part in the work, for to get the best results will require the best effort of the best heads in the state. A governing board consisting of the governor, the president of the university, the president of the school of mines, the president of the agricultural college or the director of the experiment station, the president of the academy of sciences, arts and letters, with perhaps the president of the state board of horticulture and the president of the society of engineers, would certainly be above criticism, and would adopt a broad and liberal policy that would bring about excellent results.

The plan of operation should, of course, be left to the governing board, but the bill should specify the scope of the survey, which should include both the geology and the natural history of the state. This is the belief of those who have had much to do with the older surveys.

The expense should be modest for a beginning, and the work should be developed as necessities may warrant, or men of ability in special lines may be secured. A tax of one tenth mill for fish and game produces a revenue of from $17,000 to $18,000. A tax of equal amount for a state survey will give it a good start and make it possible to do most valuable work. An appropriation of not less than $10,000, and possibly $15,000, will enable the work to start at once with sufficient breadth to develop in several directions.

The work of the survey will take many years. Most of the work in the field will be in the summer. I doubt not men from the state institutions can be secured without big outlay for salary. This is at least to be expected. It will no doubt take years to carry out some of the outlines that will develop. Men living in the state who are in the employ of the state and who are fitted should be most valuable in many ways. Others not in state institutions will be found who will no doubt gladly assist, and there are many such who are competent. There is a long list of competent men to be found in the state, competent for some one line of work, at least. A few of these are already on the roll of the academy; more of them should be.

The above plan is, I believe, feasible. In one year the legislature meets. The state is in good financial condition. There is no reason why the survey should not be started. Some one must start it. The academy should foster the move. I advocated the move last year at our first meeting. I repeat it and urge action on the part of the academy. Speak of it through the press. Present it to those who have influence. If we all work zealously and earnestly it will surely go.

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SCIENTIFIC BOOKS.

The Harriman Alaska Expedition. Vol. III., *Glaciers and Glaciation.* By GROVE KARL GILBERT, pp. i–xii, 1–231; 18 plates and 106 figures. Vol. IV., *Geology and Paleontology.* By B. K. EMERSON, CHARLES PALACHE, WILLIAM H. DALL, E. O. ULRICH and F. H. KNOWLTON, pp. i–x, 1–173; 33 plates and 18 figures. Published by Doubleday, Page and Company, New York, 1904. Size 7 by 10 inches.

Volumes one and two of the Harriman Alaska Expedition, containing a narrative of the journey and treating of the glaciers, natives, history, geography and resources of Alaska, were published in 1901. The two volumes recently issued are of special interest to geologists, and still others, as is understood, devoted to botany and zoology, are yet to come.

The Harriman Expedition, it will be remembered, was primarily a journey for pleasure and recreation, which twenty-three literary and scientific men were invited to accompany and it became a scientific reconnaissance embracing a wide range of subjects. The expedition

was conducted munificently and the series of sumptuous reports in process of publication under the editorship of Dr. C. Hart Merriam, are in keeping with the princely spirit manifest throughout the undertaking. The volumes that have appeared command attention and invite examination on account of their elegance and the good taste displayed by them. The artistic spirit which pervades them, although prominent, is subordinated to the faithful presentation of scientific results. The series of reports when completed will form a monument to the broad-mindedness of the originator of the expedition, such as no shaft of sculptured marble could furnish.

There is another point of view, however, from which the beauty and costliness of dress of the volumes in question may be considered. They are issued by a publishing house at $7.50 per volume, a price which puts them beyond the reach of many persons who would be glad to possess them. Although final reports so far as the Harriman Expedition is concerned, in reality they contain only the returns from a rapid reconnaissance. The distance from Puget Sound to Plover Bay, Siberia, and return, over eight thousand miles, was traversed by the expedition in fifty-eight days. As reports of such a voyage, during which much time was consumed in unprofitable travel, is it becoming to publish in so costly a manner? The thick paper, title pages in red and black, gilt tops, scores of plates, many of them in colors, tinted sketch-maps, vignettes, artistic chapter headings, etc., of these beautiful specimens of the bookmaker's art, like Easter bonnets and jeweled rings, are open to the criticism that the money they represent could have been better spent.

Glaciers and Glaciation.—Of all the branches of science represented by the men who accompanied the Harriman Expedition, the opportunities for study were certainly more favorable for the glacialist and the student of topographic forms than for any one else. At almost any locality from Puget Sound to the Aleutian Islands, where land is in sight, the student of glaciers and of the changes they make in the shapes of valleys, etc., can find material of special significance. In this connection Gilbert says:

> The glacier-bearing belt includes about three tenths of the vast territory of Alaska. Its exploration has but begun, yet enough is known to give it rank as the third great glacier district of the world, only the Antarctic continent and Greenland surpass it. Its ice may be roughly estimated to occupy a tenth of the surface, or an absolute area of between 15,000 and 20,000 square miles, and its expanse is so divided and scattered as to offer to the student the utmost variety of local conditions and detail. Of alpine glaciers, such as would receive individual names if near the homes of men, there are many hundreds, possibly more than a thousand; of broad, composite fields, like the Muir and Malaspina, there are about a half dozen; and more than thirty are known to reach the coast and cast bergs into the sea.

Of the vast mantle of snow and ice covering so much of Alaska, the members of the Harriman Expedition saw only a portion of the lower fringe. In southeastern Alaska and extending as far west as Yakutat Bay, the ground gone over by previous explorers was reviewed and many new facts obtained, and several modifications of previous conclusions arrived at. To the west of Yakutat Bay, and especially in the region of Prince William Sound, a fresh field for glacial studies was discovered and many important observations in reference to the distribution of glaciers, their fluctuations in length, etc., put on record. More than a dozen alpine glaciers of large size were discovered and several emptying into College Fiord were named in honor of American colleges and universities. The chief addition made to previous knowledge of the geography of the coast was the discovery of Harriman Fiord, a magnificent glaciated valley now in part occupied by the water of the sea, with many glaciers on its border, and a superb tidal glacier at its head.

The principal observations pertaining to existing glaciers presented by Gilbert may be conveniently grouped in five categories:

1. The distal ends of glaciers which terminate in the sea are shown to undergo fluctuations in length owing to seasonal changes in atmospheric conditions. These variations

are so pronounced that comparisons of the records of the position of the ice-wall of a tidal glacier made in different years need to be corrected for the time of year.

2. The influence on shore topography of the waves generated by bodies of ice which fall from tidal glaciers, or 'ice-fall waves,' is noted for the first time, and the possible influence of such waves on the shore features of partially ice-walled Pleistocene lakes suggested.

3. Anomalies in the fluctuations of neighboring alpine glaciers, as, for example, when one advances and another in an adjacent valley recedes, find many illustrations in Alaska. A discussion of the possible causes of such discordant changes when the conditions on which they are believed to depend are general and wide reaching is presented and is most suggestive.

4. The peculiar steep-sided depressions, many of them containing lakes, well known in certain formerly glaciated regions, are illustrated in the gravel deposits in front of several of the Alaskan glaciers which have recently retreated. The explanation of the origin of such depressions, first advanced, I believe by Professor W. O. Crosby, is that they are due to the melting of detached bodies of ice that were surrounded or covered by gravel deposits. The discovery of additional recent and typical examples of this nature by Gilbert gives greater confidence in the commonly accepted explanation.

5. A characteristic feature of the topography of formerly glaciated mountains is the occurrence, on the sides of the valleys once occupied by main or trunk glaciers, of tributary glaciated valleys which open into the main valleys high above their bottoms. Such tributary valleys have been termed 'hanging valleys.' The coast of British Columbia and southeastern and southern Alaska is exceptionally favorable for the study of the topographic features referred to; and in the volume under review several characteristic examples are described and admirable pictures of them presented.

The author favors the view that hanging valleys are due to the greater erosive power of a large trunk glacier over that of its shallower tributaries. That is, the discrepancy between the level of the bottom of a hanging valley and the bottom of the larger valley into which it opens is due to differential ice-erosion; the idea being that the surfaces of two glaciers which unite, are on the same level, while the bottoms of the valleys they occupy are deepened so as to be adjusted respectively to the thickness of the ice streams occupying them.

The explanation of the origin of hanging valleys by differential ice-erosion, while clearly and forcibly presented by the author, will, I think, fail to satisfy many persons who are familiar with the topography of formerly glaciated mountains. In view of the fact that Professor J. C. Branner reports hanging valleys on the Hawaiian Islands, where no suggestion of former glaciation can be claimed (*Am. Jour. Sci.*, Vol. XVI., 1903, p. 301), and that Gilbert in the volume under review with characteristic candor presents a sketch of a representative example in the mountain-wall of Plover Bay, Siberia, where concurrent evidence of glaciation is absent, suggest that at least two sets of conditions may have produced similar topographic forms. Again, in well glaciated mountains like the Cascades and Sierra Nevada, the great differences in level between a main valley and its tributary hanging-valleys, amounting in some observed instances to 1,500 or 2,000 feet, and this where the main valley is short and has but a comparatively small gathering ground for snow, must needs make the conservative glacialist pause before accepting the conclusion that such great discrepancies are due solely to differential ice-erosion. Other considerations in this connection might be mentioned, such as the fact that a deep glaciated valley with hanging valleys along its sides not infrequently heads against a cliff, and its direct continuation above the cliff also has the characteristic of a hanging valley. Then, too, hanging valleys may be claimed to occur on the sides of steep mountains, and on slopes overlooking the sea, where no evidence of a controlling ice body at a lower level is obtainable.

The above suggestions are presented and others might be added, for the purpose of indicating that the explanation of the origin of

hanging valleys, presented by Gilbert, although seemingly complete and unassailable, is perhaps not final.

In the volume under review the term 'tidal glacier' is substituted for the previously used and longer term 'tide-water glacier,' to designate ice streams which end in the sea. This substitution is welcome on account of its greater brevity, but I doubt if its meaning will be as readily grasped by the general reader as in the case of the longer term.

In the sections presented by Gilbert of the ends of tidal glaciers, the ice is represented as overhanging, and the only mode of formation of bergs that is recognized is from the breaking away of exposed portions of an ice cliff and their fall into the water at its base. The view is favored that the sea water causes a more rapid melting of the submerged portion of a glacier which advances into it, than occurs on the part of the ice above water. There can be no difference of opinion in this connection so far as the formation of most bergs from the glaciers of Alaska is concerned, but the 'blue bergs' which occasionally rise to the surface of the water at a distance of several hundred, and as estimates indicate, fully a thousand feet in some instances, in front of the visible ice-cliff of a tidal glacier, certainly indicate exceptional conditions. The birth of bergs from the extended submerged extremity of a glacier does not seem to have been observed during the Harriman Expedition.

In a chapter bearing the caption, 'General Considerations as to Glaciers,' four groups of features are discussed. (1) The broader characters of the surfaces of the lower portion of a glacier, or the 'glacier proper,' such as its evenness of surface as compared with the contours of the rock-floor on which it rests; lateral ice-cliffs due to heat reflected from the adjacent land and the influence of margining streams; and 'crevass cycle,' or the sequence of changes a series of crevasses, such as forms below an ice cascade, pass through. (2) Glacial sculpture, in the consideration of which the conspicuously different results produced by abrasion and 'plucking' are described and illustrated by photographs and sketches. (3) The pressure and erosive power of tidal glaciers, in the consideration of which an interesting theoretical discussion is indulged in in reference to the manner in which the distal end of a tidal glacier is supported. (4) The resemblances, differences, homologies and analogies of streams of water and glaciers, are clearly and most instructively indicated.

As I have attempted to show, Gilbert's sumptuous volume is most welcome to the special student of glaciers, both on account of the new facts it contains and of the new thoughts presented. It is clearly and concisely written, and must appeal to the general reader and entice him to make still more arduous journeys through the fields of glacial literature. One of its chief values is as a reading lesson for advanced students in college classes.

Geology and Paleontology.—Volume IV. of the Harriman Alaska Expedition bears internal evidence of being based on a reconnaissance much more clearly than its companion volume on glaciers and glaciation. Its table of contents reads: 'Introduction,' by G. K. Gilbert; 'General Geology,' by B. K. Emerson; 'The Alaska-Treadwell Mine,' 'Geology about Chichagof Cove,' and 'Minerals,' by Charles Palache; 'Mesozoic Invertebrate Fossils,' by William H. Dall; 'Fossils and Age of the Yakutat Formation,' by E. O. Ulrich and 'Fossil Plants from Kukak Bay,' by F. H. Knowlton.

A noteworthy result of the geological studies, as is stated by Gilbert in the introductory chapter, is the correlation on fossil evidence of slates and shales in three widely separated localities—Yakutat Bay, Prince William Sound and Kadiak Island—and the determination of their age as Jurassic. The correlation referred to of terranes in areas over 500 miles apart, as stated by Ulrich, 'is by means of a fossil species of definite character, *Terebellina palachei,* common to them all.' This fossil is the type of a new genus of burrowing worm, of which only the tubes it made, composed of cemented sand-grains, have been discovered. The assignment of a Liassic (Lower Jurassic) age is based mainly on four species of algæ belonging to two genera which

have been identified with European forms. One of the genera is reported only from the Lias and the other ranges from the Lias to the Trias and Tertiary. Besides these fucoids, the worm tubes referred to above and a new genus of lamellibranch are used in determining geological age; as stated in the text, the evidence furnished by the worm-burrows and the molluscan shell is purely inferential, but so far as it goes corroborates that of the fossil algæ as to a Liassic age. To one who is not an expert in paleontology, the arguments presented both as to correlating the widely separated terranes now referred to the Yakutat formation, and the assignment of that formation to a subdivision of the Jurassic, seem based on meager data. Among the results presented by the geologist is the evidence of Eocene strata on the Alaskan peninsula. The fossils collected at various localities form the basis for describing thirty-eight new species, twelve Jurassic and the remainder Tertiary. The Jurassic fossils include seven new genera. The descriptions of new species are accompanied by twenty-five admirable plates.

In the chapter on general geology, page 12, in describing the basaltic region about Shoshone Falls, Idaho, mention is made of 'great pustules which had been inflated on the surface of the liquid mass and then congealed and collapsed.' This explanation of the origin of the numerous 'pressure ridges' of the Snake River lava plains is so widely at variance with the conclusion reached by myself after gaining considerable familiarity with them, that it seems advisable to refer the reader to a more extended account of their characteristic, namely, U. S. Geological Survey, Bulletin No. 199, 1902, pp. 95–96.

The advantages presented by Alaska for glacial studies has already been referred to, and the reports of the geologists of the Harriman expedition, if we had no other evidence, suffice to show that the same land has an instructive geological history. Although the reports under review contain a few admirable pictures of volcanoes, only one, Bogoslof, seems to have been visited. As is well known, however, the volcanoes of Alaska present a subject for study fully as extensive and equally instructive as its glaciers, but one concerning which but little definite information is available. Another region of special interest which invites investigation and gives promise of valuable return is the vast tunda in the far north. Concerning one of these great groups of earth features, namely, the glaciers, the Harriman expedition has done good service not only in recorded results, but in indicating the richness of the field that remains to be explored. The others, as is well known, are fully as important and equally inviting. The suggestion I wish to convey by these statements is that there are room and material for study in Alaska for many more expeditions. The great and lasting results recorded in the reports of the Harriman expedition should encourage other broad-minded citizens to immortalize their names in a similar manner.

ISRAEL C. RUSSELL.

SOCIETIES AND ACADEMIES.

THE MICHIGAN ACADEMY OF SCIENCE.

THE tenth annual meeting of the Michigan Academy of Science was held at Ann Arbor, on March 31 and April 1 and 2. The new medical building, the university museum and the laboratories of botany and zoology of the University of Michigan were placed at the disposal of the academy for its sessions. The officers for this meeting were:

President—Professor F. C. Newcombe, Ann Arbor.

Vice-Presidents—Section of Agriculture, Professor W. J. Beal, Agricultural College; Section of Botany, Mr. B. O. Longyear, Agricultural College; Section of Geography and Geology, Professor I. C. Russell, Ann Arbor; Section of Sanitary Science, Professor C. E. Marshall, Agricultural College; Section of Zoology, Professor R. H. Pettit, Agricultural College.

Treasurer—Professor H. L. Clark, Olivet.

Librarian—Dr. G. P. Burns, Ann Arbor.

Secretary—Dr. Jas. B. Pollock, Ann Arbor.

The meeting opened Thursday, March 31, with a general business session at 2 P.M. Following the adjournment of this general session the various sections met for the reading of papers. Thursday evening no session