

THE WHITE HOUSE,  
January 18, 1909

NATIONAL ACADEMY OF SCIENCES,  
OFFICE OF THE PRESIDENT,  
Baltimore, January 16, 1909

*Sir:* The sundry civil act approved May 27, 1908, requests the National Academy of Sciences to consider certain questions relating to the conduct of the scientific work under the United States government, and to report the result of its investigations to Congress.

Immediately after the passage of the act a committee, consisting of five eminent men of science, none of whom held employment under the United States government, was appointed to make the necessary investigation. The members of that committee are:

R. S. Woodward, president of the Carnegie Institution of Washington, chairman.

W. W. Campbell, director of the Lick Observatory, Mount Hamilton, Cal.

Edward L. Nichols, professor of physics, Cornell University.

Arthur A. Noyes, acting president of the Massachusetts Institute of Technology.

Charles R. Van Hise, president of the University of Wisconsin.

Under date of January 9, 1909, this committee submitted its report to the council of the academy.

I have the honor to transmit herewith this report to Congress.

I am, sir, very respectfully,

IRA REMSEN,

*President National Academy of Sciences*  
THE SPEAKER OF THE HOUSE  
OF REPRESENTATIVES

REPORT OF COMMITTEE ON CONDUCT OF SCIENTIFIC  
WORK UNDER THE UNITED STATES GOVERNMENT  
*To the Council of the National Academy of  
Sciences:*

During the first session of the Sixtieth Con-

gress of the United States there was incorporated in the act making appropriations for sundry civil expenses of the government for the fiscal year ending June 30, 1909, the following section, namely:

SEC. 8. The National Academy of Sciences is required, at their next meeting, to take into consideration the methods and expenses of conducting all surveys of a scientific character and all chemical, testing and experimental laboratories and to report to Congress as soon thereafter as may be practicable a plan for consolidating such surveys, chemical, testing, and experimental laboratories so as to effectually prevent duplication of work and reduce expenditures without detriment to the public service.

It is the judgment of Congress that any person who holds employment under the United States, or who is employed by and receives a regular salary from any scientific bureau or institution that is required to report to Congress, should refrain from participation in the deliberations of said National Academy of Sciences on this subject and from voting on or joining in any recommendation hereunder.

In compliance with the terms of this legislation, the president of the National Academy of Sciences appointed the undersigned committee to consider the questions specified in said legislation, with a view of securing a report on or before the next annual meeting of the academy. This committee now has the honor to submit a report.

It should be explained, first, that in compliance with a request addressed by the president of the academy to the President of the United States, all of the executive departments of the government were directed to assist the representatives of the National Academy of Sciences in securing such information as might be necessary in preparing this report. The communication from the President of the United States announcing that such direction had been issued bears the date June 29, 1908. In conformity therewith numerous communications have been received by your committee from heads of departments and from bureaus and divisions of the government engaged in the kinds of work specified in the legislative act cited above.

In the second place, it should be stated that this committee has had access to the unpub-

lished preliminary report of a committee appointed by the President of the United States March 13, 1903, to consider many of the same questions here reported upon and others closely allied thereto. The chairman of the latter committee has also placed at our disposal a large mass of data collected by that committee.

In the third place, it should be stated that the members of your committee have been chosen in strict conformity with the requirements of the second paragraph of the legislative act quoted above.

A comprehensive interpretation of the functions of your committee shows that the field work for consideration is very large, and that it presents many difficulties requiring the most careful study before any final recommendations for legislative or executive action may be safely made. Nearly every department of the government is involved to a greater or less extent, while some departments, like the Department of Agriculture and that of Commerce and Labor, are carrying on scientific work in a great variety of ways. Thus, to illustrate the extent and variety of this work, it may be stated that surveys are now being carried on by seven different organizations under five different departments of the government; similarly, tests of apparatus, materials, foods, etc., are being made by the Bureau of Standards, by the technologic branch of the Geological Survey, by the Department of Agriculture, and to a minor degree by many other departments and bureaus of the government. Similarly, chemical work is carried on in many branches of the Department of Agriculture, by the Bureau of Standards, by the Geological Survey, by the Public Health and Marine-Hospital Service, and to a less extent by other branches of the public service.

It should be borne in mind also, in considering the present status of these organizations carrying on scientific work, that many of them have been so long established as to become integral parts of the departments to which they are assigned. Hence, any considerations looking to a consolidation or to a redistribution in the departments of these organizations should take into account their origin and historical development as well as their present

status. The experience gained through a long series of years by these organizations should indicate what special merits they possess as well as the defects of organization and efficiency they may now present.

In view, therefore, of the importance of the scientific work now carried on by the government, and in view of the certain prospect that it will increase rather than decrease in the future, your committee is disposed to look at the problems presented by this work with a desire rather to furnish constructive criticism and advice than to recommend any immediate and radical changes based on destructive criticism, however well founded the latter may be in some cases. In other words, it appears more important to your committee to provide for enlightened and efficient conduct of governmental scientific work in the future than to be influenced to any considerable degree by the imperfections of organization and the inefficiencies in conduct of that work in the past.

From a general survey of the field of work under consideration three facts appear to be clearly established, namely:

First. That the amount of actual duplication of work now carried on by the government bureaus is relatively unimportant: but that the duplication of organizations and of plants for the conduct of such work is so considerable as to need careful attention from Congress in the future.

Second. That while the consolidation of some branches of work now carried on in several organizations is probably advisable, specific recommendations in reference to such consolidation can be made wisely only after a careful consideration of all the facts by the board hereinafter suggested or by some similarly competent body.

Third. That there has never been hitherto and there is not at present anything like a rational correlation of allied branches of scientific work carried on by the government.

This last fact appears to your committee by far the most important one presented for consideration. The lack of any well-defined plan for the development of such work, its distribution in various departments, and the lack of any systematic scheme of interrelations of the

bureaus carrying on this work have led inevitably and properly to the questions submitted by Congress to the academy.

It is plainly desirable, therefore, that Congress should make immediate provision to guard against a continuance of the evils which arise from a lack of any definite plan for, and from the absence of any adequate correlation of, the scientific work of the government.

It appears to your committee that the best way to deal with the condition now confronting the government is to secure the appointment by Congress of a permanent board which shall meet at stated intervals in each year for the consideration of all questions of the inauguration, the continuance, and the interrelations of the various branches of governmental scientific work. We would suggest that such a board should consist of the heads of bureaus carrying on scientific work, of two delegates from each of the Houses of Congress, and of five to seven eminent men of science not connected with the government service.

By means of a few meetings per year, with authorization to secure the requisite information from the heads of departments and bureaus concerned, all of the complicated questions which now are at best only ill considered could be carefully determined with great advantage in point of economy and efficiency to the public service and with little or no additional expense thereto.

Such a board could take under consideration the prevailing lack of system and lack of correlation in the work in question and gradually remove these defects from existing bureaus and divisions of the public service. All questions of the assignment, of the conduct, of advisable consolidation, and of the economies of such work could be fully discussed and determined in the best interests of the government by such a board. If the heads of bureaus and divisions were required to submit their projects and estimates for work to this board before transmission to the heads of departments and to Congress, all questions of the duplication of work, of the duplication of organizations, of the duplication of laboratories or equipments, and of the most economical assignment could be readily determined

without interference in the details of management of the organizations concerned.

One of the most important functions of such a board should be that of the nomination or selection of men competent to take charge of new projects or to fill vacancies which may arise in the more important positions of the scientific work in question. It would thus be generally possible to prevent the assignment of an incompetent man to the charge of a highly technical or specialized branch of the public service. It would thus be possible also to secure men of the highest professional attainments and to prevent the calamity which has not infrequently occurred in the past of assigning important scientific work to unprofessional or incompetent men. It would thus be possible likewise to take advantage of the competition between different branches of the public service in the laudable desire of those branches to prove their efficiency by the accomplishment of the required work of the government in the best and most economical ways.

Very respectfully submitted.

R. S. WOODWARD,

*Chairman,*

W. W. CAMPBELL,

EDWARD L. NICHOLS,

ARTHUR A. NOYES,

CHARLES R. VAN HISE

WASHINGTON, D. C.,

January 9, 1909

#### *RECENT WORK OF THE MOUNT WILSON SOLAR OBSERVATORY*

MONOCHROMATIC photographs of the sun have been made daily on Mount Wilson since October, 1905, with the Snow telescope and five-foot spectroheliograph. The weather has been very favorable, permitting calcium, hydrogen and frequently iron images to be taken on 303 days in 1908, and on 113 consecutive days during the summer of 1907. Prior to March, 1908, the hydrogen photographs were made with the light of the violet line  $H\delta$ . Since that time, with the aid of plates sensitized by Wallace's formula, excellent results have been obtained with the red hydrogen line  $H\alpha$ . These record the phenomena of a region in the solar atmosphere higher than that previously