and is certainly specifically distinct. The largest specimen [No. C. 7676a], a broad-whorled form, has scratched upon it the locality "Lakur." Its dimensions are:—diameter of shell, 59·5 mm.; height of outer whorl, 18·5 mm.; thickness of outer whorl, 31 mm.; width of umbilicus, 25·5 mm. The largest specimen but one is a little better preserved, with sharper and somewhat coarser ornaments, but is not such a broad-whorled form as will be seen from its dimensions, which are:—diameter of shell, 57·5 mm.; height of outer whorl, 17·5 mm.; thickness of outer whorl, 26·5 mm.; width of umbilicus, 27·5 mm.

(To be continued.)

V.—STEVN'S KLINT.

By the Rev. E. HILL, M.A., F.G.S.

THE fine cliff of Stevn's Klint on the Danish coast is seldom mentioned in English geological writings. As it presents a clean section several miles long of the uppermost Danish Chalk, and is easily visited in a day's excursion from Copenhagen, a short sketch may have some interest for readers of this Magazine. It has none of the astonishing scenery displayed by the coasts of Muen and Rügen; the land is level and bare, the cliff is not broken and not wooded: yet it possesses a prettiness of its own.

A railway running south from Kjöge, a town south-west of Copenhagen, forks at Haarlev: the western branch leads to the famous inland quarry of Fakse,¹ the eastern to a coast hamlet called Rödvig. The Chalk in the cliff here is only a few feet high, but it rises in the eastward direction and may be followed along its edge for the full length. Or the train may be left at Storre Hedinge, a little town with a respectable hotel, whence four miles of road lead to the cliff at Höjerup, where the section is most accessible.

The ancient church here stands on the cliff, closer to the edge than those at Dunwich or Sidestrand, and, unlike those, in full use still. Guidebooks print a local legend that it would have fallen long ago but that every Christmas night it shifts itself a hands-breadth (*haneffed*, a cock's step) inland, to remain as before uninjured on the brink.

The country traversed from Storre Hedinge is level, almost without undulation, to the cliff edge. The cliff section shows this to be the upper surface of Glacial Drift, here a somewhat earthy or silty clay, containing stones and occasional boulders up to a foot across. Clean sections are not very frequent. In these, as elsewhere in Baltic Drifts, there is sometimes an appearance of divisions; e.g., about 1 or 1½ miles north of the Lighthouse I noted (in descending order): red earthy clay, 3 feet; light-brown, dry, cracked clay, with chalk and large boulders, 4 feet or more; pale chalky clay, tougher and less cracked, with more stones and flints, and with a boulder

¹ Commonly, but wrongly, Faxoe. See GEOL. MAG., 1901, p. 486.

at its base, 8 feet or more; then chalk: the line between the second and third members is sharp. One object of my visit was to examine whether any disturbances in the Chalk had affected overlying beds. At Højerup the upper surface of the Chalk is irregular, somewhat following the wavings of certain flint bands in it. There was a good section of a drift-filled hollow, where the drift showed an appearance of two members with streaks like bedding near the division. These streaks did not bend down into the hollow. If they marked beds, I concluded that here was a hollow filled by subsequent deposition, not Chalk with drift bent conjointly. The evidence would probably not have convinced a leader of opposition, but it will presently be seen that debate is silenced by a 'previous question.'

The Drift lies on an irregular surface of a white limestone, a rock which nothing I have seen in England represents or resembles. Nothing represents it, for here are the very highest beds of the Danish Chalk. Nothing resembles it, for we see white limestone seamed with bands of grey flint. Not flints, but flint (or ought I to say chert?) in solid continuous sheets. The flint is as continuous as the thicker sheets of white limestone which it divides. The flint bands may reach as much as 8 inches in thickness, and at Højerup there may be six or eight in about 25 or 30 feet vertical. Elsewhere they are often further apart and, I think, fewer. Their colour varies from light to dark grey. The limestone resembles clunch in colour and texture. It is extensively worked all along the cliff for building material. It is sawn on the spot into rectangular blocks, which are hoisted up to the cliff edge and carted inland for cottages and farm buildings.

The flint bands in the limestone do not lie horizontal or straight. They undulate gently: I estimated one arc to have 50 feet of chord to 10 feet of vertical height (what when we studied Newton's "Principia" we were taught to call Sagitta). While considering these undulations I gradually became aware that they were not always parallel. The wavy bands were not identically bowed and wavy; the intervals between them thickened and thinned; here and there a band forked or died out. I had always supposed that flint beds marked original horizontal surfaces of deposition, but here were surfaces which hardly could have been all originally horizontal. Flint sometimes fills cracks and joints. I began to speculate on bowed surfaces of yielding to stress; segregation of silica along bending lines of weakness. But this would throw doubt on many conclusions, and undermine some theories, perhaps some of my own as well as others. While so "revolving sweet and bitter thoughts" my eye fell on a guidebook remark—"Geologists regard the Fakse Chalk as a coral-reef." Stevn's Klint is only some fifteen miles from Fakse. So, after all, these waving layers, I suppose, do indicate surfaces of an old sea-floor, but an uneven one.

I find that Ussing ("Danmark's Geologi," p. 82) regards only a few inches near the base as representing the proper Fakse beds. He designates the 30 or 40 feet above as Limsten, and considers

this a deep-water deposit; though in earlier days Forchhammer had attributed the irregularity to shallowness and nearness to land. The series as a whole is designated the Newer Chalk.

At the base of this Newer Chalk I noticed a few inches of brecciated rock, possibly the part said to represent the Fakse beds. All below is often hid by a talus-slope, some thirty or forty feet high. Where this has been cleared away there is exposed also chalk, but a different chalk. It is softer, whiter, and shows lines of flints (flints, not flint; the black nodules with white skins that we know so well in our cliffs of Albion). It is designated by the Danish geologists Writing Chalk (*Skrivekalk*, translating the German *Schreibekalk*). The boundary between it and the overlying Newer Chalk is straight, and the lines of flints in it are straight also. This disposes of the question, mooted above, as to the origin of a drift-filled hollow. It shows that such hollow cannot be due to bending, for the Writing Chalk is not bent. My hope of evidence on the question whether the Drift has been affected by movements in underlying beds was destroyed. The chalk, however, has been slightly moved. A distant view of a long stretch of cliff, south of Højerup, seemed to show a straight junction-line between the two chalks, with a straight line of flints in the lower, which rose northwards, approximating to the junction-line. (This would indicate some interval of time between the two.) Also, the top of the Writing Chalk, which at Højerup is perhaps 30 feet above sea-level, some three miles north, at Eskesti, has risen to the top of the cliff, about 80 feet high. Though the Newer Chalk is absent there, it again caps the cliff a little further north, at Mandhoved Pynt, 120 feet high, the highest ground of the cliff. At Eskesti is an extensive quarry in which the straight parallel lines of flints are numerous and conspicuous.

This lower Writing Chalk yields to the sea-waves, and leaves the Newer Chalk overhanging it as a great cornice along most of the cliff. In consequence the beach can seldom be reached except by aid of ladders. In five or six miles of cliff there were only five or six spots where I found paths continuous down to the sea. The waste, however, must be slow, as the legend quoted above will show. Signs of landslip were rare. Even gullies in the cliff edge were shallow and short; only one ran 100 yards inland. The contrast between this level platform and the broken surfaces of Møen and Rügen was as great as that of Rügen's steeply dipping flint lines or Møen's contorted and shattered strata with these even, regular beds. The three localities have, however, much in common. They are all Chalk mantled with Drift; they all face east; they all stand out into the Baltic, lofty bastions against its assault.

The level strata of this cliff suggest one important reflection. Stevn's Klint presents vertical faces, sometimes over 100 feet high, to the south, east, and north. I saw the greater part, and saw no dislocation or disturbance of beds. Not twenty miles off, across the sea, is the mainland of Sweden. Where were these cliffs when a Northern Ice-sheet advanced? Or, what was the Northern Ice-sheet

when it advanced against these cliffs? Were the cliffs then safe beneath the sea? Or, was the ice-sheet accommodating and pliable? The beds are undisturbed. "Facts bein' stubborn and not easy drove," says Mrs. Gamp. Was Stevn's Klint stubborn? At any rate, it is a fact.

A Tongue of Glacial Clay.

At Rödvig, on the west side of its little port, the top of the Stevn's Klint Chalk is only about eight feet above sea-level. Over it lies eight or ten feet of Glacial Clay. The line between Chalk and Clay was clean and clear, roughly but not perfectly level. At one spot a tongue of clay ran into the chalk, about twelve feet long, not more than three inches at its thickest. Such tongues are often to be seen at such junctions, but this attracted my attention. The cliff faced south; the point of the tongue was on my right hand, and its connection with the mass of clay on the left; the tongue therefore entered the chalk from the west. Any ice-sheet at this spot may have been moving from north or east, but no one would imagine a movement from the west. The tongue was not thrust in by an ice-sheet.

FIG. 1.—Tongue of Clay in Chalk.

In the clay of this tongue were two or three flints; one, pear-shaped with a narrow stem-end, had this narrow end imbedded in the lower surface of the chalk, while its thicker part extended nearly, but not quite, to the top of the clay. It was *in situ*, but any thrust would have displaced it. So this clay had not been introduced by thrust, neither had any horizontal pressure acted on the flint. The fissure filled with clay may have been made by solution of water percolating along a crack, or by repeated freezing and expanding of water in such a crack, or by some lifting of an attached cake of ice; but certainly by no horizontal force.

FIG. 2.—Middle portion of above, enlarged.

[Figures represent tracing of diagrams in notebook made on the spot.]

It may be worth while to notice carefully such tongues elsewhere, in case some of them may afford evidences of their causes. Here the Danish Clay seems to have put out its tongue against a Baltic Glacier.

Recent Ice-Transport.

The following extract from a sixpenny Danish Tourist's Guide to Kjøge and Stevn's Klint seems worth reproducing:—[Near Vemmetofte] "in the shore-wood there lies some distance from the water a vast block, called Musestenen, as large as a labourer's hut; in the severe winter of 1895 this was carried by the ice several hundred alen (*al*, about two feet) away from the water, inland."

R E V I E W S.

I.—ROUND KANCHENJUNGA, A NARRATIVE OF MOUNTAIN TRAVEL AND EXPLORATION. By DOUGLAS W. FRESHFIELD; with an Appendix on the Geology, etc., by Professor GARWOOD, F.G.S. pp. xvi and 367; 42 illustrations and 3 maps. (London: Edwin Arnold, publisher to H.M. India Office, 1903. Price 19s. nett.)

THE somewhat restricted territory of Sikkim, lying as it does between the native Himalayan States of Nepal and Bhotan, is yet extensive enough to enable the European traveller to penetrate into the heart of the mountainous region of the eastern Himalayas, which is dominated by the stupendous mass of Kanchenjunga. The most ordinary globe-trotter nowadays can take his trip to Darjiling and there enjoy the world-famed view of the monarch of the Sikkim mountains. Nay, more, from a point in the neighbourhood easily accessible he may, under favourable circumstances, obtain a telescopic view of the still mysterious Everest group, which the jealousy of the Khatmandu Government is reserving, perhaps, for the mountain-climbers of the middle of the twentieth century.

Returning, however, to the subject of Kanchenjunga, it is one thing to admire a mountain, and another thing to go round it, as did Messrs. Freshfield, Garwood, and the Sellas, during the early Autumn of 1899. Mr. Freshfield is a mountaineer and traveller of great experience, and he states emphatically his conviction that nowhere else on the earth's surface can there be found, within so small a radius, a combination of tropical luxuriance, sylvan beauty, and mountain sublimity equal to that which meets the traveller's eyes among the valleys and highlands of Sikkim and Eastern Nepal. It is small wonder, therefore, that such a country should have attracted a certain amount of notice from previous writers. Of these he principally mentions two, viz. Sir J. D. Hooker and Major Waddell, both of whom have contributed largely, with pen and pencil, to the description of this wonderful region. There is probably no one interested in 'earth-science' who has not at some time of his life read with delight "Hooker's Himalayan Journals," written in the middle of the nineteenth century. With good reason has the author of the present work thought fit to dedicate it to "The pioneer of mountain travel in the eastern Himalayas," whose graphic pages and characteristic illustrations are by no means superseded even at the present day, whilst in the comparative