

and shook up the famous Muir Glacier so thoroughly that its seaward end was disintegrated, filling Glacier Bay with icebergs that barred out all shipping for some years. Prof. Tarr gathered evidence proving that the earthquake brought down huge avalanches of snow and rock from the mountain-sides into the glacier-basins, and he considers that the sudden accession of material has exerted a thrust which has swept slowly forward as a wave throughout the length of the glaciers. He strengthens his conclusion by showing that, at least in some cases, the unaffected glaciers are those fed from gentler slopes from which avalanches would be less likely.

The explanation raises many knotty points in the still imperfectly understood physics of glacier-movement, while the new facts constitute a very important element to be taken into account in all future discussions of ice-flow. In reading the descriptions we are reminded of the abnormal conditions found by Garwood and Gregory in the Booming Glacier of Spitsbergen (Quart. Journ. Geol. Soc., vol. liv., 1898, p. 207), and of the rapid advance and subsequent recession of the Hispar Glacier in the Karakoram Range (*Geographical Journal*, vol. xxxv., February, 1910, p. 108). Is it possible that a great mass of ice may become suddenly more mobile when its temperature as a whole reaches some critical point short of the melting stage? The glacial geologist could find ready application for some such proposition if it were presented to him with the requisite Q.E.D.

Besides these features of central interest, Prof. Tarr describes many other phenomena that will arrest the attention of the geologist; for example, the rock-channels cut by streams running along the margins of glaciers, which remind us of the old "overflow channels" lately recognised in many parts of Britain and Ireland; the "pitted plains," where morainic deposits have been spread out by streams in great "apron-fans" incorporating hidden masses of ice (see Fig. 2); the sudden slipping of a small mountain-glacier *en masse* from its high corrie into the waters of Disenchantment Bay, causing huge waves that swept destructively on to the land; and the spread of vegetation over the areas abandoned by the ice. His re-discussion of the efficacy of the glaciers as erosive agents should also be read by everyone who has shared in the long debate on this subject. The memoir concludes with a short account of the solid geology of the region, which is of less general moment.

We have scant space in which to deal with the other two memoirs, and must perforce dismiss them summarily.

(2) Mr. F. L. Ransome's monograph describes an area around Goldfield, on the hilly desert-plateau country near the border of south-western Nevada, which has recently sprung into prominence as a gold-mining centre. His historical narrative has a touch of romance in it—vast treasure lying close to the surface, yet passed over again and again by eager prospectors; then, in 1902, discovery—excitement—and disappointment; in 1903–5, renewed search crowned by success; great fortunes rapidly made and lost in the wild boom and its reaction, the feverish activity culminating in a fierce labour dispute which necessitated the calling up of federal troops at the close of 1907; and finally, the consolidation of interests and the systematic ransacking of the ground. It is estimated that the value of the precious metals recovered during the years 1904–7 from this small field was close upon 20,000,000 dollars.

As for its geology, the field is a low dome-like uplift of Tertiary lavas with associated lake-sediments, resting upon a sparingly-exposed foundation of ancient granitic and metamorphic rocks. The ore-bodies,

apparently deposited in late-Tertiary times from "acidified" solutions at no great depth, are remarkable alike for their richness and for their irregularity. The structure, origin and mineralogy of the lodes, and the petrology and chemical composition of the rocks are fully discussed, and beautifully illustrated in the plates. In respect to the eruptive sequence, the author finds no proof of the regular order which J. E. Spurr has sought to establish for the lavas of the Great Basin. In criticising this scheme the author remarks:—"To some minds the conformity here shown may appeal as corroborative, but to others, impressed by the scanty representation of the numerous members of the ideal succession in any given locality, the capacity of the scheme for assimilating not only observed sequences, but imaginary ones, raises doubt whether it really represents natural processes" (p. 105). The criticism might be applied to many another ingenious scheme in science.

(3) The San Juan Mountains in south-western Colorado, like most steep mountains of similar structure, have been subject in the past, and are still subject, to extensive landslips. Many examples of these slips, both ancient and modern, are fully described by Mr. E. Howe in the third paper on our list, and are pictured in many fine plates which almost make description superfluous. A massive series of Tertiary volcanic rocks, often carved into huge cliffs, rests on a yielding base of soft Cretaceous shales; and, among the older sedimentary formations, are thick Palæozoic limestones resting on friable shales and sandstones. Attention is particularly directed to the curious "rock-streams" which have their origin in the high cirques; and to the influence of snow-banks on the accumulation of talus at the foot of cliffs. The memoir concludes with a somewhat laboured classification of landslides in which foreign examples and their literature are freely cited.

G. W. L.

MOUNTAINEERING IN THE NORTH-WEST HIMALAYA.¹

ONE would hardly suppose, after reading this simply-told narrative of physical achievements, that the senior member—and shall we say, with Mrs. Workman's permission, leader—of the party among the peaks and glaciers of the Nun Kun group was compelled some years ago to retire from his medical practice on account of ill-health. Evidently, at great altitudes, where the vitality is lowered by insomnia attending deficient oxygenation, and where mental depression and attacks of irresolution follow a disturbed circulation, the successful explorer depends wholly on having his muscles under the complete control of a resolute mind for that last supreme fight against the irresistible instinct to descend to his natural environment. The Arctic explorer can sleep, can eat, and is the better for work to do; the mountain climber handicaps himself by his load of protective non-conductors; his respiratory difficulties are increased when in the only position of rest left to the biped, and every momentary doze through sheer exhaustion is terminated by frantic efforts to avoid the intolerable feeling of suffocation. Anyone who has experienced these troubles, which beset all climbers—even the lucky few who are proof against mountain sickness—will admire the mental as well as the physical qualities of the altitude record-breaker; for, judging by the recent sordid controversy among Arctic ex-

¹ "Peaks and Glaciers of Nun Kun: a Record of Pioneer-Exploration and Mountaineering in the Punjab Himalaya." By Fanny Bullock Workman and Dr. W. H. Workman. Pp. xv+204. (London: Constable and Co., Ltd., 1909.) Price 18s. net.

plorers, "records" have still a market value among geographers.

Although previous achievements of mountain climbers are now eclipsed by the Duke of the Abruzzi's record of 24,853 feet in the Karakorum, the exploration of the Nun Kun group by the authors of this work is likely to remain for long of special interest, on account of the circumstance that Mrs. Workman broke even her own record for women by scaling the Pinnacle Peak of 23,300 feet. The reference to this feat, however, is but a passing incident in the narrative, less drawn-out, in fact, than the accounts of the perky eccentricities of the irrepressible, pugnacious little cock of the poultry-yard—the clown of the party, who, like the indispensable figure among the acrobatic performers of the circus show, "talks all the time," as the Kashmiri *khansamah* remarked.

swadeshi are among those that exemplify new varieties of well-known type difficulties that are invariably "discovered" by non-official travellers in the Indian region; but, in the present instance, the few difficulties faced and overcome are not of the kind which travellers' descriptions often naively show to the experienced Anglo-Indian to be due to the travellers' own stupidity and ignorance of local affairs.

The additions to topographical knowledge need not be reviewed; they will be fully appreciated by officers of the Indian Survey Department, who are more conscious than their critics suppose of the shortcomings of their maps in regions which are of little direct concern to their master, the tax-payer, who has as much right to be considered as the sportsman and traveller. The authors made the experiment of taking out six experienced Courmayeur porters under an



View at sources of Hispar Glacier at 17,000 feet. In foreground avalanche-névé-bed, pinnacles mostly formed from avalanche-blocks. In middle-ground broken, horizontally stratified ice-masses. Behind these ice-wall covered with parallel sub-idence-*névé*-ridges orienting with slope. In background southern Hispar boundary mountains. Reproduced with the permission of Dr. W. Hunter Workman and Mrs. F. Bullock Workman. From "Peaks and Glaciers of Nun Kun."

The book is not a mere narrative of travellers' experiences in a little-trodden region; it discusses definite and valuable additions to geographical knowledge; important topographical corrections are made on the Survey Atlas quarter-sheet No. 45 S.W.; one-fifth of the text is devoted to the character and origin of the different varieties of ice prominences on the *névé*-surfaces and glaciers, and on the glaciers below the *névé*-line; the principal part of a chapter is devoted to a discussion of the immediate physiological effects of high altitudes; while the extremely high temperatures in sunlight at high levels and the great diurnal variations are all precisely recorded. Incidents of human interest on the journey are not forgotten—the moral weaknesses of the Kargil coolie and the price of the Wazir's devotion to the cause of

expert guide, to replace the local coolies for work at high altitudes, where muscle alone is of little service, and this innovation has now been imitated by the Duke of the Abruzzi with successful results. The disturbing uncertainty of the malingering coolie being eliminated from the problem, Dr. Workman was able, with his trustworthy porters, to make satisfactory deductions from observations regarding the altitude limitations of human activity; and he shows that, in addition to the special danger of mountain sickness as a precursor of frost-bite, insomnia and the distressing moral and physical sequelæ of imperfect oxygenation may be sufficient alone to fix the stress-limit of the human organism at something distinctly below the greatest Himalayan heights.

The curious *nieves penitentes* first described by

explorers in the Andes have been recognised by the authors also in the Himalayan region, though their conclusions have not been completely accepted by other travellers. They, however, bring together in this work observations made in the Nun Kun area during 1906, as well as others made before and since in other parts of the north-west Himalaya, and have a right, consequently, to generalise on the phenomena. The prominences grouped under the name *nieve penitente* are often roughly pyramidal in shape, and generally disposed in rows on snow and ice at altitudes at which the night temperature falls below the freezing point; they are due to the unequal melting of the superficial layers of snow and ice. The authors describe in detail eight varieties of *nieves penitentes*, which, judging by the descriptions given, might have been divided into the following two groups:—(i.) Those that are the outward and visible expression of an internal heterogeneity of physical structure induced in the snow and ice by (1) the scoring action of avalanches with a trend parallel to the dip-slope; (2) the shearing effects of slower subsidence along the slopes; (3) the development of pressure waves by the wind; and (4) the more or less regular fracturing on seracs. (ii.) Those that are due to the disposition of various adventitious covers, such as (5) thin patches of earthy material arranged by the wind, and of a kind facilitating the absorption of the sun's heat with consequent melting of the subjacent ice; (6) heavy rock-masses, which compress and protect the ice, giving rise, by melting of the clean ice around, to the well-known glacial tables; (7) thick layers of earthy material, having a protective effect similar to that of the large rock fragments, but giving rise to differently shaped prominences on account of the disintegration and fall of the marginal parts of the covers; (8) water-covers in depressed areas, where silt is deposited unequally on a previously sculptured surface. These phenomena have been discussed in greater detail by Dr. Workman in special papers published in the *Zeitschrift für Gletscherkunde* and in the *Alpine Journal*.

A notice of this book would not be complete without reference to the remarkably fine photographic plates with which it is illustrated, although the illustrations, specially selected to demonstrate the phenomena of *nieve penitente*, and perhaps the best in the book, are taken from other areas, mainly from the Hispar and associated glaciers, further north-west, in the chief-ship of Nagar. One of these is here reproduced.

T. H. HOLLAND.

THE EAST AFRICAN NATURAL HISTORY SOCIETY.¹

THERE has been founded in British East Africa a society for the study of natural history, and the activities of this society naturally extend to the adjoining Uganda Protectorate. This society recently produced the first number of a Journal, which, it is to be hoped, may run to many volumes if conducted on the lines of its first number. Mr. C. W. Hobley, C.M.G., a prominent official of British East Africa, whose service there dates from the earliest days of the British East Africa Chartered Company, has taken a considerable part in the founding of this local natural history society, and is one of the contributors to the first number of the Journal. Mr. Hobley's work in anthropology, in East African languages, in geology, in the exploration of the aquatic fauna of Lake Victoria Nyanza (it will be remembered that he was the first, or one of the first,

¹ The Journal of the East Africa and Uganda Natural History Society, vol. i., No. 1, January, 1910. (London: Longmans, Green and Co., 1910.) Price 5s. net.

to discover in that lake organisms akin to the supposed marine fauna of Lake Tanganyika, thereby lessening the acuteness of that problem), has been so remarkable that his association with the Natural History Society should be productive of interesting results.

This first number contains a very well-executed coloured illustration of a new species of francolin (*Francolinus hubbardi*). This accompanies an article on the francolins of East Africa and Uganda, which to ornithologists is of real value. The scope of this article also includes the allied genus *Pternistes*. Mr. Battiscombe gives some new and interesting information regarding the flora of British East Africa. There are several small errors in the nomenclature of this article; *Lobelia johnstoni* is given as *Lobelia johnsonii*; *Kniphofia thomsoni* appears as *K. thompsonii*, and *Musa livingstonii* is given as *M. livingstonia*. The generic name *Sansevieria* is misspelt—a very common fault in books dealing with Africa. But these are trifling defects in an account of East African botany which is of considerable interest.

The Rev. K. St. A. Rogers writes on East African butterflies. There are notes on the haunts and habits of the elephant on the Guas' Ngishu plateau by Mr. Hoey, and Mr. C. W. Hobley contributes two articles, the more important of which, from the point of view of new information, is that dealing with the Karianuss deposits of the Rift Valley—deposits which form beds of a mealy, friable rock, amounting perhaps to millions of tons of diatomite. This is a siliceous deposit, principally of organic origin, mainly composed of the skeletons of minute, lowly plants—diatoms or bacillariæ—mere cells of green or brown protoplasm originally, which enclose themselves in a flinty casing fitting together like a box and a lid. Diatoms are, of course, found in fresh-water ponds and salt seas all over the world. Mr. Hobley considers the Rift Valley to have been the scene of tremendous volcanic activity from Tertiary times onwards, and that at one period in its history this enormously long depression in the surface of East Africa was covered by much larger lakes than at the present day. These beds of diatomite are the result both of the existence of these sheets of water and of the neighbouring eruptive volcanoes.

"Picture Suswa, Longenot, and Eburu all periodically in active eruption, and in addition to lava flows ejecting great clouds of volcanic dust and streams of mud mainly composed of siliceous fragments. This is almost certain to have been thus, as is the case in all volcanoes of this kind: the steam tearing its way through the magma which formed the flows of obsidian and trachytic tuffs would naturally blow large quantities into a state of very fine division, and this would be spread far and wide by the wind and also carried into the lakes by the torrential downpours which always accompany volcanic activity. The soda-laden water would dissolve the silica and place it ready for the diatoms to work upon, and with such rich material to build with one can quite see that this form of life could flourish with great luxuriance."

Mr. Hobley considers this diatomite or kieselguhr may be of some economic value. H. H. JOHNSTON.

NOTES.

THE Astley Cooper prize for 1910 has been awarded to Prof. E. H. Starling, F.R.S., for an essay upon the physiology of digestion, gastric and intestinal.

THE Mackinnon studentship in physical sciences has been awarded by the Royal Society for a second year to Dr. R. D. Kleeman for the continuation of his researches on radio-activity; and the studentship in biological sciences has been awarded to Mr. T. Goodey for an investigation of the protozoa of the soil.