thin section normally requires one to two days for a skilled technician. Several more hours, distributed over a period of one week or so, are devoted to the mounting procedure. The finished section may provide up to ten or so individual thin sections for observation on the microscope.

Figures 3 and 4 show low magnification electron photomicrographs of two different areas of the thinned specimen from the rock. The contrast between these and Figures 1 and 2 is striking. There appear to be at least three main phases present: large tabular crystals of a micaceous material; fine-grained polycrystalline aggregates; and a relatively structureless matrix material.

The well developed crystals shown in the center of Figure 4 are similar in appearance to micas observed in optical thin sections. A closeup of one of these crystals is shown in Figure 5. The electron diffraction pattern of the crystal (Figure 6) shows that the *d*-spacings between planes which are normal to the length are much smaller than those of planes parallel to the length of the crystal, thus confirming the micaceous character. In principal, it is possible to make use of these single crystal diffraction patterns to determine the structure of the mineral in the same way as an *x*-ray diffraction pattern but if the phases present are known from *x*-ray data, it is usually not necessary to perform a detailed analysis of the electron diffraction pattern. Figure 7 shows a diffraction pattern of the matrix material. This pattern shows symmetry and interplanar distances consistent with the quartz indicated by the *x*-ray diffraction.

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CONSTITUENTS OF CACOCLASITE

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Under the title *An Interesting Mineral From Canada*, H. C. Lewis in 1884 provisionally gave the name cacoclasite to a mineral from Wakefield, Ottawa County, Quebec, which occurred as white or greyish-white, nearly square prisms with truncated corners. The crystals, up to an inch in

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width and commonly glazed on the surface, occurred in blue cleavable calcite and were reported to be associated with pyroxene, graphite, spinel, wollastonite, pyrrhotite, and other minerals. According to Lewis (1884, p. 417), a thin section of cacoclasite examined under the microscope "shows an admixture of calcite, which causes momentary effervescence when the mineral is placed in acid. The groundmass is a gray amorphous, non-refracting substance resembling altered feldspar. Scattered through this are the unaltered crystalline fragments of a colorless, transparent tetragonal mineral, doubly refracting except in sections across the axis. The whole appearance resembles that of certain specimens of melilite, and shows alteration to have occurred throughout the whole of the crystals."

"The microscopic characters are not those of a simple mineral. Dr. M. E. Wadsworth regards the colorless mineral (isotropic or tetragonal) as having replaced the gray amorphous substance, as though the latter had once occupied the entire space."

Genth (1889) obtained two additional analyses of individual cacoclasite crystals. From fusion with microcosmic salt, he concluded that one crystal (analysis 2, Table 1) contained 23.04 per cent quartz and the

TABLE 1. ANALYSES OF CACOCLASITE

	Lewis (1884)[1]	Genth (1889)	
	1	2	3
SiO_2	36.74	31.52	32.67
Al_2O_3	19.79	17.34	19.63
Fe_2O_3	1.33	0.51	0.39
CaO	38.16	40.95	36.38
MgO	0.77	tr.	0.49
Na_2O	0.32	tr.	0.31
K_2O	0.17	tr.	0.20
H_2O	0.23	1.04	2.28
P_2O	2.49	2.19	3.36
CO_2	—	6.73	4.25
	100.00	100.28	99.96

[1]After deduction of unstated amount of calcite.

other 11.63 per cent quartz. Similarly, having deducted CO_2 as calcium carbonate and P_2O_5 as apatite, Genth obtained, respectively, 15.20 and 9.66 per cent calcite, and 5.05 and 7.74 per cent apatite. He therefore concluded that "cacoclasite cannot be considered a good species, but a mixture of quartz, calcite, apatite and other unknown minerals in various proportion, which have the form of scapolite and have resulted from its alteration."

In the present re-examination of cacoclasite, four small hand specimens

ranging in size from 2 to 9 cubic inches are available for study. The specimens, which are from the Canadian National Mineral Collection, were collected at Wakefield by C. W. Willimott in 1884. In appearance the material is exactly as described by Lewis and later by Genth. The crystals are large, generally well-formed, and have a roughened, glazed surface. They are imbedded in blue cleavable calcite and associated with lesser amounts of megascopic wollastonite, clinopyroxene, pyrrhotite, and apatite. Furthermore, as one of the cacoclasite crystals analysed by Genth in 1889 was received from G. Christian Hoffman, who at the time was chemist and mineralogist of the Geological Survey of Canada, it is possible that the material now available was in fact the source of the specimen sent to Genth.

In the present work, two thin sections at a right angle were cut off the largest crystal available. The major constituents are calcite, grossular, and prehnite. These are erratically distributed in the sections. Although calcite occurs predominantly in the garnet as small blebs and elongate grains with rounded outlines, a few grains up to 2 mm. in width are also present. On the whole, the calcite in appearance resembles porphyroblastic inclusions. Similarly, prehnite is present in both small and large grains and, in only some areas, in aggregates of sheaves covering several square millimetres. Patches of brownish, clouded, extremely fine-grained prehnite are also common. Apatite and clinopyroxene are minor constituents, but a major discrepancy is the absence of the quartz reported in such abundance by Genth. Five additional crystals, each of modified cubic appearance and about one-quarter inch in width were therefore hand picked from the calcite groundmass. Two were treated with 1:1 HCl and examined by diffractometer and Guinier patterns; thin sections were cut from the remaining three. All samples contained only grossular and calcite as the major constituents; and surprisingly, prehnite was absent in four of the five samples. The absence of the quartz reported by Genth could thus conceivably be rationalized on the grounds that the various constituents of the pseudomorphs are erratically distributed. However, the uncorrected chemical analyses by both Lewis and Genth correspond well to mixture consisting predominantly of grossular. In any event, final abandonment of the name cacoclasite seems justifiable. The unidentified constituents reported by the earlier writers are grossular and prehnite.

References

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