$$\tan \varphi_1 = \frac{\frac{1}{2}qp_0\sqrt{3}}{pp_0 + \frac{1}{2}qp_0} = \frac{q\sqrt{3}}{2p+q} = \frac{\sqrt{3}}{2n+1} \quad \text{where } n = \frac{p}{q},$$

$$\tan^2 \rho = (pp_0 + \tfrac{1}{2}qp_0)^2 + (\tfrac{1}{2}qp_0\sqrt{3})^2 = p_0^2(p^2 + pq + q^2),$$

whence

$$\tan \varphi_1 = \frac{\sqrt{3}}{2n+1} \text{ where } n = \frac{p}{q}; \quad \tan \rho = p_0\sqrt{(p^2 + pq + q^2)}.$$

Since φ_1 is independent of p_0 the φ angles are alike for all hexagonal forms with like ratio of p to q. The values may be found for most cases from the table of page 25, *Winkeltabellen*. In the same way log tan ρ may be found for most forms from the tables of pages 22 and 23.

For example, to find φ and ρ for the scalenohedron $(21\bar{3}4)$ of calcite:

$$21\bar{3}4 = \tfrac{2}{4}\,\tfrac{1}{4}\ (G_1) = \tfrac{4}{4}\,\tfrac{1}{4}\ (G_2).$$

Winkeltabellen, p. 25: $p : q = 1 : 4$, $\varphi = 10° 53'$.
Winkeltabellen, p. 22: $\tan \rho = p_0\frac{1}{4}\sqrt{16 + 4 + 1} = p_0\frac{1}{4}\sqrt{21}$
$\lg\frac{1}{4}\sqrt{21} = 0.05905$
calcite $p_0 = .5695$ $\lg p_0 = 9.75552$
$\lg \tan \rho = 9.81457$ $\rho = 33° 07'$

ILLUSTRATION OF THE HEXAGONAL SYSTEM. HEMATITE FROM NEW MEXICO.[1]

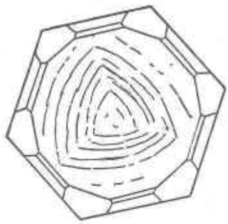
WILLIAM F. FOSHAG

U. S. National Museum

A specimen of hematite in the U. S. National Museum (Mus. No. 93761) from the western part of the San Augustine Plain, Socorro Co., New Mexico has been found to show some unusual features and seems worthy of a short description. The specimen consisted of a somewhat cellular quartz in which are embedded single hematite crystals of excellent development and lustrous faces. The hematite includes quartz and the two minerals were no doubt formed at the same time.

The crystals are thick tabular in habit and, due to the equal development of the + 1 and −1 rhombohedrons, have a hexagonal aspect. The trigonal character of the crystals is brought out, however, by concentric triangular markings on the base of

[1] Published with the permission of the Secretary of the Smithsonian Institution.



some of the crystals. These markings are not due to etching, but are connected with the growth of the crystals. They are not depressed, but slightly stepped and do not affect the brilliancy of the base. The sides of the triangles are parallel to +1 faces while the angles point toward −1. These markings are sketched on the orthographic projection shown (Fig. 31.). The forms present are 0(0001), ∞0 ($10\bar{1}0$), 10($10\bar{1}1$), 20($20\bar{2}1$), ±1($11\bar{2}1$). The signals were sharp and the deviations in the measurements from those given in Goldschmidt's tables and those of Melczer[1] are so slight, amounting to almost perfect agreement, that it is evident that this hematite is essentially pure and free from any great amount of FeO, TiO_2 or other constituents in solid solution.

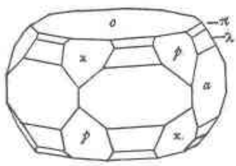


FIG. 31.

The zonal relations are brought out to better advantage in the hexagonal system, as well as in the other systems, with the Goldschmidt than the other symbols. Thus in the hematite measured, ∞0, 0, 10, 20, are in a zone, as shown by the common value for q (G_2), while the corresponding Bravais symbols $10\bar{1}0$, 0001, $10\bar{1}1$, $20\bar{2}1$, do not show this relation so well.

TABLE OF ANGLES OF HEMATITE

Form	G_1 Gdt.	G_2	Bravais		Measured φ	Measured ρ	Calculated φ	Calculated ρ
0	0	0	0001	0001	—	0° 00′	—	0° 00′
a	∞	∞0	$11\bar{2}1$	$10\bar{1}0$	0° 00′	90 00	0° 00′	90 00
π	$\frac{1}{3}$ $\frac{1}{3}$	10	$11\bar{2}3$	$10\bar{1}1$	0 00	42 10	0 00	42 14
λ	$\frac{2}{3}$ $\frac{2}{3}$	20	$22\bar{4}3$	$20\bar{2}1$	0 00	61 8	0 00	61 10
px	1 0	±1	$10\bar{1}1$	$11\bar{2}1$	30 00	57 31	30 00	57 33

LISTS OF THE HEXAGONAL AND TRIGONAL MINERALS INCLUDED IN GOLDSCHMIDT'S WINKELTABELLEN. EDGAR T. WHERRY. Washington, D. C.—This list follows the plan used with tetragonal minerals, altho it has seemed best to separate the hexagonal from the trigonal classes. In the event of the axial ratio obtained on an unknown crystal not fitting in the table, the factor by which it may be multiplied or divided is $\sqrt{3}$ or $\frac{1}{2}\sqrt{3}$. For example, a crystal of a mineral found to contain calcium and phosphorus may give on measurement $c = 0.73\pm$. No corresponding mineral

[1] *Z. Kryst. Min.*, **37**, 580, 1903.

can be found in the lists, but on multiplying by 1.732 the value 1.27 will be obtained, which will be found to correspond to apatite.

HEXAGONAL MINERALS

	c	Page
Breithauptite	0.7471	78
Cancrinite	0.7637	87
Ettringite	0.8170	133
Beryl	0.8643	65
Stuetzite (Tellurblende)	1.0851	339
Milarite	1.1466	241
Eremeyevite (Jeremejewit)	1.1840	189
Tysonite	1.1893	353
Hedyphanite	1.2234	173
Vanadinite	1.2335	357
Svabite	1.2372	333
Mimetite (Mimetesit)	1.2600	242
Apatite	1.2708	50
Pyromorphite	1.2750	280
Penfieldite	1.3450	260
Greenockite	1.4061	166
Wurtzite	1.4163	369
Niccolite (Rothnickelkies)	1.4193	306
Iodyrite (Jodsilber)	1.4196	190
Pyrrhotite (Magnetkies)	1.4291	227
Microsommite (Mikrosommit)	1.4490	241
Nephelite (Nephelin)	1.4530	247
Molybdenite (Molybdänglanz)	1.5400	242
Trimerite	1.6321	349
Loangbanite (Longbanit)	1.6437	211
Covellite (Kupferindig)	1.7200	206
Hanksite	1.7563	169
Connellite	2.0031	102
Cappelenite	2.2349	88
Catapleiite (Katapleit)	2.3605	196
Fluocerite	2.6804	148
Hessenbergite	2.7070	176
Zincite (Rothzinkerz)	2.7846	307
Tridymite	2.8624	349
Spangolite	3.0162	323
Chalcomorphite	3.3067	92

Representatives of Classes with Diminished Symmetry

Class Hemimorphic

Greenockite	1.41−
Wurtzite	1.41+
Iodyrite	1.42
Zincite	2.78+

Class Pyramidal

Vanadinite	1.23+
Mimetite	1.26
Apatite	1.27
Pyromorphite	1.28−

Peri-hexagonal, (that is, really possessing lower symmetry, but approaching so close to the hexagonal system in angles and habit as to be profitably included here).

Eremeyevite	1.18
Catapleiite	2.36
Hessenbergite	2.71−

Syn-hexagonal (thru twinning)

Trimerite	1.63
Tridymite	2.86

TRIGONAL MINERALS

	c	Page
(Beyrichite) [variety of millerite]	0.3277	68
Millerite	0.3295	242
Tourmaline (Turmalin)	0.4477	352
Friedelite	0.5470	152
Ferronatrite	0.5528	145
Phenacite (Phenakit)	0.6611	264
Willemite, troostite	0.6695	363
Pyrargyrite (Rothgiltigerz)	0.7880	302
Proustite (Rothgiltigerz)	0.8034	299
Smithsonite (Zinkspath)	0.8062	374
Magnesite	0.8095	225
Rhodochrosite (Manganspath)	0.8183	231
Siderite (Eisenspath)	0.8184	124
Nordenskioeldite	0.8221	250
Soda-niter (Natronsalpeter)	0.8266	247
Dolomite	0.8322	119
Calcite	0.8543	82
Martinite	0.8559	232
Hematolite (Diadelphit)	0.8885	114
Dioptasite	1.0622	118
Chabazite (Chabasit)	1.0860	91
Steenstrupite	1.1100	327
Hamlinite	1.1353	169
Utahite	1.1389	356
Beudantite	1.1842	68
Caryocerite (Karyocerit)	1.1845	196
Svanbergite	1.2365	334
Jarosite	1.2500	187
Alunite	1.2523	35
Melanocerite	1.2554	236

	c	Page
Aphthitalite (Glaserit)	1.2839	158
Bismuth (Wismut)	1.3035	364
Antimony	1.3236	46
Tellurium	1.3300	338
Hematite, specularite (Eisenglanz)	1.3623	123
Corundum (Korund)	1.3636	200
Ilmenite (Titaneisen)	1.3846	343
Graphite	1.3860	165
Pyrochroite	1.4002	280
Arsenic	1.4013	54
Iridium, osmium (Osmiridium)	1.4105	256
Brucite	1.5208	81
Parisite	1.6822	257
Pyrosmalite	1.8380	280
Tachydrite (Tachyhydrit)	1.9000	338
Quartz (Quarz)	1.9051	288
Cinnabarite (Zinnober)	1.9837	377
Eudialyte	2.1116	134
Ice (Eis)	2.4294	122
Chalcophyllite (Kupferglimmer)	2.5540	206
Coquimbite	2.7098	103
Tetradymite	3.1730	340
Chlorite group (Chloritgruppe)	3.3890	95
Chalcophanite	3.5267	92

Representatives of Classes with other than Rhombohedral Symmetry

Class Trigonal-hemimorphic

Tourmaline	0.45 −
Pyrargyrite	0.79
Proustite	0.80
Ice	2.43

Class Rhombohedral-tetartohedral

Phenacite	0.66
Willemite, troostite	0.67
Dolomite	0.83
Dioptasite	1.06
Ilmenite	1.38 +

Class Trapezohedral

Quartz	1.91 −
Cinnabarite	1.98

Peri-trigonal

Chlorite (group)	3.39

BOOK REVIEW

MICROSCOPIC EXAMINATION OF THE ORE MINERALS. W. Myron Davy and C. Mason Farnham. 154 pages. McGraw-Hill Book Co., New York. $2.50.

This book represents in a sense a new edition of Murdoch's "*Microscopical determination of the opaque minerals*" which was reviewed in this magazine in February, 1917. It represents, however, a great advance over that work, in that the methods originally proposed by Murdoch have been tried out by the two new authors on a large number of specimens, and modifications have been made in accordance with the experience obtained. The principal changes are these: The fine distinctions in color values have been found to be impracticable, and have been discarded as a basis of primary classification. Microchemical methods have been found to vary so much from one specimen to another of the same mineral, or even on different crystal faces on the same specimen, that little dependence is now placed upon their details. The number of reagents has been brought within practicable limits. And blowpipe reactions have been added, because they are of considerable confirmative value. It seems to the reviewer that all of these changes are distinct improvements.

There are also several valuable new features. The chapter on photomicrography of polished sections is unusually full and helpful. There are, in addition to the regular determinative tables, in which the minerals are one by one eliminated until the one under study is identified, a few tables of special properties. In one the colors of about 20 minerals showing others than shades