OUR BOOK SHELF

Researches on the Glacial Period. By P. Kropotkin. First fascicule. 827 pages in 8vo. With Maps and Woodcuts in a separate brochure. (*Memoirs* of the Russian Geographical Society, vol. vii., 1876.)

THE book consists of two parts. The first is a detailed account of a journey in Finland and a short visit to Sweden, both made in 1871 under the auspices of the Russian Geographical Society, for the special purpose of studying the glacial formations and the *ösar* (eskers or kames). The second part is an inquiry into the meaning and value of various evidences of the glacial period—the striation of rocks, the forms of rocks and mountains, the boulders, the loose deposits, and the moraines and *ösar*. Out of the seven chapters into which this part is divided only the three first (sketch of the development of the glacial theory, striation, and forms of mountains) appear in this fascicule, and the two last (loose deposits and their classification, moraines, and *ösar*) are summarised at length in an Appendix.

The first fascicule is illustrated by a hypsometric map of Finland (southern half) with all known *ösar* shown upon it; by a map of the most interesting, esker Pungaharju, five miles long; by some other maps and sections of less importance; by a section on a large scale of the loose deposits along the Tavastehus-Helsingfors Railway, and by ninety woodcuts, a large part of which are sections of *ösar*.

The main conclusions as to the glaciation of Finland are in accordance with those arrived at by Messrs. Erdmann, Wiik, Helmersen, and Schmidt, viz., that this low table-land, continuous along its north-western and southern borders with two low and flat border-ridges, was covered with an immense ice-sheet which, creeping from Scandinavia, crossed the Gulf of Bothnia, traversed Southern Finland in a direction south by east, crossed the Gulf of Finland and crept further on in the Baltic provinces. The numberless striæ, the positions and directions of which exclude any suspicion of their having been traced by floating ice, the striation on the islands of the shallow gulfs, together with that of the Onega basin, the Neva valley, and the Baltic provinces, the uninterrupted sheet of till, *i.e.*, of a true unstratified and unwashed morainic deposit covering Finland, the numberless moraines parallel to the glacial striæ, and hundreds of other evidences, settle the existence of such an ice-sheet beyond any doubt. As to traces of marine formations, there are none above a level of about 100 to 120 feet; only local lacustrine deposits cover the till above this level.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.]

Indian Rainfall and Sun-spots

I HAVE observed no notice in NATURE[1] of an important discussion which took place a month ago at one of the Royal Society's meetings on Dr. W. W. Hunter's report on the cycle of rainfall in India, and its coincidence with the periods of eleven years disclosed by sun-spot observations. As one interested in solar research I have carefully considered that report, and I think the author has made out a case within the limits which he assigns to himself. The application of the mathematical law of errors has not altered this opinion in my mind, and from a consideration of the whole subject I have been led to the following conclusions:—In the first place I would remark that in certain meteorological elements, of which the rainfall throughout the world is probably one, and the barometer *in these latitudes* is another, oscillations which we regard as non-periodic, are very large compared with periodic variations. The consequence will be that in dealing with a series of barometric observations in these latitudes, the mean difference of individual observations from the mean of the whole series, or in other words, the mean irregularity, will not be materially modified by the introduction of the comparatively small semi-diurnal variation. But this is no argument against the existence of such a variation, nor is the fact that at Madras the mean rainfall irregularity is not *greatly* reduced by the introduction of an eleven-yearly cycle any argument against the existence of such a cycle. As a matter of fact, this mean irregularity *is reduced, although perhaps not very markedly*, by the introduction of this cycle. The true test of a physical cycle is its repetition, and, since in the present important aspect of this question we cannot, perhaps, calmly wait for other sixty-four years' observations before venturing a conclusion, let us now endeavour to break these sixty-four years up into periods, and see whether we obtain any traces of physical persistence from this method. Grouping, as Dr. Hunter has done, the sixty-four years' Madras rainfall into series of eleven years, beginning with the first in 1813, we obtain the following table:—

Years employed.	Year of Series.										
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
A. 1813–23 ...	45·11	32·41	56·00	41·16	63·56	76·25	36·33	70·01	47·13	59·61	26·62
B. 1824–34 ...	33·72	56·05	60·73	88·41	37·89	36·87	32·43	44·35	18·45	37·11	39·00
C. 1835–45 ...	41·47	44·76	49·26	52·33	53·07	58·65	58·32	36·48	50·28	65·36	38·05
D. 1846–56 ...	79·81	80·99	54·76	39·81	36·88	64·32	72·69	35·82	43·20	32·32	46·99
E. 1857–67 ...	52·95	48·50	55·14	27·64	37·19	38·18	54·61	47·23	41·64	51·39	24·37
F. 1868, end.	41·43	32·31	74·10	56·35	73·67	51·83	62·90	37·12	21·49		
Whole period.	49·1	49·2	58·3	50·9	50·4	54·4	52·9	45·2	37·0	49·2	35·0

In this table 3, 4, 5, 6, 7 embrace the maximum rainfall group, and 8, 9, 10, 11 the minimum rainfall group, and the sun-spot maximum occurs generally about the beginning of 3, and the sun-spot minimum a little before 11.

We have, therefore, taking the means of the five maximum rainfall years a result = 53·4 for the whole six series, and also, taking the means of the four minimum rainfall years, a result of 41·6 for the whole six series.

But we can obtain similar results for each individual series as under:—

		Max. Group.		Min. Group.
Series A	...	54·7	...	50·8
,, B	...	51·3	...	34·7
,, C	...	54·3	...	47·5
,, D	...	53·7	...	39·6
,, E	...	42·6	...	41·2
,, F	...	63·8	...	29·3 (incomplete.)

We have thus considerable evidence of repetition. In connection with this it will be interesting to see if there is any other physical difference indicated between years of maximum and minimum spots besides mere difference of rainfall. Now a very interesting additional peculiarity has been indicated by General Strachey, who has observed that the conception of a cycle of eleven years introduces a decidedly diminished mean cyclical deviation for the minimum period. General Strachey has, no doubt, likewise remarked that this is not chiefly due to those particular years that are nearest the sun-spot minimum. I do not, however, see that we have any right in tracing a connection between solar epochs and rainfall values to insist that the minimum of the one shall correspond absolutely with the minimum of the other, and the maximum of the one with the maximum of the other. In conclusion, the fact that the introduction of a solar cycle diminishes considerably the deviation for minimum years is one of very great interest, since it is these very years that have become so practically important. I trust, therefore, that further attention will be devoted to this very interesting inquiry. BALFOUR STEWART

[1] See abstract of Gen. Strachey's paper on another page.

Natural History Museums

I AM sure that many readers of NATURE will heartily thank Prof. Boyd Dawkins for his valuable articles just published in