

marked and hear them struck on a clock. We think therefore of an hour not as an interval of time, but as an instant, which is that of the completion of the hour, 4 o'clock or 4 by the clock, meaning that four complete hours have passed since the beginning of the clock-round. When this is noon, and the hours afternoon hours, all is logical enough. We are obliged to call the beginning of the round the completion of the preceding; because though a clock may mark 0, as clocks used in observatories do, we cannot indicate nothing by a strike. Our ordinary habit, however, becomes illogical when we speak of morning hours and call them a.m. or ante-meridien; for eight hours, for instance, before noon should mean what we call 4 o'clock in the morning or 4 a.m. To be logical, the morning or a.m. hours should diminish instead of increasing; but the usage cannot well be altered, and it is not likely that ordinary people will ever adopt the astronomer's plan and count the whole day through twenty-four hours, even if astronomers try to conciliate them by dropping their practice of beginning the day at noon. For this there is now much less reason than there was in early days of the science, when it was thought desirable to keep a whole night's observations under one date; for modern astronomers make a considerable number of observations in daylight and during the day hours.

W. T. LYNN.

POPULAR GEOLOGY.¹

SOME fifteen years ago, if a book had been published under the title of "The Scenery of Switzerland," the reading public might have expected glowing descriptions of the magnificent mountains, the wild waterfalls, the quaint châteaux, the dangerous passes and precipices of that wonderful Alpine rampart of Switzerland

"Which serves it in the office of a wall,
Or as a moat defensive to a house,
Against the envy of less happier lands."

And it would have been somewhat startled on opening the book to find the first chapter dealing with the "Geology of Switzerland," and bristling with a supply of technical terms seldom to be found outside a geological text-book. Nevertheless, that is how Sir John Lubbock's new book opens, and the title is accordingly somewhat qualified on the inner fly-leaf, where it reads in full, "The Scenery of Switzerland and the Causes to which it is due."

We have already had the æsthetic aspect of the Alps presented to us by such writers as Symonds, Ruskin, and Leslie Stephen; the mountaineering aspect by such famous climbers as Whymper, Freshfield, and Conway; the scientific aspect by Forbes, Tyndall, Bonney and others; and now Sir John Lubbock seeks to combine the æsthetic and the scientific aspects. It may be said at once that the book supplies to the cultured tourist a want which has been felt more and more for some years. Years during which Dr. Lunn's inexpensive tours have brought a journey to Switzerland within the reach of modest incomes, and when popular lectures on physical and geological subjects have attracted ever-increasing interest. Besides, these are *fin de siècle* days, when the mere sensuous enjoyment of the beauties of Swiss mountains is not enough to gratify the tourist! He wants to surmount their difficulties, either physically by climbing their summits, or mentally by mastering the secrets of their structure—to *come* and *see*—yes, but also to *conquer* the grandeur of the Alps!

The intellectual conquest of the Alps, however, is not yet completed by geology; and this is the very fact which has restrained many of the veteran geologists abroad from attempting a popular book on the subject. Prof.

¹ "The Scenery of Switzerland, and the Causes to which it is due." By the Right Hon. Sir John Lubbock, Bart., M.P., F.R.S., &c. Pp. 473. (London: Macmillan and Co., Ltd., 1896.)

Fraas published in 1892 a useful book called "Scenerie der Alpen," which erred in being too geological for the ordinary tourist. In 1894, the Committee of the International Geological Congress published a special "Livret-Guide" of Switzerland, wherein pedestrian tours are planned and described geologically by the best Swiss authorities on the various areas of the Alps. With these exceptions, Sir John Lubbock entered an open field, and has done so with considerable success.

The book numbers 473 pages, arranged in twenty-five chapters. About two-thirds of it are devoted to the *geological* causes, while one-third discusses the *physical* causes which have moulded the surface features of Switzerland.

It is perhaps rather unfortunate that the book begins with three such difficult chapters as those entitled "The Geology of Switzerland," "Origin of Mountains," and "The Mountains of Switzerland." In the opening pages the reader finds himself perforce initiated into the involved question of the origin of gneiss.

"The foliation of Gneiss is probably of two kinds: the one due to pressure, crushing, and shearing of an original igneous rock such as Granite, the other to original segregation-structure" (p. 3).

A sentence like this cannot but be a stumbling-block to the ordinary reader. Granite, Serpentine, the Crystalline Schists, and the successive geological periods from Carboniferous to Miocene and Glacial time are briefly dealt with. The second chapter contrasts "Table Mountains" with "Folded Mountains," and demonstrates that the Swiss mountains belong to the latter class, having been "thrown into folds by lateral pressure." Geological terms—such as outcrop, dip, and strike; fold, fault, and fold-fault; anticline, syncline, slickenside, and cleavage are explained; various examples are also given of the dynamo-metamorphic changes induced in rocks. Attention is directed in the third chapter to the fact that the main longitudinal valleys (*e.g.* the Rhone-Rhine valley which cuts through Switzerland in the direction of the main axis, S.W.-N.E.) occupy the troughs of the mountain-folds, whereas the transverse valleys (*e.g.* the Reuss and Ticino in N.W.-S.E. direction) are independent of the folds, being "entirely due to erosion." Denudation of the surface is discussed, and the geological proofs are given of the former presence of an arch of sedimentary strata above the crystalline rocks of the central chain of the Alps. Three well-known geological sections illustrate the text—Schmidt's section from the Rhone valley at Viesch to the Averser valley in the Engadine, Favre's "Mont Blanc" section, and Heim's "Windgälle and St. Gothard" section. A computation "gives 4500 metres or, say, 14,000 feet, which erosion and denudation have stripped from the summits of the mountains!" (p. 66).

There follows a lighter series of six chapters on glaciers, valleys, rivers, and lakes. The physics of ice and ice-movement, and the characteristic features of glaciers are carefully described. Evidences of the "Former Extension of Glaciers" are considered, and abundant examples quoted of the influence which ancient moraines had in diverting the courses of rivers and damming up lakes. The chapter on "Valleys" leads us into some confusion of ideas. A "fault valley" is said to be "comparatively rare" (p. 143). The writer repeats the principle mentioned above, that cross-valleys are valleys of erosion, while longitudinal valleys are of geotectonic origin. But he then asks himself the question, "Why should the rivers, after running for a certain distance in the direction of the main axis, so often break away into cross valleys?" (p. 148). "Three possible explanations," suggested by Prof. Bonney, are given, and then the following passage occurs:—

"Under these circumstances I have ventured to make the following suggestion. If the elevation of the Swiss mountains

be due to cooling and contraction leading to subsidence as suggested in page 34, it is evident, though, so far as I am aware, this has not hitherto been pointed out, that, as already suggested, the compression and consequent folding of the strata (Fig. 43) would not be in the direction of AB only, but also at right angles to it, in the direction AC , though the amount of folding

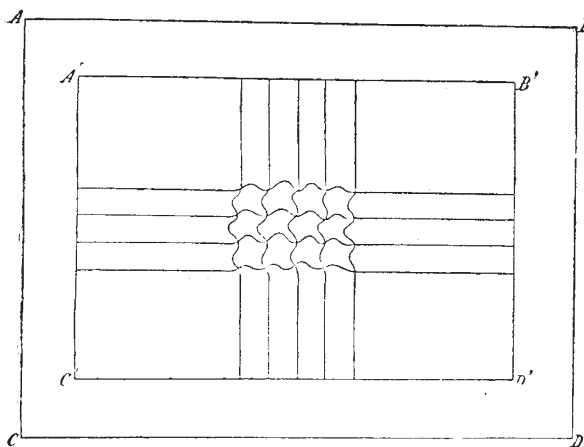


FIG. 43.—Diagram in illustration of mountain structure.

might be much greater in one direction than in the other. Thus in the case of Switzerland, as the main folds run S.W. and N.E., the subsidiary ones would be N.W. and S.E. If these considerations are correct it follows that, though the main valleys of Switzerland have been immensely deepened and widened by rivers, their original cause was determined by tectonic causes" (pp. 149, 150).

Thus the chief distinction previously made by the writer between longitudinal and transverse valleys is finally annihilated by his own suggestion that both may have had their primal cause in tectonic movements! But this idea finds by no means its first exponent in Sir John Lubbock. It is perfectly familiar throughout the writings of Austrian and German geologists. Take the following passage, which I translate from Rothpletz:—

"As the youngest expression of the mountain-forming forces, these (the transverse faults) have had a specially important influence on the present topography of the mountains, the direction of the flowing waters, and the origin of lake-basins. It is to them above all that the longitudinal synclinal folds of the Alps owe the outflow of their waters by transverse valleys; and the length of high ridges of rocks has been determined by them." ("Ein geolog. Querschnitt durch die Ost-Alpen." Stuttgart, 1894, p. 190.)

The stratigraphical facts observed by these geologists somewhat modify the theoretic suggestion of Sir John Lubbock. They prove that the transverse lines of weakness, whether of simultaneous origin or not with the longitudinal folding, were planes of movement long after the longitudinal folds had ceased to move, *i.e.* had become in technical language "dead" folds. It is this relative youth of the transverse faults which has made them so often revolutionisers of Alpine drainage. We would certainly have expected to have this important matter looked into by Sir John Lubbock, especially as he has devoted considerable space to minute matters of drainage in the three succeeding chapters on the "Action of Rivers," their "Direction," and "The Lakes."

With regard to the vexed question of the excavation of the lake-basins by glaciers, Sir John Lubbock states that "there are strong reasons against regarding glaciers as the main agents in the formation of the great Swiss and Italian lakes" (p. 210). The general reader may learn much from the chapter on "Lakes."

A very important subject is then introduced in Chapter x.—"The Influence of the Strata upon Scenery." If I

may prophesy, this is the "coming" theme in popular geology. Combining as it does the interest of beauty of form with that of varied natural phenomena, it appeals alike to artist or tourist, geographer or petrographer, physicist, chemist, or geologist. This, I repeat, is at once the grandest, the most striking, and the most popular department of the Science of Scenery; and, what is more, the student of it would rightly choose Switzerland for his field of study in preference to any other country in Europe! Yet Sir John Lubbock has devoted only one chapter of twenty pages to this subject, and has treated it in a meagre, perfunctory manner. Only one sketch-section by Baltzer illustrates this extensive subject. The reader who brings enthusiasm to the book, and has Alpine pictures in his eye, will stir life into the bare facts, but the reader who has not will fail to be impressed.

All the subsequent chapters from xi. to xxv. are geological in their bearing, and take up the districts of Switzerland in turn. The geology of the Jura mountains is sketched in simple, clear style in Chapter xi. The Miocene and Glacial deposits of the "Central Plain" of Switzerland are described in Chapter xii. The next, entitled "The Outer Alps," is one of the best in the book. It runs easily along and describes, amongst other things, the geology of the ever-fascinating Rigi and its proud rival Mount Pilatus. One almost regrets that the chapter should be brought to its close in the cloud of controversy which overhangs the history of the "Klippen." The chapter on "Central Massives" is rather overlaid with the opinions of many geologists, but concludes by regarding the Central Massives (1) "as an integral part of the general Alpine system, not as independent centres of upheaval; and (2) as complex systems of compressed folds" (p. 307).

Chapter xv., "The Lake of Geneva" is, like Chapter x., a sacrifice to science—useful, instructive, practical, but written with a marked economy of the imagination. Surely the most prosaic Englishman who has seen the view of the mountains from the northern side of the lake must remember it all his days, and feel the very words "Lake of Geneva" act like a charm upon him. This chapter in the "Scenery of Switzerland" commences as follows:—

"The Lake of Geneva is 45 miles in length, and about 10 in breadth. It is 375 metres above the sea, or 309 in depth.

"The bottom, moreover, is covered by subsequent deposits to an unknown depth, so that originally it was probably below, perhaps much below, the sea-level. Indeed, if the slopes of the mountains at Meillerie and Vevey (see Fig. 100) are continued under the bed of the lake, the alluvium must have a thickness of no less than 600–800 metres, which would make it 200–400 metres below the sea-level. The actual outlet at Geneva is in superficial débris, but the river comes upon solid rock at Vernier, 1197 feet above the sea-level, 33 feet therefore below the surface-level of the lake, and 951 above the bottom. It is, therefore, a true rock basin" (p. 308).

The same conclusion is arrived at in the same matter-of-fact way about other lakes, *e.g.* Lake of Neuchâtel (p. 259), Lake of Constance (p. 414). There are some graceful touches however:—

"The country about Vevey and Montreux is the Riviera or Switzerland. It is lovely now, but what must it have been before the monotonous terraces of the vineyards and the endless rows of vine bushes replaced the ancient forests of chestnut, birch, and beech; and the picturesque Swiss châteaux were extinguished by whitewashed villas and gigantic hotels" (p. 310).

"The Massif of Mont Blanc," Chapter xvi., again falls distinctly short of the sublimity of the subject. Is it so necessary to begin with exact figures?

"The Massif of Mont Blanc' is elliptical in outline, about 30 miles in length, and 10 in breadth, extending from S.W. to N.E. from the Col de Bonhomme, across the Valais at Martigny to the Dents de Morcles; the extreme N.E. portion being severed from the rest by the Rhone" (p. 322).

Again, why give the reader so little of Sir John Lubbock, and so much of other authors? De Saussure and Favre may indeed have "made" the geology of Mont Blanc, but why these long French quotations from their writings? Does the Pavillon de Bellevue stand in need of a testimonial to its beauty from any French writer, even Favre? (p. 327). A graver objection to Sir John Lubbock's treatment of the Mont Blanc massif is the inadequate account of its geotectonic relations. It is impossible to satisfactorily explain the "causes to which Mont Blanc is due," without setting forth its relations to the fold "trough" of the Briançonnais and the broken western end of the Valais "crest" of mountains. It is, indeed, the greatest blemish in Sir John Lubbock's book that he nowhere gives a geological insight into the structure of the Monte Rosa massif of mountains from the Simplon Pass to the St. Bernard. Yet this area is the Swiss frontier, whereas the Mont Blanc massif is almost wholly French and Italian. However fully, then, the succeeding chapter on "The Valais" treats the Rhone Valley, it misses its mark with regard to the mountains. The few notes on Zermatt and the Matterhorn, on p. 357, are quite insufficient.

The Bernese Oberland is more deftly handled than Mont Blanc. The intricacies of the overfold of gneiss are explained, and there are no fewer than six geological sections from Fellenberg and Baltzer to illustrate the fourteen pages. The Rhone, Upper Aar, Reuss, Ticino, and Rhine valleys are treated much after the fashion of the Swiss "Livret-Guide" referred to above, although without its daily itinerary. In these chapters we are made to feel that the author has himself gone over every step of the ground, but he follows the "Livret-Guide" too apparently in his geology. "Zürich and Glarus"—the title of Chapter xx.—gives an account of the variation in the movement of the old glacier which once filled the Lake of Zürich. The Glarus Mountains are described in accordance with Heim's well-known works. Chapter xxiv. on the Engadine is short. It explains the shifting northward of the watershed of the Alps, and the consequent formation of the line of lakes. The rocks of the Bernina, Julier, and Baseltgia, are also indicated.

There are 154 illustrations in the book. Almost all are of the nature of geological sections or diagrams, 123 being reproductions from the works, mostly of Swiss geologists, and a few from English authors. The remainder are simple diagrams—with the exception of familiar photographs of the Rhone glacier, the Grimsel, and the valley of Chamonix; a successful photograph of the rock-fold at the "Cascade of Arpenaz," and another of a "Scratched Pebble" from the moraine at Zürich. Two figures specially deserve to be noted, Figs. 49 and 50, the front and side view of a river cone, as they, along with one or two drawings from Heim ("Bay of Uri," Fig. 141, and "Volcanic Group of the Hohgau," Fig. 138), and from Baltzer ("View near the Grimsel," Fig. 37, and "View of the Jungfrau," Fig. 124), are the only illustrations which present to the eye of the reader scenic effects in combination with geological or physical truths. Like the text of the book, the illustrations are too technical for a thoroughly popular book on "Scenery." On the other hand, if the book lacks in imagination and style, it is not wanting in valuable and trustworthy facts, and these may be enough for the utilitarian mind.

A standard work amongst us already shows what can be made of the "Scenery" of a country in the hands of a geologist who is gifted with an artist's feeling for nature, and is a master of style. I refer to Sir Archibald Geikie's "Scenery of Scotland." Without this, we might have demanded less from Sir John Lubbock in his "Scenery of Switzerland." As it is, he has conferred a boon on the travelling English public, and broken new ground in the literature of the Swiss Alps.

MARIA M. OGILVIE.

NO. 1402, VOL. 54]

THE TOTAL ECLIPSE OF THE SUN:¹ III.

TRONDHJEM, August 14.

SINCE writing my last notes, the eclipse has come and gone, and we are homeward bound, rather depressed but satisfied that the *Volages* and ourselves had done our duty, and that it was Dame Nature alone who was to blame.

Although on the 8th the weather in the forenoon was very fine and promising, towards the latter part of the day a change set in, and dark clouds came up.

Captain King Hall, who came over from the ship in the afternoon, soon detected what was wrong; there were two currents, an easterly and a westerly one, contending for mastery. This elemental war was watched with anxiety for two or three hours, and at times the weather chances improved, but later rain set in, and we could only hope against hope. It rained during our dinner-hour in the tent, an excellent one lent us by the War Department, kept dry under foot by a tarpaulin, and a deep trench outside cut in the peat. Lieut. Martin, the navigating officer, to whose constant care many of the admirable arrangements on the island were due, who had not only taken charge of the integrator, but who has *ipsissima manu* put up all three of the discs,² remained on shore and did the honours.

A dim memory of the Latin grammar suggested champagne as an accompaniment of the well-cooked provender, for were we not bound on the morrow to face not only the *ingens æquor*, but, if all went well, something still more awe-inspiring.

Dinner over, the process of filling up all dark slides with the plates for the morrow was accomplished by Lieut. Martin, Mr. Fowler, and Dr. Lockyer, after which it was suggested that we should turn in early.

The Rev. E. J. Vaughan, my son, and I occupied one of the army tents, while Mr. Fowler and Lieut. Martin had their stretchers placed in Kiö Town Hall, as the 6-inch hut had been called. Our last survey of the weather was not one to raise our spirits to any great extent, but we were still buoyed up by the observed fact that, as a rule, the early mornings, looking eastward, were moderately clear.

As we expected the *Garonne*, on her return from Spitzbergen, to anchor near our island some time in the early morning, we had arranged with the guard to light a beacon fire directly she was sighted, to show them our whereabouts.

At 1.30 my son took it into his head to take a stroll around outside; his attention was first drawn to the beacon burning brightly on the hill, and the four marines in their lammy suits standing by the side of it. Looming up very black and large, close to our island, was the good ship *Garonne*, before her time. It was not long before we received two nocturnal visitors, Captain Harry and Mr. Müller, who had come off to see about the day's arrangements. The weather was anything but pleasant, and their return to the ship was heralded by a downfall of heavy rain.

At 4 a.m. the parties, led by Captain King Hall, began to arrive from the ship, the first thing they did on landing being to make cocoa and breakfast. Mr. Thomas, in charge of the chronometer, and the readers of the thermometers, were the first to take their stations, and for these at the time of first contact the work began with the sky almost entirely covered with clouds, with narrow

¹ Continued from page 421.

² It may be worth while to state that the eye-pointers used in connection with the discs were impromptu affairs made by the ship's carpenter, but they promised to work well. There must be fine adjustments, because it is not likely that the point to be occupied by the eye will be calculated to an inch. For these adjustments, then, we have first a horizontal bar, on which hangs a vertical piece of wood about ten inches long, free to slide. On this piece of wood slides up or down a piece of brass carrying a pointer marking the place of the eye; this is brought into position at the beginning of totality by the amanuensis.