
Review: Fiords as Rift-Valleys

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to draw meridians freehand) shows the sphere of the writer's labours to lie in Nyasaland; his experience extends over sixteen years, and it must be felt that, apart altogether from his missionary work, he has made full use of them.

'Some Austral-African Notes and Anecdotes.' By Major A. J. N. Tremearne. (London: Bale, Sons and Danielsson. 1913. Pp. xii., 215. *Illustrations*. 7s. 6d.) The author rings up his curtain on a scene of South Africa in war-time, but the bulk of the volume is concerned with incidents and experiences in British West African territories. The subjects of the various chapters are treated for the most part in light vein—they make excellent reading, and though hardly to be commented upon from any geographical standpoint, it may be permitted to refer with especial gratitude to the delightful chapters on Coast English and the Native Correspondent, and on West African journalism.

AMERICA.

THE FIRST AMERICAN VOYAGES.

'Die erste Entdeckung Amerikas im Jahre 1000 n. Chr.' Von Dr. Gustav Neckel. R. Voigtländers Verlag in Leipzig, n.d. Pp. 92. Price 80 Pf.

The author gives the story of the Norse voyages in extracts from the Icelandic chronicles, as Reeves did so fully for English readers ('The Finding of Wineland the Good:' 1895). He agrees with Prof. Storm that the Helluland, Markland, and Vinland of Karlsefni (A.D. 1003) were Labrador, Newfoundland, and Nova Scotia respectively, but doubts whether the Vinland of Karlsefni was identical with Leif's (A.D. 1000), which may have been situated near Boston or even farther south. He therefore rejects as untrustworthy the statement of the Flatey book, that Karlsefni and his companions found and inhabited the huts erected by Leif. Yet it does not seem improbable that they may have been guided to the spot by information obtained from the former expedition, nor impossible that one of Leif's men may have accompanied Karlsefni. There is no reliable and definite record of subsequent visits to Vinland, but a ship is spoken of as having come from Markland; and there is no mention of Norse settlements in America. All that can be affirmed with any confidence, is that Norsemen made voyages to the coasts of America, and that the physical features and vegetation, as described by them, agree with those of the countries above mentioned. So much, at least, may be reasonably accepted. Mr. Babcock (*ante*, p. 194) objects that grapes do not ripen north of Massachusetts, but Cartier found them on the St. Lawrence.

MATHEMATICAL AND PHYSICAL GEOGRAPHY.

FJORDS AS RIFT-VALLEYS.

'The Nature and Origin of Fjords.' By J. W. Gregory, F.R.S., D.Sc. London: John Murray. 1913. pp. xvi., 542. *Diagrams and Illustrations, Bibliography, and Indices*. Price 16s. net.

Prof. Gregory has often previously shown his power of thinking easily in terms of oceans and continents; and he does it well in this work, transmuting his personal knowledge of the African Rift-valley and many other regions into a world-splitting hypothesis, with the cracks still open. He claims that all real fjords, wherever found, are rifts or fault-fissures, somewhat modified by later agencies but originated by great earth-movements late in Tertiary times; and he brings together a mixed multitude of authorities and of observations to support his case.

How that "bonny fighter," G. H. Kinahan, the last but one of the old champions of "fissure-valleys," would have relished this book, had he lived just a little

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longer! And how he would have scoffed at the moderation of its author! His 'Valleys and their relation to Fissures, Fractures and Faults,' referred to with mild approbation by Prof. Gregory, was published in 1875; either too late or too early; for it fell on days when the views that it advocated had been abandoned, and when the adequacy of rivers to excavate the biggest and deepest valleys of the Earth had been convincingly established. More recently Sir H. H. Howorth couched a lance in the same forlorn cause, in 'Ice or Water' (1905, vol. 1, chap. ix.), but without much avail. Of late years, however, there have been indications from various quarters of a returning swing of the erosion-pendulum, so that physiographers will not be altogether unprepared for Prof. Gregory's pronouncement. Nevertheless, the first impression of most will be that this is a set-back, not of the pendulum but of the clock. Revived with such weighty argument, the "fissure-hypothesis" for the special case of the fiords is likely to receive careful reconsideration and rediscussion alike from geographers and geologists; yet, that the present work will suffice to re-establish it even for this case is, at least, doubtful.

Prof. Gregory's main thesis is concisely stated in his preface: "All the fiord-systems of the world have the same essential characteristics. Fiords occur in trough-shaped valleys that are arranged along fractured lines or networks; their plan resembles that of cracks in a fractured sheet of brittle material, and does not agree with that of systems of valleys cut by rivers or glaciers. Fiords are restricted to plateaus which are composed of firm and usually old rocks and to districts which are on the borders of sunken areas. All the fiord-areas have been affected by a similar succession of earth-movements; they were uplifted into plateaus after the great crustal disturbances which upheaved the existing mountain-systems of the world. During these uplifts the areas composed of hard rocks were cleft by radial or intersecting cracks, and the subsidence of belts of country along these cracks, or the removal by wind, water, and ice of the decayed material along the clefts, produced the great fiord-valleys. After the plateau-forming uplift, the fiord-areas have undergone a series of oscillations, during which many of the valleys have been drowned by the entrance of the sea, while the unequal movements and tilting of the region have formed deep basins in many of the fiord-valleys.

"The fact that most of the fiords are in the colder regions of the earth is a coincidence, due to the polar areas having been affected by greater oscillations than the equatorial zone. The mountainous coasts beside the warmer seas are indented by fiords in the occasional areas, where the edges of foundered regions have undergone a succession of movements similar to those around the heaving polar areas" (p. vi).

It may be said at once that there is hardly a point in which these opinions cannot be legitimately challenged, even when the author's skilfully massed evidence has been duly weighed. But the task of the challenger will be formidable, from the immense range of the subject, if for no other reason; and we can here only just skirmish on the fringe of the controversy. Before venturing even so far let us briefly recapitulate the contents of the volume.

After the summarizing preface from which we have already quoted, the book contains, in the first part, a statement of the supposed problem as to the origin of fiords, a classification and nomenclature of the coast types of the Earth, and a discussion and definition of fiords and allied coastal features. Then, in the second part, there is presented a systematic description of the fiord-systems of the world in detail, with a passing review of the literature of the subject in each region; and, in the third part, the author develops his conclusions and

controverts antagonistic views. A long bibliography adds to the usefulness of the book, and a few scenic plates, with numerous maps and diagrams in the text, serve well to illustrate the subject-matter.

While pressing his main thesis steadily forward, Prof. Gregory manages to bring into prominence several side-issues of geographical consequence; among them, the vexed question of glacial erosion and hanging valleys; the nomenclature of processes of denudation; the æsthetic effect of land-shapes, and its influence upon human character; and the deformation of the Earth under contraction. The broad range and confident grasp of the author on all these matters, together with the easy style of his exposition, will commend his book to many readers beyond those interested in the main discussion.

To the average field-geologist with the "parochial or provincial" outlook deprecated by the author in his preface (p. vii), it will seem most probable that Prof. Gregory, like Kinahan and Howorth before him, has cast the net of his hypothesis too widely, gathering in valleys of as varied quality as the poets who have yielded the quotations at the headings of his chapters. And it is upon all the result of local criticism in detail that the hypothesis will ultimately stand or fall. Every experienced geologist is aware that valleys frequently coincide with fault-lines, and that the stretches where there is this coincidence are often exceptionally deep and straight. Indeed, when a valley suddenly takes a deep straight course across hard rocks, one regards the fact as presumptive evidence for the presence of a fault; and, in the same way, when a fault-line is found to strike across the "grain" of the land, as is so commonly the case, one looks instinctively for its sign in a more or less recognizable depression or notch on the ridges between the valleys. But it can usually be proved beyond question that all such features are the secondary results of faulting, from the bringing of hard and soft rocks locally into juxtaposition, or from the weakening of resistance by local crushing or the development of "shatter-belts" (a term, by the way, that the author, on p. 457, wrongly assigns to Peach and Horne, instead of to its originator, Dr. J. E. Marr). We find, in short, that the fault-line has been etched out by differential erosion, but only in those places where the favourable conditions have been produced, and to the degree proportionate to these conditions; where such are wanting, the fault promptly loses its surface-expression, and masks its trail under the general outlines of the land. Prof. Gregory is, of course, well aware of these secondary fault-features, and he specifically rules them out of the category of his "tectonic" valleys (p. 394); but there can be little doubt that some—perhaps many—of his selected fiord-company are of this type.

Most field geologists, again, will find it hard to grasp Prof. Gregory's conception of faults produced on a catastrophic scale as gaping fissures. Indeed, it is not quite clear how far the author himself carries the idea. He allows that the hypothetical late-Tertiary fissures that are supposed to have given origin to the fiords were enlarged by running water in pre-Glacial times, and by ice during the Glacial period, but he does not explicitly define his views as to their first state. In his general argument, however, it seems to be assumed that the fault-fissures gaped open with sufficient rapidity to entrap the older drainage in ready-made new valleys. This is not the kind of faulting with which geologists are familiar. Our evidence indicates that most faults have been produced gradually; sometimes, perhaps, by slow continuous displacement; but more often by successive short slips (causing earthquakes), with long intervals of quiescence. In many cases it is demonstrable that the surface features produced by individual slips were so slight as to have been soon overpowered and obliterated by the normal processes of erosion. Only in a few desert regions have the insignificant scarps

of recent faults been observed; and one can recall no case in which a scarp of this kind is known to have permanently overmastered a pre-existing drainage system.

Further, in view of the rate at which land-surfaces of high relief in every part of the world are re-shaped by the agencies of erosion, most geologists and physiographers will hesitate to entertain the suggestion of a world-wide fissure-system so recent that the scars still persist. Right or wrong, the hypothesis runs counter to the uniformitarian grain of prevalent ideas, and must be closely scrutinized before it is accepted. The old explanation that the fiord-areas are deeply trenched because they are high lands bordering the sea, therefore peculiarly favourable for sharp erosion by rivers or glaciers or both, has a broad simplicity that still commends it.

On the much-debated question as to the excavatory energy of glaciers, Prof. Gregory holds an intermediate position, granting that the old ice-streams have been to some degrees effective in planing and modifying the fiord-valleys, but denying that they have been a principal factor in the production of the trenches. It is singular that in the long dispute on this subject there has been so little said about the conditions on the rim of the great Antarctic plateau bordering the Ross barrier. In this region we know that enormous confluent glaciers discharge through straight deep trenches from the upland snow-fields, and it seems improbable that any other conditions have ruled during the existence of the plateau at its present elevation. So far as the reviewer is aware, it is not supposed that the valleys have ever been empty of ice, or that there has been any opportunity for running water to aid materially in their excavation. And if this be the case, then it must be granted that here, at any rate, the ice-streams have proved that they are fully capable of valley-excavation on an extensive scale.

G. W. L.

HYDROLOGY.

'Rainfall Reservoirs and Water Supply.' By Sir Alexander R. Binnie. London: Constable & Co. 1913. *Illustrations*. 8s. 6d. net.

We might describe the book before us as beginning with hydrography and as ending very definitely in hydrology; for while the earlier chapters deal with such matters as rainfall, drainage systems, catchment areas, floods and evaporation, the later ones go on to such highly technical subjects as reservoir and aqueduct construction, water storage and supply to houses, in which water is studied in its mechanical properties and not as an element in the processes of physical geography. As all land waters have their ultimate origin in rain, the book naturally commences with a somewhat elaborate discussion on the more practical aspects of rainfall study, such as mean annual fall, fluctuations from year to year, and the difficult question of the relation of "run off" to amount of rain. The rainfall statistics given refer to this country or India, where the author has had professional experience in applying a knowledge of rainfall conditions to the procuring of water supplies. In view of the abundant rainfall figures quoted in connection with the great storage reservoirs, natural and artificial, in the north of England, it is not a little remarkable that there is not a single reference to the work of the British Rainfall Organization, whose director, Dr. H. R. Mill, is so constantly consulted by engineers like Sir Alexander Binnie, in a professional capacity. There is, it is true, some allusion to the statistical methods of the founder of the organization, the late Mr. G. J. Symons.

We would do well, in the connection of rainfall, to correct two errors in Sir