MINERALOGY AND THE FIELD GEOLOGIST[1]

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Now that we have reached the ripe old age of four years, we are inaugurating a dinner and short Presidential Address which we hope will become an annual event.

E. W. Nuffield, who did such a good job of serving as our President for the first three years, has thus far escaped delivering an address. However, you obviously would not wish to hear from me two years in succession, and it is my hope that we may be able to have him back at our dinner next year to speak to us.

Recently the Paleontological Society[2] revived the annual address with the thought that the Science and the Society had unique problems and unique contributions to make, and I believe the same thing applies very definitely to our Association.

I thought tonight we would discuss some of the relations between mineralogy and field geology, as seen by those of us who work in both.

When I leave the laboratory in the Spring for the field, I cannot help but regret that I am also leaving behind hard-won skills in special mineralogical techniques which, to a certain extent, will have to be brushed up on before I can use them again on my return in the Fall. I am also keenly aware of the fact that, with this division of time between field and lab, I am unable to take up a highly specialized field, such as structural crystallography, or do experimental work on systems involving synthetic minerals. For the valuable information that these studies provide, I must be indebted to my colleagues in those fields.

However, field studies reveal important mineralogical facts that can be obtained nowhere else. No matter how carefully we seek to simulate natural conditions in the lab, no matter how painstakingly we study the individual minerals in the lab, we can never see minerals in their natural environment except in the field. As N. L. Bowen early pointed out, and E. S. Larsen, Jr., has stressed, the only valid test of petrological theories has to be made in the field.

The give and take between field geology and mineralogy works both

[1]Address of the President of the Mineralogical Association of Canada given at the fourth annual meeting of the Association in Toronto, March 3, 1959.

[2]G. Arthur Cooper: Presidential Address: The science of paleontology, *Jour. Paleontology*, **32**, 1010, 1958.

ways. After all, minerals are the building blocks of rock units that go to make up our three-dimensional geological structures. If the constituents of these units are wrongly identified, or, just as important, insufficiently understood, wrong correlations are made and the geological picture we build up is incorrect. This truth was observed by Sir William Dawson in his autobiography. Referring to his studies at Edinburgh in 1841 he wrote:

> "I was surprised to find how little even some of the more eminent English geologists of that day seemed to know of mineralogy, and consequently how uncertain was their diagnosis in the field of the nature of rock masses."[3]

It is rather discouraging to realize that this observation is sometimes still applicable to our own geological studies.

Today more detailed studies, areal and underground, are indeed revealing that gross petrographic and mineralogical work is not good enough. It is necessary to go back and forth between the laboratory and the field to correlate and to interpret observations made in both places. While field geology makes its contributions to mineralogy, mineralogy must be a cornerstone of field geology.

An example of the way in which the mineralogical field worker and the laboratory researcher growing synthetic minerals can learn from each other was shown in some work we did on pumice[4] from Bridge River, British Columbia. When we showed slides of thin-sections of the pumice at a Mineralogical Society of America meeting, M. J. Buerger commented on the similarity between the aligned glassy inclusions in the feldspars in the pumice, and the lineage structure with the uncrystallized glass blebs he had noticed in growing certain synthetic minerals. From this analogy we were able to interpret the pattern as a probable expression of lineage structure under rapid crystallization. Professor Buerger, for his part, was edified to see in nature a pattern he had hitherto studied only in synthetic minerals.

Another field study[5] in the Bridge River gold camp furnishes a rather simple but important example of the aid mineralogy gives the geologist. In this area identification problems sometimes arise because of deformation and alteration in certain albitite dikes. Where albitite is adjacent to the gold-quartz veins it is intensely sheared, and in the mine workings it

[3]J. William Dawson: *Fifty years of work in Canada, scientific and educational*, p. 47, Ballantyne, Hanson and Co., London and Edinburgh, 1901.

[4]L. S. Stevenson: Pumice from Haylmore, Bridge River, British Columbia, *Amer. Mineral.*, **32**, 547–552, 1947.

[5]J. S. Stevenson: Geology and mineral deposits of the Bridge River Mining Area, British Columbia, Unpublished Report, *Brit. Col. Dept. Mines.* 1953.

looks very much like sheared soda granite. Shearing along the veins produces, with both rocks, a fine-grained quartz-sericite schist. At first I could make the distinction only microscopically, when I saw that if the sericite schist was derived from the granite, it contained eyes of quartz, the quartz being the remains of the abundant large grains of anhedral quartz that characterized the soda granite; if derived from the albitite the quartz eyes were missing. After the microscopic difference was recognized, it was possible to distinguish between the two types of schist in careful field work. The distinction is of practical importance because the veins usually show greater persistence where they follow albitite dikes.

The viewpoint of the field geologist is also helpful in mineralogical work in the field of medicine.

For example, in the study of urinary calculi,[6] urologists have asked mineralogists to identify the mineral content of these kidney stones because they needed more exact information that that given by chemical analysis. But, as in petrology, the identification of constituent minerals is only the beginning of study. When I first looked at kidney stones I was impressed with the fact that they usually contained more than one mineral and had been built up in successive and varied stages like many geological mineral deposits. Such stages may well represent variations in the patient's body chemistry, and the physician may be able to supply the "field evidence" by which petrogenesis and pathogenesis may be correlated.

Again in the field of medicine, recently while studying residue from ashed lung tissue of a patient at the Royal Edward Hospital, Montreal, I was reminded of field studies I had made in British Columbia when I collected dust samples from different working faces in Bridge River mines, and found significant mineralogical differences in the dust from place to place. With "field evidence" supplied by the patient's case history, it was possible to show that his condition resulted, not from employment at the mine where he had worked in recent years, but from conditions in a rock quarry where he had worked several years before. So even in ashed lung tissue, there may be a mineralogical sequence to be worked out.

The interdependence of field geology and microscopy can also be demonstrated by an illustration from Sudbury, Ontario. This is concerned with the problem of origin of many of the very fine-grained strikingly homogeneous white rocks in the Whitewater series that have sometimes been called rhyolites. In many places these rocks show close and involved folding. These outcrops can be seen easily be visitors to the Sudbury district, and are a familiar sight to many geologists and tourists. Careful

[6]O. C. Lucas, J. S. Stevenson, and L. S. Stevenson: Petrologic study of a urinary calculus, *Trans. Royal Soc. Can.*, **44**, Series III, Sec. IV, 35–40, 1950.

mineralogical studies of these rocks show that most of them consist principally of quartz with minor feldspar and sericite. Although the rock has been deformed and largely recrystallized, some quartz pebbles and many irregular quartz grains are still readily recognizable. The minor but genetically significant sericite is distributed in thin lines of rods, weaving between the quartz grains and occurring in alternating sericite-rich and sericite-poor layers, as would be expected in clay-rich and clay-poor layers of sediments. Thus with evidence supplied by mineralogical and textural features as seen in the laboratory, the field problem is clarified and the rock may be identified as a quartzite.

In another Sudbury study, it was found to be practical to differentiate between two types of norite that have usually been considered to be a single rock. Brown-weathering norite was seen in thin-section to be characterized by brown hypersthene, whereas a green-weathering norite was seen to contain abundant hornblende but little unaltered hypersthene. After this difference was determined in the laboratory and found to apply to all outcrops of these types, it was a useful field criterion for further mapping and study.

Michael Fleischer[7] in his Presidential Address to the Mineralogical Society of America gave some amusing examples of the empirical methods used by metallurgists in unsuccessful attempts to separate by mechanical means elements that mineralogical study would have shown were combined in a single mineral. As he said, the point is not that mineralogists should feel smug and superior, but that they have sometimes held themselves aloof from practical problems, and have failed to educate others to recognize the proper role of the mineralogist and the need for his services.

If the Canadian mineralogist keeps constantly aware of the philosophy of the field geologist, and if employers of geologists are made aware of the contributions that trained mineralogists can make to their programmes, there should be great scientific opportunities ahead for mineralogy and for the members of our Association.

[7]Michael Fleischer: Some problems of chemical mineralogy, *Amer. Mineral.*, **38**, 149–162, 1953.