plainly visible on the trunk stream. Here, for a distance of nearly fifteen miles above its end, the whole surface "is broken into ice hillocks, separated by deep depressions and heavily coated with débris of every size from mud and sand to granite blocks 20 to 50 feet in diameter," such as may be seen in the gigantic glacier-table, for the picture of which (Fig. 1) we are indebted to the Royal Geographical Society. From slightly below the entrance of the Haigatum tributary a band of white ice appears among these hillocks, which broadens out as it rises until it occupies all the southern side of the glacier. On the northern side the hillocks persist for eleven and a half miles farther up. They vary in height from about 50 to 230 feet, or even more, and sometimes recall drumlins in their linear arrangement and form. Beyond these hillocks the ice, as would be expected, is fairly free from débris. In the other parts, while the lateral moraines are large, medial moraines are practically absent.

The surface exhibits some other peculiarities. Over two-thirds of its area lakelets, occupying ice-basins, are unusually common. Thus, as might be anticipated, it is but little crevassed. In fact, the only ice-fall is at the beginning of the descent from the actual pass, where the subglacial valley floor naturally steepens. In these circumstances the "hummocky" surface appears at first sight anomalous, but of this Dr. Workman offers a satisfactory explanation. The trunk stream of the Hispar receives at least a dozen tributary glaciers, most of them large. The valley, however, is a trench of only moderate breadth, bounded by steep, rocky walls. As the side streams are too strong to be ponded back by the main one, they force their way downwards side by side with it. Thus the pressure becomes greater than the resisting power of the ice, and this is squeezed upwards into ridges and protuberances. These are favourable to the formation of lakelets, which extend up to an elevation of about 16,000 feet, surface streams being correspondingly rare. Other lakelets, formed by dams of ice or moraine, occur at the side of the Hispar and its tributaries, as may be seen in Fig. 2. Intra-glacial moraines, due to the excretion of débris which has been engulfed in large crevasses, may also be observed, as well as the usual structures of *névé* and glacier-ice.

The scenery of this region of snowy peaks and giant glaciers has a general resemblance, though on a grander scale, to that of the Alps and the Caucasus, and its dominant outlines are indicative of the action of fluviatile rather than of glacial erosion. It is also worth noting that, notwithstanding the trough-like shape of the valley occupied by the Hispar ice-stream, neither the map nor the photographs suggest any marked truncation of the spurs past which it moves. Yet here, where several ice-streams are crowded into a comparatively narrow corridor, we might expect to find its rocky wall even undercut by their struggle to force a passage. The Hispar Glacier was one of several on which in 1906 the Geological Survey of India fixed marks in order to study their advance and retreat. It then appeared to be practically stationary, and had thus continued to the time of Dr. Workman's visit. So, too, had the Yengutsa Glacier, which reaches the valley-floor a little below the end of the Hispar. Yet, about five years prior to 1906, it had rapidly advanced for a distance of nearly two miles. One minor point of interest may be mentioned. Grouped spires or pyramids of snow or ice were not seldom observed, resembling the *niéves penitentes* of the Andes, to which Dr. Workman, though not without protest from Sir Martin Conway, extends the name.

T. G. BONNEY.

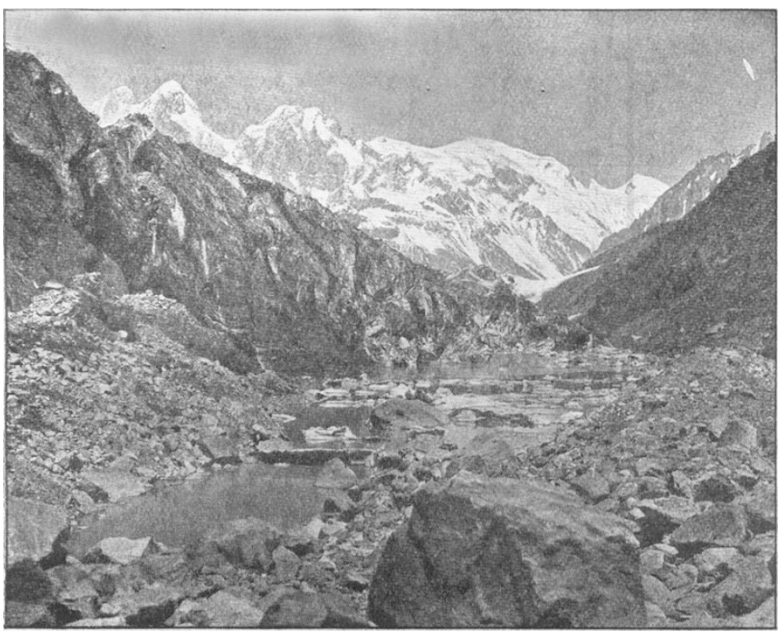

FIG. 2.—A border-lake near the junction of the Jutmaru with the Hispar Glacier. It is enclosed by a lateral moraine and the mountain-wall on the right, and the high side of the Jutmaru Glacier on the left, from which the ice-fragments floating on the water are derived. The stratification of the blackened glacial ice is well seen. Behind are the high snow-peaks walling in the Jutmaru. (From the *Geographical Journal*)

HALLEY'S COMET.

SINCE its conjunction with the sun Halley's comet has been seen from several observatories, and on April 16 was seen with the naked-eye by the observers at Cape Town. Thus there is some reason for hoping that, given clear morning skies, the comet may become easily observable in England, although its low altitude at sunrise, until after it has transitted the sun on May 19, is not favourable.

The following is part of the ephemeris calculated for April and May by Dr. Smart, and communicated by Mr. Crommelin to the *Astronomische Nachrichten* (No. 4379):—

Ephemeris for Greenwich Noon.

1910	R.A. h. m.	Decl. ° ′	1910	R.A. h. m.	Decl. ° ′
April 24 ...	23 50·3 ...	+ 7 47	May 20 ...	5 3·4 ...	+19 8
28 ...	23 50·9 ...	+ 7 56	21 ...	6 9·9 ...	+17 40
May 2 ...	23 54·5 ...	+ 8 18	22 ...	7 3·1 ...	+15 14
6 ...	0 3·1 ...	+ 9 5	23 ...	7 44·8 ...	+12 40
10 ...	0 21·6 ...	+10 30	24 ...	8 18·3 ...	+10 24
12 ...	0 38·5 ...	+11 41	25 ...	8 40·1 ...	+ 8 31
14 ...	1 5·8 ...	+13 27	26 ...	8 58·9 ...	+ 6 59
16 ...	1 49·9 ...	+15 59	27 ...	9 13·1 ...	+ 5 45
17 ...	2 23·1 ...	+17 29	28 ...	9 24·6 ...	+ 4 45
18 ...	3 7·3 ...	+18 51	29 ...	9 33·8 ...	+ 3 50
19 ...	4 3·2 ...	+19 43	30 ...	9 41·4 ...	+ 3 15

As will be seen from the ephemeris, the comet, when near the sun, will travel very quickly across our line of vision, traversing Aries, Taurus, Orion, and part of Gemini between May 16 and 22.

On May 20 the distance of the comet from the earth will be about fourteen million miles, but by May 30 this distance will have increased to more than forty million miles.

The two diagrams here given show, roughly, the conditions of observation, Fig. 1 for the eastern apparition, Fig. 2 for the western. In Fig. 1 the stars are shown approximately as they appear to an observer in London looking due E. one hour before sunrise (*i.e.* 3.30 a.m.) on May 1; the dated circles represent

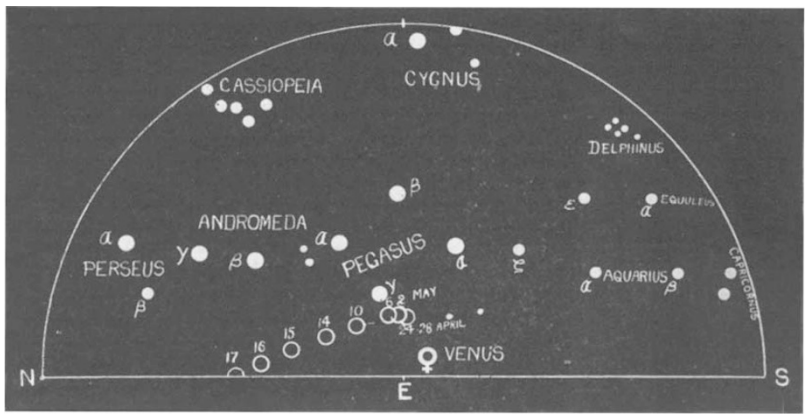

FIG. 1.

the approximate positions of the comet for the date given. Unless the eastern sky is fairly clear it is questionable whether Venus will be seen. It is obvious that to see the comet during its period as a "morning star" one must get away from the smoke-laden horizon found near large towns, and ascend to as great an altitude as possible. The observation will probably not be a simple one, for at this time of the year the sky, an hour or so before sunrise, is never dark unless cloudy; the dawn comes quite early. For this morning apparition, the Great Square of Pegasus should act as a splendid "warner" and landmark, just as it did in the evening apparition of comet 1910*a*. This mutual association of the two comets with Pegasus affords a good example of one of the chief difficulties experienced by those astronomers who have endeavoured to trace Halley's comet amid the mass of brief and very general records of comets in ancient chronicles. Fig. 2 illustrates the conditions after May 20, when the comet will be an evening star; the observer is supposed to be looking due W. at one hour after sunset on May 25 (about 9 p.m.); with a clear horizon, Procyon may serve as the indicator, but in any case Gemini and Leo will afford ready landmarks. It is now the general opinion, and hope, that no chart will be necessary during the last week or so in May, for the comet gives indications that it will probably be bright enough to be seen without difficulty. One favourable point is, of course, that during the morning apparitions the tail will rise before the comet, whilst under the conditions shown in Fig. 2 it will set later.

That the comet has developed a tail of some size is shown by photographs taken at Juvisy on February 12 and at Ottawa on February 10. The former shows a thin, feeble tail 1° 30′ long, the latter, which is reproduced in Fig. 3, a tail ½° long. From M. Baldet's drawing, made at the Juvisy equatorial on March 5, it would appear that the southern branch shown by him, Fig. 4, was probably too faint to impress itself on the Juvisy photograph. It is interesting to recall, here, that in the 1835 apparition the comet, for some time after passing perihelion (November 16), showed no trace of the tail, which on October 15 had extended to a distance of 20°. According to Sir John Herschel in his "Outlines of Astronomy," the comet was not picked up, after perihelion, until January 24, 1836, and then presented a small, round, well-defined disc, rather more than 2′ in diameter.

According to a correspondent of the *Morning Post*, the comet was seen at Greenwich Observatory, as a nebulous disc, some 30″ in diameter, in the 10-inch telescope, on the morning of April 18. A nucleus, from 3″ to 5″ in diameter, was recognised, but no definite tail could be seen, probably on account of the approaching daylight; there was, however, a lack of definition, on the western side of the head, probably denoting the presence of the tail. With the 13-inch telescope the comet was followed until 4.25 a.m., and was estimated to be as bright as a second or third magnitude star.

While the chance of capturing a sample of the comet, as suggested by Dr. Allen, is perhaps very small, it is a pity that apparently no action is being taken. The passage of the earth through a comet's tail is so rare an occurrence that even a small opportunity ought not to be missed. In the April number

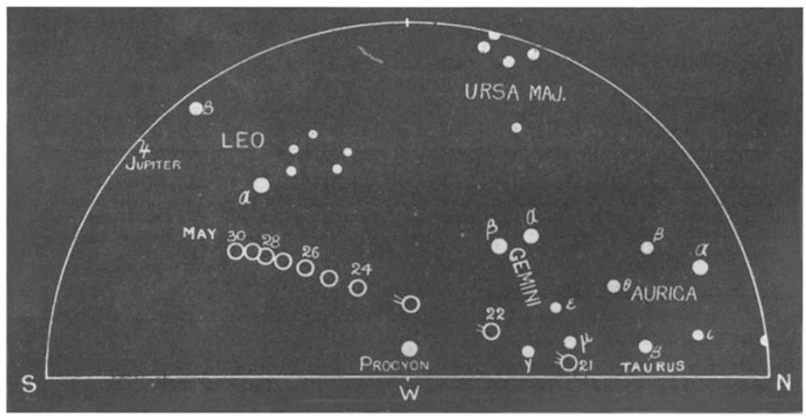

FIG. 2.

of the *Bulletin de la Société Astronomique de France*, M. C. E. Guillaume suggests the liquefaction of a large quantity of air which could afterwards be treated by fractional distillation, and possibly some cometary matter recognised. He points out that very minute quantities of the rare gases, *e.g.* krypton, are thus secured from immense volumes of air, and that it is now possible to liquefy 1000 cubic metres of air per hour; as he remarks, it is just possible that by this means the chemical study of the comet

might become a by-product of an industrial operation.

M. Flammarion suggests that if there is any palpable material at so great a distance from the head, it might be possible to measure the minute rise of temperature produced by the earth rushing through it at the rate of 77 kms. (forty-eight miles) per second.

FIG. 3.—Halley's Comet, 1910, February 10. Photographed at Ottawa.

The possibility of detecting the nucleus of the comet when it is crossing the sun's disc appears to be very remote. As pointed out by Prof. W. H. Pickering, a solid dark mass would need to have a diameter of at least seventy miles in order to be detected under these conditions, and, from the fact that Herr Archenhold saw a twelfth-magnitude star transitted by the comet, on December 5, without changing either in colour or brilliancy, it is extremely unlikely that masses of this order of size are contained in the comet's head; but the Kodaikanal spectroheliograph, in the hands of Mr. Evershed, may be able to disclose the cometary vapours during the transit.

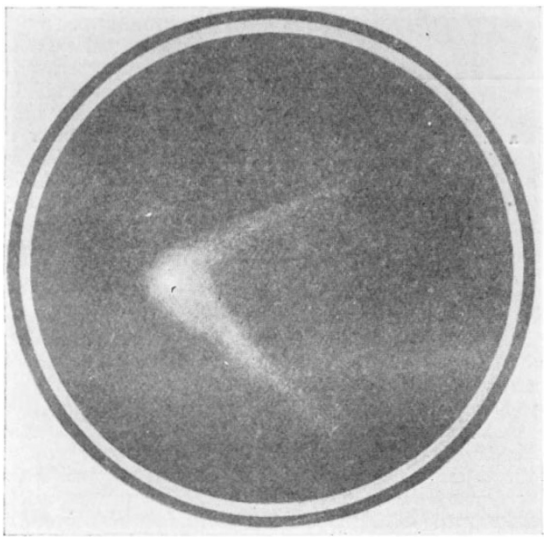

FIG. 4.—Halley's Comet, 1910, March 5. From a drawing by M. Baldet.

There have been many surmises as to what will be the effect on the earth and atmosphere. Some of these are notable only for their extravagance, but it does seem probable that an exceptional display of aurora may be generated, and also that we may experience the mistiness of the atmosphere which was generally noted in 1861, before it was known that we had passed through the tail of the great comet of that year. It has been suggested, too, that we may see the extension of the tail as a series of diverging streamers, as was also noted in 1861.

Reports from China state that the comet is being used as an omen to inflame the rioters in the disaffected districts, and that the authorities are exhibiting pictures of the comet, with accounts of its previous apparition without ill-effects, in order to reassure the inhabitants. While there is, of course, no possible likelihood of serious misapprehension in this country, it is obvious that there yet lingers a certain amount of superstition concerning the baneful effects of comets. We would suggest to all teachers that the May apparition will afford an excellent opportunity for giving real, "live" nature-study lessons, which should effectively eradicate such superstitious fancies from the minds of the rising generation.

ROMAN BRITAIN.[1]

THE first of the two volumes referred to below contains a fully illustrated account of the excavations carried out early in 1907 by the Manchester and District Branch of the Classical Association on the site of the Roman fort at Castlefield, Manchester. The second volume is a supplementary volume by the same association, describing excavations of an earthwork at Toothill, Cheshire, and at the Roman Fort Melandra.

The first volume is something more than a mere dry-as-dust description of excavations. It contains a number of very interesting and informing essays dealing with different departments of the subject, and written by experts, so that the general reader will have no difficulty in understanding the nature and value of the work that has been so efficiently carried out. Both volumes are ably edited by Mr. F. A. Bruton, of the Manchester Grammar School.

An interesting article on the name of the fort, by Prof. James Tait, shows how difficult it is to suggest an etymology of an ancient place-name which will withstand the assault of destructive criticism. The name Mancunium, which is usually associated with the Roman fort at Manchester, has been derived by various authorities from the Welsh, *main*, "a stone"; from the Welsh *man*, "a place," and *cenion*, "skins"; from the Welsh *meini cochion*, "redstones"; and from the Old Celtic *mammion*, suggesting a derivation from *mamma*, "mother." The last derivation applies to the form *Mamcunio*, one of the half-dozen different readings found in various ancient manuscripts.

Among the inscriptions found in the course of the excavations are several on altars dedicating them to the goddess "Fortune, the Preserver." The inscriptions, however, give very little information as to the details of the Roman occupation, though one inscription appears to imply that at one time soldiers from Rætia (Tyrol) and from Noricum formed part of the Manchester garrison.

Among the objects were a considerable number of coins and articles of bronze, silver, iron, and glass.

1 "The Roman Fort at Manchester." Edited by F. A. Bruton. (Manchester: University Press; London: Sherratt and Hughes, 1909.) Price 5s. net.
"Excavations at Toothill and Melandra." Edited by F. A. Bruton. (Manchester: University Press; London: Sherratt and Hughes, 1909.)