

A glance at the first few chapters will give an idea of the scope of the work.

The first chapter is entitled, "The Identity of all Forms of Ancient and Primitive Medicine." It is a discussion from an ethnological standpoint of what has been determined concerning the condition of medicine among primitive races of ancient and modern times, in which are found traces of modern tendencies in medicine. Chapter II. is given up to Egyptian medicine. The chapter opens with a brief discussion of the fossil remains of man leading up to a statement of the antiquity of Egyptian civilization. Our author says: "At the same time the gap between paleolithic and neolithic man is much greater than that between the people of the late Stone Age and the civilizations of Egypt and Mesopotamia." The following pages are devoted to a discussion of medicine among the Egyptian peoples from the time of the earliest known physician I-em-hetep (4500 B.C.) to the time of the predominance of Greek thought. The most important Egyptian medical documents are the papyri of Brugsch, Ebers and Hearst, the chief of these being probably the Ebers papyrus, which was discovered by Georg Ebers at Thebes in 1872 and dates back to 1550 B.C. It is interesting to note the absence of all anatomical learning in Egypt until the time of the introduction of Greek thought which resulted in the famous Alexandrian school.

Chapter III. is devoted to Sumerian and Oriental Medicine. "To sum up what we owe to Oriental Medicine, the Babylonians specialized in the matter of medical fees, the Jews originated medical jurisprudence and public hygiene and ordained a weekly day of rest, and the Hindus demonstrated that skill in operative surgery which has been a permanent possession of the Aryan race ever since."

Chapter IV. treats of Greek medicine and is divided into three sections: (1) Before Hippocrates, (2) The Classic Period (460-146 B.C.), (3) the Græco-Roman period (146 B.C.-476 A.D.). Chapter V. gives a discussion of the Byzantine period (476-732 A.D.). "Although the Byzantine power lasted over a thousand years (395-1453 A.D.) medical history

is concerned chiefly with the names of four industrious compilers (Oribasius, Aetius, Alexander of Tralles, and Paul of Aegina) who were prominent physicians in the first three centuries of its existence." Chapter VI. is devoted to the Mohammedan and Jewish periods (732-1096 A.D.). The titles of the next two chapters, "The Medieval Period" (1096-1438), "The Period of the Renaissance, the Revival of Learning and the Reformation" (1438-1600), will give an idea of the trend of the work.

In a compilation of such magnitude it is impossible that all errors should be avoided, and if attention is called here to a few errors in proof-reading it is with no thought of deduction, but with the hope of adding to the usefulness of the work. On page 24, 13th line from the top *metal work* is evidently intended, instead of mental work as it is printed; on page 184 the last year of Robert Hooke's life was 1703, instead of 1763 as printed. In the index to personal names the page reference to Carl Ferdinand von Arlt should be 549, instead of 547, McClung should be 474, instead of 592. In the index to subjects (p. 761) Sex, determination of, should read 474 instead of 592. These defects are of minor importance, but are rather annoying when one has to search for the correct page. In four weeks' almost continuous use of this volume the above errors are the only ones which have come to my notice.

ROY L. MOODIE

UNIVERSITY OF ILLINOIS,
COLLEGE OF MEDICINE,
CHICAGO.

THE NATURE AND ORIGIN OF FIORDS

THERE are two groups of geologists whose ideas regarding the origin of fiords are mutually opposed. The first group may be designated as the "glacialists," because in their opinion all the phenomena peculiar to fiords may be explained as the result of extensive glacial over-deepening of pre-glacial river valleys near the sea. The second group, or "non-glacialists," reject the theory of ice erosion, and attempt to account for the phenomena of fiords in other ways.

Members of the non-glacialist group are by no means in agreement among themselves as to the origin of fiords. They agree on one thing only,—that ice did not excavate these deeply submerged canyons. Some consider fiords the product of normal stream erosion followed by a partial submergence which permitted the valleys to be drowned. Others think that peculiar jointing of crystalline rocks enabled streams to carve peculiar valleys which were later submerged. A few even appeal to “some force not yet known to the geologist.” Formerly many observers were inclined to regard every fiord as either a gaping chasm or a rift valley formed by the dropping down of a narrow strip of the earth’s crust between two parallel faults. This tectonic theory of the origin of fiords, once much in vogue as an explanation for all valleys, is now generally regarded as obsolete. It is this theory which Professor J. W. Gregory defends in a spirited manner, in his recently published book on “The Nature and Origin of Fiords.”¹

Gregory divides his volume of more than 500 pages into three parts. Part I. outlines the problem which fiords present to the geologist, and discusses at much length different classifications of shorelines. Perhaps most readers will feel that here the author has laid undue stress on unimportant details of classifications which are empirical at best, and would have welcomed some attempt at a classification more truly genetic than any of those considered. In Part II., comprising about two thirds of the printed text, the author describes the fiord systems of the world, with the object of proving that the fiords of each district can best be explained on the basis of the tectonic theory. With the fiords of Norway, New Zealand, and other typical fiord areas, he classes the drowned valleys of the Dalmatian coast and other submerged normal river valleys which few besides the author would regard as fiords. Part III. is in part a résumé

and amplification of the author’s arguments against the glacial theory of fiord formation and in favor of the tectonic theory; and in part an elaboration of a theory of polar oscillations which might fracture the earth in such a manner as to explain the actual distribution of fiords. For in the author’s opinion “the ultimate cause of fiords is the rupture of wide areas of the earth by the pulsation due to the titanic forces started by those disturbances which upheaved the existing mountain systems of the world.”

The book is abundantly illustrated with sketch maps and diagrams and a limited number of excellent engraved plates. A partial bibliography of the subject of fiords covers 26 pages, while the text is filled with citations from the works of other investigators. Subject, authority and locality indexes are provided. A fairly long “errata” slip suggests inadequate proof-reading, and appears itself to stand in need of revision. Thus a reference to page 468 tells us that the sentence “The occurrence of the chief fiords and mountain-systems on the western sides of the continents is probably a consequence of the rotation of the earth from east to west,” should be made to read “is probably a consequence of the rotation of the earth whereby raised areas lay from east to west.” (Presumably “lay” should be changed to “lag.”) But there is inserted on page 468 another erratum slip which advises us to read the sentence as follows: “The occurrence,” etc., “is probably a consequence of the rotation of the earth from west to east, whereby raised areas lag.” The reader may take his choice of these corrections; but after he has arranged this sentence satisfactorily his troubles are not over, since three additional corrections must be made in the two sentences which succeed it. Under such circumstances the reader may be pardoned if he is unable to discover what the author meant to say.

A word of explanation may properly precede the more detailed examination of Gregory’s book. When an author of recognized ability produces a book which, however valuable, does not contain much novel material nor many

¹ “The Nature and Origin of Fiords,” by J. W. Gregory. John Murray, London, 1913. Pp. 452.

new interpretations, a brief summary may give a fair conception of the nature of the work. When an author of no standing advocates unusual or startling interpretations, a very short review may suffice to characterize his effort. But when a writer of good standing, profiting by personal observations over an extended field, decides to support in an elaborate treatise a theory rejected as untenable by most of his colleagues in the science, something more than passing notice is required. "The Nature and Origin of Fiords" is the most elaborate work on this subject which the reviewer can recall. In it the well-known author of "The Great Rift Valley" supports a theory which the reviewer in common with most students of land-forms regards as untenable. The reasons for not accepting Gregory's arguments and conclusions should therefore be made plain.

Gregory's book was written primarily to disprove the glacial theory and to establish the validity of the tectonic theory of fiord origin. One might anticipate, therefore, that the author would set forth in the clearest terms the essential points of each theory, and more especially the critically important points of contrast between the two. Only after such an analysis would the reader be adequately prepared to weigh the evidence for and against the theories, and to decide intelligently between them. Unfortunately, while Gregory discusses both theories repeatedly, he presents no adequate analysis of either; and only after the reader has followed with increasing perplexity through a maze of contradictory arguments does he finally discover that the author's conceptions as to what are implied by the glacial and tectonic theories often differ radically from the generally accepted views. In order that we may properly appreciate the author's treatment of this important matter, let us summarize hastily some of the essential elements of each theory.

According to the glacial theory, fiords are partially submerged glacial troughs. The troughs of glaciated mountains far from the sea are similar to fiords, except that the former have not been drowned by marine waters. In both cases the troughs were formed

by extensive glacial over-deepening of former river valleys. The preglacial valleys guided the glaciers which later came to occupy them, and by confining the ice streams to the narrow limits imposed by the valley walls insured a maximum efficiency of glacial erosion. The glacial theory asks no questions as to what determined the courses of the preglacial valleys; but it is fully recognized that among other causes ancient fault lines must be considered, since a fault may give a crushed zone which is weaker than the unfractured rock, or may bring a belt of weak rock into such position that subsequent valleys will soon be excavated along it, and hence parallel to the fault.

According to the tectonic theory, on the other hand, fiords are directly due to forces within the earth which cause a pronounced local and recent deformation of the earth's surface. This deformation may be in the nature of a gaping fissure where the rocks have parted along a fault or joint plane; or it may consist of a rift valley or graben caused by the down-dropping of a narrow strip of the earth's crust between two parallel faults. Such depressions may later be modified by river or glacial action; but the essential features of fiord topography must have existed prior to such modification. And whereas, according to the glacial theory, many fiords may be located along fault lines or joints, according to the tectonic theory *every* fiord must be so located.

Without pursuing this contrast further, let us turn again to Gregory's treatment of the problem. His misconceptions of the glacial theory are at once apparent. We have seen that this theory involves the recognition of preglacial river valleys which determined the courses of the more recent ice streams. Yet Gregory devotes a large amount of space to arguing that the valleys existed before the ice came, under the erroneous impression that this is incompatible with the glacial theory. In chapter after chapter this remarkable position is vigorously maintained. Indeed, he tells us that "The most conclusive argument against the glacial origin of the fiords is the preglacial age of their valleys; and it appears

to be admitted for practically all fiord-areas that the valleys are preglacial" (451). "The most fatal objection to the glacial origin of the fiords is the preglacial age of their valleys" (263).

It also follows from the glacial theory that the ice streams, being compelled to coincide in direction with the preglacial valleys, must often pursue courses which make large angles with the general direction of ice advance. Yet our author in combating the glacial theory lays much emphasis upon the fact that fiords are not always parallel to the general movement of the ice. "The distribution and arrangement of these Alaskan and British Columbian fiords is quite inconsistent with the theory of their glacial origin. The development of the fiords appears quite independent of the glaciation of the country; the direction of the fiords is not simply radial from the chief glacial centers" (317-18). "The direction of the ice-movement, however, did not fully agree with the trend of the fiords" (140). "Most fiord countries supply abundant instances of the fiords and the ice-movements having different directions" (451).

A still more serious misapprehension is entertained by the author as to the significance of the oft-observed coincidence between fiords and fault lines. As already noted, the glacial theory of fiord origin fully recognizes the fact that the preglacial valleys, later transformed into fiords, were often excavated along ancient fault lines. To prove the presence of a fault-line through a fiord is therefore to prove nothing as to the glacial or tectonic origin of that fiord. But Gregory is not of this opinion. A very large proportion of his argument against the glacial theory consists simply in showing that faults are associated with fiords. Indeed, he is often content to show that *some* fiords in a region are traversed by faults; or even that faults are known which trend parallel with the fiords of a given region; and on such a basis concludes in favor of the tectonic theory of fiord origin. Often he goes so far as to admit that the fiord-valley was not formed by crustal deformation, but by stream erosion along a crushed or weak rock zone;

yet he cites even such cases in support of the tectonic theory, entirely ignoring the all-important distinction between valleys produced by erosion along ancient fault lines, and depressions due to deformation along recent fault lines. The fiords of western Iceland are described as "connected with a series of fractures" (141) while "Faults are numerous around the Greenland coast, and in many cases they coincide with the fiords" (265). "The evidence for these faults (in Alaska) is often obscured, and along the fiords such faults could hardly be recognized; but their recognition by Messrs. Moffit and Capps in the Nizina district renders it probable that intersecting faults may be widely distributed through Alaska, and form planes of weakness along which the fiords have been excavated" (322-23). "The tectonic origin of the (New Zealand) fiords has been recently advocated by Speight. He accepts Andrews' view that they are old river valleys modified by glaciation, but he recognizes that the original course of the valleys was dependent on lines of fracture in the earth's crust" (365). The most pronounced glacialist would accept much of Gregory's lengthy argument against the glacial theory, as a statement of conditions normally to be expected on the basis of that theory.

A careful study of the author's ideas concerning tectonic valleys in the hope of finding some explanation for the apparent lack of consistency in his arguments, only increases one's perplexity. On page 394 we read: "Some valley systems are due to the folding of the earth's crust, which has raised soft bands to the surface, where they are worn into valleys, while the harder rocks resist and remain as ridges. The faulting of the earth's crust also produces bands of weak and shattered rocks which are easily washed away, and thus many valleys have been worn out along fault lines. Joints have a somewhat similar effect. . . . Such valleys, though their directions have been determined by earth movements, are valleys of excavation. Tectonic valleys, on the other hand, are the direct results of the earth-movements themselves." This is a clear

statement of the generally accepted distinction between erosion valleys guided by structure, and tectonic valleys; but it is directly contradicted by the major portion of the author's arguments on the preceding 300 pages of the book. The contradiction is even more amazing when we compare this statement with one on page 455, where tectonic valleys are divided into several groups and one group is defined as follows: "Valleys formed along fault-planes owing to the removal by denudation of a belt of rocks which has been crushed by earth-movements." It is clear that the author's ideas as to what constitutes a tectonic valley, the most vital point in his entire book, were confused and contradictory, and varied from time to time as he wrote. Similar contradictions regarding other matters appear so frequently throughout the book that it is often quite impossible to know what opinion the author really holds regarding essential points in the problem he discusses.

Throughout the book much reliance is placed on *authority*, and hundreds of quotations favorable to the tectonic theory are adduced to strengthen the case for that theory. Many of these quotations date back to a time when the knowledge of land forms was in its infancy; others are from writers unqualified to speak authoritatively on the interpretation of land forms; and occasionally the author quoted wrote in a poetic or figurative sense. In the chapter on Alaskan fiords Gregory writes: "The explanation of these fiords as simply due to glacier corrosion seems to me quite inadequate. That they are due to the action of some tectonic force has been recognized by many visitors to them. Mr. John Burroughs has graphically expressed this view." Then follows this quotation from Mr. Burroughs: "The edge of this part of the continent for a thousand miles has been broken into fragments, small and great, as by the stroke of some earth-cracking hammer, and into the openings and channels thus formed the sea flows freely, often at a depth of from one to two thousand feet." The fact that Mr. Burroughs is not a geologist, and is therefore presumably unacquainted with

Alaskan geology, did not deter Gregory from citing this bit of imagery as a substantial confirmation of his theory. Views unfavorable to the tectonic theory are also quoted at length, but are quickly dismissed as untenable. Favorable views are as quickly accepted. In neither case is there any serious attempt to present the quoted author's evidence, review his line of argument, and then subject his conclusions to critical analysis before accepting or rejecting them.

Another reason for accepting Gregory's work with reserve is found in his frequent misinterpretation of the views entertained by authors from whom he quotes. His own belief in the tectonic theory was so strong that he unconsciously read into the works of others ideas favorable to his theory which they did not express. Of the many instances of this I will cite but a few. On page 309 Gregory refers to the work of Tarr and Martin on the Yakutat Bay earthquake, and while he acknowledges that these authors recognized but one fault along Russell fiord, and attributed the present depth and form of the fiords to glacial erosion, he goes on to say that "the shores of this fiord appear to lie along two old faults, the prolongation of which formed the valley occupied by the Hidden Glacier, and movements along the two faults would explain the facts as well as along one fault. This earthquake illustrates how fiord valleys have been formed by parallel trough-faults. . . . Tarr and Martin's memoir shows that the formation of fiord-valleys by trough faulting is still in progress in Alaska." After reading this, one unfamiliar with the memoir in question will be surprised to find that Tarr and Martin considered the faulting hypothesis of origin for these fiords at length, adduced a variety of evidence opposed to this theory, and concluded by showing that it was quite impossible to explain the fiords as a product of faulting. According to Martin the stratigraphic evidence positively proves the absence of two parallel faults. In support of his position Gregory says that in a later memoir Tarr "attached less importance to glacial action" in the formation of fiords.

On the contrary, the memoir cited is a most vigorous argument in favor of the glacial theory of fiord formation. In it Tarr writes: "Of all the hypotheses proposed, glacial erosion alone appears capable of explaining all the facts. . . . The facts set forth in this chapter prove conclusively that ice has eroded in this inlet to a remarkable degree. . . . Those who oppose vigorous glacial erosion are in the position of those who opposed river erosion long after the majority of workers accepted it—that of ultra-conservatism."²

Gregory cites Mendenhall's discussion of differential warping in the Cook Inlet region of Alaska, and continues: "These two fiords, therefore, according to Mendenhall, occur along a depression due to earth-movements, and the same explanation offers the simplest interpretation of many other Alaskan fiords and fiordstraits. They appear to be of tectonic rather than of glacial origin" (324). But Mendenhall's report conveys a very different idea.³ He shows that normal river valleys were occupied by glaciers which "greatly modified" them, and that then these glacially modified valleys were submerged by a depression of the land. Only later, after the fiords had already been in existence for some time, began the differential warping cited by Gregory. As this was an unequal *uplift*, it tended to *destroy* fiords by raising them above the sea-level, not to make them. It is difficult to understand how even an enthusiast for the tectonic theory could find in this faint differential uplift an argument for the tectonic origin of the deep-cut Alaskan fiords. The same might be said of the author's appeal to the differential uplift of the Labrador Coast, as described by Daly, as an explanation for the rock basins and thresholds of Labrador fiords (283); for it is impossible to see how the slight warping of a little more than one foot per mile described by Daly, could account for the re-

versed slopes of more than 250 feet per mile in the fiords.

Spurr is also quoted in support of the tectonic origin of Alaskan fiords. Gregory writes: "According to Spurr the lake-basins are preglacial. He says that 'all the lakes of southwestern Alaska, so far as observed by the writer, occupy mountain-valleys which are evidently the ancient river-valleys of the late Miocene'" (319). This quotation from Spurr says nothing at all about the preglacial age of the lake basins. The preglacial age of the valleys alone is indicated; and the context from which this quotation was taken makes it quite clear that the lakes, and consequently their basins, are of more recent date.⁴

Gregory's interpretations of his field observations do not always carry conviction. Photographs and sketches of typical glacial troughs with well-developed catenary curves are described as "V-shaped valleys" and "normal denudation curves," apparently because slight bendings of a trough cause the distant profile of one trough wall to intersect the foreground of the opposite wall (Plate V., Figs. 73*d*, 73*e*). It is truly remarkable that such a drawing as Fig. 73*d* could be cited by any one as a "V-shaped valley"; but even more remarkable is the author's attempt to show that the well-known contrast between the forms of glaciated and non-glaciated valleys does not exist (425-32). Although the author has traveled widely, he "can not remember to have seen any considerable mountain-chain or mountain-area in any non-glaciated district which does not show truncated spurs, spurless walls and hanging valleys" (447). The supposed tectonic origin of Cattaro Bay, one of the Dalmatian "fiords," is illustrated by a beautiful photograph of the bay, in which what appear to be triangular "flat-irons" or hogbacks formed by resistant layers in the folded beds, are described as "triangular facets due to faulting" (Plate VI.).

Many readers will hesitate to accept Gregory's arguments because of the significant

² R. S. Tarr, "The Yakutat Bay Region, Alaska," U. S. G. S., Professional Paper 64, p. 118, 1909.

³ W. C. Mendenhall, "A Reconnaissance from Resurrection Bay to the Tana River, Alaska, in 1898," U. S. G. S., 20th Annual Report, Pt. VII, 332-34, 1900.

⁴ J. E. Spurr, "A Reconnaissance in Southwestern Alaska in 1898," U. S. G. S., 20th Ann. Rept., Pt. VII., p. 258, 1900.

omissions which characterize the text. Against many of the arguments made by the author, other writers had previously raised very serious objections. We look in vain for any answer to many of these objections, or even mention of them. In the chapter on Dalmatian fiords, there is no intimation of the fact that a normally dissected belt of folded mountains, partially submerged (which is the type of topography found in this region) will necessarily have the long, narrow bays, the steep sided, spurless valley walls, and the short cross-valleys which the author erroneously correlates with those features in fiord districts often described in the same terms, but which really present a distinctly different topographic aspect. The fact noted by the author (202) that one of these drowned valleys has been called a "fiord" in Baedeker's guide book, can not be regarded as very significant. In support of the tectonic theory the author states that the Dalmatian valleys are not arranged like the members of ordinary river systems, as in Dalmatia the branchings and bendings are usually rectangular (207). He does not recognize that in all folded mountain regions involving rock layers of different resistance, the ordinary river valleys normally have this rectangular or "trellised" pattern. His arguments for the tectonic origin of the submerged Dalmatian valleys would apply with precisely as much force to the valleys of the folded Appalachians, the Juras and other similar dissected folds. The short cross valleys are not recognized as a normal product of river erosion across a narrow ridge of hard rock, but are interpreted in accordance with that ancient theory, long ago abandoned by most geologists, which explained the cross valleys as short cracks formed by bending brittle material. The substantial reasons which led geologists to abandon this theory as untenable are not referred to by the author.

It would be easy to multiply indefinitely examples of the unsound reasoning which seems to the reviewer to deprive the book before us of most of its value. The instances I have cited are not isolated examples which

might be explained as the result of careless writing, but are typical of the book, as a whole, and must fairly represent the author's mental attitude toward the problem of fiord formation. It seems to the reviewer, therefore, that Gregory's attempt to rehabilitate a discarded theory of fiord formation must be considered a failure.

DOUGLAS W. JOHNSON

SPECIAL ARTICLES

THE IMPORTANCE OF A CONSIDERATION OF THE FIBER PROTEINS IN THE PROCESS OF BLEACHING COTTON

THE nitrogen which is found in the ripe cotton fiber seems to have some bearing upon the yellowing of bleached cotton cloth, as was pointed out by J. C. Hebden in his paper read in Troy before the American Institute of Chemical Engineers.¹ He showed that in the process of bleaching cotton cloth after the first caustic boil 91.5 per cent. of the proteins were removed from the fiber, whereas of the fats and waxes only 20.4 per cent. were removed; and after the second caustic boil 91.7 per cent. of the proteins and only 64 per cent. of the fats and waxes were eliminated; the "chemick" and the "sour" together, he showed, removed 12.05 per cent. of the remaining protein impurities and 10.23 per cent. of the remaining fats and waxes. According to his analysis, after all the bleaching operations there were still left on the fiber 30.4 per cent. of the total fatty and waxy impurities, whereas of the total proteins there were left only 7.3 per cent., and as the cloth which he analyzed had undergone a "good bleach," he felt safe in inferring that it is the failure to remove the protein impurities from the cotton that results in a "bad bleach" or causes the yellowing of cloth in steaming or during storage.

So far as we know, the investigator above referred to was the first to point out the possibility that the proteins of the fiber played such a part in the bleaching of the cloth. Previous to this it has been believed that the fatty and waxy matters and especially the

¹ *Journal of Industrial and Engineering Chemistry*, September, 1914, Volume 6, No. 9, page 714.