religion, mysticism, and metaphysics; 3.5 per cent. of the titles were mixed and indefinite; 4 per cent. dealt with animal psychology; 36 per cent. with human psychology; and 6.5 per cent. with what approached physical and general anthropology.

I found further that the publications included in your index, and hence those in which you are interested, range from anatomy and histology of the nervous system to mathematics on the one hand and metaphysics on the other, covering practically the whole vast range of phenomena relating to the nervous system and mental activities of man and animals. This shows indefiniteness, incomplete crystallization.

As psychology advances, its field will doubtless become better differentiated, and possibly separated into a number of special subbranches. When this happens the relations of the various subdivisions of psychology and those of anthropology will be more evident and easier of precision. It will then be found that your anatomical and physiological section will have many points of contact with physical anthropology, while your sections on behavior, beliefs, habits, dreams, etc., will connect in many respects with the anthropological studies which are to-day grouped under the terms of ethnology and ethnography.

However, even such clarified relations would be of no great importance, were it not for the fact that psychology must as time passes on enlarge the scope of its activities, until no small part of these shall really become anthropological.

And here I must define anthropology. Its old definition as the "science of man" is not sufficient, being too comprehensive and too indefinite. But if you will examine the activities in any branch of anthropology, you will find that although they deal with a vast array of subjects they are all characterized by certain something distinctive, and this is the *comparative* element. Anthropology is essentially a science of comparisons. It is comparative human anatomy, physiology, psychology, sociology, linguistics, etc. And being comparative it does not deal with individuals or mere abstract averages, but with groups of mankind, whether these are social, occupational, environmental, racial, or pathological. In brief, it is the science of human variation, both in man himself and in his activities.

Let us now return to psychology. In the course of its development, psychology will unquestionably find its choicest field in group studies. It has already begun in this direction. It compares classes with classes, as during the late war; it will enter in the not far distant future into race psychology; and it will compare other definite human groups with groups, study their variations and the causes of these, study evolution, involution, and degenerations of the nervous organs of mankind as a whole—and all this will be or be very near to anthropology.

A word in conclusion. Anthropology and psychology as they are to-day, are fairly independent branches of scientific activities, with no closer actual bonds and interdependence than those that exist, for instance, between either of them and sociology, or history. But in their further development and particularly that of psychology, the two branches will approach closer together until an important part of their activities will be in the same orbit.

A. HRDLIČKA

THE FUNCTIONS AND IDEALS OF A NATIONAL GEOLOGICAL SURVEY. II

Kinds of Work to be Undertaken by a National Geological Survey.—There has been considerable difference of opinion as to the kinds of work that should be undertaken by a national geological survey. Shall its field be confined to what may be included under geology or shall it embrace other activities, such as topographic mapping, hydrography and hydraulic engineering, mining engineering, the classification of public lands, the collection and publication of statistics of mineral production and the mechanical arts of publication such as printing and engraving. These various lines of activity may be divided into two main classes—those that are more or less contributory to or subordinate to the publi-

cation of geologic results, and those that have little if any connection with geology.

The speaker is one of those who believe that a geological survey should be essentially what its name implies—that it should confine its activity to the science of geology. This opinion is held, however, in full realization of the fact that here as elsewhere some compromise may be necessary. This may be dictated by law or may be determined by policy.

The organic law of the U. S. Geological Survey, for example, includes among the duties of the organization "the classification of the public lands." There may be some difference of opinion as to what the framers of the law meant by this provision, but it is at least a reasonable conclusion that they intended the sort of classification adopted by the General Land Office. If so, the determination of the so-called "mineral" or "non-mineral" character of public lands is undoubtedly a proper function of the U. S. Geological Survey, although it is one that was neglected by that survey for many years and has not yet received the recognition of a specific appropriation, except recently, in connection with the stock-raising and enlarged homestead acts.

Topographic Mapping.—Inasmuch as the preparation of a topographic map is a necessary preliminary to accurate and detailed geologic mapping, a geological survey is vitally interested in seeing that satisfactory maps are available as needed. Whether the national geological survey should itself undertake this mapping depends upon circumstances. If another government organization is equipped for doing this work and can provide maps of the requisite quality when needed, it would appear that the geological bureau should leave this work to the other organization, particularly as the maps required to keep abreast of geologic requirements are likely to constitute only a part of the work of the topographic bureau. There are certain decided advantages, however, in having the topographic work done by the geological survey and these advantages must be weighed against other considerations. With the topographic and geologic work under a single control, the geologist is more likely to be assured of getting the kind of map desired at the time needed. Cooperation between geologists and topographers is apt to be both closer and more flexible than were the two staffs in separate organizations. Finally the field work in topography and geology is in some respects alike and is carried out by similar methods and equipment. Occasionally the two kinds of work can be combined and carried on simultaneously.

The general question, Whether a national geological survey shall do its own topographic mapping, appears to be one that can not be answered once for all but must be determined for each country. In an old country where accurate and detailed maps have long been made by military and other organizations, a geological survey may be under no necessity of providing its own topographic base maps. In a new country, where exploration is still in progress, the geological survey may have to make its own topographic surveys. The The main point, as I see it, is that the geological survey must have maps of the standard required by it with the least possible delay, but should not undertake to make them itself if other organizations that can and will provide the maps needed are already in the field.

We have seen that there is at least a very close connection between topographic and geologic mapping and that in this relation may lie a sufficient reason why both kinds of work should be undertaken by the same organization. Is there as good a reason why the study of geology and the collection of statistics of mineral production should be united?

Statistics of Mineral Production.—When shortly after the organization of the U. S. Geological Survey the collection of statistics was begun, those geologists who were most influential in urging that the survey should undertake statistical work adduced as the principal reason that the people desired such figures and if the Geological Survey did the work it would be able to secure larger appropriations than if the task were left for others.

It does not appear to have been thought at that time that geologists were the only men who could satisfactorily do statistical work or that it was necessary to impose this task on them. Subsequently, however, the work was apportioned among the geologists. The reasons for this step appear to have been first, that the results of having the statistical reports prepared under contract by specialists who were not on the regular staff of the organization had proved unsatisfactory; second, that by apportioning the work among the geologists already on the staff not only would the apparent cost in money be less than under the former arrangement, but it would, in a book-keeping sense, be very much cheaper than taking on new men for this particular work; finally, it was argued that geologists could apply their knowledge of the field relations of ore deposits to improve the character of statistical reports and would themselves benefit by additional opportunities to visit and examine many deposits that they might not otherwise see.

It is undoubtedly true that the statistical reports of the United States Geological Survey have greatly improved in accuracy, fullness, and general interest since this plan was adopted. It is also true that some geologists have turned their opportunities as statistical experts to good account both in enlarging their experience and by gathering material that has been worked into geological papers. Nevertheless, the policy has, in my opinion, been a mistake both economically and scientifically. It has insidiously filched the time of highly trained men who have shown originality and capacity for geologic research and has tied these men down to comparatively easy and more or less routine tasks. Some geologists who were once scientifically productive no longer contribute anything to geological literature but are immersed in work that men without their special geological training could do as well. To a certain extent the policy is destructive of scientific morale. A young geologist sees that a man who publishes annually or at shorter periods reports on the statistics of production of some metal becomes widely known to all interested in that metal and is considered by them as the United States Geological Survey's principal expert on that commodity. This easily won recognition, with all that it implies or seems to imply in the way of promotion and of industrial opportunity must constitute a real temptation so long as a scientific man is expected to contribute his own enthusiastic devotion to science as part payment of his salary. The incidental geological opportunities offered by statistical work are found chiefly in connection with a few of the minor mineral resources, rather than with such industrially dominant commodities as petroleum, iron or copper, and these opportunities for the individual geologist are soon exhausted and are likely to be purchased at a price far out of proportion to their value. The supposition that geological training is essential for good statistical work in mineral products is a fallacy, and no man who shows promise of making real contributions to geologic science should be placed in such circumstances that he is virtually forced to worship an idol whose head may be of gold and precious stones but whose feet are assuredly of clay. I am emphatically of the opinion that the collection of mineral statistics is not logically a function of a national geological survey. If, however, such a survey is committed to this task by law, by the lack of any other organization to do the work, or by well considered reasons of policy, then it is even more certain that the duty should not devolve upon geologists at the expense of their own science, but should be cared for by a special staff. Some cooperation between the statistical staff and the geologic staff may be advisable but the extent of this cooperation should be determined by those fully alive to the necessity of safeguarding geology against encroachments by statistical work.

Water Resources.—Studies concerned with the occurrence of underground water are of course as much geological as those concerned with the occurrence of petroleum. Investigations of surface waters, however, including stream gaging and the study of water-power

come within the field of engineering and have so little connection with geology that it is difficult to see any logical ground for their inclusion within the group of activities belonging properly to a geological survey. In an ideal apportionment of fields of endeavor among the scientific and technical bureaus of a government, stream gaging and estimation of water-power would scarcely fall to the national geological survey. As it happens, the United States Geological Survey does perform these functions and I am not prepared to say that there is not ample legal and practical justification for this adventitious growth on a geological bureau. There has been little or no tendency to draft geologists into hydraulic engineering and consequently the principal objection urged against the inclusion of statistical work within the sphere of a geological survey does not here apply. Apparently the only practical disadvantages are the introduction of additional complexity into a primarily scientific organization and the consequent danger of the partial submergence of principal and primary functions by those of adventitious character.

It should be pointed out in this connection that certain studies of surface waters, especially those that are concerned with the character and quantity of material carried in suspension and in solution in river waters, have much geological importance. Such studies supply data for estimating the rate of erosion and sedimentation. They are to be regarded, however, rather as an illustration of the way in which geology overlaps other branches of science and utilizes their results than as reason for considering hydraulic engineering as normally a function of a geological survey.

Foreign Mineral Resources.—One of the results of the war was to suggest the advantage to the citizens and government of the United States of a central source of information concerning the mineral resources of foreign countries. The United States Geological Survey undertook to gather this information, primarily for the specific purpose of supplying data to the American representatives at the Peace Conference. As the director of the survey states in his fortieth annual report:

> Two general purposes were served—first that of obtaining a clear understanding of the relations between our own war needs and the foreign sources of supply from which these needs must or could be met; second, that of obtaining an understanding of the bearing of mineral resources upon the origin and conduct of the war and upon the political and commercial readjustments that would follow the end of hostilities.

This work, of a kind that so far as known had not previously been undertaken by any national geological survey, has been continued with the view that it is important for those who direct American industries to possess as much information as possible concerning those foreign mineral resources upon which they can draw or against which they must compete. The results aimed at are directly practical and are largely obtained by compilation of available published and unpublished material as it is manifestly impossible to make direct detailed investigation of the mineral resources of all foreign countries. Nevertheless the work appears to fall appropriately within the field of a geological bureau and if it can be made to furnish the opportunity, hitherto lacking, for geologists in the government service to make first-hand comparison between our own mineral deposits and those of other lands the experiment will probably bear scientific fruit.

Mineralogy and Paleontology.—Mineralogy and paleontology are so closely related to geology that there can be no question of the propriety of including the pursuit of these sciences within the scope of a geological survey.

Chemistry and Physics.—The application of chemistry and physics to geological problems admits of more discussion. Chemical work, however, as carried on in connection with geological investigations is of such special character and must be conducted in such intimate contact with geological data as to make it almost certain that better results can be obtained with a special staff and equipment than would be possible were the routine

and investigative work in geological chemistry turned over to some central bureau of chemistry. The same argument is believed to be applicable also to physics. Research in geophysics was at one time a recognized function of the United States Geological Survey but since the founding of the geophysical laboratory of the Carnegie Institution of Washington, this field has been left almost entirely to that splendid organization which is unhampered by some of the unfortunate restrictions of a government bureau. Under these particular and unusual conditions this course may have been wise, although it does not negative the conclusion that, in general, investigations in geophysics are logically and properly a function of a national geological survey.

Soils.—The study of soils, with reference to origin, composition and classification, is unquestionably a branch of geology, but the geologist, with tradition behind him, generally looks upon soil as a nuisance and geological surveys have reflected his attitude. In the United States the classification and mapping of soil types has for some years been in progress by the Department of Agriculture. While quite devoid of any enthusiasm for engaging in soil mapping, I wish to point out merely that this work, if its results justify its performance by the government, and if the classification adopted is based on chemical, physical and mineralogical character rather than on crop adaptability, is properly a function of the national geological survey.

Seismology.—Another subject that is comparatively neglected by national geological surveys is seismology. It can scarcely be asserted that earthquakes have no economic bearing and conspicuous or destructive examples usually receive some official attention —after the event. The comparative neglect of systematic study of earthquakes is probably due to a number of causes. One of these is that few geologists specialize in seismology—a science in which little progress can be made unless the investigator possesses unusual qualifications in mathematics and physics. Another reason probably is that to most men the difficulties in the way of gaining real knowledge of the causes of earthquakes and especially of predicting with any certainty the time, place, intensity and effects of earthquakes appear rather appalling. Finally earthquake prediction or even the recognition of the possibility of future earthquakes in a particular part of the country is likely to have consequences decidedly unpleasant to those responsible for the prediction. Experience in California has shown that a community still staggering from a violent shaking may insist with some acerbity that nothing of any consequence has happened and that it never felt better in its life.

Notwithstanding these difficulties, I believe that a national geological survey, in a country where serious earthquakes have taken place and may occur again, should consider the collection and interpretation of seismological data as part of its duty. Such work is regional in scope and can not be carried far by local initiative and by individual investigators on their own resources. In spite of difficulties I believe that it is within the range of possibility that some day we shall be able to predict earthquakes with sufficient reliability to give the prediction practical utility.

Summary.—Briefly summarizing what has gone before, I conclude that the chief primary function of a geological survey is geological research and that the spirit of investigation should be the same whether the work is undertaken to increase knowledge and to serve as the starting point for further attacks on the unknown, or is begun with a definite economic or practical result as its desired goal. Compromise and concession are inevitable but the necessity for making them should not and need not permit the real purpose of the organization to sink from sight. If the members of a scientific bureau can confidently feel that those charged with its direction make such concessions wisely with the higher purposes of the bureau really at heart their whole attitude towards their work will be entirely different from that into which they will fall if they become convinced that scientific ideals receive

only perfunctory regard and that the real allegiance is directed elsewhere.

What may be called the chief secondary function of a national geological survey is believed to be popular education in geology both for the benefit of the people and as providing the most enduring basis for the support of such an organization by a democracy. Such education should be conducted through every possible channel and in close cooperation with all of the educational institutions of the country. One of its objects should be the revival and encouragement of amateur geological observation and study. In this connection I heartily approve the present trend in the policy of the American Association for the Advancement of Science and believe that this great organization will fulfill its purpose and advance science much more effectively than in the past if it will leave to the various special scientific societies the holding of meetings devoted to the presentation of scientific papers, and devote itself to the popularization of science and to the encouragement of cooperation between different branches of science.

Personnel.—Finally a few words may be said concerning the relation between the personnel of a geological survey and the results obtained by the organization. If such a survey is to attract to its service men of first-rate ability and to hold these men after their development and experience has made them of the highest value, certain inducements must be offered. Salary is unfortunately the first of these that comes to mind under conditions that continually force the scientific men in government service to recognize painfully how inadequate at present is the stipend upon which he had existed before the war. It is all very well to insist that the scientific man does not work for money and should not trouble his thoughts with such an unworthy consideration. Nevertheless if he is to do the best of which he is capable he must be lifted above the grind of poverty, be able to give his children those educational advantages that he can so well appreciate, have opportunity for mental cultivation and feel his social position to be such that he can mingle without humiliation with his intellectual peers. If it is destructive to the scientific spirit to set up material gain as an object it may be equally blighting to scientific achievement to force the attention continually downward to the problem of meager existence. The normal scientific man usually has other human beings dependent upon him and the traditional spirit of self-sacrifice and the indifference to material reward that are commonly attributed to the true investigator may, when these members of his family are considered, come very close to selfishness.

However, salary, important as it is, is by no means the only determinant. If it is reasonably adequate most men who are animated by the spirit of science will find additional reward in their work itself if this is felt to be worthy of their best efforts. A man of first rate scientific ability, however, will not enter an organization in which consecutive application to a problem is thwarted, in which he is expected to turn to this or that comparatively unimportant task as political expediency may dictate or in which the general atmosphere is unfavorable to the initiation and prosecution of research problems of any magnitude. If a man of the type in mind finds himself in such an uncongenial environment he is likely to go elsewhere. The final effect upon the organization will be that its scientific staff will be mediocre or worse and it will become chiefly a statistical and engineering bureau from which leadership in geology will have departed.

If, on the other hand, a young geologist can feel that every possible opportunity and encouragement will be given to him in advancing the science of geology; that results on the whole will be considered more important than adherence to a schedule; that imagination and originality will be more highly valued than routine efficiency or mere executive capacity; that he will not be diverted to tasks for which, important as they may be, his training and inclination do not particularly fit him; that those directing the organization are interested in his develop-

ment and will give him all possible opportunity to demonstrate his power of growth; and that appreciation and material reward will be in proportion to his scientific achievement; he will then be capable of the best that is in him and will cheerfully contribute that best to the credit of the organization that he serves.

A national geological survey should hold recognized leadership in geology in the country to which it belongs and attainment of this proud position must obviously depend upon the quality of its geological personnel. With respect to personnel at least three conditions may be recognized—first, that in which the ablest geologists in the country are drawn to, and remain in service; second, that in which geologists perhaps of a somewhat lower grade as regards scientific promise are attracted to the service for a few years of training and then pass out to positions where the opportunities for research or for increased earnings are greater; and third, that in which able young men no longer look upon the geological survey as a desirable stepping stone to a future career. Who can doubt that it is the first condition that raises an organization to preeminence in science and the last that marks opportunities lost or unattained? Those responsible for the success of a geological survey, if they be wise, will watch the trend of the organization with reference to these conditions much as the mariner watches his barometer and, like him, if the indication be threatening, take action to forestall disaster.

F. L. RANSOME

DAVID S. PRATT

DR. DAVID S. PRATT, formerly assistant director of the Mellon Institute of Industrial Research of the University of Pittsburgh, died in St. Louis, Mo., on January 28, after a short illness from pneumonia. He was a member of the American Chemical Society and of the following fraternities: Phi Kappa Sigma, Sigma Xi, Alpha Chi Sigma, and Phi Lambda Upsilon.

Dr. David Shepard Pratt was born in Towanda, Pa., on September 20, 1885, the son of Charles Manville and Louise Hale (Woodford) Pratt. Following the completion of the collegiate course at Cornell University (A.B., 1908), he was appointed a fellow in chemistry at that institution (1909-1911) and in 1911 he received the degree of Ph.D. Dr. Pratt then joined the staff of the Bureau of Chemistry, Washington, D. C., as asistant chemist, but shortly afterward was selected as chief of the Organic Division of the Bureau of Science in Manila, P. I., where he spent three productive years in chemical research and as a member of the Pure Food and Drug Board. In 1914 he decided to return to the states and accepted a professorship of chemistry at the University of Pittsburgh. Dr. Pratt occupied that chair and the headship of the organic department of the school of chemistry at "Pitt" from 1914 to 1917, in which year he was made an assistant director of the Mellon Institute of Industrial Research. On January 1, 1920, Dr. Pratt resigned at the institute and was arranging to enter consulting chemical practise in St. Louis, Mo., at the time of his fatal illness.

Dr. Pratt was known principally for his published investigations on phthalic acid derivatives, but his reports of researches on various problems in the domain of tropical chemistry have also been of importance and he was a recognized authority on chemical Philippiniana. At the Mellon Institute Dr. Pratt enjoyed broad opportunities to apply, in the inquiries of the industrial fellowships under his supervision, his splendid equipment in chemistry and many results of technical importance were obtained through his suggestive aid. His profound knowledge of pure organic chemistry and his familiarity with research methodology were respected by his associates and played a prominent part in establishing the high success of the system in operation at the institute. His departure to enter professional practise was sincerely regretted by all of the members of the institution. He is survived by his wife, Fredonia Elizabeth (Johnson) Pratt, and an infant son, David Shepard Pratt, Jr.

W. A. H.