

system of examination which Mr. James Geikie has most ably carried out.

The superficial formations of Scotland, especially a wide-spread stony clay, known as "Till," first claims his attention; and the manner in which this occurs, and the scratched stones which are found in it, lead to the conclusion that ice was the agent by which it was produced. "Each stone in the till gives evidence of having been subjected to a grinding process. Almost every fragment has been jammed into the bottom of a glacier, and, held firmly in that position, has been grated along the rocky surface underneath, or over a pavement of the tough stony clay itself." All the theories of the formation and the motion of glaciers are examined—the phenomena of Arctic glaciers, and their action upon the rocks over which they move. The origin of icebergs, and the transportation of rock *débris* by them, one after the other, receive a full share of attention. The physical changes which take place in those vast fields of moving ice, and the part which solar heat plays in their formation, their progress, their regelation, and their dissolution, are explained with care. We must, however, state that this is, to us, the least satisfactory portion of this interesting volume. The flow of solids, under the influence of mechanical force, which has been the subject of some fine experiments, appears quite sufficient to explain glacial movement, without the aid of the processes of crushing and re-cementing, of thawing and freezing (regelation), which have been severally brought in to explain the phenomenon. The causes of cosmical changes of climate, both astronomical and geological, are naturally the subjects of consideration; and Mr. Croll's theory, which shows that changes of climate result indirectly from astronomical causes, is, in the main, adopted,—the effects due to the elevation or depression of large tracts of land, and the consequent alteration in atmospheric or oceanic currents being thought to be insufficient to produce the great climatal changes, of which we have evidence, over countries so large as those under consideration.

The post-glacial and the more recent deposits of Scotland form the starting-point for an examination of the superficial deposits of England and Ireland, of Scandinavia, of Switzerland, and of North America. The cave deposits of England and their relation to the two great periods into which archaeologists divide their "stone-age" in the history of man—namely, the Palæolithic, or Old-stone period, and the Neolithic, or New-stone period—advance this remarkable story to the time of the first appearances of man in the British Isles.

There is a great charm in the well-balanced union of cultivated powers of observation and analytical method, with considerable imagination and much poetical feeling, which runs through the pages of this volume. A short quotation from the concluding chapter will show this, and give a favourable example of Mr. James Geikie's style. Having described a period upwards of 200,000 years ago, when the Earth's position in space produced an intensely severe climate over these Islands and a large portion of the Continent, he continues:—

"Ere long this wonderful scene of Arctic sterility passed away. Gradually, the snow and ice melted

and drew back to the mountains, and plants and animals appeared as the climate ameliorated. The mammoth and the woolly-coated rhinoceros roamed in our valleys, the great bear haunted our caves, and pine-trees grew in the south of England; but the seasons were still well marked. . . . Step by step, the climate continued to grow milder, and the difference between the seasons to be less distinctly marked, until eventually something like perpetual summer reigned in Britain. Then it was that the hippopotamus wallowed in our rivers, and the elephant crashed through our forests; then, too, the lion, the tiger, and the hyena became denizens of English caves. Such scenes as these continued for a long time; but, again, the climate began to change. The summers grew less genial, and the winters more severe. Gradually, the southern mammalia disappeared, and were succeeded by Arctic animals. . . . Once more the confluent glaciers overflowed the land, and desolation and sterility were everywhere. . . . We cannot yet say how often such alterations of cold and warm periods were repeated; nor can we be sure that palæolithic man lived in Britain during the earlier warm intervals of the Glacial epoch. But since his implements are met with at the very bottom of the very oldest palæolithic deposits, and since we know that the animals with which he was certainly contemporaneous, did occupy Britain in early inter-glacial ages, and even in times anterior to the Glacial Epoch itself, it is in the highest degree likely that man arrived here as early, at least, as the mammoth and the hippopotamus."

Such is the remarkable story of one period of the Earth's mutations, and that period beyond all others the most interesting, since it belongs to the time when man first planted his foot upon this British land. We have indicated but imperfectly the philosophical spirit which marks every step of the inquiry into the wonders of this "Great Ice Age," and we strongly recommend the volume to all who are prepared to read thoughtfully, and weigh the evidences of truth carefully, in the assurance of finding that there are, indeed, "Sermons in Stones."

The drawings and maps which accompany this volume are well executed, and will greatly aid the reader in following our author through the argument which he has so well sustained.

DR. LIVINGSTONE.

Trieste, Feb. 7, 1874.

I LEAVE to others the painful task of commenting upon the life and labours of the greatest African traveller known to history, and I trust that the two Expeditions, Eastern and Western, led by our gallant countrymen will not be allowed to suffer from his premature death. They cannot, sad to say, discover Dr. Livingstone, but they are both doing good service to geography, and want of supplies would be simply fatal to them.

I confess myself unable to understand the accepted report of the lamented explorer's last wanderings; how, going eastward, and crossing the Chambeze (east), he could have traversed the Lya-pula (west), and yet have died in Lobisa (again east). But leaving this garbled account to future explanation, I would offer a few remarks upon his crowning labours.

This is the third time that the heroic Scotchman has passed between the Tanganyika and the Nyanza (Kilwa) Lakes. The first was in February, 1867, when, after rounding the latter, he marched upon the southern end of the former, and discovered the projection which he has called Liemba. The second was in the middle of the same year, when he returned from Liemba, and struck the Moero water. The third was in 1872, when, after parting from Mr. Stanley, he passed from Unyanyambe to Lake Bangweolo or Bemba (Bembe?).

It becomes necessary to insist upon this fact. A lately published volume, which honours me

by introducing my name amongst distinguished African travellers, has evidently been compiled without consulting anything that I wrote upon the Expedition of 1856-59. A reviewer of my last publication determines that Dr. Livingstone never passed between Lakes Tanganyika and Nyanza. May I be permitted to remind these gentlemen of Dr. Johnson's counsel to authors, viz., that it is generally advisable to read before you write.

R. F. BURTON, F.R.G.S.

'ANIMAL LOCOMOTION.'

IN the cause alike of science and truth, I am desirous of saying a few words in reply to a notice of the above work which appeared in the *Athenæum* of January 31st, 1874.

In the notice referred to, it is stated "that it would have been fortunate if this work had never appeared, as it calls for a fresh discussion of the question as to the nature of flight and the history of the discovery of the correct explanation of its mechanism, a subject which does but little credit to British science, and must raise ill feeling on the other side of the Channel. . . . In 1867, Dr. Pettigrew gave a lecture at the Royal Institution, and published a Memoir in the *Transactions* of the Linnean Society, 'On the Mechanism of Flight.' On a single page, and nowhere else in that memoir, the movements of the anterior and posterior margins of the wing of a bat, bird, or insect in flight, are said to be 'represented with a considerable degree of accuracy by a figure-of-8 laid horizontally,' thus  $\infty$ , four arrows, in the original figure, being placed, one by the side of each of the horizontal portions of the loops of the 8, all directed to the right. 'In this diagram, the course pursued by the anterior or thick margin of the pinion during extension is indicated by the thicker portion of the figure, that pursued by the posterior, or thin margin, by the thinner portion. These conditions . . . are reversed during flexion'; from which it is evident that the figure-of-8 refers only to the twisting or rotation of the wing on its long axis, and not to the movement of the axis itself, or to the wing as a whole."

Your readers will judge for themselves. I confine myself to a statement of facts. It is conceded by the writer of the notice, that in 1867, I delivered a lecture, and published a Memoir in the *Transactions* of the Linnean Society, and that in the memoir, the anterior and posterior margins of the wing of the insect, bat, and bird are described and delineated as making figure-of-8 movements. This is quite true.

It is further stated, "that on a single page, and nowhere else in that Memoir" those movements are referred to. This is wholly untrue. It so happens that the movements in question are described, not on one page, but on a great many pages, viz., at pages 225, 226, 228, 231, 232, 233, 249, 265, 266, 269, 273, 274, and 275. The movements are also figured at page 233 (diagrams 5 and 6); page 249 (Figs. 14, 15, and 16); and at Plate XV. (Figs. 58, 59, 61, 73, 74 and 75). In short, the task which I set myself in the Memoir in question was to show that the wing was a screw *structurally*, or when at rest, and that it was a screw *functionally*, or when moving. I described and delineated not only the margins of the wing as making figure-of-8 curves, but also the body and tip of the wing (*vide* diagrams 5, 6, 14, 15 and 16, and figs. 58, 59, 61, 73, 74 and 75). That I was perfectly aware that not only the margins, but also the body and tip of the wing, made figure-of-8 curves, will be evident from the following passages:—

"The figure-of-8 action of the wing" (I here speak of the whole wing and not of its margins) "explains how an insect or bird may fix itself in the air, the backward and forward reciprocating action of the pinion affording support, but no propulsion. In these instances the backward and forward strokes are made to counterbalance each other," (p. 233). . . . "The down and up strokes, as will be seen from this account, cross each other," (p. 225). . . . "Although the figure-of-8 represents, with considerable fidelity, the twisting of