V.—CONTRIBUTIONS TO CEYLON GEOLOGY:

OCCURRENCE OF CORUNDUM *IN SITU*¹ NEAR KANDY, CEYLON.

By A. K. COOMÁRASWÁMY, B.Sc., F.J.L.S., F.G.S., Director of the Mineral Survey of Ceylon.

THE present notes are based on field observations made in 1900. The section described is now obscured.

Corundum is abundant in the gem-bearing gravels of Ceylon, but with the exception of the case here described no localities are known where it occurs *in situ*; the present occurrence is therefore of considerable interest, although not very satisfactory in itself.

Crystals of corundum were found in the surface soil on a piece of land known as Tenna Hena, and situated east of Kandy, and three-quarters of a mile north-east of Talatnoya bridge. The exact spot is shown in a map accompanying a paper on the crystalline limestones of Ceylon (Quart. Journ. Geol. Soc., 1903, vol. lviii, pl. xiii). A small excavation had been made, and a few pounds of corundum extracted and sold for use as emery, before my visit to the spot. All the rock exposed was decomposed, and crumbled in the fingers, being in a condition resembling sand.¹ I therefore carried on an excavation for two months, hoping to reach hard rock suitable for microscopic examination, but although a depth of about 30 feet was reached, no sufficiently hard rock was found.

At the corundum pit the 'beds' of granulite dip northwards at a high angle. A conspicuous soft yellow micaceous band 7–3½ inches wide marks the position of the sapphire-bearing zone. The sapphires occur in fair abundance in a less decomposed felspathic rock occupying a few inches on either side of this yellow micaceous band in the upper part of the shaft, but on the south side only in the lower part. The associated types of granulite are chiefly acid leptynite. The corundiferous band is about three yards from the northern boundary of a band of crystalline limestone about seven yards wide (in the lower part of the pit the distance was apparently less). There is nothing to suggest any connection between the occurrences of corundum and limestone. It is a little strange that corundum has not so far been found in the crystalline limestones of Ceylon, although so characteristic of similar rocks in Burma.

The sapphires are of fair size, the largest about three quarters of an inch in diameter, and though of a bright blue colour, are useless as gems owing to their opacity and well-developed cleavage, and often weathered, bleached, and hydrated condition. Rhombohedral cleavage and a basal parting are alike well displayed. Combinations of the hexagonal prism and basal plane are most usual, giving a columnar aspect; the forms observed include *c* (0001), *a* (1120), *r* (1011), *n* (2243); some double crystals with basal planes inclined at

¹ It is very usual for the granulitic rocks of Ceylon to be found in this friable, sandy condition, to a considerable depth. This mode of alteration is totally distinct from the formation of laterite, nor does it appear to be due to the kaolinization of the felspars, as these are translucent, and the analysis shows that but little water is present. The change partakes perhaps rather of the nature of a physical disintegration.

a little over 90° resemble twins, but the basal planes (*c̄*) are not quite in the zone *cr*, so that this resemblance appears to be deceptive. I am indebted to Mr. L. J. Spencer, M.A., for these crystallographic details.

The soft, yellow, micaceous band consists of biotite, plagioclase (quite fresh and glassy), greenish-yellow, soft, serpentine-like decomposition-products after pyroxene (?), and minute quantities of garnet and iron-ore. An analysis (No. I) by Mr. W. C. Hancock, B.A., shows that this yellow micaceous band contains a relatively slightly larger proportion of alumina than the corundiferous rock itself.

The corundiferous felspathic rock consists mainly of orthoclase-microperthite, with also plagioclase, biotite, corundum, and small quantities of garnet, green spinel, and zircon. It is not possible to make quite certain of the total absence of quartz; a consideration of the amount of alkali which is, according to the analysis, available would indicate the presence of a small percentage of free quartz; I have not, however, been able to detect any.

The microperthite is in a very fresh condition, the plagioclase still more so. The corundum in the rock has usually a 'court' of feldspar free from biotite, separating it from the remainder of the rock, consisting of feldspar with scattered biotite.

Professor Sollas, F.R.S., has very kindly made a mineral analysis of the crumbled rock, with the following results:—

Heavy minerals over 3·34 (chiefly corundum)	7·6
Orthoclase, s.gr. 2·56	64·2
Oligoclase (with possibly a little quartz), s.gr. 2·65	23·5
Biotite, s.gr. 2·8–2·92	4·7
	100·0

Mr. Hancock has chemically analysed the same material (No. II); No. III shows the same with water removed and ratios calculated to 100; No. IV, the molecular ratios.

	I.	II.	III.	IV.
Si O ₂	47·09	58·44	59·02	·983
Al ₂ O ₃	20·24	20·79	21·00	} ... ·210
Fe ₂ O ₃	9·45	·58	·59	
Fe O	3·04	3·85	3·89	} ... ·065
Mg O	2·04	·43	·43	
Ca O	3·41	2·24	2·26	} ... ·192
Na ₂ O	1·74	2·85	2·88	
K ₂ O	4·67	9·83	9·93	} ...
H ₂ O	9·49	1·36	—	
	101·17	100·37	100·00	

Calculations based on the analysis show that there is a small excess of alumina (above that required for the feldspars and biotite) which might be expected to have crystallized as corundum; this excess, however, is smaller than the mineral analysis would lead one to expect.¹

¹ The presence of free quartz would raise the amount of available excess alumina, as indicated by the chemical analysis. After careful microscopic examination, however, I feel that there can hardly be any appreciable quantity of free quartz present, if any.

We have, however, in this occurrence a clear case of the occurrence of corundum (and spinel) in a member of the 'Charnockite Series' in Ceylon, in a thin zone interbanded with normal varieties of granulite. It seems more likely that in this case the presence of corundum has resulted from a local variation in the constitution of the consolidating magma than that the magma should have absorbed some rock rich in alumina of which no trace remains here or elsewhere.

The additional alumina can hardly have been obtained from the yellow micaceous band, for in that case the accompanying iron and magnesia would probably have prevented the formation of corundum; this band seems rather to have consolidated from a 'magmatic streak' which, though (like the corundiferous band) rich in alumina, contained too much iron and magnesia to allow of the formation of corundum.

VI.—RIVER CURVES ROUND ALLUVIAL PLAINS.

By T. S. ELLIS.

(PAGE-PLATE XIX.)

IN the GEOLOGICAL MAGAZINE for October, 1902, Dr. Callaway mentions the explanation of these curves that I gave in a paper printed twenty-one years ago. His quotation should be read with the immediate context—"These [the tributary streams] keep open a channel into which the larger stream falls." This is the essence of my argument.

Professor Phillips and Sir A. Geikie have remarked that an alluvial plain in the course of a river may be regarded as an old lake-bottom, now drained; the lake-like appearance being renewed in times of flood. Let us suppose *ABCD* (Fig. 1) to represent such an area with a river flowing through it in a straight line, and, on one side, a tributary stream, or, to use a shorter and more expressive term, an affluent, coming in at an angle. Such a condition, if it existed, would not continue even in consolidated alluvial soil; it is still less likely to have existed in the soft mud when the area was first drained. A succession of floods would certainly wash away the bank where the affluent, coming through it, had caused a break in its continuity. By this the river-bed opposite the affluent would be expanded beyond its requirements when at low water. At every flood the whole of the bed of the river and the adjoining area of land will be covered with water, the ordinary river channel being effaced. From this water suspended matter falls and forms a deposit, visible after the flood has subsided, but in greater quantity on the banks by the sides of the low-water channel than on the adjoining land. The difference is, in my view, thus explained. The water deep down in the river-bed is subjected to great pressure by that above it, so as to be, relatively to the freely moving current on the surface, stagnant. Any suspended matter in the current that falls into this relatively stagnant water sinks to the bottom, and, in the absence of current there, remains; whereas, in the flood over the land adjoining the river, there is less depth of water, and therefore less liability of the suspended matter to fall below the line of current necessary to keep it in suspension.