The American Mineralogist

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The American Mineralogist—Journal of the Mineralogical Society of America

A journal containing articles on mineralogy, crystallography and allied sciences, issued about the 15th of every month. Contributions are invited from everyone.

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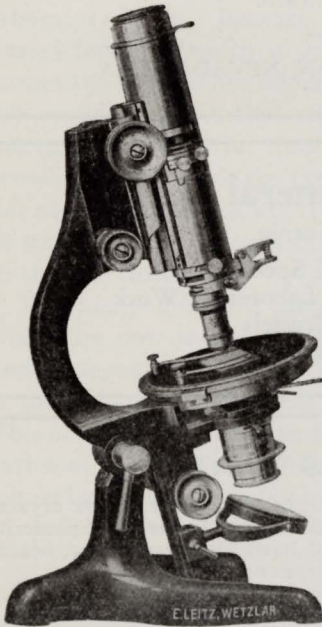Remittances should be sent to Professor **Alexander H. Phillips,** Princeton University, Princeton, New Jersey.

THE NOMENCLATURE OF SILICA

GILBERT HART, *Birmingham, Alabama.*

In its many forms, silica has been used in all stages of civilization, from the ancient flints of the Stone Age to the modern silica laboratory ware. Because of its many uses, and of the many varied forms in which it occurs, silica has been called by more names than any other mineral. Many of the older names of flint are now so obsolete that repetition is needless, but many of the present-day names for quartz gems are unknown save to a few jewellers. Then, too, the exact research of the modern laboratory has shown several distinct crystallographic varieties of silica; some of which are closely connected with the temperatures experienced in their life-history.

The many different names, and their different connotations, which are now in use for silica minerals, call for a classification and arrangement in a more ample, yet more concise manner than is to be found in the usual discussion of the varieties of silica. This article is written with the hope of making a scientific classification of these names, so that the use of the different terms will no longer be a cause for tedious searching for definitions.

I. CRYSTALLOGRAPHIC VARIETIES

These varieties are named in the order formed with descending temperatures.

Recrystallization changes occur at the temperatures noted when ample time is allowed for the action, often in the laboratory only in the presence of catalysts. Besides the changes at these critical temperatures, there are probably similar changes from unstable forms towards quartz at atmospheric temperatures, especially after long time intervals. With fairly rapid cooling or heating intermediate forms may not occur in their stable zone, but a direct change from one to another without the intermediate product may take place. Most of the recrystallization changes noted are found to occur at both ascending and descending temperatures.

(A) SILICA GLASS—amorphous, a true non-crystalline glass, stable below the melting point and above the "gc" temperature.

Quartz Glass, Fused Silica, Fused Quartz, are other names for this super-cooled liquid. In most forms at atmospheric temperatures there are traces of cristobalite.

(B) CRISTOBALITE—isometric, or pseudo-isometric, "gc" range is at 1710° where cristobalite changes to glass as temperatures rise, or glass to cristobalite as they fall.

Christobalite, an alternate spelling.

Beta Cristobalite, also called High Cristobalite, is the high temperature product, forming in the "gc" range in cooling. It is isometric, and in cooling recrystallizes to

Alpha Cristobalite, or Low Cristobalite, at 200–275°, providing cooling through the "ct" and "tq" ranges has been too rapid for recrystallization. It is tetragonal.

(C) TRIDYMITE—hexagonal, bipyramidal. "ct" range is at 1470°, where cristobalite changes to tridymite on cooling. Glass may crystallize as tridymite at 1670° if the cooling was too rapid through the "gc" range.

Beta Second Tridymite, or Upper High Tridymite, is the high temperature product, forming in the "ct" range in cooling, and which recrystallizes to

Beta First Tridymite, also called Lower High Tridymite, at 163° if cooling was too rapid for the "tq" transformation. This in turn alters to

Alpha Tridymite, or Low Tridymite, at 117°, which is the usual tridymite of nature.

Asmanite—a meteoric tridymite, related to the above series.

Vestan—a doubtful silica mineral, probably to be ascribed to tridymite.

Granuline—a doubtful pulverescent mineral which seems allied to tridymite on optical grounds.

(D) QUARTZ—hexagonal, forms from tridymite in the "tq" range at 870° in cooling. Glass may change to crystalline quartz at about 1400° providing cooling was too rapid for the "gc", "gt" and "ct" transformations.

Beta Quartz, or High Quartz, is the high temperature product, forming at the "tq" point. It is hemihedral. On cooling it recrystallizes to

Alpha Quartz, also called Low Quartz, at 573°, yielding the stable low temperature mineral. It is tetartohedral, showing polarity along the c axis and is divisable into

Right Hand Quartz and

Left Hand Quartz

(E) CHALCEDONY—a cryptocrystalline, or very finely fibrous mineral, which has not been successfully located in the thermal equilibrium diagram. Heating to 725–850° usually results in an alteration to tridymite, which thereafter acts as normal tridymite. Chalcedony is usually found as a deposit from solutions, and may be a mixture of glass and quartz, or more probably an intermediate product in the dehydration of the opal colloid. Various subdivisions of chalcedony have been made on optical grounds.

Chalcedony—biaxial, positive, elongation positive.

Chalcedonite—biaxial, negative.

Lussatite—biaxial, positive, parallel elongation.

Quartzine—biaxial, positive, negative elongation.
Pseudochalcedonite.
Lutecite.
Jenzschite—differently soluble, but of same S. G. as chalcedony.
Melanophlogite—possibly impure chalcedony.
Sulfuricin—probably a chalcedony rich in sulphur.
(F) Colloidal Silica—is usually hydrous, and is commonly described under opal.

II. PHENOCRYSTALLINE VARIETIES

Both alpha and beta, right hand and left hand quartz are present in the varieties here considered. Rarely, perhaps, are included tridymites or cristobalites, but their occurrence is rare, and specimens are not often found under other than their type names.

(A) Clear large crystals, which may or may not have crystal faces, but are essentially large single individuals.
  (1) Colorless, transparent, lustrous.
    (a) Crystal—indicative of the clearness of ice.
    Mountain Crystal.
    Rock Crystal.
    (b) "Diamond" indicative of the clearness of true diamond, and of the use as a substitute for diamond. Quartz "diamonds" are usually of local value only, though sometimes sold as imperfect diamonds. The locality of the specimen is shown in its name.

Alaska Diamond	Irish Diamond
Alencon Diamond	Isle of Wight Diamond
Arkansas Diamond	Lake George Diamond
Baffa Diamond	Marmoros Diamond
Bohemian Diamond	Marmorosch Diamond
Brazil or Brazilian Diamond	Mora Diamond
Briancon Diamond	Occidental Diamond
Bristol Diamond	Paphos Diamond
Buxtom Diamond	Pecos Diamond
Cape May Diamond	Pseudo-diamond
Cornish Diamond	Quebec Diamond
Dauphine Diamond	Schaumberg Diamond
False Diamond	Trenton Diamond
Fleurus Diamond	Unripe Diamond
Herkimer Diamond	Vallum Diamond
Horatio Diamond	Wicklow Diamond
Hot Springs Diamond	

    (c) "Pebble" or "Stone" indicative of the water-worn surface of crystal-clear quartz.
    Pebble.
    Brazilian Pebble.
    Bristol Stone.
    Coradgee Stone.

    Rain Stone—a double meaning of a water-worn pebble supposed to repre-
sent petrified rain-drops.

    Rhinestone.

    Show Stone.

    Vellum or Vallum Stone.

(d) Other clear quartzes:

    Beryl—old name, applied particularly to engraved stones, only very rarely
used with this meaning at the present time.

    Dragonite   ⎱Water-worn quartz with brilliant luster, supposed to be
Dragon's Eye⎰petrified eyes of the mythological dragon.

    Jewel of Perfection—Japanese term for rock crystal.

    Rock Quartz.

    White Sapphire.

    White Topaz.

(2) Colored crystals, color usually uniform, but may be zoned or irregular in a
single individual.

(a) Violet, purple:

    Amethyst—typical name for this color.

    Occidental Amethyst-differentiates true amethyst (quartz) from other
minerals of similar color.

    Oriental Amethyst is applied to exceptionally beautiful specimens of ame-
thyst.

    Siberian Amethyst refers to a dark colored amethyst whose color by
artificial light is fine red.

    Bishop's Stone.

    Lavendine.

    Soldier's Stone.

(b) Blue, indigo:

    Azure Quartz.

    Sappharine.

    Sapphire—usually applied to corundum gems, and when used in connec-
tion with quartz usually has that name added.

    Sapphire Quartz.

    Sapphirine.

    Siderite.

    Water Sapphire—usually applied to cordierite gems, but also to quartz,
rarely.

(c) Yellow, golden:

    Citrine is the typical name for this color, and includes all quartz of yellow
cast.

    Golden Quartz.

    Yellow Quartz.

    "Topaz"—much of the topaz of commerce is yellow quartz, or decolorized
smoky quartz.

    Bohemian Topaz.

    Colorado Topaz.

    False Topaz.

    Golden Topaz.

Indian Topaz.

Maderia Topaz.

Occidental Topaz.

Saxon Topaz.

Schnecken Topaz.

(d) Smoky browns, smoky yellows:

Smoky Quartz is typical of any smoke-like color.

Cairngorm—the Scotch name for particularly pellucid smoky quartzes, which is now applied to most which are suited for gems.

Cairngorm Stone.

Cairngorum } alternate spellings adopted in different localities.
Carngorn

Scotch Pebble—this term is also applied to small agates freed from the lavas, and worn by water to rough polish.

Scotch Topaz.

Smoke Stone.

Smoky Topaz.

(e) Color red:

Arizona Ruby.

Bohemian Ruby.

Apricotine—yellowish red.

Hyacinth.

Jacinto—dark red.

Mont Blanc Ruby.

"Ruby" applied as is diamond to quartz of the color of true ruby, but always with a qualifying name to show origin. This use of ruby and diamond is quite distinct from that of topaz, which is adopted by jewellers as a name for yellow quartz.

(f) Color black:

Morion—deep black, often almost opaque, but more usually will transmit light fairly well, and almost totally reflect angular light.

(B) VARIETIES NAMED FROM PECULIARITIES OF CRYSTALLIZATION OR SHAPE.

Most are of the rock-crystal variety, but the other types occur both colored and sagenitic varieties.

(1) Parallel groupings and intergrowths of large individuals.

Babel or Babbel Quartz—rock-crystal with flat pyramidal growths on the large pyramidal faces, the tiers of which have a fanciful resemblance to the tower of Babel.

Cavernous Quartz—with deep etched cavities parallel to the faces.

Sceptre Quartz—parallel grouping of small knob-shaped crystal atop a slender prism.

(2) Fibrous groupings.

Barrel Quartz—corrugated veinlets, whose sheaves of fibres are barrel-shaped.

Cross-course Spar—radiated vein-quartz.

Fibrous Quartz.

Radiated Quartz.

(3) Other groups.

Drusy Quartz—small crystals in parallel growth, as crusts, or lining geodes, or in central part of veins.

Globular Quartz—porphyritic quartz phenocrysts in spherical outline, may be twins showing as spherical sectors or round individuals.

Mineral Blossom—drusy quartz.

Potato Stone—quartz geode.

Twisted Quartz—simple quartz prism warped as through pressure and now made up of spirally arranged individuals.

(C) VARIETIES NAMED FROM INCLUSIONS OF FOREIGN MINERALS. Sometimes in definite crystals, irregularly dispersed or arranged in adherence to crystallographic lines or planes; also inclusions of liquid or gas.

  (1) Crystalline inclusions.

    (a) Spangles:

Aventurine is the common type name, and includes all spangled quartzes.

Avanturine is an alternate spelling.

Avanturine Quartz.

Aventurine Quartz.

Gold Quartz contains native gold in visible spangles.

Gold Stone, yellow iron oxides, simulate gold.

Hyacinth of Compostella, red hematite inclusions.

Imperial Jade, green aventurine.

Imperial Yu Stone, green actinolite (?) inclusions.

Lizote, blue inclusions of silver ore.

Rusty Quartz, discolored by iron oxides.

Rubasse or Rubace—red hematite inclusions.

    This name is also applied to quartz stained red by artificial means.

Sinople or Sinopal—red hematite spangles.

Sunstone, very rare variety with yellow spangles.

    (b) Needles:

Sagenite is the type name, and rutile is the most common acicular mineral in sagenites.

Byssolite, fine greenish actinolite or asbestus needles.

Crispite.

Cupid's Darts—goethite inclusions.

Fleches d' Amour—rutile needles.

Hair Stone—crowded full of a matted mass of acicular crystals.

Hedgehog Stone—radiated needles of geothite.

Love Arrows—rutile needles.

Needle Stone.

Onegite—goethite inclusions.

Reticulated Quartz—rutile needles in rectangular patterns.

Rutilated Quartz—rutile needles.

Sagenitic Quartz.

Thetis Hair Stone—green acicular actinolite inclusions.

Venus Hair Stone.

    (c) Fibres, usually parallel and yielding a cat's eye effect when cut across fibres; also sometimes showing asterism.

Cat's eye is the type name.

Asteria shows asterism.

Asteriated Quartz.

Cat's Quartz.

"Crocidolite" applied to a replacement of the original crocidolite by quartz which retains enough of the silicate to color the replacement and often to give cat's eye effects.

Crocidolite Quartz.

Hawk Eye or Hawk's Eye, applied to crocidolite replacement.

Hungarian Cat's Eye.

Occidental Cat's Eye.

Quartz Cat's Eye.

Sapphire Quartz, blue because of crocidolite, often only faintly chatoyant, indicating an almost complete replacement of the fibrous crocidolite.

Schiller Quartz.

South African Cat's Eye—crocidolite replacement.

Starolite
Star Quartz }asteriated quartz.
Star Stone

Tiger's Eye, brownish to yellow crocidolite replacement, showing alteration previous to the introduction of silica.

Wolf's Eye Stone.

(d) Layers of clay or scaly mineral deposited on former crystal planes, which were covered by later deposits of the same orientation on the quartz crystal.

Capped Quartz, in which the shells of quartz are separable.

Cap Quartz.

Ghost Quartz, in which the outline of the smaller crystal is visible.

Phantom Quartz, in which chlorite grains show the smaller crystal.

Skeletal Quartz, in which the smaller crystal is not of the same form as the outer one.

(e) Densely distributed inclusions, usually this type is found in rocks of which silica is the major part, and the inclusions represent the residual of other minerals included in the original sediments.

Ferruginous Quartz.

Actinolitic Quartz.

Arenaceous Quartz.

Chloritic Quartz.

Micaceous Quartz, etc.

(2) Liquid inclusions, usually of water, also carbon dioxide, or hydrocarbons, visible through the presence of a bubble of air or other gas which moves as the specimen is turned.

Hydrolite.

Water Stone.

(3) Gaseous inclusions, often in films in cracks yielding an iridescent stone or more rarely in larger masses, showing when opened as pungent odors

Cotterite—has a metallic pearly luster and probably belongs here.

Eldoradoite—an iridescent quartz.

Iridescent Quartz.

Iris—often natural, but may also be artifically produced.

Chert
Hornstone
   Sinter   Siliceous Sinter
   Sil-sinter   Quartz Sinter
   Geyserite, usually opaline, rarely anhydrous.
(4) Vein Quartz, usually of igneous origin.
   Bastard Quartz   Buck Quartz
   Buck Stone   Dead Quartz
   Float Stone   Mice-eaten Quartz.
   Spar   Sucked Stone
   Sugar Spar   Sugary Quartz

IV. CRYPTOCRYSTALLINE VARIETIES OF SILICA

Chalcedony is the type name, but this has been divided into several optically distinct types, as noted above. Usually very finely fibrous and sub-microscopic. Surface usually botryoidal, fracture hackly, luster waxy, translucent to opaque.

(A) VARIETIES NAMED FROM COLOR.
   (1) Color uniform:
   Cacholong—whitish cloudy.
   Chalcedony is usually whitish, and is often used to refer to any uniformly
      colored specimen.
   Calcedony   Chalcedon
   California Moonstone—white to gray.
   Moonstone—usually applied to feldspar, also to white chalcedony.
   Mother Stone—whitish chalcedony.
   Occidental Chalcedony—somewhat opaque, whitish.
   Oriental Chalcedony—very translucent white chalcedony.
   Rainbow Chalcedony—structurally in thin concentric layers, but of uniform
      color, may exhibit iridescence when cut across layers.
   White Agate—uniform white chalcedony.
   Mohava Moonstone—translucent lilac-hued chalcedony.
   Violite—purple.
   Blue Chrysoprase—blue.
   Blue Moonstone—blue.
   Keystoneite—blue.
   Sapphirine—blue chalcedony, note also that this is a silicate mineral, and is
      also applied to blue quartz.
   Zafirina—blue chalcedony.
   Chrysoprase—green translucent chalcedony.
   Jade—true jade is a silicate, but the term is often wrongly applied to green
      chalcedony.
   Plasma—green translucent chalcedony.
   Canary Stone—rare yellow carnelian.
   Cambay (or Camboy) Stone—carnelian.
   Carnelian—translucent red chalcedony.

Cornelian   Sardine

Sardine Stone   Sardius

Sard—rich brown translucent chalcedony.

Sardoine

(2) Banded, color and structure, Agate is the type name, and refers to any banded chalcedony.

  (a) Straight bands:

    Onyx—is typical of straight bands one of whose colors is white.

    Carnelonyx—white and red bands.

    Carnelian Onyx—white with red bands.

    Chalcedony Onyx—white and pale colored bands.

    Chalcedonyx—bands of gray and white.

    Nicolo—black or brown base, with bluish white top band.

    Onicolo   Onychite

    Onyx Stone   Oriental Onyx

    Oriental Sardonyx—black base, white intermediate band and brown or red top layer.

    Sardagate—white and orange-red bands, may be semi-transparent.

    Sardian Onyx   Sardian Stone

    Sardony   Sard Onyx

    Sardonyx—white and brown bands.

    Saturnine Onyx—with very dark lower band, giving the stone a dark appearance throughout.

    Amber Agate—yellowish, translucent.

    Amberine—yellowish green.

    Banded Agate.

    Blood Agate—red to pink.

    Carnelian Agate—with predominating bands of carnelian.

    Cer Agate—chrome-yellow.

    Occidental Agate.

    Oriental Agate—finely marked and very translucent.

    Riband Agate—parallel bands.

    Ribbon Agate.

    Sardachate—with predominating bands of red carnelian.

    Semi-carnelian—yellow agate.

    Striped Agate—wide parallel stripes.

  (b) Curving bands, often concentric, probably formed by successive layers deposited in spheroidal cavities, as in lavas.

    Eye Agate—concentric rings, usually showing a dark center.

    Aleppo Stone   Eye Stone

    Cyclops—a single large eye.

    Ring Agate—concentric differently colored bands, often with pale chalcedonic center, or a druse.

    Rainbow Agate—shows iridescence when cut across the concentric structure.

  (c) Broken bands, zigzag, or otherwise discontinuous.

    Brecciated Agate—angular fragments of agate cemented by amethystine quartz.

Fortification Agate—parallel zigzag lines, as though an agate broken and cemented by very narrow bands of chalcedonic silica.

Ruin Agate—zigzag bands resembling ruins.

(3) Colors mottled, perhaps due at times to inclusions but more often there is no disconuity of the silica, merely a changing of pigment.

Catalinite—green, red, and brown mottlings.

Catalina Sardonyx.

Cloudy (or Clouded) Agate.

Cloudy (or Clouded) Chalcedony.

Frost Stone—gray ground, with scattered patches of white.

Prismatic Moonstone—cloudy chalcedony.

Rice Stone—a ground color spotted with white spots resembling rice grains.

Sandy Sard—brown chalcedony spotted with darker browns.

St. Stephen Stone—with round blood-red spots.

White Carnelian—cloudy white or very pale reddish.

(B) VARIETIES DUE TO LUSTER.

Wax Agate—yellow agate with pronounced waxy luster.

(C) VARIETIES NAMED BECAUSE OF MECHANICAL INCLUSIONS. Some of the uniformly colored chalcedonies belong here because their color is due to some definite mineral, as the blues are often due to chrysocolla, but their name is applied to the color and not the impurity. Many impurities are dendritic.

(1) Dendritic inclusions:

Moss Agate is the type name for dendritic chalcedony.

Dendritic Agate.

Fancy Agate—with particularly delicate markings.

Flower Stone—when the dendrites are flower-like.

Indian Agate	Mocha Pebble
Mocha Agate	Mocha Stone
Montana Agate	River Agate

Scenic Agate—when the dendrites suggest landscapes.

Tree Agate—dendrites resemble trees.

Tree Stone.

(2) Other solid inclusions:

Myrickite—bright red cinnabar inclusions.

Opal Agate—alternating layers of opal and chalcedony.

(3) Other inclusions of liquid or gas. Perhaps the iridescence of Rainbow Chalcedony and Agate are due to thin air films between the concentric layers.

Enhydros—hollow nodules of chalcedony partly filled with water.

Water Agate—shell of chalcedony containing a bubble of water.

(D) ARTIFICALLY ALTERED CHALCEDONY AND AGATE. This mineral is porous enough to absorb dyes, and agate is often differentially porous so that different layers will absorb different dyes, yielding a varicolored product. Colors are, like quartz, altered by heat.

Burnt Carnelian ⎫
Burnt Stone   ⎬ color made red by heating.
                   ⎭

Emeraldine— stained green.

False Lapis ⎫
Swiss Lapis ⎭ stained blue.

V. MIXTURES AND INTERGROWTHS OF QUARTZ, JASPER AND CHALCEDONY

Some of these close associations of the varieties of silica suggest that quartz is an ultimate product of recrystallization which may take place after very long periods of time.

> Agate Jasper—intermediate between jasper and chalcedony, a close mixture, often banded or veined.
>
> Hemachate—light colored chalcedony spotted with red jasper.
>
> Hyaline Quartz— quartz with bluish opalescent cast due to the presence of chalcedony.
>
> Jaspagate—opaque jasper with chalcedonic inclusions.
>
> Jasponyx—onyx, part of whose layers are jasper and part chalcedony.
>
> Kinradite—jasper with spherulites of quartz.
>
> Texas Agate—agate jasper.

VI. PSEUDOMORPHOUS SILICA

(A) ORGANIC PSEUDOMORPHS. Many fossils are preserved by silicification of their softs parts, or of their calcareous shells and bones. Particular names are given to:

Fossil Coral

Beckite	Beekite
Coral Agate	Orbicular Silica
Petoskey Agate	Petrified Honeycomb

Silicified Wood

Agatized Wood	Chinarump
Jasperized Wood	Petrified Wood
Shinarump	Wood Agate
Wood Stone	

(B) SILICA REPLACING OTHER MINERALS, as fluorite, barite, etc., but definite names for such replacements are limited to Haytorite—chalcedonic replacement of datolite.

VII. ROCKS, AND OTHER MIXTURES PREDOMINATELY SILICEOUS

The rocks listed in III-(C) often contain appreciable impurities and also may consist wholly of silica. Many other rocks contain large proportions of silica, particularly the acid igneous rocks, of which possibly vein quartz is an extreme. Most sedimentary rocks, except limestones and coal, contain large amounts of detrital quartz. Most metamorphics also carry large percentages of free silica, both as recrystallized material from the sediments, and as material added by the metamorphic agencies. Furthermore, quartz is an important part of many weathering products, alluviums, gossans, etc.

BARYTOCELESTITE FROM THE KINGDEN LEAD MINES, GALETTA, ONTARIO

E. L. Bruce and Margaret Light, *Queen's University*

Galena and sphalerite occur in many places in eastern Ontario. A common type of occurrence is in well defined veins which cut vertically through beds as late as Ordovican. The veins show a decided banding with many vuggy openings along the central part. The greater part of the vein-filling is calcite in which the galena commonly occurs in crystals arranged more or less continuously along certain planes, but the planes are not themselves continuous. Sphalerite is intergrown with galena in varying proportions. The vuggy openings in the central part of some of the veins show a variety of minerals of the later vein stages. At the old Frontenac lead mine at Perth Road, Frontenac County, the openings in the vein contain well formed crystals of sky-blue celestite up to two inches in length. Marcasite is one of the late minerals to crystallize.

At Galetta, west of the City of Ottawa, a vein of this type has been worked for some years for its lead content. At places the well banded calcite vein is open along the medial line. At other places the central part is filled with very transparent selenite which forms crystals as much as a foot in length. The galena is well crystallized. It carries some brown sphalerite distributed as fine grains through the galena crystals. In the open spaces barite of a light brownish color covers the surface of the calcite. Later than the barite and distributed as rosettes on its surface is marcasite and later again are small nests or tufts of needle shaped crystals of a sulphate that contains both barium and strontium. The relation of the water, and a later period of clear selenite, that in places occupies the central part of the vein, to the barytocelestite is not definitely known as the two have not yet been seen together. The deposition of the vein minerals, therefore, took place in an early ore stage in which calcite and galena were deposited in alternating zones deposition of sulphates and marcasite in the vein cavities. The order of crystallization in this last stage was barite, marcasite, barytocelestite, and selenite with the period of the last two not definitely known.

The barytocelestite is in needle-like crystals with the shorter measurements from 0.08 mm. to 0.1 mm. The length is approximately ten times as great. A chemical analysis of as pure material as could be obtained gave the following result.

Ba SO₄	81.5 per cent
Sr SO₄	18.5
	100.00

Qualitative tests for calcium gave negative results and in the above analysis only barium was determined and the strontium sulphate was assumed to make up the remainder. From this the formula appears to be approximately $5BaSO_4 \cdot SrSO_4$.

Optical examination shows that the value of the index of refraction for vibrations parallel to the longer direction of the crystal is 1.63 and that this is greater than the index for the shorter direction. The interference color is ordinarily slate gray and assuming a thickness of 0.1 mm. the birefringence is 0.001 and the value for the index of refraction in the shorter direction is 1.629. It is likely that in the refractive index liquids the crystals are lying on the base and hence these two values are the least and mean indices with the mean index that for the direction parallel to the elongation of the crystal. By analogy with barite and celestite this would be the b crystallographic axis.

Walker[1] has described a stalactitic barite from Madoc which carries 13.95 per cent SrO. This mineral he states is later than the flurite and incrusts it.

The succession of minerals at Galetta shows an interesting variation in the vein forming solutions. During the main ore stage the solutions deposited sulphides and carbonates. Then came the sulphates with barium sulphate as the first to form followed by either the strontium or the calcium sulphates. Celestite occurs in nodules in the Palaeozoic limestones in the vicinity of Kingston. These are neither in nor near veins but apparently formed by segregation of the celestite during the formation of the limestone. If the celestite nodules are contemporaneous with the limestone it seems possible that the presence of strontium in the vein forming solutions during the later stages of formation of the Galetta and Perth Road lead veins may be due to admixture of the original

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[1] *Am. Mineral.*, Volume 4, page 79 (1919).

galena-bearing solutions, possibly from deep seated sources, with shallow water solutions which had dissolved from the limestones some of their strontium content. This is in agreement with the hypothesis suggested by Uglow for the calcite-barite-fluorite-galena veins of this district. He[2] assigns these deposites to solutions in part of meteoric, in part of magmatic origin.

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THE FLORENCE METEORITE OF WILLIAMSON COUNTY, TEXAS

John T. Lonsdale, *University of Texas.*

The Florence Meteorite, the history of which is given below,[1] is of interest because of its excellent state of preservation and petrographic characters. The stone was a small one, measuring 11.5×14×11 cm. and weighed 3640 grams before cutting. The shape was roughly rectangular with four faces approximately plane the other two being rounded. All faces except the rounded ones show the characteristic pitted surfaces, the largest pits being 2 cm. in greatest dimensions. The unbroken surface of the stone is black while the interior is light gray. The black surface material is present as an exceedingly thin skin of oxidation. Plate I, figure 2 shows the external features of the meteorite.

[2] *Ontario Bureau of Mines*, Volume **XXV**, Part No. 2, page 40.

[1] The meteorite fell on the night of January 21, 1922 on the farm of T. H. Lindsey, five miles northeast of Florence, Williamson County, Texas. The stone subsequently came into the possession of Dr. F. W. Simonds of the University of Texas to whom the writer is indebted for details concerning the history of the fall and for the opportunity of studying the specimen. Through the kindly offices of Dr. G. P. Merrill of the U. S. National Museum the stone was cut, sectioned, and analyzed. One half of the meteorite and a cast are deposited in the U. S. National Museum while the other half and a second cast remain in the collections of the University of Texas.

Details concerning the fall of the stone show that it fell at about 8 P. M. after darkness had come on. The direction was from the southwest and the fall was accompanied by a noise "almost like thunder and a great light streak toward the west." The stone fell on the edge of a dry water-course covered with cobbles and "did not knock much of a hole in the ground." The stone was found the next morning ten or twelve hours after the fall. The latitude and longitude of the locality as nearly as can be stated are 30° 52' north and 97° 43' west.

Thin sections show the stone to be a chondrite with several kinds of chondrules and to contain mainly olivene, enstatite, metallic iron and iron sulphide. Olivene and enstatite are the most abundant minerals but metallic iron is plentiful. Texturally the stone consists of chondrules, fragments of chondrules, silicate minerals and metallic iron imbedded in a ground mass of the same materials. Glass is lacking and veining was not seen in the sections studied or on polished surfaces of the stone. The presence of fragments of chondrules and a general brecciated aspect of the stone cause it to be classed as a gray breccia-like chondrite (Cgb). Plate I, figure 3 shows the general textural features of the stone.

Metallic iron is abundantly developed generally as a matrix mineral though small grains are found in chondrules. In the larger granular olivene chondrules the metal occupies interstices between the grains of the silicate. The shape of the iron grains is very irregular there being both isolated irregular masses and larger more continuous masses inclosing grains and fragments of silicates. In the latter type of occurrence, the pattern formed suggests intergrowth of the two materials. In a number of cases the iron is rimmed by minute grains and fragments of iron sulphide.

Enstatite occurs in chondrules and as anhedral crystals and grains in the general mass of the stone. The chondrules generally radiate in which the enstatite is very finely fibrous. In some of these bodies the fibers radiate irregularly the resultant shape being fern like or plumose. PLATE II, figure 3 shows one of the radiating enstatite chondrules while Plate II, figure 4 shows a large enstatite chondrule with a barred structure. Enstatite occurs also in the porphyritic chondrules where it forms the groundmass in which the phenocrysts are set.

Olivene is found in chondrules of various kinds, as large grains and crystals, and as smaller grains in the mass of the stone. Some of the larger crystals both in chondrules and otherwise are euhedral though the greater number are anhedral. Plate I, figure 4 shows a section from a chondrule containing a number of euhedral olivenes. Single crystals of the mineral form the monosomatic chondrules found and in a few cases granular chondrules occur composed entirely of olivene. In most instances, however, other minerals such as iron or enstatite are present. In the porphyritic chondrules olivene is generally subhedral to anhedral and in one case the center of the chondrule is formed of a single large olivene set in the

fibrous enstatite and surrounded by smaller grains of olivene. Plate I, figures 1 and 4 and Plate II, figures 1, 2, 5, and 6 show the various occurrences of the mineral.

Iron sulphide is present in appreciable amount in the stone. It is a matrix mineral occurring in irregular masses and as minute grains frequently in association with metallic iron. In one section a single small plate of plagioclase feldspar was observed. The mineral was brownish on the edges and showed polysynthetic twinning. During the analysis Mr. Shannon isolated grains of chromite and of a silicate resembling diopside.

The most striking feature of the Florence Meteorite is the variety of chondrules present. These are both monosomatic and polysomatic the forms present including granular, porphyritic, radiating, grating or gridiron, barred and others for which no descriptive names are known. All of the chondrules are somewhat irregular in shape and lend a breccia-like aspect to the stone. The more perfect ones are oval in shape in cross section while the greater number are irregular or even fragmentary. Measurements of the chondrules show sizes ranging from 0.3 mm. for a fibrous olivene chondrule to 1.35 mm. for a porphyritic chondrule. Olivene chondrules are more abundant than enstatite, though the latter are numerous. The granular chondrules consist of anhedral grains of olivene with or without other minerals. In the large chondrule of the type shown in Plate II, figure 1, iron is present in addition to olivene, but in other examples only the silicate is present, the irregular grains being arranged in a mosaic pattern without other material filling the interstices. A fibrous or barred olivene chondrule is shown in Plate II, figure 2, in which the fibers are parallel and essentially straight. Radiating enstatite chondrules are present as shown in Plate II, figure 3. These differ from the fibrous olivene chondrules in that the fibers are radially and eccentrically arranged. In some of these masses the outer ends of the fibers flare outward giving a plumose appearance. The gridiron or grate chondrule in Plate I, figure 1, is monosomatic, a single crystal only of olivene being present. Two of the most striking chondrules are shown in Plate II, figures 5 and 6. Both are of olivene one being barred in three directions, the other being divided roughly into quadrants best observed between crossed nicols.

A chemical analysis of the meteorite, made by Mr. E. V. Shannon of the United States National Museum, is given below:

	Per cent
Metallic portions	17.62
Troilite (calculated by writer)	5.01
Rock material	77.37
	100.00

The composition of the metallic portion is:

	Per cent
Iron	91.277
Nickel	8.270
Cobalt	.426
Copper	.009
Phosphorus	.018
	100.000

The composition of the soluble silicate portion is shown in Column 1 below. The insoluble part is shown in column 2 while column 3 gives the net composition of the stone with the metallic portion included.

	1	2	3
SiO_2	28.069	56.94	36.115
Al_2O_3	0.542	4.86	2.756
TiO_2	trace	trace	trace
FeO	18.104	8.98	10.880
CaO	1.628	4.86	2.782
MgO	35.714	22.28	23.370
MnO	1.465		0.539
NiO	0.379	None	0.140
Fe	8.509		19.290
Ni			1.492
Chromite		0.60	
Co			0.075
Cu			0.002
S	4.884		1.842
P			0.003
P_2O_5	0.706		0.259
Cr_2O_3			0.183
K_2O		1.28	0.573
Na_2O		0.87	0.388
	100.00	100.37	100.689

EXPLANATION OF PLATES

PLATE I

Figure 1. Monosomatic chondrule with grating structure.
2. The stone before cutting.
3. Thin section of the stone. Black is metallic iron and iron sulphide. Light colored areas are olivene and enstatite. A number of chondrules are in the field and the breciated character of the stone is well shown.
4. Thin section of a porphyritic chondrule. The light areas are olivene crystals, a number of which are euhedral. The darker portions consist of a felty, fibrous mass of enstatite.

PLATE II

Figure 1. Granular olivene chondrule composed of irregular grains of olivene with interstices occupied by metallic iron.
2. Fragment of barred or fibrous olivene chondrule.
3. Radiating enstatite chondrule, very finely fibrous.
4. Enstatite chondrule with fibers well developed and arranged in groups at sharp angles.
5. Olivene chondrule composed of fibers or laths of the mineral oriented in three different planes.
6. Olivene chondrule somewhat similar to 5. The fibers are indistinct but between crossed nicols are seen to be arranged in four directions dividing the chondrule into quadrants.
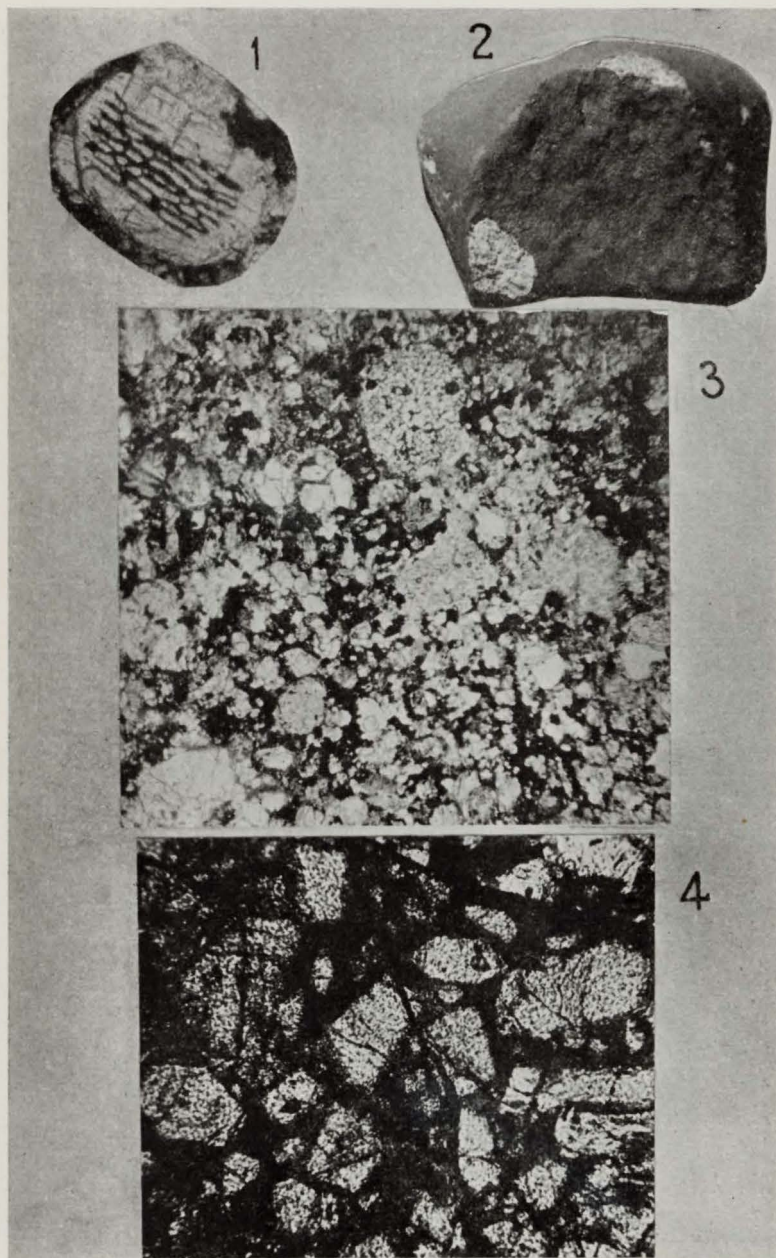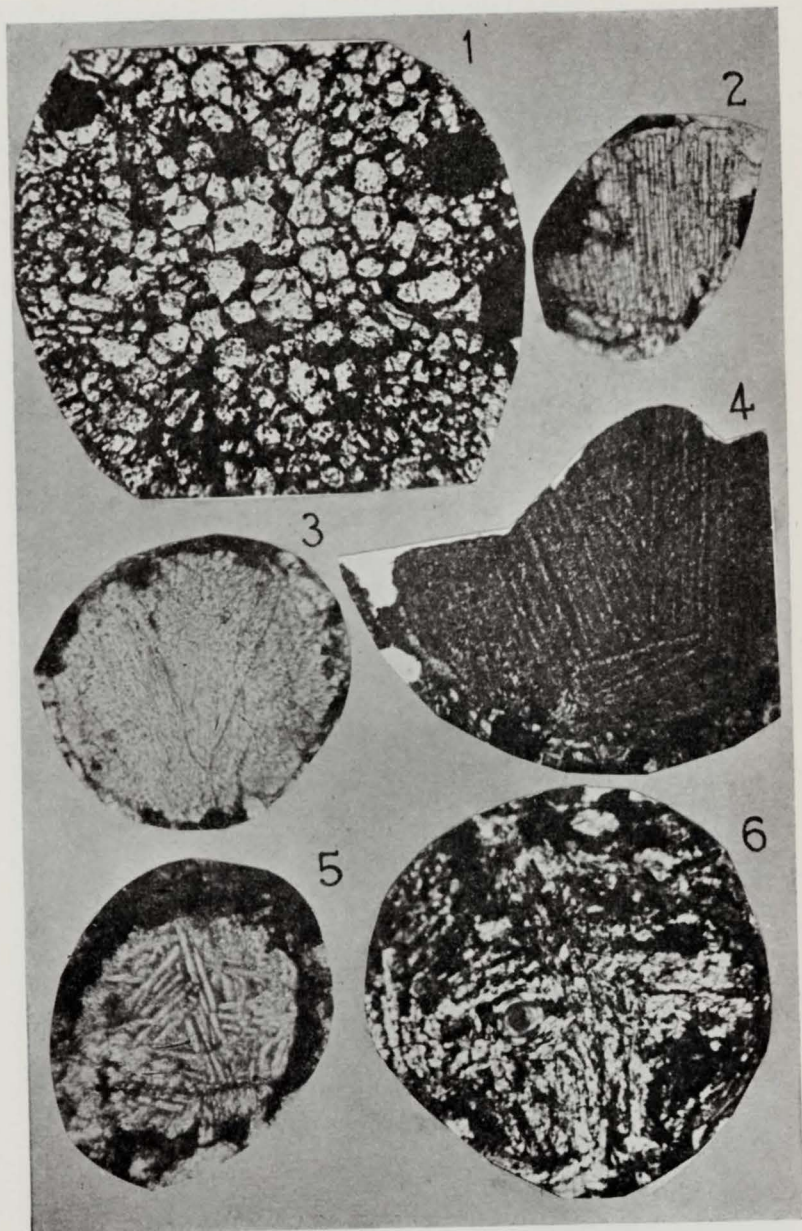
Plate I

PLATE II

A REEXAMINATION OF THE LEAD SULPHOSALT KEELEYITE FROM BOLIVIA[1]

EARL V. SHANNON, *United States National Museum,*
and
M. N. SHORT, *United States Geological Survey.*

The mineral keeleyite, a sulphosalt of lead from the Oruro district of Bolivia, was originally described by Mr. S. G. Gordon[2] as a new species having the formula $2PbS \cdot 3Sb_2S_3$. The first analysis, which was made by Whitfield, was corrected on the assumption that the contaminating sulphide was principally chalcopyrite. Later it was found that the so-called chalcopyrite was in reality stannite. The first formula as above deduced was $2PbS \cdot 3Sb_2S_3$. Since the tin present would be included and weighed with the antimony, there was opportunity for a considerable error in the important relation existing between basic and acid sulphides in the compound, and some doubt was entertained as to the correctness of the formula derived for the mineral. Some reviewers questioned the validity of the mineral as a distinct species and, in fact, one of the present writers allowed a review of the original description to be published over his name (E.V.S.)[3] questioning the reliability of the formula adduced. In a commendable effort to further establish or discredit his species, Mr. Gordon has encouraged and assisted continued work on this mineral. The single original specimen, measuring $3 \times 5 \times 7$ inches[4] was not obtained in place but was found on the *cancha* of the San José mine at Oruro. Mr. Gordon had hoped, on his second visit to Bolivia in 1925, to obtain more material for a more thorough and extended investigation of the mineral. As these hopes were not realized, a new analysis and mineralographic examination was made on the original specimen.

As originally described by Gordon the specimen was a mass of cavernous quartz studded with small, white, quartz crystals. The cavities contain sheaf-like aggregates of acicular, dark metallic gray crystals of keeleyite, some pyrite and small twinned crystals of

[1] Published by permission of the Acting Secretary of the Smithsonian Institution and of the Director of the U. S. Geological Survey.

[2] Samuel G. Gordon, Keeleyite, a new lead sulfantimonite from Oruro, Bolivia. *Proc. Acad. Nat. Sci., Philadelphia*, vol. 74, p. 101 (1922).

[3] *Amer. Mineralogist*, vol. 8, p. 167, Sept. 1923.

[4] This specimen has since been broken into two pieces, one of which is in the collection of Mr. George Vaux, Jr., of Bryn Mawr, Pa.

stannite. The keeleyite crystals are deeply striated and furrowed, due in part, to parallel and subparallel growth. No measurable crystals were found.

The sample for reexamination, prepared for analysis by Mr. Gordon and turned over to the writers for investigation, consisted of approximately a half gram of acicular crystals which had been individually selected under a microscope and freed from all visible impurities. A mineralographic examination showed this material to be unusually pure. A further result of the microscopic work was to demonstrate that keeleyite is distinctly different from zinkenite in both color and microchemical reactions and that this mineral does not agree with any lead sulphantimonite for which data are at hand. The microchemical and other properties are given below and compared with zinkenite:

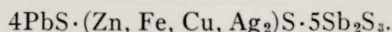|	ZINKENITE	KEELEYITE
1:1 HNO_3	Quickly tarnishes brown to black with slow effervescence; rubs to iridescent gray	Negative
1:1 HCl	Negative; fumes tarnish slowly; rubs faint.	Negative
20%KCN	Negative	Negative
20% $FeCl_3$	Negative	Negative
40% KOH	Slowly develops grain structure	Stains dark gray
5% $HgCl_2$	Negative	Negative
Aqua regia	Quickly stains black	Stains iridescent.
Hardness	Soft	Soft or medium
Color	Grayish white	Gray
Anisotropism	Moderate	Moderate
Form	Prismatic	Prismatic

The data given above for zinkenite are those of Davy and Farnham.[5] These were confirmed in their entirety on a specimen of zinkenite from Wolfsberg (in the Harz) in the National Museum collection (Cat. No. 83,982). Aside from the difference in action toward reagents, keeleyite is distinctly darker gray in color than any of the other sulphantimonites of lead as seen in polished surface under the microscope. A specimen in the Museum collection (Cat. No. 94,618) labelled "keeleyite, not from type" which as received from Mr. Gordon consists of gray needles thickly and firmly embedded in a white clay. This gray mineral was found to be identical mineralographically with the analyzed keeleyite.

[5] Microscopic examination of the ore minerals. McGraw-Hill Book Co., **1920,** page 62.

The analysis of the pure mineral, carried out by standard methods, gave the following results:

CONSTITUENTS	PER CENT			RATIOS
Insoluble	0.60			
Lead (Pb)	29.80	.144		
Silver (Ag₂)	0.52	.002		
Iron (Fe)	0.84	.015 } .190		.038 × 5
Zinc (Zn)	1.24	.019		
Copper (Cu)	0.64	.010		
Tin (Sn)	0.18	.002		
Arsenic (As)	0.27	.004 } .366		.037 × 10
Antimony (Sb)	43.32	.360		
Sulphur (S)	23.02	.717 .717		.036 × 20

100.43

The above results and ratios indicate the formula $5RS \cdot 5Sb_2S_3$, or $PbS \cdot Sb_2S_3$ with the lead in part replaced by small amounts of zinc, iron, copper and silver in the order named. In view of the ideal purity of the analyzed sample there is no possibility of eliminating the miscellaneous bases as due to admixtures. The sum of these various bases bears a ratio to the lead of 1:4, so that the formula can be more exactly made to represent the analytical results by expansion to

$$4PbS \cdot (Zn, Fe, Cu, Ag_2)S \cdot 5Sb_2S_3.$$

Such formulas are not unknown among the sulphosalts since Schaller's formula for jamesonite is $4PbS \cdot FeS \cdot 3Sb_2S_3$ and owyheeite has the formula $8PbS \cdot 2Ag_2S \cdot 5Sb_2S_3$. In spite of the mixed character of the accessory bases, it seems entirely probable that this formula expresses the difference between the composition of keeleyite and zinkenite.

In this connection it is well to reconsider the first analysis of keeleyite made by Whitfield and published by Gordon in his original description of the mineral. Subsequent examination, by both Gordon and Shannon of the same keeleyite shows the impurities mixed with the mineral to be only pyrite and stannite, the pyrite being in coarse crystals, easily recognized on account of their color. The stannite, dark in color and not anticipated, probably did contaminate the sample to some extent. In interpreting the original results all of the iron and copper were deducted as extraneous and the formula derived from the relation between lead and antimony (the latter contaminated by the unrecognized tin) was $2PbS \cdot$

stannite. The keeleyite crystals are deeply striated and furrowed, due in part, to parallel and subparallel growth. No measurable crystals were found.

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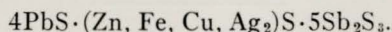|	ZINKENITE	KEELEYITE
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In this connection it is well to reconsider the first analysis of keeleyite made by Whitfield and published by Gordon in his original description of the mineral. Subsequent examination, by both Gordon and Shannon of the same keeleyite shows the impurities mixed with the mineral to be only pyrite and stannite, the pyrite being in coarse crystals, easily recognized on account of their color. The stannite, dark in color and not anticipated, probably did contaminate the sample to some extent. In interpreting the original results all of the iron and copper were deducted as extraneous and the formula derived from the relation between lead and antimony (the latter contaminated by the unrecognized tin) was $2PbS \cdot$

$3Sb_2S_3$. The original analysis is given in column 1 of the following table. In column 2 are given the ratios of the original analytical figures while in columns 3 and 4 are given the residual ratios as nearly as possible after deducting 7.74% of stannite, all of the copper being used, by way of trial, as the only possible index to this constituent. It will be seen that the corrected ratios indicate the formula $4PbS \cdot FeS \cdot 5Sb_2S_3$.

	1	2	3	4
Lead (Pb)	25.80	.125	.125	.031× 4
Iron (Fe)	2.77	.049	.031	.031× 1
Copper (Cu)	2.25	.035		
Antimony (Sb)	43.46	.362	.344	.034×10
Sulphur (S)	24.54	.765	.693	.035×20
	98.82			

The only other explanation of the difference between keeleyite and zinkenite is that the formula commonly ascribed to zinkenite is wrong and that this mineral actually has the formula $2PbS \cdot 3Sb_2S_3$ or $3PbS \cdot 4Sb_2S_3$. However this may be, it is definitely established that keeleyite is different from the other sulphosalts of lead and can be accorded full species rank.

APATITE CRYSTALS FROM WIANT'S QUARRY, NEAR PILOT, MARYLAND

EARL V. SHANNON,[1] *U. S. National Museum.*

In Mr. Samuel G. Gordon's paper on desilicated granitic pegmatites[2] of the vicinity of the Pennsylvania-Maryland state line he states that the albitite of Wiant's quarry, three quarters of a mile northeast of Pilot, Cecil County, Maryland, is filled with miarolitic cavities which are lined with minute, colorless, albite crystals. He further says that minute, transparent, greenish, highly modified beryl crystals occur rarely implanted on the albite while not infrequently the rest of the cavity is filled with matted masses of dark green actinolite needles.

[1] Published by permission of the acting Secretary of the Smithsonian Institution.
[2] *Proc. Acad. Nat. Sci. Philadelphia,* **1921,** part 1, page 179.

In the course of the writer's investigations of the minerals of Maryland in cooperation with the State Geological Survey, Wiant's quarry was visited. Mr. Gordon then suggested that it was probable that the supposed beryl crystals were in reality apatite. None of the crystals were found at this time but Mr. Gordon very kindly forwarded the writer several specimens which he had previously collected. These have been studied in the Museum's laboratory and the mineral found to be apatite.
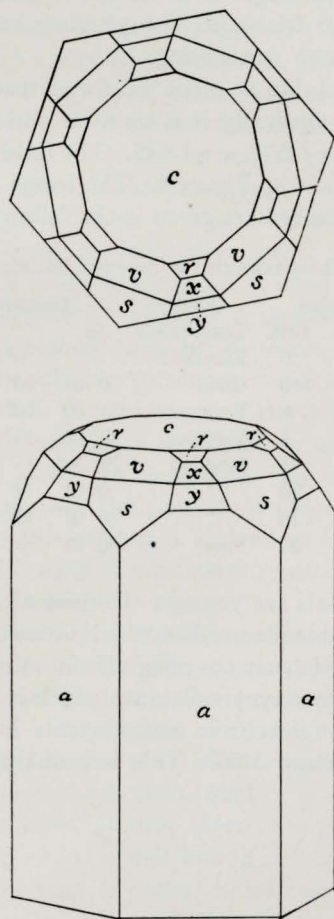

Fig. 1.

The apatite crystals are sparsely scattered over the drusy crusts of colorless or brown, iron-stained albite crystals which line the narrow miarolitic cavities in massive white albite. Individual crystals of the apatite reach a length of 4 or 5 mm. with a thickness of 2 mm. although most of them are somewhat smaller. The larger ones are green but the smaller ones are colorless and are not easy to distinguish from the colorless albite crystals on which they rest. The longer apatite crystals show cleavage parallel to the base *c* (0001). Many of the larger ones are bluish-green, partly opaque, and rather soft and friable as though they had suffered partial disintegration through weathering.

The apatite is soluble in nitric acid and reacts for phosphoric acid and fluorine. Optically it is uniaxial and negative with the refractive indices $\epsilon = 1.631$, $\omega = 1.635$. The habit of the crystals is as shown in the drawing, Figure 1. The forms observed together with the angles measured are given in the following table:

MEASUREMENTS OF APATITE CRYSTAL

Form		Symbol		Quality	Measured		Calculated	
No.	Letter	Miller	Gdt.	Description	ϕ	ρ	ϕ	ρ
1	*c*	0001	0	Excellent	° ′ 0° 00′		° ′ 0° 00′	
2	*a*	10$\bar{1}$0	∞0	Good	0° 01′	90° 00′	0° 00′	90° 00′
3	*b*	11$\bar{2}$0	∞	Very poor	31° 09′	90° 00′	30° 00′	90° 00′
4	*v*	11$\bar{2}$2	½	Very poor	30° 06′	36° 34′	30° 00′	36° 16′
5	*s*	11$\bar{2}$1	1	Medium	29° 54′	55° 45′	30° 00′	55° 43′
6	*r*	10$\bar{1}$2	½0	"	0° 01′	22° 50′	0° 00′	22° 57′
7	*x*	10$\bar{1}$1	10	"	0° 01′	40° 21′	0° 00′	40° 16′
8	*y*	20$\bar{2}$1	20	Poor	0° 01′	59° 32′	0° 00′	59° 27′

The apatite crystals are younger than the albite but are clearly older than the hornblende needles which occasionally occur in the cavities. As a last deposit covering all the minerals there is seen occasionally a brown clayey substance which is transparent under the microscope, nonpleochroic and variable in refractive index, the mean being around 1.60. This is probably an iron bearing beidellite.

ON THE DETERMINATION OF ALKALIES IN ROCKS AND MINERALS

EARL V. SHANNON,[1] *U. S. National Museum.*

In mineralogical analysis, and to a lesser extent, in rock analysis, the average laboratory worker is seldom in a position to undertake extensive researches into the field of devising new or unique methods for the determination of any particular constituent. He does, however, owing to paucity of available sample, have to display in many cases, considerable ingenuity in combining standard methods in such a way as to determine a large number of constituents on the same very small portion of material. The care with which these involved combinations must be used is emphasized by the fact that, in many instances, no second portion of the sample can be obtained in case of accident or error.

Whatever method is used in the determination of alkalies: whether by the usual J. Lawrence Smith method, by direct decomposition with acids, or determined after every thing else is removed from solution by volatile reagents, the final process usually consists in weighing them as the mixed chlorides of sodium and potassium with subsequent separation of the chloroplatinates by solution in alcohol. By this method the potassium is obtained in the form of chloroplatinate, insoluble in alcohol, whereas the sodium salt of the same acid is soluble. By weighing the mixed chlorides and calculating the potassium chloroplatinate back to potassium chloride the sodium is arrived at by difference. Any error in the determination of potassium results in a corresponding error in the results for sodium.

The simplest method, after obtaining a clear solution of the mixed chlorides, is to add a considerable excess of platinic chloride and evaporate to approximate dryness on the water bath. The residue is then covered with a large excess of alcohol. At present it is difficult to procure ethyl alcohol of satisfactory purity or freedom from denaturants. Alcohol of unknown quality is unsatisfactory as it tends to reduce the excess platinic chloride to platinum or to some insoluble compound or to deposit some gummy substance. Methyl alcohol, on the other hand, is just as satisfactory if not better than ethyl alcohol and can be purchased anywhere in relatively pure form without question and at a fairly low price.

[1] Published by permission of the acting Secretary of the Smithsonian Institution.

For some years it has been the practice of the writer to filter the platinic potassium chloride on a small tared gooch crucible and to weigh it after drying at 120°C. This method gives excellent results provided that certain precautions are observed. The ordinary potassium salt is anhydrous, relatively stable, and represented by the formula K_2PtCl_6 or $2KCl \cdot PtCl_4$. This crystallizes in the isometric system, is yellow in color and practically insoluble in alcohol although easily soluble in hot water. Sodium forms no analogous salt and under the same treatment enters into a hydrated salt, represented by the formula $Na_2PtCl_6 \cdot 6H_2O$. This crystallizes in the triclinic system and is easily soluble in alcohol of almost any type or strength. The difference in behaviour of these alkalies provides the accepted easy method for their separation.

Despite all the precautions suggested by the foregoing it has been found recently that errors could and did enter into ordinary alkali determinations, particularly those which had been required to stand for some time in the laboratory atmosphere at that stage following the addition of the platinic chloride reagent. Although potassium and sodium are not isomorphous in the formation of the chloroplatinates, ammonium and potassium both form anhydrous chloroplatinates crystallizing in the isometric system. The ammonium salt is less soluble, both in hot water and in alcohol than the corresponding potassium salt. Ammonium chloride or other ammonium vapors are generally present in the laboratory atmosphere. This is easily demonstrated by the coating which forms on well washed glassware in a few days. In the laboratory of the writer, which is large, well ventilated, and accomodates only two workers, the glassware fogs promptly and the distilled water, dripping through several inches of air space, gives a distinct reaction for chlorine. Where the workers are busy and crowded the fumes are much more concentrated. It would appear that the ammonia vapors are quickly absorbed by the neutral chloroplatinate solution with the formation of ammonium chloroplatinate. With this factor left out of consideration the ammonium salt would be disregarded and weighed as potassium yielding an abnormally high result for this constituent with a correspondingly low result for sodium. This error is naturally magnified if, for any reason, the determination is delayed at this stage.

In consideration of the foregoing it is obvious that, unless a determination is carried to completion without the slightest delay

the results will be more or less in error if the weight of the potassium chloroplatinate is taken as final. Fortunately it is easy to overcome this handicap. Where it has been necessary to allow a determination to stand the weight of the potassium chloroplatinate should not be relied upon. This salt should be dissolved in hot water, the solution passing into a porcelain crucible. It is then slightly acidified with hydrochloric acid, a few drops of pure mercury are added and the whole evaporated to dryness on the steam bath and gently ignited. The residue in the crucible is the platinum from both potassium and ammonium chloroplatinates and potassium chloride, the ammonium salt having been volatilized. Simple leaching with hot water will remove the potassium chloride which can either be weighed directly after evaporation in a platinum dish or determined by difference after weighing the ignited filter and separated platinum in the original crucible.

It seems best to have the original platinic chloride reagent in solution in alcohol rather than in water and to filter it before use to avoid adding ammonium salts with the reagent.

The prejudice of many chemists against the use of platinum chloride prepared from laboratory scrap platinum appears to have no reasonable basis. The iridium content of ware made in recent years is very small since the price of iridium has been higher than that of platinum. Even where the iridium content of the solution is considerable it would appear to have little effect. The atomic weight of platinum (195.23) and iridium (193.10) are very similar. The two form analogous compounds with the alkalies which do not differ appreciably in solubilities in alcohols and water. Potassium chloriridate forms black octahedral crystals which serve to indicate the presence of iridium in the solution.

NOTES AND NEWS

STUDIES IN THE MICA GROUP (A DISCUSSION). A. F. HALLIMOND.

In a recent contribution to the *American Mineralogist* Dr. A. N.Winchell has included a very interesting comparison between a revision of his theory of the micas and the theory I ventured to suggest some time ago in the *Mineralogical Magazine*. The two theories yield in general very similar values for the composition of the principal minerals concerned, but Winchell's present assumption that Al_2O_3 is replaced by $MgO \cdot SiO_2$ necessitates a steady dimunition in the ratio $K_2O:SiO_2$ as the MgO increases, while my own suggestion that Al_2O_3 is replaced by MgO leaves this ratio unaltered. Dealing with the composition of muscovite, he remarks that a

number of 'probably inaccurate' analyses (of sericite etc.) contain an average ratio $K_2O:SiO_2$ of only 69:600. I had disregarded these because I felt that the materials were of too doubtful a nature: if they are to be accepted we must both seek a new end member for this section of the group, since Winchell's earlier formula contains $8 SiO_2$ (75:600) and his present formula $7 SiO_2(86:600)$. But I still think the best course is to leave the old analyses of sericite for better mineralogical identification: there remains a sufficient number of analyses of clean muscovites. Winchell points out that pure muscovite would not serve to test the substitution theories. But very few of the published analyses represent pure muscovite; out of the 46 analyses I quoted, no fewer than 25 contain over $30MgO:600SiO_2$, representing over 30 per cent of the phengite molecule; they are, therefore, well adapted for testing his theory. Referring to my diagram showing the incidence of potash ratios in these micas, he considers that 'the relative frequency of the potash ratios is not the question at issue.' But it is unfortunately the case that his theory requires a susbstantial diminution of this ratio, to below 96, in more than half the analyses plotted, and of this there is little trace in the muscovite diagram or in the diagrams for the other types of mica where similar considerations would obtain.

Reduction of the potash ratio to 95 would correspond with a reduction of roughly 0.5 in the percentage of potash, a quantity almost within the total accidental deviation to which isolated mineral analyses are subject. In these circumstances an ideal test of the theories would consist in a series of recent analyses made by the same observer, upon materials selected with care and graduated from pure muscovite up to the highest available content of MgO. Fortunately a series of this kind is available in the well-known research by Kunitz: the lowest ratio observed was 99:600, and there was no trace whatever of a progressive diminution in $K_2O:SiO_2$ as the magnesia increased. This was pointed out at the time by Kunitz in his own interpretation of the data, and until his analyses have been superseded it would seem that Winchell's substitution of $MgO \cdot SiO_2$ for Al_2O_3 cannot be maintained.

Winchell further observes, "It seems strange that it should be necessary to point out that it is not safe to conclude that the more uncommon ratios are all due to errors and do not actually occur." His reference to my work is incorrect, for my statement was (*Min. Mag.*, vol. **XX**, p. 307) "the small deviations being readily explained, either by experimental errors *or by the presence of small quantities of other molecules.*" A reply on this point is therefore unnecessary.

With regard to the analysis of protolithionite which Winchell was unable to trace, I regret that the description should read 'Dana protolithionite 2' instead of 'polylithionite 8.' The ratios are correctly given and the analysis will be found on the page indicated a few lines below the position incorrectly given in my footnote.

In closing, I should like to express my appreciation of the very full discussion which Winchell has accorded to my theory; the free interchange of views will, I feel sure, greatly assist in the interpretation of these difficult compounds.

GARNETS IN THE NAVAJO COUNTRY

ALBERT B. REAGAN, *Ganado, Arizona.*

The Navajo country occupies northeastern Arizona and parts of New Mexico and Utah. It is bounded on the east by the 108th meredian, and its other three sides are bounded by the valleys of the large rivers—the San Juan, the Colorado, and the

Little Colorado and Puerco, natural boundaries that have long been recognized by the native tribes. Its area is approximately 25,725 square miles, 22,400 square miles of which are held in reserve for the Hopi and Navajo Indians.

In this region garnets are found associated with basic intrusive rocks at more than twenty places, occurring most abundantly in agglomerate of volcanic origin; and are sufficiently abundant to be of commercial value in four localities—Moses Rock, Mule Ear, and Garnet Ridge, near the Utah-Arizona line; and Buell Park, in the Red Lake volcanic field. The ultimate source of the garnets appears to be a richly garnetiferous diorite gneiss, boulders of which are fairly abundant as inclusions in the igneous rocks.

These stones, known as "Arizona rubies," are pyrope garnets and range in color from the light shades to the very dark shades of the characteristic color of Burgundy wine. Many of the stones possess great beauty and are offered for sale both as uncut stones and as jewelery in all the trading stores in the region, and many cities of the west also have them for sale.

These stones are collected only by the natives of the region who find a ready market for them.

According to the announcement made on cover four of the October issue of the *American Mineralogist*, the entire stock of Ward's Natural Science Establishment has been presented by the members of the Ward family to the University of Rochester as a foundation in memory of the late Mr. Frank A. Ward, who for nearly fifty years served as President and Treasurer of the Establishment. The University in accepting this gift agrees to continue the Establishment as a supply house for a period of at least five years, the present staff remaining and receiving the assistance of the scientific staff of the University.

This announcement is very significant and will interest all readers of our Journal. The Establishment was founded sixty-five years ago by Henry A. Ward who held the chair of Professor of Geology at the University of Rochester. During all these years the Establishment has served as a distributing base for mineralogical, geological and biological supplies. It is safe to state that all collections of note whether private or in school, college or museum, both in this country and abroad, have been enriched from time to time by accessions secured from this great source of supply. It is but natural then that Ward's Establishment should now occupy an unique and almost indispensable position in our educational system.

After the death of Mr. Frank A. Ward the members of the family felt that some contingency might arise in the future which would close the Establishment and thus seriously hamper the scientific work which had been carried on for so many years. In the arrangement announced above a plan has been formulated whereby the future of the Establishment is assured for a definite period at least and the past service rendered to science and education continued and enlarged.

The University of Rochester is to be congratulated as this gift brings to the University material collected from all parts of the World. The geologists and mineralogists should also benefit by this transfer for with the recent large increase in endowment of the University of Rochester the financial resources now behind the Establishment should make it possible to undertake a larger number of collecting trips and to secure the best material obtainable for general distribution at moderate cost.

Dr. Reinhard Brauns, professor of mineralogy and petrography in the University of Bonn, has been elected a foreign member of the Norwegian Academy of Sciences at Oslo.

Dr. Eugene Allen Smith, emeritus professor of mineralogy and geology in the University of Alabama and state geologist since 1873, died on Sept. 7, aged eighty-six years.

According to *Science News* (Sept. 16, 1927) airship frames and light weight pistons may soon be made from beryllium or its alloys. The metal is about a third lighter than aluminum but is much harder, scratching glass easily. It is four times as elastic as aluminum, twenty-five per cent more elastic than steel, and shows a very high resistance to the corrosive action of salt water. Chemically it is related to aluminum and easily forms alloys with it. As it expands at about the same rate as cast iron its use for pistons seems feasible.

Mr. J. H. Ten-Eyck Burr of Cazenovia, New York, an enthusiastic member of The Mineralogical Society of America, died at Point Pleasant on the New Jersey coast on August 11th, 1927.

PROCEEDINGS OF SOCIETIES

PHILADELPHIA MINERALOGICAL SOCIETY

Academy of Natural Sciences, September 1, 1927

A stated meeting of the Philadelphia Mineralogical Society was held on the above date with the president, Mr. George Vaux, Jr., in the chair. Seventeen members and seven visitors were present. The resignation of S. Perlstein was read and accepted. Upon favorable recomendation of the council Messrs. John Hope and Phillip Ries were elected junior members. Nominations for the officers for 1927–1928 were made.

Mr. Biernbaum reported trips to the French Creek iron mines, to the Paterson, New Jersey trap quarries, and to museums and collections in Montreal, Canada. Specimens collected, and received in exchange were exhibited. The secretary *pro tem* exhibited specimens of analcite, apophyllite and natrolite collected at Cornwall, Pa., by H. F. Zerger. Mr. Trudell reported a trip to Moore Station, N. J., with Messrs. Knabe and Gordon. Mr. Cienkowski described a visit to the quarries at Stockton, N. J. Dr. Newcomet spoke of finding microscopic apophyllite at Moore Station, N. J.   SAMUEL G. GORDON, *secretary pro tem*

Important Notices

The eighth annual meeting of the Society will be held December 29-31, 1927, at Western Reserve and Case School of Applied Science, Cleveland, Ohio. It is planned to publish in the December issue of the Journal a *preliminary* list of titles of papers to be presented before the Society at its annual meeting. Titles of papers should be sent to the Secretary *at once* if they are to appear in the December number.

According to Professor Charles P. Berkey, Secretary of the Geological Society of America, a symposium on structural geology is being arranged for the Cleveland meeting. The symposium will supplement Mr. Arthur Keith's presidential address on "The large structural features of North America with special reference to mountain building."

The decennial index covering volumes 1-10 of The American Mineralogist is now ready for distribution. An edition has been ordered large enough to supply both present and future needs. Subscribers are asked to send in their orders to the Editor, if they have not already done so, and to instruct their libraries to do likewise. The modest price of 50¢ which has been placed upon the decennial index should bring it within the reach of every subscriber.

The first five volumes of The American Mineralogist have been reprinted and bound with paper covers. They may be purchased at $3.00 per volume plus postage. Also a limited number of individual monthly issues are on hand and these will be sold at 30¢ each as long as they last. This is an opportunity to complete your files and own a complete set of the Journal starting with volume 1, 1916. Has your library a complete set? All inquiries and orders should be sent to the Editor

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