convex to the front (as usual), slightly thickened, and the anterior covered border smooth and concave (preserved for about three lines in antero-posterior length). The dorsal surface, from the anterior margin to about ten lines back, is covered with the characteristic scale-like markings of the genus, composed as usual of semi-oval, narrow, prominent ridges, the wide open part of the curve directed forwards and the convexity backwards, averaging about ten in longitudinal and about seven in transverse direction in six lines, and rather more regularly equal than in *P. bilobus*. The entire antero-posterior length of the segment is 2 inches 5 lines, the posterior portion, of about 1 inch 9 lines, as usual in the genus, being free of scale-like sculpturing. The entire breadth of segment I estimate would have been about $6\frac{1}{2}$ inches.

None of the Merostomatous Crustacea have been found before in this country, and Mr. Spry has presented the type-specimen to the National Museum.

II. — ON THE OCCURRENCE OF ALLANITE IN THE HORNBLENDE-GRANITE OF LAIRG, SUTHERLANDSHIRE.

By Lieut.-General C. A. McMAHON, F.R.S.

IN the September number of the GEOLOGICAL MAGAZINE for 1898, Mr. J. S. Plett, B.Sc., describes, at p. 388, the occurrence of Allanite in the granite of Fell Hill, Cree Town, Kirkcudbrightshire, and in a biotite gneiss in Sunday, one of the Orkney Islands.

I have recently been re-examining a slice taken from a sample of Heddle's 'Syenite' collected by me at Lairg, Sutherlandshire, some years ago, and I find it contains a very good crystal of allanite.

The rock is a hornblende-granite, and the slice, when examined under the microscope, is found to contain the following minerals; namely, orthoclase, plagioclase, quartz, biotite, hornblende, sphene, apatite, zircon, chlorite, and allanite.

The sphene is rather abundant and is idiomorphic in characteristic forms. The chlorite is the product of the alteration of biotite.

The allanite is in a lath-shaped, badly terminated, crystal, which distinguishes, and has the major (+) axis, at 36° to the line of elongation. The slice is therefore one parallel to the clinopinacoid. It is of pale orange-yellow colour in transmitted light (my slice is a very thin one), and is distinctly but feebly pleochroic. When revolved between crossed nicols it shows, prior to extinction, a decided zonal structure, which cannot be seen in ordinary transmitted light. The crystal is traversed by irregular cracks, more or less transverse to the direction of elongation; but no regular cleavage is to be seen.

Good-sized crystals of allanite appear to be rare; but crystals and grains of microscopic size are numerous in the rock, and I succeeded in isolating many of them. The mineral in the Lairg granite is brown-red in reflected light, and when the rock is pounded up its peculiar colour marks it off from the other minerals and enables the petrologist to pick it out from them with the aid of

a good pocket lens. The mineral possesses considerable lustre, and bright facets catch the light and facilitate its isolation. Crystalline faces are numerous and often suggest those shown at fig. 4, p. 522 of Dana's "System of Mineralogy," 6th edition. The fracture of the mineral is subconchoidal.

The specific gravity of the Lairg mineral is over 3.32, and consequently it sinks readily in methylene iodide. It would be difficult to ascertain the exact specific gravity of the Lairg mineral, as, owing to the microscopic size of the fragments, heavy liquids of viscous character—as, for instance, cadmium borotungstate above a certain density—are of no use.

The refraction of the mineral is also high, being well over 1.740 that of methylene iodide. On the other hand its double refraction is weak, exhibiting no colour higher than a decidedly dull yellow of the 1st order of Newton's scale.

The pleochroism of the Lairg mineral is usually distinct and occasionally strong, the change of colour being from a brown-red, or red-brown, to a brown-yellow. Sometimes, but rarely, there is a suspicion of green in the brown.

As regards the optical character of the crystals the Lairg specimens are positive. I have been able to observe the interference figure in convergent polarized light in many of the isolated fragments, and its sign is uniformly positive. Dana, in his "System of Mineralogy," 6th edition, 1892, says that allanite is optically negative; but Michel Lévy, in his "Les Minéraux des Roches," gives the sign as $\pm$. The Lairg specimens therefore support Michel Lévy's view.

Mr. J. J. Harris Teall, F.R.S., has very kindly allowed me to examine thin slices of another Scotch granite, that of Hildesay, in his private collection, in which a precisely similar mineral to that in the Lairg rock occurs, which he had previously suspected to be allanite. The mineral in these two rocks are clearly identical, and the description of one would do for the other. Extinction in one of Mr. Teall's crystals is nearly straight, showing elongation approximately parallel to the orthopinacoid, but in other crystals it varies, being generally about 34° . One of the crystals shows the zonal structure well.

In the Hildesay granite the allanite is associated with much epidote, but this mineral does not appear to be present in the Lairg rock. My slice contains none, and I have not observed any among the crushed fragments.

The allanite of the Lairg hornblende-granite appears to be an original constituent; it is corroded by the quartz of the groundmass, and it encloses numerous micro-crystals which appear to represent two mineral species; but they are too minute for exact determination.

The Lairg mineral fuses easily in the flame of a Bunsen burner, but is very slightly attacked by hydrochloric or by nitric acids. When ground to a fine powder it yields on prolonged heating to *aqua regia*.

On all the points noted above, the Lairg mineral agrees with allanite; and as I know of no other mineral which, on all points,

fits the above evidence, I do not see room for doubt regarding its identification.

In the future, varieties of allanite will no doubt be distinguished from one another, the varieties being dependent on the proportion of the rare metals, and also on the proportion of manganese present in them; but the accurate determination of them will be no easy matter. The collection of material, for instance, from the Lairg rock, is a work of labour; and when obtained, the microscopic fragments are found under high powers to be stuffed full of endo-minerals.

III.—GLACIATED VALLEYS IN THE CUILLINS, SKYE.

By ALFRED HARKER, M.A., F.G.S., of H.M. Geological Survey of Scotland.
(Communicated by permission of the Director-General.)

MANY geologists have recognized that valleys, which have once been occupied by large glaciers, exhibit peculiarities which can only be ascribed to glacial erosion modifying the earlier water-worn form of the land-surface. Indeed, anyone who allows ice-action to be locally a factor of importance in erosion, must expect that the resulting topographical forms will differ in some measure from those proper to water-erosion. Not only does ice, in virtue of its physical properties, obey different laws as regards pressure and flow, but, what is of equal importance, it fills the whole valley instead of following certain narrow channels. We may hope that, just as Gilbert and others have worked out the principles of water-erosion, so the much more difficult problem of ice-erosion may some day be reduced to analysis. An attempt in this direction has been made by McGee in a paper on "Glacial Cañons,"¹ which, however, I cite here rather for its brief summary of the observed characteristics of glaciated valleys.

The object of the present note is merely to draw attention to a district in which these characteristics are exhibited in their most typical form. This is due to two facts. Firstly, the mountain-group of the Cuillins is wholly carved out from a single rock (gabbro), so that all complication arising from the juxtaposition of harder and softer materials is eliminated. Secondly, there are none of the difficulties which attach to a district once overridden by foreign ice. The glaciation of the Cuillins was entirely local, and, although the ice passed over some of the lower watersheds, the flow in the main valleys was always in the natural direction. Further, the topographical forms are not only of a simple order, but are also very clearly exposed. In the mountain tract the drift is never thick enough to obscure the shape of the ground, and the higher valleys, like the mountains themselves, show nothing but naked rock. Since the erosion under existing conditions is a negligible quantity, we have the forms of the valleys displayed practically as they were left by the ice.

The chief characteristics of the valleys in the Cuillins are summarily as follows. It is important to notice that, while some of them (e.g. rock-basins) belong to glacial erosion only, others consist

¹ Journal of Geology, vol. ii (1894), pp. 350-364.