ART. III.—*On a New Mode of Occurrence of Scapolite*;
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THE writer has recently met with the mineral scapolite under circumstances which appear to be exceptional, but which nevertheless admit of a rational explanation. The explanation set forth below is such that similar occurrences may be expected in other localities. The scapolite occurs in a vein of pegmatite, part of the pegmatite being composed of scapolite and quartz.

The occurrence in question is situated at Lot 20, Range 8, of the Township of Buckingham, Quebec, at the locality known as the Walker mine. There is an old excavation from which graphite was formerly taken, at a point 500 ft. north of the main pit. All the rocks here exposed are of pre-Cambrian age. The country-rock is composed of well-banded gneisses with a small amount of Grenville limestone on the east face of the pit. The gneissic banding at the south end of the pit dips

approximately vertically, and strikes along the length of the pit, i. e. N. 20° E. The northern end of the pit is occupied by a rounded nose covered by a pegmatite vein. The pegmatite has been broken through during mining operations, exposing the gneiss below it. From the exposures now to be seen it appears probable that the gneiss has been folded into a sharp anticline. The pegmatite which was intruded at a later date has taken on the form of an anticline, pitching to the south at an angle of 35°, assuming a form which is comparable with those of the saddle-reefs of Bendigo and of the "barrels" of Nova Scotia. The pegmatite vein has a thickness of about one foot and its upper surface is peculiarly smoothed. This surface was in close contact with the graphite ore-body, the ore being about one foot in thickness and being composed of almost solid graphite at the contact with the pegmatite, becoming poorer in graphite away from the pegmatite. With the removal of the ore this smoothed surface has been laid-bare, showing an appearance very similar to the smoothed and polished surfaces connected with glaciation.

A thin section of the ore from the east face shows it to be an altered Grenville limestone impregnated with graphite, and shows the development of lime-bearing silicates as at the main pit.*

At the point where the pegmatite and altered limestone are in contact the pegmatite is seen to be composed of quartz and a greenish-yellow mineral, at first supposed to be a variety of feldspar, but found on examination to be scapolite. This scapolite-pegmatite is an integral part of the pegmatite vein, and as such, is distinct from the altered limestone carrying the graphite, and also carrying scapolite. The area of the scapolite-pegmatite is but small, amounting to a few square feet only.

Microscopic characters.—The rock is composed essentially of quartz and scapolite. The relations of the two minerals to each other are usually like those of a eutectic, and simulate the olivine-anorthite type† rather than the orthoclase-quartz type of eutectic relations. Occasionally, however, the scapolite shows a tendency to the development of crystalline form. The scapolite, then, crystallized in part before the quartz, in part simultaneously with the quartz. The quartz shows strain shadows and has inclusions of small particles of graphite. Strings of gas bubbles are present and many very fine elongated needles of an opaque mineral are numerous in the quartz, being similar to those usually referred to rutile, though the characteristic twinning of that mineral is not seen.

The scapolite shows the uniaxial and negative character of that mineral, and in basal sections the development of two cleav-

* 12th International Geological Congress, Guide Book No. 3, p. 103.

† Geol. of Small Islands of Inverness-shire, Harker, 1908, p. 86.

ages at right angles. The development of the prism faces of the first and second order, $m(110)$ and $a(100)$, is well shown in basal sections of those individuals which crystallized before the quartz. It has a high birefringence, indicating it to be nearer meionite than marialite. The analysis confirms this. Some sections show abundant inclusions of the type characteristic of scapolite. Some of them are negative crystals and occur with definite linear arrangement with their elongation

FIG. 1.

FIG. 1. Smoothed upper surface of pegmatite dike with banded gneiss below it. Walker mine, Quebec.

parallel to one of the cleavage directions, while others show roughly circular cross-section and have no definite arrangement. The latter type may be unpropitious sections of negative crystals. The nature of these inclusions has not been more closely investigated.

There is a small amount of a chloritic mineral present. It has been formed at the expense of the scapolite and is associated with graphite. A part of the chloritic mineral shows radial arrangement. Calcite occurs in very small amount within the scapolite and with the chlorite and is probably a decomposition product of the scapolite.

Interpretation.—The explanation of the occurrence is simple. The pegmatite, before consolidation, assimilated a small amount of the limestone into which it intruded, and the assimilated lime gave rise to the formation of the lime-bearing silicate scapolite, instead of orthoclase, as in the rest of the vein. The chlorine required for the formation of the scapolite was an original constituent of the pegmatite, and is seen to have been capable of transmission, at least to a small distance, into the country rock, as shown by the presence of scapolite in the altered limestone of the ore mass.

A partial analysis of the scapolite of the pegmatite vein, which has a specific gravity of 2.690 [pycnometer], shows it to contain 16.24 per cent of CaO. This, taken in conjunction with the fact that the feldspar of the vein is orthoclase, clearly indicates that its formation is a result of the assimilation of lime from the country rock.

This occurrence, in addition to the novel features described above, throws an important light on the problem of assimilation by igneous magmas. It shows that in the case of even a small vein of pegmatite, such as is usually regarded as being intruded at low temperatures, speaking relatively of magmatic temperatures, the absorption of lime from a limestone country rock can take place, and that also, which is the important point, the absorbed lime may go toward the formation of lime-silicates and not merely be re-deposited as calcite. If assimilation may take place on the small scale represented in this occurrence (involving only a few cubic feet of magma), it is probable that on the larger batholithic scale it may play an important part in the change of the average composition of a large magma-reservoir, and so become an important factor in the differentiation of rock types. Limestone is a rock which lends itself to assimilation perhaps more readily than any other. Some of the possibilities arising from the assimilation of limestone have been discussed recently by Daly.* The present paper can be regarded as a proof of the possibility of assimilation and as showing that assimilation of limestone is a comparatively easy process requiring temperatures that are easily within experimental reach. So that the experimental proof that new rock types of the more restricted kinds can be formed from an average magma by the assimilation of limestone should now be undertaken in the laboratory.

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* Bull. G. S. A., xxi, pp. 87-118, 1910.