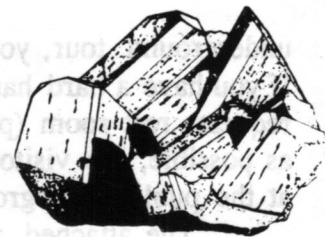


# friends of mineralogy colorado chapter



## Friends of Mineralogy - Colorado Chapter Newsletter No. 5, September, 1993

September Meeting: 7:30 p.m., Thursday, Sep. 9, 1993  
Denver Museum of Natural History  
V.I.P. Conference Room, at rear of T-rex Cafeteria  
(enter museum at security door to left of main entrance)

### Program - Video Night Double Feature: *Silver and Platinum* courtesy of U.S. Bureau of Mines

This being the week before the "big show", everyone is just too preoccupied to attempt to arrange (or to pay attention to?) a live-speaker program. Our alternative is a pair of two short, highly acclaimed videocassette programs about minerals and mining: **Silver** (28 minutes), produced by the U.S. Bureau of Mines in cooperation with The Silver Institute, and **Platinum** (20 minutes), produced by the USBM in cooperation with the Platinum Guild International Inc. The silver video includes underground views of the Coeur d'Alene silver mines, and "Platinum" was filmed in the U.S., Europe, and South Africa.

Also at the meeting, we will discuss and preview specimens brought in so far for the FM "Colorado Beryl" exhibit at the Denver Show. Additional specimens, and ideas or offers of help in putting the exhibit together, are all welcome. Please bring your material or ideas to the meeting, or call Neal Hinrichs, who is coordinating the exhibit, before the meeting (233-0790).

### Field Trip!: Sweet Home mine, Alma, Colorado - Sep. 25 and Oct. 2

Courtesy of Bryan Lees, FM members are being invited to visit and tour the Sweet Home mine on Sep. 25, and/or Oct. 2, 1993. Each tour will be limited to about 12-15 people, and you must register in advance. Sign-up will be in the order requests are received; however, to give the greatest number of people an opportunity to visit the mine, we are asking any person who has already visited the mine to defer to those who have never done so (we will put you on a waiting list if space is available). To sign up for the tour, please call Pete Modreski at 978-9926, with your preference of the two dates.

The group visiting the mine should meet at the entrance to the mine, located up Buckskin Gulch (the road to Kite Lake) a few miles west of Alma, at 10 a.m. Following (or before) the

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FMCC officers: *Pete Modreski, pres.*  
*Jim Hurlbut, vice-pres.*  
annual dues - \$13.00

*Ed Raines, secretary*  
*Eunice York, treasurer*

*Ed Gray, director*  
*Glen Johnson, director*  
*Dave Weller, director*

**Mailing address: FMCC, P.O. Box 150401, Lakewood, CO 80215-0401**

underground tour, you will be welcome to search for minerals on the old Sweet Home mine dumps. If you have a hard hat, mine light, and waterproof or steel-toed boots, please bring them. One final request: rest room (port-a-potty) capacity at the mine is very limited. Bryan requests that, insofar as possible, the visitors should plan to use rest room facilities in Fairplay on their way to Alma, or at the public campground at Kite Lake. Thanks for your cooperation!

The attached article by Dan Kile and Bryan Lees gives an updated report about the current year's mining activity at the Sweet Home. Bryan will be giving a slide show about the Sweet Home mine at the Denver Show (11 a.m. Saturday Sep. 18); and again at the November FM meeting (Thursday, Nov. 11).

**Meeting Locations:** Our September meeting will be in the VIP room in the Museum; this is a change from the earlier announced location. The remaining two 1993 meetings (Oct. 14 and Nov. 11) will be held in the Ricketson (west side) Auditorium at the Museum.

**Program Previews:**

**October 14** - Several short programs are planned; one will be a talk on "Bazzite - scandium beryl from Mount Antero", by Dale Denham.

**November 11** - "The Sweet Home Mine in 1993", by Bryan Lees. Members and friends of all Denver area mineral clubs are invited to come to this meeting.

**New Members:** We welcome the following new members who have joined FM during the past few months (addresses and phone numbers are given, to add to the membership roster you received with the last newsletter):

Caroline Gray (formerly Cook), 1043 S. Madison St., Denver CO 80209 (733-1026)

Mary Pojar, 5300 Cherry Creek Dr. S., #813, Denver, CO 80222 (757-6314)

Ed Rogers, P.O. Box 455, Poncha Springs CO 81242 (719 539-4113)

Telahun Z. Yohannes, 6845 W. 32nd Ave., Wheat Ridge, CO 80033 (238-5106)

[Please note: Norm Bennett's address, listed in our last roster, is no longer correct; he has moved from Florida back to the Denver area for the time being--we'll supply a current address if available (Norm is keeping one step ahead of us; his April-May newsletter was just returned by the Post Office). Ed Rogers' address was listed in the last roster, without a phone number. Our last roster also included an address for former FMCC member Keith Williams; he is not a current member, but we wanted to print his new West Virginia address for interested members.]

**Minerals of Colorado Project:** The final compilation of the complete manuscript is still taking place; this stage is taking longer than planned, mostly due to the length of the book. Gene Foord is in charge of the manuscript assembly, assisted by Shirley Mosburg. Gene is away on a trip to Russia right now, but as soon as he's back they will complete the manuscript work so it can be submitted to the USGS for official review. The photo committee (Ray Berry, Jack Thompson, Ed Raines, Chauncey Walden, and John Muntyan) is working on photographing specimens and planning what other photographs are needed, and Bill Chirnside and Jim Hurlbut have been planning the layout of the locality maps. More information will be reported when available.

**Mount Antero book:** *Antero Aquamarines* by Mark Jacobson was printed in June and copies have been distributed to most of the FM members who ordered them by now. If you do not yet have yours, you may pick it up at the Denver Show. Additional copies may be purchased at the show

from retail book dealers, for the regular price of \$19.95 softbound, \$34.95 hardcover. Mark was in Denver during part of July-August, and about 35 of our members were able to meet with him at the author party on July 28.

**Treasury:** Our treasury balance as of July 28 was \$13,015.46. Our May 1993 auction produced \$854.75 in net proceeds for FM; total receipts were \$1481.00, less \$551.25 for percentages of sales returned to donors and shared with Colorado School of Mines, and \$75.00 museum setup charge. The money raised will be held in reserve for use as needed for publication of *Minerals of Colorado*.

**Denver Show:** Is almost here. You can help with two FM-sponsored activities at the show: the *FM Beryl Exhibit* (see the information about our September meeting on page one of this newsletter); and the *FM Mineral Identification Booth*. We need volunteer helpers at the identification booth on all four days of the show; please sign up at the Sep. 9 meeting, or call Pete Modreski at 978-9926. If you would like to volunteer to help with other jobs at the show (ticket sales, set-up, etc.), please call Judy Knoshaug, 423-2923.

**RMFMS Meeting--**The "House of Delegates" meeting of the RMFMS (Rocky Mountain Federation of Mineralogical and Lapidary Societies), of which FMCC is an affiliated member, will be held at 1:00 p.m. on Saturday, Sep. 18, at the Inn at the Mart. Each Federation member organization should be represented by a member or by proxy. Do we have an officer or other interested FM member to volunteer to attend and represent us?

The deadline for all exhibits to be entered in the show is past (including the "Prospector's Trophy" for personally field-collected specimens, for which the deadline was Sep. 1). We thank all those who are taking the trouble to prepare exhibits; and we'll see them at the show! Complete information about show programs and other events was printed in our last (August) newsletter. Preceding the show, a benefit auction (for CSM and DMNH) will be held poolside at the Colorado Mineral and Fossil Show, Holiday Inn, at 5:00 p.m. on Tuesday, Sep. 14--all are invited.

**New Book, *Topaz*, by Don Hoover:** Don B. Hoover, a Denver geophysicist and gemologist, is the author of *Topaz*, a new volume in the Butterworth-Heinemann Gem Books series (Oxford, England). The book, hardbound, 207 p., includes chapters on all aspects of the gemstone topaz: history, chemistry and crystal structure, crystallography, optical and physical properties, color and luminescence, inclusions, geology of its deposits, world sources, and "large and important topaz gems and crystals". There are four pages of color photos (one crystal from Texas is illustrated, but alas, none from Colorado), and a number of diagrams and maps. The retail price of the book (converted to \$ U.S.) is approximately \$55.00. Earlier books in the series include "Amber", "Beryl", "Corundum", "Garnet", "Jet", "Pearls", and "Quartz".

Another new book by the same publisher is *The care and conservation of geological material: minerals, rocks, meteorites, and lunar finds*, by Frank M. Howie (1992; 138 p.; \$74.95). This is said to contain sections on conserving light-sensitive minerals and gems, temperature and humidity-sensitive minerals and gems, pyrite, meteorites, etc. The price is a bit steep (most would say, very steep), but it may have some useful information; perhaps DMNH has a copy we can examine.

**Upcoming elections for 1994 FMCC Officers:** We'd like to encourage everyone to think about volunteering to serve as officers or directors for FM next year. Nearly all of our officers and directors will be finishing their terms at the end of this year; a nominating committee will be appointed at the September meeting, and suggestions for nominations will be accepted then and at the October meeting. This is the time for everyone to think about how an organization doesn't run itself, and how everyone has to pitch in and make it work. We hope we'll be hearing from you!

## Recent Developments at the Sweet Home Mine, Park County, Colorado

Daniel E. Kile and Bryan Lees

As everyone (well, almost everyone) knows, the Sweet Home mine, source of world-class rhodochrosite crystals, is back in operation this year. But in spite of intensive efforts, rhodochrosite has proved elusive during three months of mining. Few people realize that most of the magnificent specimens at the last Denver and Tucson shows originated from only two pockets (called the "Rainbow" and "Good Luck" pockets - see accompanying figure) collected during the 1992 season; four other pockets found during this time provided interesting specimens but were "financially inconsequential." Thus, it was the fortuitous location of only two pockets that kept the Sweet Home operation financially viable this year - a somewhat risky venture by most standards.

Once found, preparation, including cleaning, trimming, and necessary repair of the specimens, takes almost three times longer than the actual time required to find the pocket and mine the contents. The "Alma King" and the "Rose," displayed amid great fanfare at the last Tucson show, required three months preparation time.

The net result of last year's operation yielded approximately 1,700 numbered specimens (of which most were priced at less than \$250.00) that comprised only 20-30% of the total specimens mined. The remaining 80% of the specimens were of "low end" wholesale quality. Less than 5% of the total rhodochrosite mined comprised good to excellent specimens, a statistic not surprising to any experienced field collector.

It is therefore quite obvious that continued operation of this mine depends on the slim chance of finding lucrative pockets containing saleable specimens. This must be balanced against expenses to operate the mine, which have been quite considerable to say the least. For example, startup costs in 1991 amounted to approximately \$200,000. The main expense was incurred in widening the tunnel to permit passage of diesel-powered mine vehicles. Other expenses included installation of a ventilation system (\$6,000); a mine survey and geologic assessment (\$20,000); drills, hoses, drill bits, steel (\$15-20,000); construction of the surface shop and portal renovation (\$40,000); purchase of two LHDs (load, haul, dump vehicles, \$80,000 each); slusher (\$2,000); miscellaneous collecting tools (splitters, saws, fiber optic probe, etc.); and acquisition of a compressor (\$20,000). And most of these expenses were incurred before the first specimen was collected! (do you still think you want to lease and operate a mine?) Lest we forget, the monthly utility bill runs about \$1,500 to run this stuff. But on top of these expenses, the most significant operating cost by far is for personnel, i.e., labor and workman's comp. There are three miners and a surface manager on-site (not counting Bryan), five people engaged in cleaning and preparation, and a lawyer retained to advise on the legal aspects of a legion of federal, state and local regulations. Not to mention four (worried?) investors and five mine owners (Leonard Beach is the majority owner) who have a stake in the financial aspects of the operation. All told, the daily mining cost is somewhere in the neighborhood of \$1,500 per day.

Equipment failure must also be factored into the profit/loss ledger. Not only breakdown due to normal wear and tear in the mine (such as the day that two jackleg drills were broken at the top of the stope, necessitating a long haul to the portal each time, or the repair of the hydraulic system of an LHD, which took two months for parts and cost \$6,000), but also unpredictable onslaughts of nature, specifically lightning strikes near the portal that twice burned out the ventilation fan. In 1991, lightning arresters with 60,000 amps protection were installed, and even these were fried in the past year!

With the expenses outlined above, it is not surprising that as of September 1st of last year the project was in the red. Sales at the Denver and Tucson shows improved the financial picture, but to date no profit has been made, as all the cash has been put back into the mine (some things in mining just don't seem to have changed over the last 100 years...). Unfortunately, the rhodochrosite-bearing veins do not contain payable quantities of ore, so there is no possibility of gaining auxiliary income from precious metals, even if shipping and smelting costs permitted it.

Exploration in 1993 has thus far included development of two raises and an ore pass to fa-

Facilitate removal of waste rock. Additionally, geologic maps of the mine (scale 1"/10'), mine surface (scale 1"/100'), and surrounding region (scale 1"/500') were completed. Such seemingly esoteric work can yield important information not only on the origin of the rhodochrosite, but also on the age of the rhodochrosite-bearing veins (these veins were dated at 30.5 million years by potassium-argon age dating, based on the last period of vein alteration) and prospects for future development. In addition to these studies, a ground penetrating radar (GPR) program was recently completed. The short wavelength, high frequency radar has been shown to penetrate approximately 20 feet into the solid rock wall. Although the application of this type of survey to the development of mineral specimen recovery is largely unproven, initial results seem promising. Indications of pocket structure, and more importantly, the location of hidden faults in the surrounding rock, suggest possible locations of intersecting fault structures that are favorable to pocket formation. On a positive note, the GPR indicated the possibility of a small pocket in an area that was subsequently proved out, but on the down side there was no conclusive evidence of any large pockets in the unmined area. Two other areas probed by GPR remain to be mined later this year.

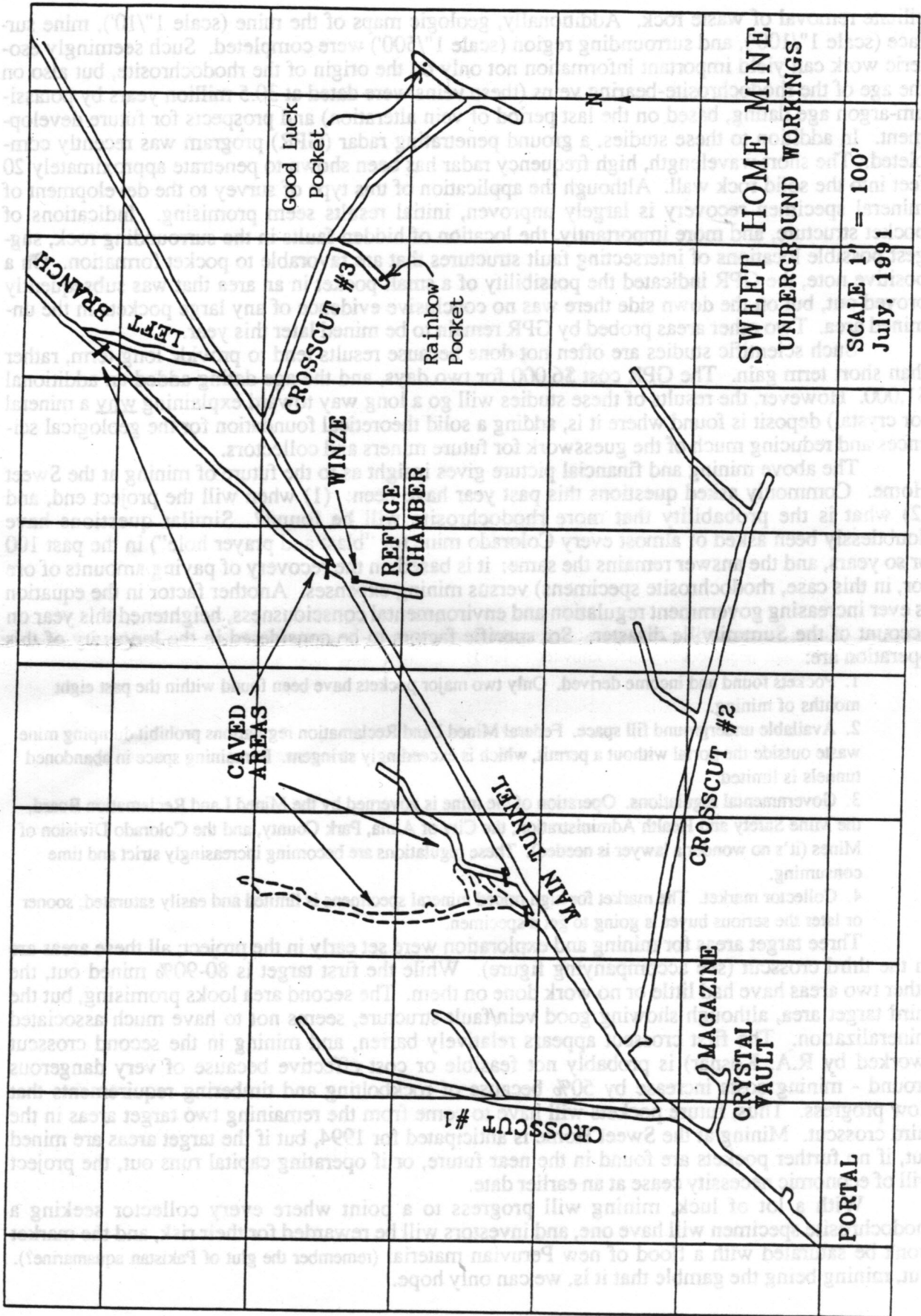
Such scientific studies are often not done because results tend to provide long term, rather than short term gain. The GPR cost \$6,000 for two days, and the age dating added an additional \$1,000. However, the results of these studies will go a long way toward explaining why a mineral (or crystal) deposit is found where it is, adding a solid theoretical foundation for the geological sciences and reducing much of the guesswork for future miners and collectors.

The above mining and financial picture gives insight as to the future of mining at the Sweet Home. Commonly asked questions this past year have been: (1) when will the project end, and (2) what is the probability that more rhodochrosite will be found? Similar questions have doubtlessly been asked of almost every Colorado mine (or "blast and prayer hole") in the past 100 or so years, and the answer remains the same: it is based on the recovery of paying amounts of ore (or, in this case, rhodochrosite specimens) versus mining expenses. Another factor in the equation is ever increasing government regulation and environmental consciousness, heightened this year on account of the Summitville disaster. So, specific factors to be considered in the longevity of this operation are:

1. Pockets found and income derived. Only two major pockets have been found within the past eight months of mining.
2. Available underground fill space. Federal Mined Land Reclamation regulations prohibit dumping mine waste outside the portal without a permit, which is exceedingly stringent. Remaining space in abandoned tunnels is limited.
3. Governmental regulations. Operation of the mine is governed by the Mined Land Reclamation Board, the Mine Safety and Health Administration, the City of Alma, Park County, and the Colorado Division of Mines (it's no wonder a lawyer is needed). These regulations are becoming increasingly strict and time consuming.
4. Collector market. The market for high priced mineral specimens is limited and easily saturated; sooner or later the serious buyer is going to get a specimen.

Three target areas for mining and exploration were set early in the project; all these areas are in the third crosscut (see accompanying figure). While the first target is 80-90% mined out, the other two areas have had little or no work done on them. The second area looks promising, but the third target area, although showing good vein/fault structure, seems not to have much associated mineralization. The first crosscut appears relatively barren, and mining in the second crosscut (worked by R.A. Kosnar) is probably not feasible or cost effective because of very dangerous ground - mining costs increase by 50% because of rockbolting and timbering requirements that slow progress. Thus, future pockets will have to come from the remaining two target areas in the third crosscut. Mining at the Sweet Home is anticipated for 1994, but if the target areas are mined out, if no further pockets are found in the near future, or if operating capital runs out, the project will of economic necessity cease at an earlier date.

With a lot of luck, mining will progress to a point where every collector seeking a rhodochrosite specimen will have one, and investors will be rewarded for their risk, and the market won't be saturated with a flood of new Peruvian material (remember the glut of Pakistan aquamarine?). But, mining being the gamble that it is, we can only hope.



**SWEET HOME MINE  
UNDERGROUND WORKINGS**

SCALE 1' = 100'  
July, 1991

The column below, by Dan Kile, is the first of a series he has written for the Rocky Mountain Federation (RMFMS) Newsletter. We will begin reprinting these columns here.

## Optical Identification of Minerals - The Petrographic Microscope

### Part I

Daniel E. Kile

Mineralogical Technical Chairman, RMFMS

### Introduction

Advances in mineralogy and geology in the mid to late 1800s and early 1900s paralleled the development of optical mineralogy. The importance of this cannot be overstated - the physical and crystallographic properties of virtually every mineral are intrinsically related to its optical properties because the internal atomic arrangement that controls the external crystal morphology and physical properties (such as hardness) also controls the behavior of light as it passes through the mineral. This phenomenon can be observed with a specialized instrument called a petrographic microscope that allows observation of minute mineral grains under polarized light.

Although a rigorous optical mineralogy course at the college level seems intended to weed out those students whose talents may be more closely aligned with the humanities, an understanding of the fundamentals, and even the basic use, of a petrographic microscope for mineral identification can be mastered by anyone willing to invest a modest amount of time in learning the concepts of optical mineralogy, and expense for a microscope and essential accessories. Such knowledge lends itself not only to a more complete understanding of physical and optical constants of minerals and gemstones given in reference books, but can also facilitate identification of samples of unknown minerals.

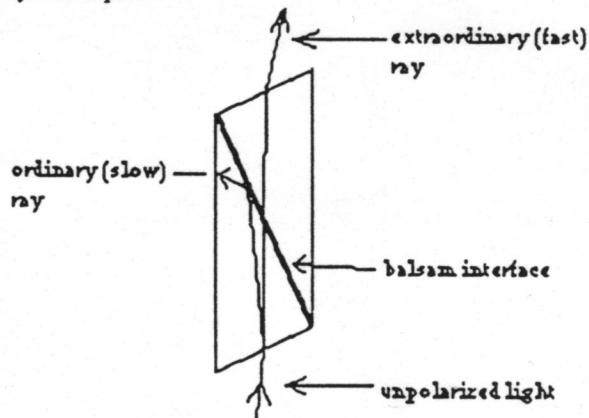
The behavior of light transmitted through crystals is dictated by their internal atomic arrangement. Those minerals whose internal structure is the same from any perspective (or those substances without an ordered atomic arrangement, such as glass) will not affect light as it passes through - these are called **isotropic** minerals, and are comprised of minerals in the isometric crystal system. Thus, the high level of atomic symmetry that gives a uniform and symmetrical external crystal form also results in a crystal structure that has little effect on light. But most crystals have differences in symmetry and atomic structure when viewed from different angles; it is this feature that causes light to be separated into two rays as it passes through. These minerals are **anisotropic**, and comprise most of the known mineral species, namely, those in the tetragonal, hexagonal, orthorhombic, monoclinic, and triclinic crystal systems. Further distinctions, again a result of internal atomic arrangement that affects the behavior of transmitted light, can be made between the more ordered crystal systems such as tetragonal and hexagonal (uniaxial) minerals, and less ordered (lower symmetry) such as orthorhombic,

monoclinic and triclinic (biaxial) minerals. These aspects will be discussed later.

### Polarized Light: The Nicol Prism

The development of the petrographic microscope began with the invention by William Nicol, in 1829, of a calcite prism that could separate light into two distinct beams<sup>1</sup>. Almost everyone has observed how a single dot on a white paper is split into two images by cleavage piece of calcite; it is this property that was used by Nicol to design a prism from a rhombohedron of calcite that, when cut and recemented with balsam, separates light into two rays having different velocities (the vibration directions of these rays are mutually perpendicular; this aspect will be discussed later). Although polarized light was created earlier using thin sections of tourmaline, the relative freedom from color as well as the clarity of optical calcite permitted features related to the transmission of light through an anisotropic mineral, such as refractive index, optical sign, extinction angle, and birefringence, to be accurately measured.

The Nicol prism, shown below, is simply constructed of a cleavage rhomb of calcite that is cut along a diagonal and recemented with balsam. As light enters the rhomb, it is split into two rays with different velocities. Since velocity is related to the degree that light is bent when it enters the crystal (a change in velocity is why objects under water do not appear to be where they actually are), each ray is deflected at different angles. Only one ray, the **extraordinary ray** (*epsilon*, or "ε") passes through with little change in direction; the other, slower ray, the **ordinary ray** (*omega*, or "o"), is deflected toward the side of the crystal and absorbed there by black paint.



These aspects will be further discussed in a later part of this series; the next part will discuss the design of both early and contemporary petrographic microscopes.

<sup>1</sup> William Nicol, "On the Method of So Far Increasing the Divergence of the Two Rays in Calcareous-Spar that Only One Image May be Seen at a Time". Edinburgh New Philosophical Journal, VI, 1828-9, p. 83-94.

