A
SYSTEM
OF
MINERALOGY,

COMPRISING THE

MOST RECENT DISCOVERIES:

INCLUDING

**FULL DESCRIPTIONS OF SPECIES AND THEIR LOCALITIES, CHEMICAL ANALYSES
AND FORMULAS, TABLES FOR THE DETERMINATION OF MINERALS,
WITH A TREATISE ON MATHEMATICAL CRYSTALLOGRAPHY
AND THE DRAWING OF FIGURES OF CRYSTALS.**

ILLUSTRATED BY SIX HUNDRED WOOD CUTS.

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"*Hæc studia nobiscum peregrinantur, rusticantur.*"

FOURTH EDITION,
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VOLUME I.

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1854.

clear bead colored by iron; with salt of phosphorus a bead orange while hot, and purplish gray and opaque on cooling. Reaction of boracic acid.

Occurs in granular limestone two and a half miles S. W. of Edenville, N. Y., with spinel, chondrodite, serpentine, etc. Crystals usually small and slender; sometimes over two inches long, and three-eighths of an inch broad.

V. PHOSPHATES, ARSENATES, ANTIMONATES, NITRATES.

1. ANHYDROUS.

1. APATITE GROUP.—Crystallization Hexagonal. Oxygen ratio of bases and acids, (exclusive of fluorid or chlorid), 3 : 5.

Apatite,	$\dot{\mathrm{Ca}}^3\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{P}}}+\frac{1}{3}\mathrm{Ca(Cl,F)}$.	**Zwieselite,**	$(\dot{\mathrm{Fe}},\dot{\mathrm{Mn}})^3\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{P}}}+\frac{1}{3}\mathrm{FeF}$?
Osteolite,		**Pyromorphite,**	$\dot{\mathrm{Pb}}^3\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{P}}}+\frac{1}{3}\mathrm{PbCl}$.
Cryptolite,	$\dot{\mathrm{Ce}}^3\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{P}}}$.	**Mimetene,**	$\dot{\mathrm{Pb}}^3\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{As}}}+\frac{1}{3}\mathrm{PbCl}$.

2. XENOTIME GROUP.—Crystallization Dimetric. Oxygen ratio 3 : 5.

Xenotime,	$\dot{\mathrm{Y}}^3\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{P}}}$.

3 MONAZITE GROUP.—Monoclinic. Oxygen ratio 3 : 5 to 4 : 5.

Monazite,	$(\dot{\mathrm{Ce}},\dot{\mathrm{La}},\dot{\mathrm{Th}})^3\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{P}}}$.	**Kühnite,**	$\dot{\mathrm{R}}^3\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{As}}}$
Wagnerite,	$\dot{\mathrm{Mg}}^3\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{P}}}+\dot{\mathrm{Mg}}\,\mathrm{F}$.	**Lazulite.**	

4. TRIPLITE GROUP.—Trimetric. Oxygen ratio 3 : 5 to 4 : 5.

Triphyline,	$\dot{\mathrm{R}}^3\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{P}}}$?	**Triplite,**	$\dot{\mathrm{R}}^4\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{P}}}$.

5. FISCHERITE GROUP.—Trimetric. Oxygen ratio 6 : 5.

Fischerite,	$\overset{\cdot\cdot\cdot}{\bar{\mathrm{Al}}}{}^2\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{P}}}+8\dot{\mathrm{H}}$.	**Peganite,**	$\overset{\cdot\cdot\cdot}{\bar{\mathrm{Al}}}{}^2\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{\mathrm{P}}}+6\dot{\mathrm{H}}$.

Appendix. **Hopeite, Amblygonite, Herderite, Carminite.**

6. ROMEINE GROUP.

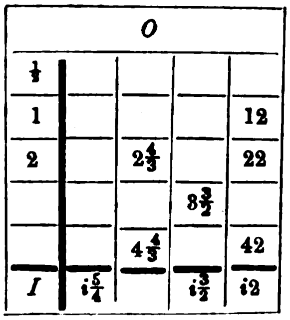
Romeine,	$\dot{\mathrm{R}}^3\bar{\mathrm{Sb}}\ddot{\mathrm{Sb}}$.

APATITE, *Werner*. Phosphate of Lime. Spargelstein. Phosphorit, *W.* Asparagus stone. Moroxite. Eupyrchroite, *Emmons*. Augustite. Pseudo-apatite, *Breit.*

Hexagonal: often hemihedral. $O:1=139° \; 47'$; $a=0{\cdot}7323$. Figures 190, 191, and the annexed.

$O : \frac{1}{2}=157° 5'$. $O : 3\frac{3}{2}=110° 3'$. $O : 42=108° 51$.
$O : 2=120° 36'$. $O : 12=143° 47'$. $I : 3\frac{3}{2}=149° 37'$.
$O : 4\frac{4}{3}=105°$. $O : 22=124° 30'$. $1 : 1$ (pyr.)$=142° 20'$.

Descloizeaux makes $1 : 1=142° 15'$, and $O : 1=139° 45'$. Cleavage: *O*, imperfect; *I*, more so. Also globular and reniform, with a fibrous or imperfectly columnar structure; also massive, structure granular.



Observed Planes.

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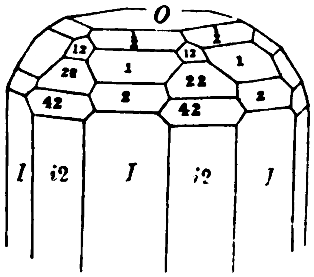

H.$=5$, sometimes 4·5. G.$=3·25$. Lustre vitreous, inclining to subresinous. Streak white. Color usually sea-green, bluish-green; often violet blue; sometimes white; occasionally yellow, gray, red, and brown; none bright. Transparent—opaque. A bluish opalescence sometimes in the direction of the vertical axis, especially in white varieties. Cross fracture conchoidal and uneven. Brittle.

Composition.—$\dot{\mathrm{C}}\mathrm{a}^{3}\dddot{\bar{\mathrm{P}}}+\frac{1}{3}\mathrm{Ca}(\mathrm{Cl}, \mathrm{F})$=Phosphoric acid 42·26, lime 50·0 fluorine 3·77, calcium 3·97; or phosphate of lime 92·26, and fluorid of calcium 7·74, with Ca Cl sometimes replacing part of the fluorid. According to G. Rose, (Pogg. ix):

	Snarum, Norway,	Cabo de Gata, Spain.	Arendal, Norway.	Greiner, Tyrol.	St. Gothard, Tyrol.
Phosphate of lime,	91·13	92·066	92·189	92·16	92·31
Chlorid of Calcium,	4·28	0·885	0·801	0·15	trace
Fluorid of Calcium,	4·59	7·049	7·01	7·69	7·69
	G.=3·174	G.=3·235	G.=3·194	G.=3·175	G.=3·197

Other analyses: 1, Rammelsberg; 2, Weber, (Monatsb. Preuss. Akad. 1851, 173); 3, C. A. Joy, (Inaug. Diss., 45); 4, T. H. Henry, (Phil. Mag):

	$\dddot{\bar{\mathrm{P}}}$	$\dot{\mathrm{C}}\mathrm{a}$	Ca	Cl	F	
1. Schwarzenstein,	42·58	49·66	4·06	0·07	3·63,	Rammelsberg.
2. Snarum,	41·54	53·46	—	2·66	!	$\ddot{\bar{\mathrm{F}}}\mathrm{e}$, $\bar{\mathrm{C}}\mathrm{e}$, $\dot{\mathrm{Y}}$ 1·79, Weber.
3. Faldige,	43·01	55·24	—	0·05	!	$\ddot{\bar{\mathrm{F}}}\mathrm{e}$ 0·09, Joy.
4. Huel Franco,	41·34	53·38	—	—(loss)	2·32,	$\dot{\mathrm{F}}\mathrm{e}$, $\dot{\mathrm{M}}\mathrm{n}$, 2·96, Henry.

Weber's analysis corresponds to 90·66 per cent. $\dot{\mathrm{C}}\mathrm{a}^{3}\dddot{\bar{\mathrm{P}}}$, 4·17 Ca Cl, 3·07 Ca F. Bischof has found magnesia in some apatites. The *Eupyrchroite* of Emmons (a compact concretionary subfibrous variety) afforded C. T. Jackson the constituents of apatite, with only the impurities $\dot{\mathrm{F}}\mathrm{e}$ 2·00, $\dot{\mathrm{C}}\mathrm{a}\ddot{\mathrm{C}}$ 2·77, $\dot{\mathrm{H}}$ 0·50. G.=3·053.

B.B. infusible alone except on the edges; gives the test of phosphoric acid, With biphosphate of soda or borax fuses without difficulty to a glass, which on cooling, has a crystalline structure; also fuses if mixed with carbonate of iron; dissolves slowly in nitric acid, without effervescence. Some varieties are phosphorescent.

Apatite usually occurs in crystalline rocks. It is often found in veins in gneiss or mica slate, and particularly those containing tin and iron ore; also in granular limestone. It is sometimes met with in serpentine, and occasionally, as in Spain, in ancient volcanic rocks.

Among its localities are Ehrenfriedersdorf in Saxony, Schwarzenstein and Pfitsch in the Tyrol; Amberg in Bavaria; Zinnwald and Schlackenwald in Bohemia; Caldbeck Fell in Cumberland, Devonshire; St. Gothard in Switzerland. The greenish-blue variety, called *moroxite*, occurs at Arendal in Norway, and Pargas, Finland. The *asparagus stone* or *spargelstein* variety, which is obtained at Zillerthal in the Tyrol, and Villa Rica, Spain, is translucent, and has a wine yellow-color; it is imbedded in talc. The *phosphorite* or massive radiated varieties are mostly obtained from Estremadura in Spain, and Schlackenwald in Bohemia.

Large crystals of apatite are found in St. Lawrence County, New York, in white limestone, along with scapolite, sphene, &c. One crystal from Robinson's farm, in Hammond, was nearly a foot in length, and weighed eighteen pounds. The prisms are frequently well terminated. Also in crystals about a mile southeast of Gouverneur, and two miles north; and also in Rossie, with sphene and pyroxene, two miles north of the village of Oxbow. Also on the bank of Vrooman lake, Jefferson Co., in white limestone, fine green prisms from half to five inches long; Sanford mine, East Moriah, Essex Co., in magnetic iron ore, which is often thickly studded with six-sided prisms; also at Long Pond, Essex Co.; near Edenville, Orange Co. in prisms from half an inch to twelve inches long, of a bright asparagus green color, imbedded in white limestone; and in the same region, blue, grayish-green, and grayish white crystals; two miles south of Amity, emerald and bluish-green crystals; at Long Pond, Essex Co., with garnet and idocrase; at Greenfield, Saratoga Co., St. Anthony's Nose, and Corlaer's Hook, less interesting; fibrous mammillated (*Eupyrchroite*) at Crown Point, Essex Co., about a mile south of Hammondsville; at Hurdstown, Essex Co., where a shaft has been sunk and the apatite mined; masses brought out weigh occasionally two hundred pounds, and some cleavage prisms have the planes three inches wide. In *New Hampshire*, crystals, often large, are abundant, four miles south of the north village meeting-house Westmoreland, in a vein of feldspar and quartz, in mica slate, along with molybdenite; some fine crystals at Piermont, N. H., in white limestone on the land of Mr. Thomas Cross. In *Maine*, on Long Island, Blue-hill Bay, in veins ten inches wide, intersecting granite. In *Massachusetts*, crystals occasionally six inches long, are obtained at Norwich, (northeast part), in gray quartz; at Bolton abundant, the forms seldom interesting; also sparingly at Chesterfield, Chester, Sturbridge, Hinsdale, and Williamsburgh. In *Pennsylvania*, at Leiperville, Delaware Co., in Bucks Co., three miles west of Attleboro. Apatite has also been found near Baltimore, *Maryland;* at Dixon's quarry, Wilmington, *Delaware*, of a rich blue color; on the Morris Canal, near Suckasuny, N. J., of a brown color, in massive magnetic pyrites; Phosphate of lime in nodules occurs in Silurian rocks in Canada and elsewhere, which are supposed to be coprolites; at Burgess, C. W., in large green crystals; at Grand Calumet in calcite, in delicate blue crystals; in trap of St. Norbert, C. E., in transparent amethyst, rose, or colorless crystals, some one inch long, and one-sixth in diameter.

Apatite was named by Werner from *απαταω, to deceive*, in allusion to the mistake of the older mineralogists with regard to the nature of its many varieties.

The *Pseudoapatite* is an impure apatite; analysis by Rammelsberg, J. pr. Chem. lv, 486.

The *talc-apatite* of Hermann, (J. f. pr. Ch. xxxi, 101), is from chlorite slate in the Schischimskian mountains near Slatoust. It contains Lime 37·50, magnesia 7·74, phosphoric acid 39·02, sulphuric acid 2·10, chlorine 0·91, fluorine and loss 2·23, oxyd of iron 1·00, insoluble 9·50=100, whence the formula $3\dot{Ca}^3\ddot{P}+\dot{Mg}^3\ddot{P}$. But from the variety of its constituents and the large per-centage of insoluble ingredients, Berzelius suggests that the magnesia may possibly come from the gangue. G.= 2·70—2·75. In six-sided crystals, grouped or single.

ALTERED FORMS.—The *Osteolite* of Bromeis is supposed to be apatite which has become earthy in appearance, and lost its fluorine and chlorine, (Ann. Ch. Pharm., lxxix, 1). It has a compact texture like lithographic stone, or else is earthy, and adheres to the tongue. G.=2·89. Composition, $\dot{Ca}^3\ddot{P}$. Analyses: 1, Bromeis, compact part, (loc cit.); 2, Rütz, earthy, (ib.); 3, Ewald, intermediate part, (ib.); 4, G. Besanez, (Ann. Ch. Pharm., lxxxix, 221):

	$\ddot{\bar{\text{P}}}$	$\dot{\text{Ca}}$	$\dddot{\text{Si}}$	$\dddot{\bar{\text{Fe}}}$	$\dddot{\bar{\text{Al}}}$	$\dot{\text{Mg}}$	$\dot{\text{K}}$	$\dot{\text{Na}}$	$\ddot{\text{C}}$	$\dot{\text{H}}$
1. Hanau,	36·88	49·41	4·50	1·85	0·93	0·47	0·76	0·62	1·81	2·28= 99.51
2. "	37·41	40·24	2·75	2·78	1·25	0·79	0·81	0·46	2·34	3·45=101·28
3. "	37·16	48·20	2·03	2·31	*trace*	1·85	0·73	0·43	2·55	3·63= 98·80
4. Amberg,	42·00	48·16	4·97	1·56	——	0·75	0·04	0·02	2·21	1·31=101·02

From near Hanau between Ostheim and Eichen, and also from Amberg in the Erzgebirge. Occurs in altered dolonite.

CRYPTOLITE, *Wöhler*, Götting. gel. Anzeig. 1846, 19, and Poggendorff's Annalen, lxvii, 424.

In acicular hexagonal prisms. G. about 4·6. Wine-yellow, transparent.

Composition.—$\dot{\text{Ce}}^3\ddot{\bar{\text{P}}}$, in which the cerium is part didymium=Protoxyd of cerium 69·4, phosphoric acid 30·6. Analysis by Wohler, (loc. cit.):

Oxyd of cerium 73·70, protoxyd of iron 1·51, phosphoric acid 27·37=102·58.

The excess is owing as supposed to a change of the protoxyd of cerium to peroxyd. Soluble in concentrated sulphuric acid. Not altered by a moderate calcination.

Occurs in the green and red apatite of Arendal, and distinguished on putting the apatite in dilute nitric acid; constitutes 2 or 3 per cent. of the mass; it was found especially in the red apatite, or in reddish points of the green, and associated with particles of magnetic iron, hornblende, and another cerium ore of a hyacinth-red color, supposed to be monazite. This mineral was looked for in the yellowish apatites of Snarum without success. Occurs also with apatite in the Tyrol. (?) Named from κρυπτος, *concealed*.

It has been suggested that Cryptolite is a cerium apatite.

PHOSPHOCERITE, *H. Watts*, Quart. J. Chem. Soc. July 1, 1849, ii, 131.—The phosphocerite, as recognized by Mr. Watts, has the composition essentially of the cryptolite, but is said to differ in crystalline form. According to Watts and Chapman, (loc. cit. p. 154), the form is probably dimetric; yet as the crystals of both this species and the cryptolite are microscopic, the two, as observed by Chapman, may yet be brought together. They occur as a grayish yellow powder along with the cobalt ore of Tunaberg, and are associated with dark purple crystals of another kind and dodecahedral form, (Fe^3S^4), which are strongly magnetic. The crystalline forms most common in the powder are an octahedron and a square or rectangular prism, terminating in a four-sided pyramid parallel with the lateral planes, resembling fig. 382, under zircon. G.=4·78. H.=5·0—5·5. Colorless or pale sulphur-yellow. Lustre vitreo-resinous or adamantine.

Composition.—$(\dot{\text{Ce}}, \dot{\text{La}}, \dot{\text{D}})^3\ddot{\bar{\text{P}}}$. Analysis by Watts, (loc. cit.): Protoxyd of cerium, lanthanum, didymium 67·38, phosphoric acid 29·66, oxyd of iron 2·95=100.

The oxyd of iron and a little cobalt detected are probably impurities. B.B. according to Chapman, it vitrifies partially on the edges, tinging the flame at the same time slightly green. Affords the reaction of phosphoric acid and also of cerium, producing however with borax and salt of phosphorus a glass which is pale violet-blue when cold, either due to the presence of didymium, or a minute portion of cobalt ore.

[The analysis of cryptolite gives more nearly the oxygen proportion of 2 : 3, corresponding to 10 of $\dot{\text{Ce}}$ and 3 of $\ddot{\bar{\text{P}}}$.]

ZWIESELITE, *Breit.* Phosphate of Iron and Manganese. Eisenapatit, *Fuchs.*

Hexagonal? Supposed to be isomorphous with Apatite. Occurs in crystalline masses. Cleavage: distinct in three directions, but imperfect.

H.=5. G.=3·97. Lustre greasy, color clove-brown. Streak grayish-white. Fracture uneven or imperfect conchoidal.