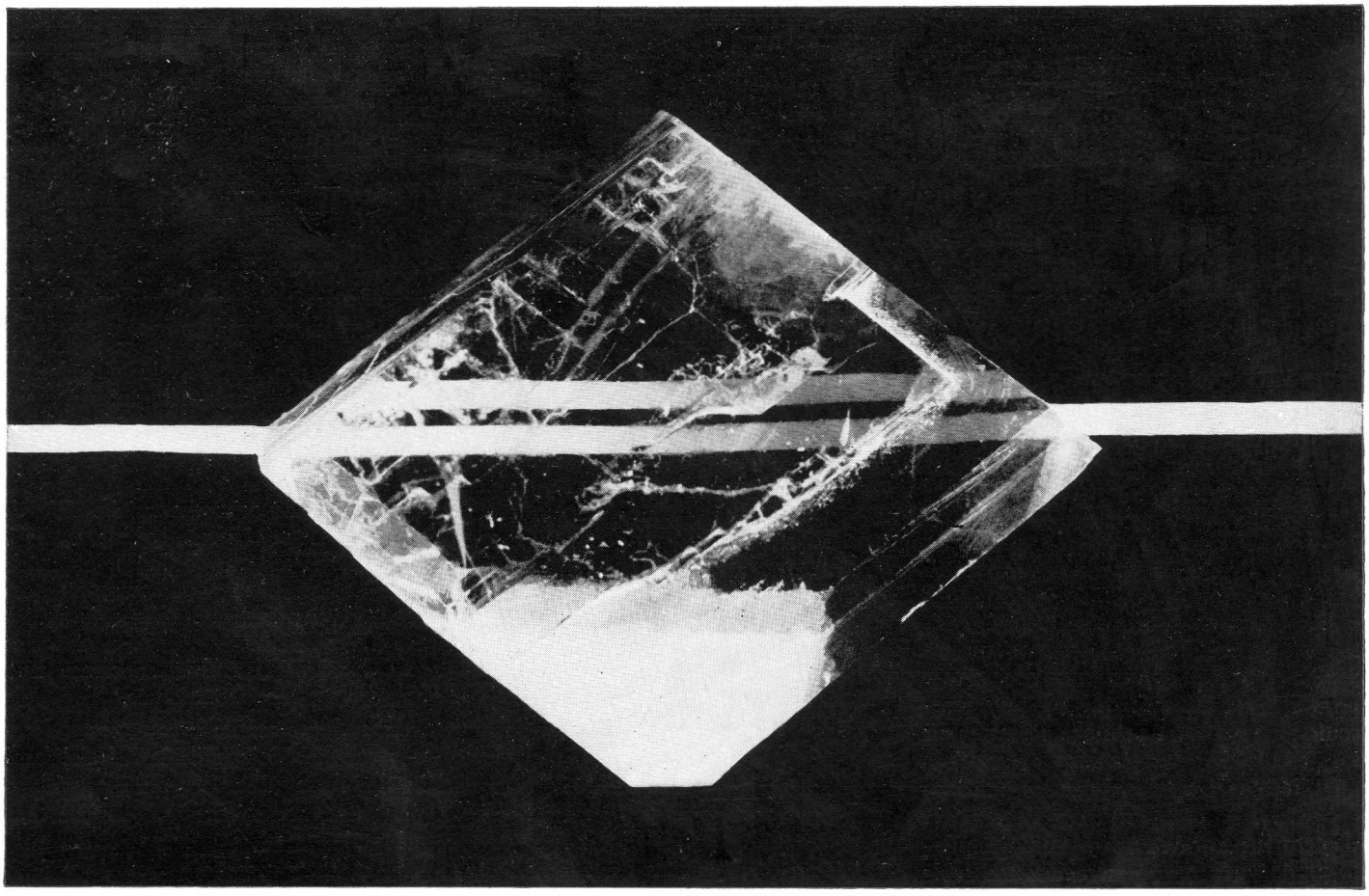


This photograph shows the double refractory quality of a Calcite rhomb.

Rock That Makes You See Double

Having a hardness of only three, calcite crystals do not qualify as gem stones, but they make attractive specimens for a collector, and when found in clear pure form they have a useful place in the scientific laboratories. John Hilton believes there is a great field in the desert Southwest for calcite collectors. Here are some suggestions as to where to look for the crystals, and what to do with them if you find them.

By JOHN W. HILTON

WE were standing in a strange room—one of those mysterious laboratories in which high tension wires are strung about in alarming proximity and the air vibrates with the whir of giant X-ray tubes.

I had gone there as a youngster in my 'teens to deliver some calcite crystals, and Dr. Jesse W. M. DuMond was telling me the important part calcite plays in a scientific laboratory.

It is a highly technical subject, but Dr. DuMond of the California Institute of Technology reduced the story to terms any layman could understand.

"You see," he explained, "X-ray has varying wave lengths just as does ordinary light. But unlike the latter, they cannot be separated into their spectrum by an ordinary glass prism. Optical calcite is used instead. Other crystals have been tried but nothing quite equals Iceland spar as a reflector in this type of instrument.

"When the beam from an X-ray tube is introduced through this slit in the apparatus it strikes the crystal at a critical angle. Some of the rays penetrate only a short distance before they are reflected back out of the crystal, but varying wave lengths penetrate to different depths and are therefore reflected back at different points in the crystal. These separated beams of the X-ray are caught on this flourescent screen or a photographic plate and we are able to get an accurate picture of the varying intensity of the different wave lengths produced by a given piece of equipment."

One might well ask what all this has to do with the desert. The answer is that our arid Southwest is one of the most promising potential sources of Iceland spar. Although no large scale mining operations have yet been undertaken in this region for the recovery of optical calcite, hundreds of dollars worth of this crystal substance has been dug from surface pockets in the desert area in the past 10 years.

Optical calcite or Iceland spar was so named for its first commercial discovery in Iceland. It was mined there for many years but in recent times the quarries and open pits have been mostly worked out and abandoned. Much of the material now on the market comes from other sources.

Chemically, this interesting mineral is nothing more than a very pure form of

limestone or calcium carbonate. It has a hardness of three in the standard scale. Belonging to the rhombic division of the hexagonal system of crystallization, it has been found in literally hundreds of different crystal variations, all belonging to this one general system. Its cleavage remains the same regardless of the variation in its surface angles. When this mineral is struck a sharp blow it separates along definite planes that meet at exact angles to form a perfect rhombohedron. These angles of cleavage in calcite remain the same mathematically whether the specimen be found in Iceland or South Africa.

One of the most interesting properties of calcite is its double refraction. Perhaps I should explain the term "double refraction."

A pencil placed in a glass of water has the appearance of bending in a definite angle at the water line. This is visible evidence of the refractory power possessed by water. It has been found that light rays passing from air into any denser transparent substance are refracted or "bent" to a greater or less degree. This angle of difference is called the angle of refraction. A peculiarity of the mineral world is that light passing through minerals, except those belonging to the cubic system, is refracted at two separate angles. This property is known as double refraction.

In most cases the angle between these two rays is so slight as to be unnoticed by the naked eye. But in the case of Iceland spar it is so pronounced that when a crystal of this mineral is placed over small print or lines two distinct images are produced. It is a case in which you "see double."

The mathematics, optics and physics involved in this process of light splitting would fill an entire issue of the Desert Magazine were I scientist enough to write it. Suffice to say that calcite is doubly refractive to a very high degree, and because of this property and others its clear, optically perfect crystals are both interesting and valuable to science.

One instrument especially interesting to gem collectors is the dichroscope. Equipped with a prism of calcite this apparatus discloses two images of the gem. If the stone under inspection is dichroic, the two images will be of slightly different colors, representing two tints that are blended in the normal coloring of the gem. If the stone is monochroic and belongs to the cubic system both images will remain the same color as the 'scope is revolved.

Advanced mineral collectors and students of mineralogy use polarizing microscopes in the determination of unknown mineral specimens. The polarizing device in such instruments consists of two Nicoll prisms made of two calcite crystals cut at the proper angle and cemented together.

The occurrence of calcite in the desert in most cases is essentially the same as in Iceland — that is, as fillings or partial fillings in cavities in volcanic rock. There are two general theories as to how these crystals were formed. According to one explanation the calcite was an original component of the molten magma and crystallized out as the lava cooled. The other theory, and to me the more plausible one, is that the calcite entered empty gas pockets in solution of hot volcanic water after the lava had partially or wholly cooled.

In some deposits the calcite fills the entire cavity of the lava bubble, while in other instances the nodules of calcite have a surface that resembles an agate geode. When such a specimen is held to the light, however, the greater transparency identifies it as a substance much clearer that the purest agate.

The finest calcite I have ever found was on the Mojave desert of California in the form of loose crystals inside of giant thin-walled geodes. In the Cady mountains of that region I have found geodes containing crystals of optically good calcite weighing several pounds each. In most cases the walls of such geodes consisted of a thin layer of agate

View of Borrego badlands in Southern California where many fine calcite crystals have been found.

coated with tiny quartz crystals, and are too thin to be removed intact from the mother rock.

Before that area became a popular hunting ground, many fine crystals were taken from the Cady mountain area. Some of my best finds were made there, and one of the largest crystals I recovered was visible sparkling in the sun a quarter of a mile away.

Most of the surface specimens in that area have now been removed but I am sure there are still many beautiful crystals in geodes concealed beneath the surface—to be exposed by cloudbursts at some future time. The occurrences are not plentiful enough, however, to justify mining.

In some of the volcanic areas on the Mojave and Arizona deserts calcite occurs as linings in volcanic fissures and in pockets adjacent to these. Such deposits may be worked at a profit if the grade of crystals is consistently good.

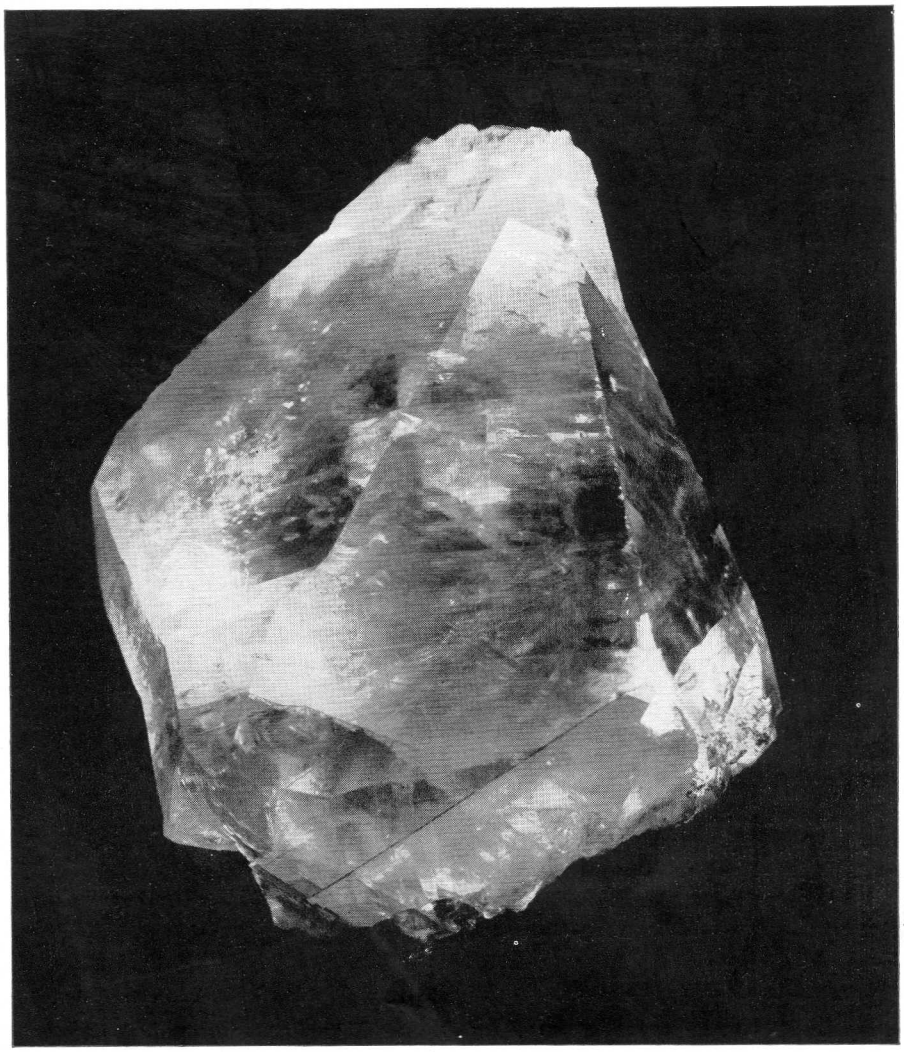
Impurities Add to Beauty

Calcite also occurs as crystal groups in metal veins but in such formation is seldom of optical quality for the reason that a slight trace of metal makes it unfit for scientific use. For specimen purposes, however, some of the most beautiful calcite crystals in the world have been found in occurrence with metallic ore.

A less common occurrence of Iceland spar is where limestone has recrystallized as a secondary mineral in alluvial deposits. One region where such deposits are found is in the Borrego badlands of Southern California. In this rugged highly-eroded area of ancient sandstone, some of which contains fossils of prehistoric mastodons, camels and horses, are long fissures evidently caused by the upthrust of the Santa Rosa mountains. These fissures undoubtedly extend to a very great depth, and hot water has entered with limestone in solution, to be recrystallized in lens-shaped cavities near the surface.

Some of these lenses have yielded fine calcite of an optical grade, and have produced mineral specimens rivaling those of the world's most famous localities. Although crystals have been mined from this region for several years no large scale workings have been undertaken. It is possible that this and other areas in the Southwest desert may some time furnish the optical calcite for this country, especially in the event that war should cut off the foreign supply.

Optical companies and buyers of calcite today purchase the bulk of their material from other countries, and some of them resort to practices which tend to discourage production of calcite at home. Instances have been known where buyers requested that a 10 or 20-pound sample be shipped at the producer's expense—and then made no effort to pay for it.



Calcite crystal of the dogtooth variety.

Prospectors or miners should send small samples to their state mining bureau or to an accredited university. Such institutions are always willing to report as to the grade and possible market for such crystals.

At the present time there are a number of small concerns attempting to make a livelihood through buying and reselling the lesser known minerals found by prospectors who have only a vague idea as to their value. Some of the firms will offer only a small fraction of the current price, or will write enticing letters mentioning possible markets for 10-ton lots and requesting large samples of the best material. Payment is seldom made for these samples—which may have a very high value.

A reputable firm will request a reasonable sample, offering to pay for it at the market price if it meets standard requirements—otherwise it will be returned at shipper's expense. Unfortunately, this type of dealer is still the exception.

The demand for optical calcite is less than in former years due to the invention of a synthetic plastic having the faculty for polarizing light in much the same manner as the Nicoll prism of calcite. This substance, called polaroid, is replacing calcite where Nicoll prisms are used. Since calcite is most commonly found in small crystals it follows that the market for this mineral has suffered.

Large perfect crystals of calcite suitable for specialized scientific work, however, still have a ready market and should be sold direct to the institution which uses them. Such laboratories generally are working on a non-profit basis for the good of mankind, and they deserve to obtain their materials at as low a cost as possible. Usually they will pay a fair price for the crystals they select—and more often than not this figure will be higher than the offer of the so-called mineral broker.

I know of no more interesting way to spend a week or month's vacation in the

desert than in the search for calcite. There are still thousands of miles of possible calcite-bearing volcanic hills in Arizona, Utah, Nevada and New Mexico which await the exploration of those interested in this mineral.

Calcite is such an obviously different mineral that when one enters a country where it may occur it is advisable to show samples of it to cattlemen, sheepherders, Indians or ranchers in the region for the purpose of securing possible leads as to where it may be found.

A few don'ts for calcite collectors should be mentioned. First, don't attempt to cleave a fine clear crystal into a perfect rhomb. Leave that to men in laboratories and instrument shops who are equipped and trained for this sort of work.

Don't try hurriedly to pry crystals from the matrix. Calcite is very brittle and will stand little pressure without being shattered beyond all use.

Pack 'em Well

Don't attempt to transport crystals without wrapping and packing them. Searchers should carry soft paper and small boxes in the collecting sacks for this purpose. Good crystals should not be transported by car over rough roads or sent through the mail without soft paper wrapping and careful packing with excelsior or sawdust in a wooden box.

Finally, don't imagine yourself rich when you find a large crystal that appears to be perfectly clear. Laboratory tests sometimes prove that such crystals contain microscopic impurities or imperfections that make them unfit for anything but mineral specimens.

All over the world today countless scientists are working toward the solution of obscure problems of the universe. These men in most cases are giving their lives unselfishly to research in order to make the world a better place in which to live. I refer to men like Dr. DuMond whose inventions are saving human lives, astronomers reaching out in the vastness of the universe solving riddles of time and space, biochemists in their laboratories peering through polarized microscopes at tiny samples of crystallized salts, finding perhaps some new truth about the structure of matter, or some new process to synthesize a useful drug.

It is a fine thing to know that aside from the joy and possible remuneration for the crystal, that the discovery of a really fine piece of optical calcite is helping along the work of the pioneers in human betterment.