Dolomite Contact Skarns of the Broadford Area, Skye : A Preliminary Note

By C. E. Tilley

THE metamorphism of the Durness dolomite horizons in the aureole of the Beinn an Dubhaich granite of Skye has long provided one of the best known examples of dedolomitization and progressive thermal metamorphism of siliceous dolomites recorded in the literature. Harker's study (1904) concerned itself primarily with assemblages regarded as derived without notable accession of material during metamorphism and the occurrence of products of metasomatic origin at the contact of the granite has hitherto received but little notice in print. Yet as long ago as 1897, Geikie had written of this contact : " . . . the most abundant and interesting deposits are metalliferous. Fragments of a kind of ' gossan ' may be noticed all along the boundary line of the boss, and among these are pieces of magnetic iron ore and sulphides of iron and copper. The magnetite may be seen in place immediately to the south of Kilbride. A mass of this ore several feet in diameter sends strings and disseminated particles through the surrounding granophyre and is partially coated along its joints with green carbonate of copper " (Geikie, 1897, p. 384). It is of interest to note further that a record of " a mineral resembling humite " from this same contact is made in the Annual Report of the Geological Survey for 1896 (1897).

In Harker's later account (1904, p. 159) the only reference to products of the character referred to above is in a footnote to his description of the petrography of the Skye granites and granophyres, where he writes : " In one place only, 50 yards S.E. of the old ruined Manse at Kilchrist was found a lode of magnetic iron ore. It cuts the granite vertically bearing a little N. of W. and terminates at the junction of the granite with the Cambrian limestone."

The next recorded stage in the study of these ores is to be credited to Professor W. Q. Kennedy, who in September, 1940, while on other investigations in Skye, noted on the 6 inch Geological Survey maps of the Strath Suardal area by Harker and Clough a reference to a " magnetic iron ore lode " near the old Manse at Kilchrist. This occurrence is that referred to by Harker in 1904. Kennedy's examination of this outcrop led to the preparation of a preliminary report for the Geological Survey (dated 1st March, 1941, but unpublished). In this report (*Report on the Contact Metamorphic (Pyrometasomatic) Magnetite Deposits in the Cill Chriosd area, Isle of Skye*) the true significance of the skarn character of the iron ore was realized and a number of associated skarn silicates was recognized. The data of this report were made available to Home Ore Control of the Ministry of Supply and eventually under the supervision of Mr. G. Duncan, Mr. S. H. U. Bowie, of Aberdeen University, conducted a magnetometer survey of the contact near Kilchrist. Further work brought to light a number of additional localities along the contact with strong indications of magnetic ore and on some of these exploratory trenching and excavation was carried out.

In the course of his field studies Professor Kennedy made an extended collection from the original Kilchrist and other localities on the northern border of the granite with a view to carrying out detailed petrological investigations. In this task he invited my collaboration and since 1943 several extended field visits to the principal localities have been made, partly in his company. With the laboratory investigations, however, Professor Kennedy has unfortunately not been able to continue, and at this stage when those studies are well advanced, I am glad to acknowledge my indebtedness to him not only for the opportunity to participate in the examination of these most interesting assemblages but also for his guidance in the field over the new contacts revealed in 1940–41, and for much fruitful discussion during the earlier stages of the work.

Mr. Bowie, whose work with the original magnetometer survey has already been noted, informs me he carried out these studies along with geological work at Kilchrist in December, 1940, and February, 1941, and that he had determined the presence of a mineral of the humite group in the skarn rocks at that locality. His further studies were interrupted at the beginning of 1942 by war service and finally discontinued in 1946. The results of his work at Kilchrist will, I hope, soon be made available.

Recent reference (Tilley, 1947) to the dolomite contact skarns of the Broadford area has been made in the description of cuspidine, an important constituent in a group of these assemblages, an example of which has been figured (*loc. cit.*, p. 92).

In the present note a brief statement on the assemblages met with in the skarns will be made, a detailed account of the numerous parageneses being deferred to a later time.

Here is presented mainly the record of the chief minerals of the skarns. The skarns may be divided broadly into two groups.

Group I.—Skarns at the immediate contact characterized by minerals stable with free silica—grossularite, wollastonite (and its solid solutions), clinopyroxenes (both diopside and hedenbergite) and plagioclase. These are derived by silication of the dolomite. The group is normally subdivided into distinct zones of contrasted composition and has a lateral extent of only a few inches across the vertical contact of granite and dolomite. The skarns may be bordered directly by metamorphosed dolomite or be followed by the ore skarns.

Group II.—Ore skarns often of considerably greater lateral extent following on the " limestone side " of the contact zone. These are especially characterized by the chief ore, magnetite together with the undersilicated minerals, forsterite, monticellite, minerals of the humite group (chondrodite, humite, clinohumite), and cuspidine. Clinopyroxene is often an important associated mineral. As a group these assemblages are associated with a boron-fluorine pneumatolysis and like the preceding group (Group I) are often multizoned with magnetite restricted to a particular zone. When the skarns of Group II replacing dolomite contain " sponge forms ", these have their own aureole of concentric metasomatic zones, the chert itself being ultimately wholly replaced.

Among the boron-bearing minerals of the skarns are ludwigite fluoborite, datolite, szaibelyite, and a new mineral, *harkerite*—a carbonate-borosilicate of calcium and magnesium.

These two groups of assemblages correspond broadly to two stages in the process of contact metasomatism, each group within itself containing secondary minerals—the first, the earlier, arising from directly local metasomatism at the granite contact, the second, later, and deriving by the passage of ore bearing solutions not directly local in origin, probably ascending from below and attacking preferentially the dolomite which has acted as an absorption apparatus. These ore skarns are, however, not confined to the dolomite against the skarns of Group I. Kennedy, in his report, drew attention to their development in " bays " or pockets of dolomite along the granite contact. Such " bays " at granite-limestone contacts have long been recognized as likely centres for active ore deposition : furthermore, in Skye the occurrence of pre-granitic dolerite dykes enclosed in the dolomites has provided contact surfaces which the ore solutions have used as channel ways. A striking example is that of Camas Malag where ore deposition has followed the contact of a pre-granitic dolerite within an embayment of dolomite. In their spatial relations to the skarns of Group I, however, the ore skarns accord well with the thesis of Umpleby (1916) that ore tends to occur on the " limestone side " of contact zones.

These then are the exomorphic zones. Against the inner zone the granite is modified but this endomorphic effect is traceable across the contact for only a short distance. The hornblende and biotite which are the normal ferromagnesian minerals of the Beinn an Dubhaich granite mass give place to clinopyroxene but the chemical nature of this mineral and indeed the petrographic character of the modified granite is found to be adjusted to the varying chemical composition of the inner exomorphic zone against which it abuts.

In the table adjoining a summary record of the metamorphic minerals of the Durness limestone horizons in the aureole of the Beinn an Dubhaich granite is given. These are separated into three groups, those of the aureole beyond the skarn zones and the Groups I and II of the skarn zones as already briefly mentioned. The most abundant minerals of these two zones are indicated by asterisks.

In a later communication the paragenetic assemblages of these multizoned skarns will be dealt with in detail.

Metamorphic Minerals Developed in the Durness Limestone Horizons in the Aureole of the Beinn an Dubhaich Granite, Skye

Aureole, beyond the Skarn Zones	Skarn Zones		
	Group I	Group II (Ore Skarns ; Boron and Fluorine Pneumatolysis)	
Talc	*Grossularite/Andradite	Magnetite*	Bornite
Tremolite	Wollastonite* and solid solutions	Diopside*	Chalcocite
Forsterite	*Diopside/Hedenbergite*	Forsterite*	Covellite
Diopside	Spinel	Monticellite*	Chalcopyrite
Periclase	Plagioclase*	Cuspidine*	Azurite, Malachite
Wollastonite (rare)	Vesuvianite	Fluor	Pyrite
Spinel	Xanthophyllite	Chondrodite*	Zincblende
Grossularite (rare)	Phlogopite	Humite	Galena
Brucite	Orthite	Clinohumite*	
Serpentine	Clinozoisite/Epidote	Ludwigite	
Chlorite	Prehnite	Fluoborite	
Hydromagnesite	Apophyllite	Szaibelyite	
	Pectolite	Datolite	
	Xonotlite	Harkerite	
		Grossularite/Andradite	

* Most abundant skarn minerals.

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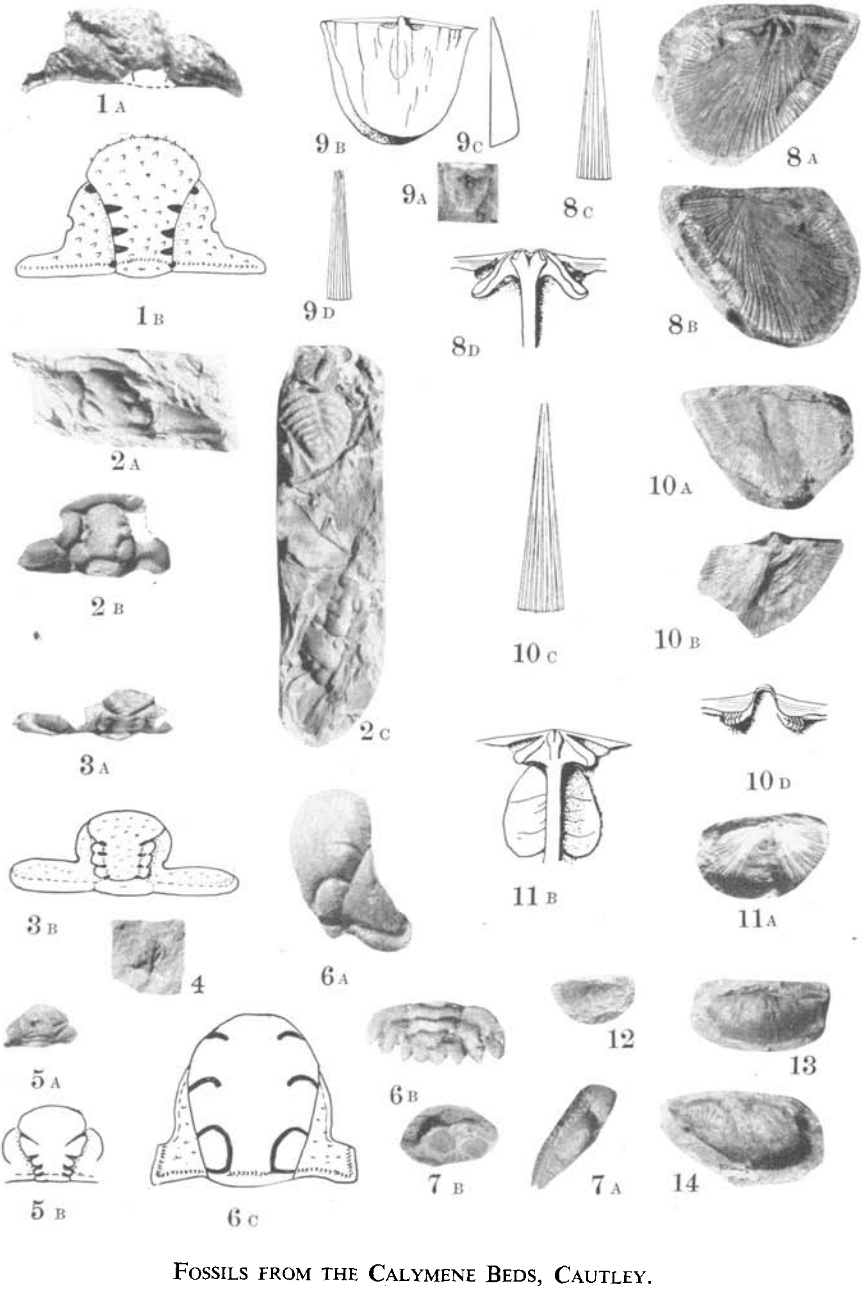

FOSSILS FROM THE CALYMENE BEDS, CAUTLEY.

FIG. 1.

FIG. 2.

FIG. 3.

TYPICAL STONY BEDS OF THE NEW RED SANDSTONE, SOUTH DEVONSHIRE.