

The High Pamir.<sup>1</sup>

THE term "Pamir," when strictly used, connotes the level floor of a wide-based mountain-valley in the uplands that connect the Hindu-Kush and Karakoram ranges to the south with the Alai and Tianshan ranges to the north. On its eastern side this tract rises rather abruptly from Kashgar; westward, it descends more gradually to Ferghana.

While nearly horizontal from end to end, the surface of such a valley-floor is usually undulating, and is almost always drained by a central stream with a boulder-strewn bed which is depressed somewhat below the level of the main valley-floor. Often such streams widen into a lake or lakes with low, bare banks; in the case of one Pamir—the Alichur—the lake is at the western end and has mountainous shores. The rivers of the eastern valleys flow towards the Kashgar plain; the western streams flow to join the Oxus. The valley-floors are generally 12,000 to 14,000 ft. above sea-level, often 5 miles wide, and sometimes exceed 50 miles in length. The slopes overlooking them that have a western or southern exposure usually have huge bare basal screes of talus, and are steeper than the less barren slopes that look east or north. Conflicting views have been advanced as to the formation of these striking flat-floored valleys. Whatever the true explanation may be, they are now being steadily filled up as the result of disintegration of the slopes on either side.

The ranges which separate these valleys are loftier in the eastern portion of this region than elsewhere; one eastern peak, Mustagh-ata, is 27,500 ft. high. Some of the north-western peaks exceed 23,000 ft.; the south-western ranges are only 17,000 to 20,000 ft. high. The latter extend further west than the portion of the region marked by the presence of flat valley-floors, the streams of which, now flowing with more rapid descent, find their way to the Oxus through narrow glens and mountain-gorges.

Ser Marco Polo, six hundred years ago, had heard of this elevated region. He knew that the word "Pamer" signifies a plain, but he appears to have thought that there was in the region only one great plain, "twelve days' journey in length." Modern Russian writers also apply the name "Pamir" to the whole of this upland tract. But they regard, with justice, the ranges that separate the various valley-floors as of most physiological consequence, and, therefore, include in the Pamir that area in which the valleys between these ranges are steep and narrow, as well as the portion in which the valleys are flat and wide, terming the former Low Pamir and the latter High Pamir. English authors also extend the meaning of the word "Pamir," but in another sense. As used by us, the term connotes not only the floor

of a wide mountain-valley, but also the slopes that bound it on either hand. The "High Pamir" of the Russian traveller we therefore speak of as "The Pamirs."

The climate of this region is rigorous, for the winters are long. July and August are the only months when its plants grow and flower. Though the days are then mostly bright, and the thermometer, an hour before sunset on an August afternoon, may register 75° F., the temperature during the ensuing night may be 14° F., and even in July snowstorms occur. As a rule, however, bitterly cold winds blow day after day until sunset, and, even when the days are calm, brief but violent evening gales may sweep down the mountain-slopes, carrying with them gravel and stones. At noon on an overcast August day the water welling from a hot spring may be partly converted into ice as it trickles away. The air is dry; in 1898 the average humidity was 38 in July and 21 in August. Periods of more than three months may pass without falls of rain or snow. Even on the high passes in March the snow is rarely so deep as to impede travel, for at 12,500 ft., the elevation at which the Kirghiz seek winter-quarters, it does not prevent their herds from finding pasturage.

Seen from a high divide, the valley-floors below appear brown save for the narrow green belts which skirt the rivers. One looks north over a valley to a brown mountain-slope the wide screes of which resemble darker shadows; or south to another mountain-slope with a green zone close under its snow-fields, green patches near its mountain-streams, and usually a fainter green tinge elsewhere. In the clear atmosphere, the lines of the watercourses that score the mountain-slopes are well defined, and seem deeper than elsewhere on slopes facing east or west. This appearance is deceptive; what from afar are taken for the shadows of deep clefts one finds on closer view to be lines of vegetation along the south side of each shallow stream-bed (Fig. 1). The reaction of the vegetation both to exposure and to moisture at the root is, in this region, so marked as to be perceptible miles away.

Our floristic knowledge of the High Pamir is considerable. Before 1890 Russian travellers had visited the region. In 1891 Sir F. E. Young-husband collected a few plants in the Taghdumbash, an eastern Pamir. In 1895 an Indian Pamir Boundary Commission, approaching by way of Gilgit and Bozai Gumbaz, entered the region from the south on July 20, and remained there until September 16. During this period Lt.-Col. Alcock was able to visit the eastern end of the Great, and to make a thorough botanical investigation of the Little, Pamir. A list of the species collected, prepared by Mr. J. F. Duthie, was published in Alcock's "Report on the Natural History Results" of this Commission on April 12, 1898. In June, 1898, a Danish expedition, led by

<sup>1</sup> "The Second Danish Pamir Expedition. Conducted by Lieut. O. Olufsen. Studies in the Vegetation of Pamir." By Ove Paulsen. Pp. ix+132. (Copenhagen: Gyldendalske Boghandel, 1920.)

Lieut. (now Prof.) O. Olufsen, entered the High Pamir by the Kisil-art pass (14,300 ft.) on its northern border, spent a month in camp near Lake Jashil-kul (13,500 ft.) in the Alichur Pamir, and in September marched south to the western end of the Great Pamir, and thence through Wakhan and Goran to Chorock (7000 ft.) in Shugnan. After wintering there from November, 1898, to February, 1899, the expedition retraced its steps and left the High Pamir by the Kisil-art at the end of March. The floristic results of this expedition have been published in numerous papers, mainly by Prof. Paulsen, a member of the expedition. In 1901, and again in 1904, the

we find that, while many plants are common to all, some are peculiar to each. We still await an equally careful survey of the Pamirs with streams that flow eastward, and of the slopes which overlook Kashgar.

While the last word cannot yet be said with regard to the phytogeography of the High Pamir, B. Fedtschenko, probably justifiably, felt, after his first visit in 1901, that the time was ripe for an ecological review of its vegetation. In this he recognised eight distinct plant-associations—aquatics; river-bed bushes; plants of the haughs along the river-banks; plants of the bluffs between the haughs and the true valley-floor; "desert"

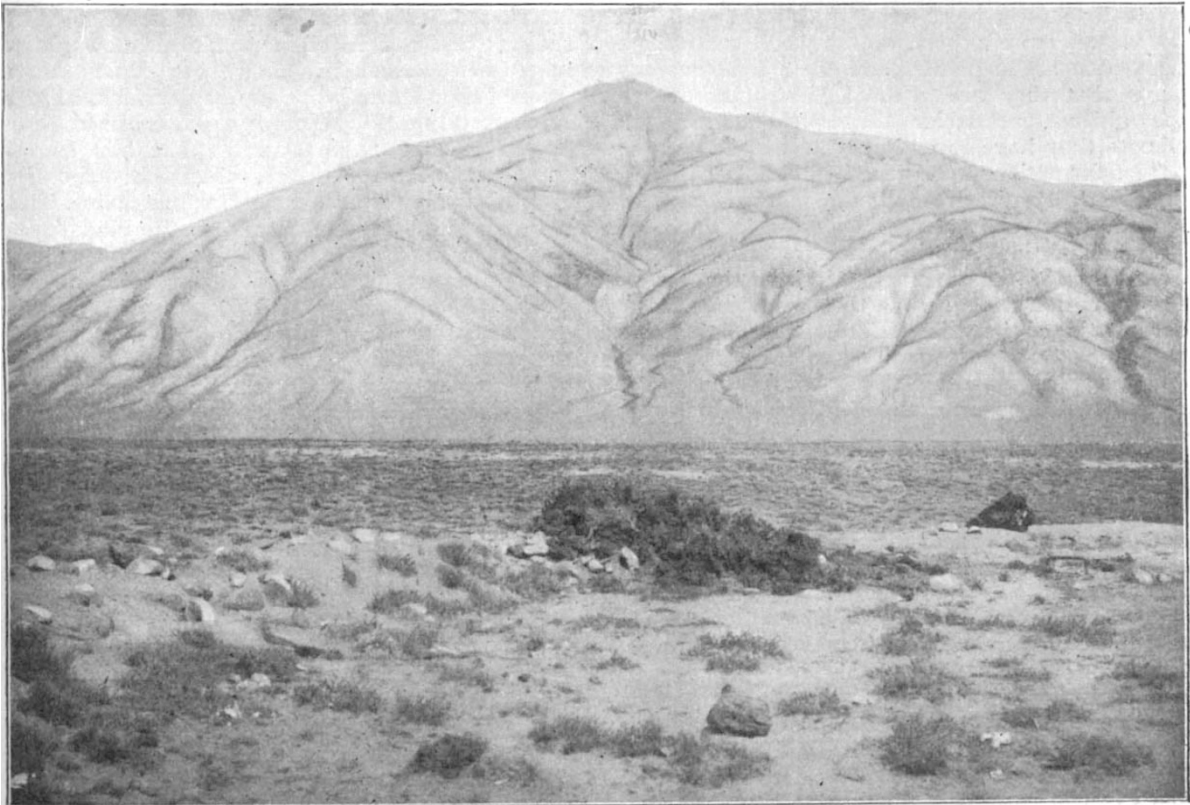


FIG. 1.—The plain east of Mardjanaj. In the foreground a heap of fuel, tufts and stems especially of *Artemisia*, *Eurotia*, and *Chrysanthemum amiricum*. The mountain behind shows dark vegetation lines in furrows of dry watercourses. From "Studies in the Vegetation of Pamir."

High Pamir was traversed by Mme. Olga Fedtschenko and her son, Mr. Boris Fedtschenko, both well-known authorities on the flora of Turkestan. The route of the Danish expedition was followed in both cases, so that Alcock is still our only authority for the area investigated by him. The systematic results of these journeys have been incorporated by Mme. Fedtschenko in a "Flore du Pamir," published in 1903, with supplements in 1904, 1905, 1907, and 1909. However, our knowledge of High Pamir plants is probably still incomplete. All the valleys investigated by Alcock, by the Danish party, and by the Fedtschenkos are drained by rivers which flow to join the Oxus, and, even as regards these Pamirs,

vegetation of the actual undulating valley-floor and of the major portion of the downs and slopes enclosing the valleys; patches of alpine meadow along brooks fed by melting snows; alpine meadows close under the snow-line; and willow-thickets in one particular sheltered ravine in the Jaman-tal. In summarising his results Fedtschenko has grouped these associations, with an additional salt-marsh-association, in three distinct plant-formations—meadows, subdivided into alpine patches, damp-meadows, and salt-marshes; stony wastes, including what he terms "Eurotia desert" and the vegetation of the bluffs leading from the valley-floor to the riverside haughs; and woody formation, including the *Myricaria*

bushes of boulder-strewn stream-beds and river-banks, and the willow thickets of the Jaman-tal.

In his careful ecological study of the results of the Danish expedition, Paulsen, with arguments that compel conviction, suggests that these "stony wastes" scarcely fall within the "desert" category. Fedtschenko's "Eurotia desert," in particular, Paulsen prefers to regard as "fell," using this term with a connotation corresponding with that of the word "forest," to signify that the plants involved show adaptation to cold and snow rather than accommodation to drought and heat. High Pamir plants display few expressions of adaptation to drought; their habit and their histology alike suggest that they are more influenced by strong light than by dry air. Further, they agree more closely, on the whole, with alpine than with arctic plants, and their structure suggests that they are affected more markedly by the altitude at which they grow than by the climate they have to endure.

The formations recognised by Paulsen for the dry High Pamir are four in number, and are named, from characteristic species in each, the *Trigonella*-, the *Eurotia*-, the *Arenaria*-, and the *Poa attenuata*-formations. Of these the *Trigonella*-formation is defined as the vegetation, largely xerophytic, of the valley-floors of the High Pamir, and the *Eurotia*-formation as the xerophytic vegetation on mountain-slopes with a southern or a western exposure; the *Arenaria*-formation is a special association, only seen well-developed near Lake Jashil-kul, which is a transition between the *Trigonella*-formation and the mesophytic vegetation on mountain-slopes exposed to the north; and the *Poa attenuata*-formation includes all the mesophytic associations of mountain-slopes with a northern aspect. In his comparison of the two systems, Paulsen regards Fedtschenko's alpine meadows as identical with his own *Poa attenuata*-formation; unites Fedtschenko's damp-meadows and salt-marshes in what he himself terms "swamp-meadow"; and recognises Fedtschenko's "woody formation." As regards Fedtschenko's "Eurotia desert" and "Bluff" associations, Paulsen's concordance is of a tentative nature; he suggests that the former may be his own *Trigonella*-formation, the latter his own *Eurotia*-formation. Clearly, however, the *Eurotia* desert of Fedtschenko includes the *Trigonella*-, the *Arenaria*-, and the *Eurotia*-formations of Paulsen, who apparently does not regard Fedtschenko's "Bluff" association as a definite entity. There is nothing save Fedtschenko's expression "and so forth" to support the suggestion that this author's "Abhänge u.s.w." may include mountain-slopes with a southern exposure; the "Bluff" association plants mentioned by Fedtschenko are not met with on the slopes to the north or east of a flat valley-floor. Interesting though this particular plant-association may be, a student of the High Pamir vegetation may be excused if he regards it as being, like the "woody formation" in the boulder-strewn river-beds, an intruding element that, favoured by special conditions, has extended up-

wards from the narrow valleys of the Low Pamir. For the sake of convenience we may also exclude the floating and submerged plant-associations of the marshes and lakes, not as being devoid of interest, but as not being distinctive of the High Pamir.

When the vegetation characteristic of these Pamirs is regarded from the English traveller's point of view, account must be taken both of the open surface of the valley-floor and of the slopes that rise from it on either hand. In dealing with the open surface we may begin with the green ribbon of vegetation that skirts the streams and fringes the lakes. This green belt includes two marked plant-associations: water-meadows or marshes, characterised by the presence of tufted sedges; and haughs of mountain meadow grasses mixed with which are many gay alpine plants. These High Pamir marshes may furnish, all told, some forty species, whereof a score are to be expected in any single Pamir. The haughs may supply about fifty species, of which one-half to two-thirds may be present in any one valley. These two plant-associations constitute one plant-formation, composed exclusively of mesophytic plants. In this respect it does not differ from the *Poa attenuata*-formation of the slopes with a northern exposure that bound the valley to the south or the west. Though as rich in species as the rest of the valley-floor, this green belt is less interesting ecologically than the open surface above the Bluff.

That open surface, notwithstanding its bare appearance as seen from above, is far from being devoid of vegetation. If the flora be of a poor type, that type is highly developed, and is made up of scattered tufted xerophytes with an admixture of cushion-plants. The individual plant-clumps are often a yard or more through, and usually a pace or two apart, so that, where vegetation occurs at all, it clothes approximately half the ground, though scattered irregularly over the valley-floor are many bare stretches of hard sand and shingle, variable in extent, and often coated with a saline efflorescence. Sometimes such saline spots sustain a few halophilous species, which thus constitute a distinct plant-association, while in the vicinity of the hot springs that occur in some of these high valleys a few peculiar species constitute yet another association. Excluding these two relatively unimportant elements, the vegetation of the High Pamir valley-floors, taken as a whole, is remarkably uniform throughout the region, and may be regarded as a distinct plant-formation. The number of species involved varies somewhat in different valleys; thirty may perhaps be a fair expectation for a particular Pamir; fifty is about the number for the High Pamir as a whole. The formation is, then, about as rich in species as the riverside mesophytic one, but in this case the species most plentiful in any single Pamir are, with few exceptions, those most plentiful in all the valleys.

Along the route followed by the Danish expedition and the Russian travellers the slopes that

overlook the valleys from the north or the east differ greatly from the anticlinal ones. The great screes along the base of a northern or eastern range are nearly, if not quite, bare; the rocky stream-beds and the open slopes are sparingly furnished with some of the more drought-resisting members of the plant-formation on the valley-floor below. The Little Pamir, however, is described by Alcock as having grassy downs on either hand. The long axis of that Pamir runs from west-south-west to east-north-east. We may therefore conclude that the slope which looks south also looks sufficiently east to escape extreme desiccation, while the one which looks north does not look sufficiently west to bring about that condition. The western influence on this slope may explain the absence from Duthie's Little Pamir list of many of the species present in some of the other Pamirs, in spite of the fact that Alcock collected every plant he saw except a rhubarb never met with in flower. In valleys other than the Little Pamir the total number of species recorded from mountain-slopes looking south or west scarcely reaches a score, all of them distinctly xerophytic in character.

On slopes with an eastern, and especially with a northern, aspect a relatively luxuriant flora, rich in species of a more or less mesophytic character, makes its appearance and constitutes a plant-formation closely related to, and perhaps not really distinct from, the mesophytic formation in the haughs along the banks of the main stream below. The two formations are, in fact, continuous through the mesophytic vegetation that accompanies the streams, fed from snow-fields or small glaciers, the broad channels of which open on the valley-floor at right angles, and cross that floor in order to join the river. Nearly four times as many species are met with on mountain-slopes with a northern exposure as may be found on those that front the sun. The increase in amount of vegetation is even more marked than the increase in the number of species. The poor and open furniture of the sun-baked slopes looking south or west gives place to a plant-covering usually closer, on these moister slopes that face the north, than on the open valley-floor.

The relationship between the vegetation of a flat Pamir and that of the containing slopes is fully understood only if it be realised that the valley-floor plant-formation is a "complex" of at least three distinct plant-associations. When this floor is quite horizontal all the species of the formation may be intermingled; but this condition is rare. Usually the surface is undulating, and more plants are to be found on the rises than in the depressions. Some species in the depressions grow equally freely on the rises; a few prefer the depressions; one or two are confined to them. On the rises the plants on the side facing north or east differ from those on the side facing west or south, and this arrangement is repeated with every rise from end to end of a Pamir. Though these slopes are never very pronounced, the adjustment between the species concerned and

the conditions that affect them is so fine that, even when the inclination is too slight to be perceptible to the eye or the muscular sense, the alternating bands of species appropriate to the anticlinal exposures demonstrate undulation of surface, and reveal the effect due to the enjoyment of a greater or less amount of heat and light, and of a larger or smaller supply of moisture.

Cushion-plants like *Acantholimon diapensioides*, one of the commonest of High Pamir plants, may occur on either aspect of a rise or in the depressions between successive rises; they may even be met with occasionally on the screes. In spite of this wide power of accommodation, *Acantholimon* does not appear on slopes exposed to the north. The very xerophytic *Eurotia ceratoides*, another common and widespread species, is, however, almost confined to the southern or western aspect of the undulations; this plant may occasionally be found on the screes, and is perhaps the species most characteristic of dry mountain-slopes facing the south. These slopes, indeed, rather than the valley-floor, might be looked upon as the distinctive home of *Eurotia*, were it not that the genus invades from the valley-floor those mountain-slopes that face the north. In many places these latter slopes show faintly that alternation of ridge and depression which is so marked a feature of the valley-floor. The depressions on such a hillside provide a footing for vertical bands of green vegetation composed wholly of mesophytic plants; the ridges between, even when barely perceptible to the eye, are marked by the presence of sparsely scattered small tufts of *Eurotia*. The grass *Stipa orientalis*, another common High Pamir plant, grows freely on either face of the undulations in the valley-floor, but avoids the intervening depressions. It is as much at home on high slopes facing west or south as is *Eurotia*; often these two are the only plants to be found on such dry slopes.

Among the valley-floor plants that are confined to the eastern or northern aspect of the undulations is *Trigonella Emodi*, and it is on this account that Paulsen has termed the vegetation of the valley-floor the *Trigonella*-formation. It has, however, to be noted that this species has not been recorded from the Little Pamir, although from Alcock's account the vegetation of that valley-floor is essentially the same as the vegetation of the other flat Pamirs. A species that occurs only in the depressions on the valley-floor is *Arenaria Meyeri*. This plant gives its name to the *Arenaria*-formation of Paulsen, a local plant-formation which links the vegetation of the valley-floor with that of the slopes exposed to the north. The species most distinctive of these high mountain-slopes with a northern aspect is *Poa attenuata* (Fig. 2), which Paulsen does not record from any valley-floor, but which, it would appear from what Alcock tells us, may be found in the Little Pamir not only on the mountain-slopes to the south, but also on the open surface of the valley, and even on the downs to the north. On this and on other mountain-grasses feed the herds of

Marco Polo's "exceeding great wild sheep, having horns, some of them six spans long," the "forms" of which, Alcock tells us, are to be

had been told that in this region "are excellent pastures, so that in them a lean horse or an ox may be fat in ten days." Five hundred years later the same opinion was expressed in very nearly the same words, for Lieut. J. Wood, who journeyed to the sources of the Oxus eighty years ago, was assured by the Kirghiz that "the grass of the Pamir is so rich that a sorry horse is here brought into good condition in less than twenty days." The experience of the Pamir Boundary Commission of 1895 did not belie these older estimates, for Alcock informs us that, "of the many pack-animals met with on our return march from Gilgit to Kashmir, none approached our baggage-ponies in condition."

Pamir air may perhaps assist the Pamir grass, for the climate of these lofty uplands is as healthy as it is severe. Paulsen describes in poetic terms the sense of well-being experienced by the Danish explorers during their halt near Lake Jashil-kul in August, 1898. Their days, it is fair to admit, were days of gentle breeze or calm. If such halcyon seasons be a feature of the valley sheltered by the Shatyr-tash, that Pamir is favoured beyond those that lie between the Ak-baital pass and the Alai range, or those between the Chargush pass and the Hindu-Kush.

However this may be, Prof. Paulsen, in these "Studies," has provided an account of the High Pamir and its vegetation so clear and so fascinating that his readers must feel prepared to face the bitter winds experienced by Alcock in the Aksu Pamir in 1895, and by Fedtschenko in the Karakul Pamir in 1904, should fate afford any of them an oppor-

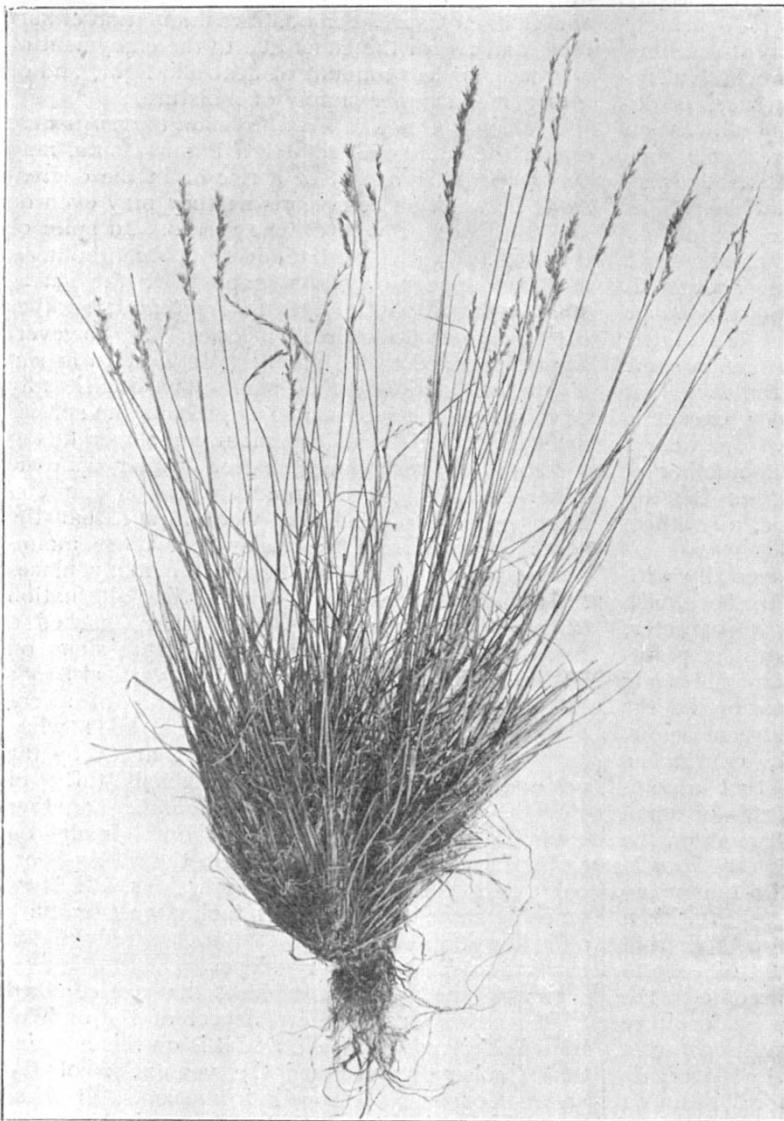


FIG. 2.—*Poa attenuata*, Trin. (about half natural size). From "Studies in the Vegetation of Pamir."

found especially on the bare, unstable screes to the north of a Pamir. The economic botanist knows that *Ovis poli* is not the only creature which finds this herbage wholesome. Marco Polo

tunity of visiting the region and subjecting the eastern valleys to the careful study bestowed by him and his companions on so many of the western ones.

### Primitive Chronology.

By DR. J. L. E. DREYER.

THE study of the ideas of uncivilised races with regard to chronology has generally been left to travellers who derived their information from natives among whom they dwelt for only a short time. The progress of civilisation among such races has often made it difficult to obtain trustworthy information about the way in which the

division of time was formerly regulated among them. When attempts have been made to collate the information to be found in books of travel and in works on ethnography, as has been done in the ninth chapter of Ginzler's "Handbook of Chronology" (vol. ii.), the result has been a collection of scraps rather than a systematically