PETERSON FIELD GUIDES

Rocks and Minerals

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Preface to the Fourth Edition

IN THE TWENTY YEARS that have elapsed since the First Edition of this *Field Guide,* there have been some changes of emphasis in mineral collecting and an unforeseen growth in the number of collectors. Mineral specimens have won popular recognition as objects of beauty and merit and many are now regarded as suitable accessories for elegant houses; they are approved by interior designers and their price has skyrocketed. At the same time, more and more sources have been ravished and seemingly inexhaustible deposits have given out, particularly those promising Mexican sources. An increasing recognition of investment values in fine specimens, supplementing the popular demand for colorful accents (worthless examples to the true mineral connoisseur, fortunately), has driven prices to levels that older collectors find shocking.

Seven minerals that were not included in the earlier editions have been added in this Fourth Edition. All are relatively rare, but popularity, especially at shows frequented by competitive-minded collectors, has shown them to be of enough general interest and sufficient availability in attractive specimens from dealers to justify their inclusion here. Scolecite, brazilianite, and euclase are among these.

The rise in interest and price of minerals has also had the fringe benefit of enormously improving the quality of specimens. Many are obtained by professional collectors who have researched old localities known for their attractive specimens and who then—often at some risk—have succeeded in obtaining outstanding examples that they have carefully preserved in order to reach a dealer's shelf in an unblemished state. Would that the old-time miners, with far greater chances of obtaining good specimens, had had the ability and skills of the present generation, who must search through their leavings. What wonders we would now have.

Sadly we must concede that the attitude of the general public toward mineral collecting has changed much more than has the attitude of those responsible for most mineral production. The majority of the mines still officially discourage any collecting. We have heard tales of the deliberate smashing of crystals in magnificient pockets by mine foremen; such vandalism is not only stupid, it is well nigh criminal, and should be stopped by any sort of pressure that collectors and aware individuals can apply. The wonders formed by nature are unique, and ore veins represent the seepings of cubic miles of magma. The mere occupation of the apex of a vein, although it does give a company the right to mine, should not be taken as justification of thoughtless destruction of objects of beauty and singularity for a few cents' worth of metal. Mines that encounter specimens of great artistic and scientific merit should be required to make some arrangement to preserve them for the world to view. Those who appreciate fine minerals should form themselves into groups to apply pressure in any legal way possible, through the press or as stockholders, to force the mine operators to arrange for specimen preservation in one way or another. It matters not how the mine companies arrange this. Ideally, the mine could collect and sell specimens and thereby make more profits for the stockholders. If the mine owners consider this too trivial, they can close their eyes to the miners' thefts, as many do, and in this way avoid getting a bad name. Or they could allow qualified collectors to do the collecting under reimbursed supervision when the mine is not working. Surely with goodwill and understanding something could be worked out, any required insurance coverage arranged, and any extra costs repaid.

The important thing is to save the specimens, and that must be done now, while the mine is working and while it is still in the shallower levels where pockets abound and secondary minerals have formed. It *cannot be postponed* for a more convenient time. The regrettably common production man's can't-be-bothered attitude must be replaced by intelligence and an enlightened recognition of the operators' public obligation to this and future generations as they plunder the earth. The mining engineers of the next decades could easily be the men who have been inspired in their youth by the very specimens so thoughtfully saved. The author pleads for coordinated action in this respect on the part of collectors organized into groups. Such are the Friends of Mineralogy, who have made a good start. In view of all that must be done, their efforts are only a beginning. Surely there must be some lawyers and insurance men among the world's lithophiles who could develop some sort of insurance coverage for the protection of the mine and quarry operators.

The writer wishes to express his appreciation to many who have helped in the preparation of the book. First and foremost, to the authorities of The American Museum of Natural History who gave the writer the experience and the use of collections so essential to the original work and to many of the illustrations. Guenever Pendray Knapp and Walter Holmquist were responsible for the major part of the work on the crystal drawings. Eunice Robinson Miles assisted with the tedious photographic chore of the black and white photographs, and the author did most of the color work. Jane Kessler Hearn aided by checking the blowpipe and chemical tests and the revision of the manuscript. Helen Phillips,

of Houghton Mifflin Company, put in many extra hours on the difficult copy-editing job. Local collectors have helped through the loan of specimens and by giving locality information. They have also helped indirectly to determine the minerals included, because their constant stream of specimens for identification has shown where emphasis should be placed.

Since this is a practical work, intended to be of the greatest possible value to the amateur, the author would appreciate additional observations on tests and mineral occurrences that can be included in later editions of this *Field Guide*.

Contents

Illustrations

PART I

An Introduction to the Study of Rocks and Minerals

1

Your Mineral Collection

ROCKS AND MINERALS are fine introductions to the study of natural history and to a greater appreciation of nature, because they are tangible and often beautiful objects that can be preserved in collections. They do not fade and lose their beauty, like flowers; making a collection of them harms no living thing. Unlike many other objects of nature that may be arranged in collections, their preservation actually conserves them for future generations. Often, particularly in recent years, such accumulations from old collections have served useful purposes for scientific and economic studies of inaccessible and abandoned mines. Someday many old mines may come to life again, reopened because studies of specimens that were saved when the mines were running have indicated that other minerals occurring there are now of value, though they were thought worthless at the earlier time.

A general collection is best for the beginner, so that he will become familiar with the overall principles of mineralogy. Later he might better specialize in some narrower field. If mineral specimens are sufficiently large, pure, and typical, their definitive characteristics are more easily observed than in small, impure samples. They should be large enough in size and freshly broken or exposed in order to show a characteristic surface.

Read, observe, and learn all there is to know about each mineral, so that you will recognize each the next time you encounter it, even though it may appear in a different guise. Cultivate the acquaintance of other collectors in your vicinity and see their collections. You will thereby learn faster what good specimens look like. When you collect, keep a careful record of the place from which each example came.

Before visiting private property ask permission if you can, and hold back on the collecting in ore piles you may find at a mine or quarry. Even a few pounds of some minerals (like beryl) are valuable, and the quarry owner is not likely to be pleased to find his hoard stripped on a Monday morning after leaving it unguarded over a weekend. When you have the owner's permission, do not abuse the collecting privileges granted to you; one bad experience will put the whole mineral-collecting fraternity in a bad light. Do not clean out a locality or batter up crystals you cannot take out yourself — there will be other collectors after you. Encourage others to join you in the hobby. From today's collectors come tomorrow's professional mineralogists. Join local mineral societies and work to improve their meetings. *Study some* *phase of mineralogy and make yourself a master of it;* you will get as much out of you hobby as you put into it. Visit museums and see what they have from your localities. Take pride in the museums and give to them, because they cannot exist without your support. The principal funds for the purchase of specimens may be your financial contributions.

There is in the basic sciences no more educational hobby than mineralogy. It combines chemistry, physics, and mathematics. A lifetime of study would not make you the master of every phase.

Care of the Collection

Collect specimens that are the right size for the space you have available. Crystallized specimens, when obtainable, should be the goal of the collector. Wrap them carefully and label the wrapper at once if you plan to visit several localities on a single trip.

When you arrive home wash them carefully to remove dirt and stains. Persistent iron stains can be removed by a soaking in oxalic acid to dissolve the limonite, but try the solution on an inferior specimen first to make sure that the acid does not attack the mineral itself. (A saturated solution of oxalic acid that has been diluted slightly is best: first dissolve all the dry acid crystals that will go into a water-filled glass or plastic vessel, then dilute the solution a little.)

When you are out collecting look particularly for calcite-filled veins, since calcite can be dissolved to expose insoluble silicate or oxide minerals. This is done by soaking the specimens in dilute acetic or hydrochloric acid in a plastic jar or an all-glass aquarium. Here, too, try out a small specimen first, to see whether the mineral you want to save is also attacked by the acid. Acetic acid is far safer than hydrochloric; dioptase, for example, can be ruined by hydrochloric acid, but has a fine luster after a brief, weak acetic-acid soaking to remove calcite.

Plan some sort of catalog and numbering system. A personally modified Dana number system is good.* Give the Dana number and then your own. Your first pyrite specimen would be 2911 — 1, your sixth pyrite would receive the number 2911 — 6. Paint a neat white rectangle on an inconspicuous place on the back of the specimen and when the paint is dry write on the number in India ink. The added protection of a thin coat of varnish will keep it from rubbing off when the specimen is handled or washed.

Arrange the collection in shallow drawers or on shelves in a nice

*The Dana numbers will be found in the classic mineralogy text used by all professional mineralogists: *Dana's System of Mineralogy,* 7th edition, rewritten and enlarged by Palache, Berman, and Frondel, to be completed in four volumes, three of which have been published.

and not too crowded display, and plan on some definite arrangement: locality, Dana order, groups of all ores of one metal, crystal systems, etc.

Discard poorer specimens as you find better ones. Do not let your collection become dirty and overcrowded, and avoid broken and bruised crystals.

Finally, since your space and resources are both limited, consider specializing in some field: one mineral, one group, one locality, a crystal system, or the like. You cannot rival the overawing accumulations of the museums, but you can easily excel them in one or another specialized category.

Collecting Equipment

The equipment needed for the collecting of minerals is easily obtained and is inexpensive. With more experience at specific collecting localities, you will add tools as their need is shown. Improvisation and originality are the mark of the experienced collector, who may scorn the commonplace but more expensive tools.

The first fundamental is a *hammer*. Any hammer will do, though in most hard rocks the prospector's pick will be found the most acceptable (Fig. 1). This has a fairly small tapered head and the back is drawn out to a point. He who tempers his own hammer should be careful not to temper it too hard, for steel splinters are likely to fly off a very hard head. The best plan is to make the center the hardest point and the edges fairly soft; this can be done by heating the head and carefully dropping single water drops on the center of the striking surface, thus cooling the outer edges more slowly. The pick end, in contrast, must be very hard or it will soon become dull; due caution should be observed in its use.

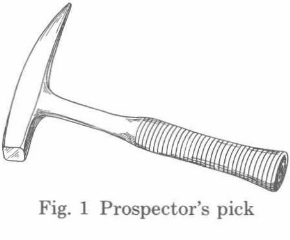

Fig. 1 Prospector's pick

Lighter hammers and sledgehammers may be needed for special tasks; a light sledge is a useful thing to carry about in the car if one usually drives when collecting. Cold chisels are also useful for carefully working crystals out of solid rock, where they are apt to be shattered by heavy blows. Very light hammers and the picks your dentist has discarded are excellently adapted for finishing the trimming of the specimen or for opening crystal pockets after a mass has been brought home.

Next in utility to the collector is some sort of *magnifying glass;* and for field work the inexpensive ones are ordinarily as useful as the highly corrected lenses. In using them we generally look at selected small crystals and so do not really require the larger field of sharp focus of the more expensive lenses. Do not get too high a power, 8× to 10× is usually sufficient; a trained observer can see more with a 10-power lense than the beginner with a magnification twice as high. A 20× lens has a small field and too little of it is sharp at one view for it to have any use in ordinary field work.

A *collecting sack* or container of some sort stuffed at the start with enough wrapping paper to protect completely all the specimens collected is desirable when any prolonged trip is planned. Usually it is wiser not to start wrapping the day's haul until toward the end of the day — after a careful elimination of the first specimens that looked far better at the time they were picked up than they do after a couple of hours of collecting.

If one is collecting residual heavy minerals in loose gravels on slopes or in streambeds, a *shovel,* a *sieve,* and a *rake* will be found useful. Many collectors like to carry a *gold pan* and wash for gold "colors." Long deep pockets in solid rock cannot be brought home, but a short *stove poker* is ideal for freeing crystals from the walls. An *auto jack* will turn over boulders too heavy to turn by hand. All sorts of adaptations to overcome special difficulties are part of the fun of collecting. A portable *ultraviolet light,* which permits the collecting of fluorescent minerals at night, and a portable *Geiger counter,* for prospecting among radioactive minerals, are two more specialized tools that can give good results.

Once in the laboratory, specimens should be trimmed, washed, and, if necessary, cleaned up before they are cataloged and arranged.

Testing Equipment

The laboratory of the mineral collector will harbor many of the simpler reagents and equipment of the chemist. Though the testing methods of the professional mineralogist require much expensive equipment, the traditional blowpipe and chemical tests of the amateur (and the professional of the last generation) are still perfectly satisfactory. They could profitably be amplified by experimentation in using new equipment, new reagents, and new techniques.

The *Bunsen burner* is the fundamental piece of equipment when a source of gas is available. Bottled gas can be obtained in many places where piped gas is out of the question. Small disposable cans of bottled gas are available. Failing that, for field testing, an alcohol flame, a cigarette lighter, or a paraffin candle can be used, though none is as satisfactory as the gas flame. The air inlet of the Bunsen burner (named for a 19th-century German chemistry professor at Heidelberg) should be adjusted so that the flame is blue-violet, with a bright inner cone of blue unburned gas. The pressure should be kept down so that the flame burns quietly, without a roaring sound (Fig. 2). There are two parts to this flame. The hottest place is just above the center, where there is often a slight yellow touch. The lower part of the flame, just at the tip of the blue cone, has gas in excess and takes oxygen from anything placed within it. For this reason it is called the *reducing flame,* and oxidized compounds placed here will lose any removable oxygen, or will be "reduced."

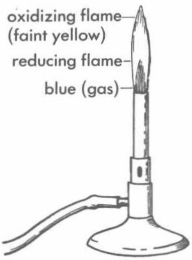

Fig. 2 Bunsen burner

At the far tip of the flame, where the last of the gas is being burned, oxygen is now in excess, so objects heated in this part of the flame will be, like the gas, free to take oxygen from the air, to oxidize if they can; this part of the flame is known as the *oxidizing flame.* For certain tests (the bead tests discussed later) these two parts of the flame are important, and the beginner should practice with easily oxidized and reduced compounds in the borax beads (iron, for instance) to see where he gets the best results. He will learn how long it takes to change completely the color from that of the oxidized bead to that of the reduced bead and back again to the oxidized bead. The blue inner cone is relatively cool, so the bead should be held near its top, high enough in the flame to keep it red-hot, for if it becomes too cool it cannot react.

In conjunction with the Bunsen burner we use our lungs on a *blowpipe,* an equally fundamental piece of equipment (Fig. 3).

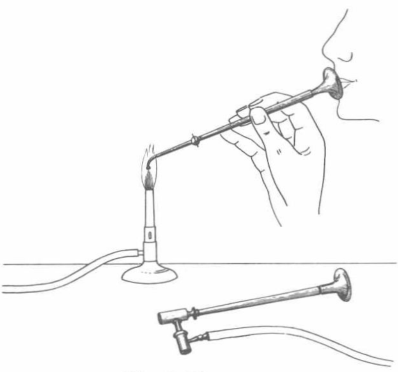
Fig. 3 Blowpipes