

diameter and at right angles to this another diameter, meeting the circumference at two points B, B', 90° from *a* and *a'*. A circular arc drawn through BB' and *c* (001) will cut the diameter *aa'* at a point K, whose distance from the center P can be calculated in a right-angled spherical triangle in which the hypotenuse (*ac*) and the adjacent angle at *a* are known. Hence the position of K is fixed. Again, draw the diameter *bb'*, and at right angles to it another diameter, *AA'*. If L is the point on *bb'* where it is cut by the circular arc through *ccb'*, the distance PL can be similarly calculated. With K and L both fixed, it is easy to draw *aca'* and *ccb'*, and thus determine the position of *c*. After the zone circles *aca'* and *ccb'* have been drawn, the position of any dome (*hOl* or *Okh*) can be similarly found by a single calculation, and as the prisms have been fixed it is easy to locate any required pyramid.

On the general method of projection applicable to triclinic crystals, see Groth, Phys. Kryst., p. 579, *et seq.*, and Liebisch, Geometr. Kryst., p. 124, *et seq.*

APPENDIX B.

TABLES TO BE USED IN THE DETERMINATION OF MINERALS.

This Appendix contains a series of tables, more or less complete, of minerals arranged according to certain prominent crystallographic or physical characters. These, it is believed, will be of service not only to the student, but also to the skilled mineralogist. Table I., of Minerals arranged according to System of Crystallization, is intended to embrace all well-recognized species, though those of relatively greater importance, especially as regards occurrence, are indicated by being printed in heavier type.

The other tables make no claim to completeness, being limited often to common and important species.

For an exhaustive system of Determinative Tables based particularly upon blowpipe and chemical characters, the student is referred to the work of Professors Brush and Penfield, mentioned on p. 256.

I. MINERALS ARRANGED ACCORDING TO THEIR SYSTEM OF CRYSTALLIZATION.

The following lists are intended to include all well-recognized species, whose crystallization is known, arranged according to the system to which they belong, and further classified by their luster and specific gravity; the hardness is also given in each case.

I. CRYSTALLIZATION ISOMETRIC.*

A. LUSTER UNMETALLIC.

	Specific Gravity.	Hardness.		Specific Gravity.	Hardness.
Sal Ammoniac (p. 319)...	1.53	1.5-2	Arsenolite (p. 330).....	3.7	1.5
Kalinite (p. 535).....	1.75	2-2.5	Schorlomite (p. 419)....	3.81-3.88	7-7.5
Faujasite (p. 460).....	1.92	5	Hercynite (p. 339).....	3.9-3.95	7.5-8
Sylvite (p. 319).....	1.98	2	Sphalerite (p. 291).....	3.9-4.1	3.5-4
Halite (p. 318).....	2.14	2.5	Nantokite (p. 317)....	3.93	2-2.5
Hydrophilite (p. 321)...	2.2		Marshite (p. 317).....	5.6?	
Sodalite (p. 412).....	2.14-2.30	5.5-6	Alabandite (p. 292)....	3.95-4.04	3.5-4
Analcite (p. 460).....	2.2-2.3	5.5-5	Perovskite (p. 487)....	4.03	5.5
Noselite (p. 413).....	2.25-2.4	5.5	Berzelite (p. 495).....	4.08	5
Northupite (p. 364)....	2.38	3.5-4	Gahnite (p. 339).....	4.0-4.6	7.5-8
Haüynite (p. 412).....	2.4-2.5	5.5-6	Pyrochlore (p. 489)....	4.2-4.36	5.5-5
Leucite (p. 381).....	2.45-2.50	5.5-6	Koppite (p. 489).....	4.45-4.56	
Lazurite (p. 413).....	2.38-2.45	5.5-5	Zirkelite (p. 346).....	4.71	5.5
Sulphohalite (p. 521)....	2.49	3.5	Hatchettolite (p. 489)...	4.8-4.9	5
Ralstonite (p. 323).....	2.58	4.5	Lewisite (p. 516).....	4.95	5.5
Voltaite (p. 537).....	2.79	3-4	Atopite (p. 516).....	5.03	5.5-6
Langbeinite (p. 523)....	2.83		Percylite, Boleite (p. 322)	5.08	2.5
Zunyite (p. 414).....	2.87	7	Mauzellite (p. 516)....	5.11	6-6.5
Pollucite (p. 382).....	2.90	6.5	Manganosite (p. 332)....	5.18	5-6
Boracite (p. 518).....	2.9-3	7	Senarmonite (p. 330)...	5.2-5.3	2-2.5
Pharmacosiderite (p. 513)	2.9-3	2.5	Embolite (p. 319).....	5.3-5.4	1-1.5
Nitrobarite (p. 517)....	3.2		Cerargyrite (p. 319)...	5.55	1-1.5
Fluorite (p. 320).....	3.2	4	Miersite (p. 319).....	5.6	
Helvite (p. 414).....	3.16-3.36	6-6.5	Microlite (p. 489).....	5.5-6.1	5.5
Garnet (p. 415).....	3.3-4.3	6.5-7.5	Iodobromite (p. 319)....	5.71	1-1.5
Rhodizite (p. 518).....	3.4	8	Bromyrite (p. 319)....	5.8-6	2-3
Danalite (p. 414).....	3.43	5.5-6	Cuprite (p. 331).....	5.85-6.15	3.5-4
Hauerite (p. 301).....	3.46	4	Eulytite (p. 414).....	6.11	4.5
Diamond (p. 271).....	3.52	10	Bunsenite (p. 332)....	6.4	5.5
Spinel (p. 338).....	3.5-4.1	8	Monimolite (p. 496)....	6.58; 7.29	5-6
Periclase (p. 331).....	3.67	6			

* Some pseudo-isometric species are here included. Species with submetallic luster are placed under B, but some species are included in both lists.

B. LUSTER METALLIC (AND SUBMETALLIC).

	Specific Gravity.	Hardness.		Specific Gravity.	Hardness.
Hauerite (p. 301).....	3.46	4	Canfieldite (p. 316).....	6.28	2.5-3
Sphalerite (p. 291).....	3.9-4.1	3.5-4	Ullmannite (p. 302).....	6.2-6.7	5.5-5
Alabandite (p. 292).....	3.95-4.04	3.5-4	Smaltite, Chloanthite (p. 301).....	6.4-6.6	5.5-6
Cubanite (p. 297).....	4.0-4.1	4	Skutterudite (p. 307).....	6.7-6.86	6
Dysanallyte (p. 488).....	4.13	5-6	Willyamite (p. 302).....	6.87	5.5
Stannite (p. 315).....	4.3-4.52	4	Polyargyrite (p. 315).....	6.97	2.5
Chromite (p. 341).....	4.3-4.57	5.5	Laurite (p. 302).....	7.0	7.5
Binnite (p. 308).....	4.5	2.5-3	Argentite (p. 288).....	7.2-7.36	2-2.5
Tennantite (p. 313).....	4.4-4.49	3-4	Iron (p. 281).....	7.3-7.8	4-5
Tetrahedrite (p. 312).....	4.4-5.1	3-4	Galena (p. 287).....	7.4-7.6	2.5-3
Magnesioferrite (p. 341).....	4.57-4.65	6-6.5	Eucairite (p. 289).....	7.5	2.5
Pentlandite (p. 293).....	4.6	3.5-4	Metacinnabarite (p. 292).....	7.8	3
Polydymite (p. 296).....	4.5-4.8	4.5	Clausthalite (p. 288).....	7.6-8.8	2.5-3
Jacobsite (p. 341).....	4.75	6	Naumannite (p. 288).....	8.0	2.5
Sychnodymite (p. 296).....	4.76		Altaite (p. 288).....	8.16	3
Linnaeite (p. 297).....	4.8-5	5.5	Tiemannite (p. 292).....	8.2-8.5	2.5
Carrallite (p. 297).....	4.85	5.5	Hessite (p. 289).....	8.3-8.9	2.5-3
Bixbyite (p. 343).....	4.95	6-6.5	Copper (p. 278).....	8.8-8.9	2.5-3
Pyrite (p. 300).....	4.95-5.10	6-6.5	Uraninite (p. 521).....	9-9.7	5.5
Franklinite (p. 341).....	5.07-5.22	6-6.5	Silver (p. 278).....	10.1-11.1	2.5-3
Magnetite (p. 339).....	5.18	6-6.5	Sperryllite (p. 302).....	10.6	6-7
Bornite (p. 297).....	4.9-5.4	3	Lead (p. 279).....	11.4	1.5
Gersdorffite (p. 302).....	5.6-6.2	5.5	Palladium (p. 281).....	11.3-11.8	4.5-5
Cuprite (p. 331).....	5.85-6.15	3.5-4	Amalgam (p. 279).....	13.7-14.1	3-3.5
Brongnardite (p. 309).....	5.95	3.5	Platinum (p. 280).....	14-19	4-4.5
Corynite (p. 302).....	5.95-6.03	4.5-5	Gold (p. 275).....	15.6-19.3	2.5-3
Argyrodite (p. 316).....	6.1-6.2	2.5	Iridium (p. 280).....	22.6-22.8	6-7
Cobaltite (p. 301).....	6-6.3	5.5			

II. CRYSTALLIZATION TETRAGONAL.

A. LUSTER UNMETALLIC.

Mellite (p. 542).....	1.64	2-2.5	Torbernite (p. 515).....	3.4-3.6	2-2.5
Darapskite (p. 517).....			Trippkeite (p. 516).....		
Apophyllite (p. 452).....	2.3-2.4	4.5-5	Octahedrite (p. 346).....	3.8-3.95	5.5-6
Löweite (p. 535).....	2.38	2.5-3	Rutile (p. 345).....	4.18-4.25	6-6.5
Ecdemite (p. 516).....	6.9-7.1	2.5-3	Xenotime (p. 494).....	4.45-4.56	4-5
Sarcosite (p. 426).....	2.54-2.93	6	Powellite (p. 541).....	4.53	3.5
Marialite (p. 426).....	2.57	5.5-6	Thorite (p. 430).....	4.4-5.4	4.5-5
Mizzonite (Dipyre), (426)	2.62	5.5-6	Fergusonite (p. 490).....	4.4-5.8	5.5-6
Wernerite (Scapolite), (p. 426).....	2.66-2.73	5.5-6	Zircon (p. 428).....	4.68-4.7	7.5
Meionite (p. 425).....	2.70-2.74	5.5-6	Romeite (p. 516).....	4.71	5.5-6
Edingtonite (p. 460).....	2.70	4-4.5	Sipylite (p. 490).....	4.89	6
Chiolite (p. 321).....	2.84-2.99	3.5-4	Ganomallite (p. 408).....	5.74	3
Melilite (p. 426).....	2.9-3.1	5	Scheelite (p. 540).....	5.9-6.1	4.5-5
Gehlenite (p. 427).....	2.9-3.1	5.5-6	Phosgenite (p. 364).....	6-6.09	2.75-3
Meliphanite (p. 407).....	3.01	5.5-5	Calomel (p. 317).....	6.48	1-2
Sellaite (p. 321).....	2.97-3.15	5	Wulfenite (p. 541).....	6.7-7.0	2.75-3
Zeunerite (p. 515).....	3.2	2-2.5	Cassiterite (p. 344).....	6.8-7.1	6-7
Pinnite (p. 520).....	3.27-3.37	3-4	Matlockite (p. 322).....	7.2	2.5-3
Vesuvianite (p. 428).....	3.35-3.45	6.5	Tapiolite (p. 492).....	7.36-7.5	6
			Stolzite.....	7.87-8.13	2.75-3

B. LUSTER METALLIC (AND SUBMETALLIC).

	Specific Gravity.	Hardness.		Specific Gravity.	Hardness.
Chalcocopyrite (p. 297).....	4.1-4.3	3.5-4	Polianite (p. 345).....	4.84-5.0	6-6.5
Rutile (p. 345).....	4.18-4.25; 5.2	6-6.5	Reinite (p. 542).....	6-6.4	4
Fergusonite (p. 490).....	4.4-5.8	5.5-6	Hauchecornite (p. 295).....	6.4	5
Hausmannite (p. 342).....	4.7-4.86	5.5-5	Tapiolite (p. 492).....	7.36-7.5	6
Braunite (p. 343).....	4.75-4.82	6-6.5	Plattnerite (p. 346).....	8.5	5.5-5

III. CRYSTALLIZATION HEXAGONAL.*

Rhombohedral species are distinguished by a letter R.

A. LUSTER UNMETALLIC.

Ice (p. 331).....	0.9	1.5	Jarosite (p. 537) R.....	3.20	2.5-3.5
Cyprusite? (p. 537).....	1.75	2	Raimondite (p. 536).....	3.20	3
Ettringite (p. 538).....	1.75	2-2.5	Hamlinite (p. 503) R.....	3.23	4.5
Thaumasite (p. 483).....	1.88	3.5	Pyrochroite (p. 351) R.....	3.26	2.5
Gmelinite (p. 459) R.....	2.04-2.17	4.5	Jeremejevite (p. 518).....	3.28	6.5
Coquimbite (p. 535) R.....	2.09	2-2.5	Diopside (p. 424) R.....	3.28-3.35	5
Utahite (p. 536) R.....			Svanbergite (p. 516) R.....	3.30	5
Chabazite (p. 458) R.....	2.08-2.16	4-5	Cronstedtite (p. 475) R.....	3.35	3.5
Levynite (p. 459) R.....	2.09-2.16	4-4.5	Hematolite (p. 507) R.....	3.35	3.5
Hydronephelite? (p. 463).....	2.26	4.5-6	Connellite (p. 530).....	3.36	3
Soda niter (p. 517) R.....	2.26	1.5-2	Mesitite (p. 359) R.....	3.33-3.42	3.5-4
Tridymite (p. 328).....	2.28-2.33	7	Rhodochrosite (359) R.....	3.45-3.60	3.5-4.5
Brucite (p. 351) R.....	2.38-2.4	2.5	Svabite (p. 501).....	3.52	5
Cancriinite (p. 411).....	2.42-2.5	5-6	Siderite (p. 359) R.....	3.83-3.88	3.5-4
Microsommitte (p. 411).....	2.44	6	Rhabdophanite (p. 509) R.....	3.94-4.01	3.5
Kaliophilite (p. 410).....	2.49	6	Wurtzite (p. 295).....	3.98	3.5-4
Carphosiderite? (p. 536) R.....	2.50	4-4.5	Corundum (p. 333) R.....	3.95-4.10	9
Metavoltine (p. 537).....	2.53	2.5	Willemite (p. 422) R.....	3.94-4.19	5.5
Chalcophyllite (p. 511) R.....	2.44-2.66	2	Sphaerocobaltite (361) R.....	4.02-4.13	4
Nephelite (p. 409).....	2.55-2.65	5.5-6	Melanocerite (p. 407) R.....	4.13	5-6
Hanksite (p. 530).....	2.56	3-3.5	Tritomite (p. 407) R.....	4.20	5.5
Ferronatrite (p. 536) R.....	2.56	2	Nordenskiöldine (518) R.....	4.20	5.5-6
Milarite (p. 369).....	2.57	5.5-6	Caryocerite (p. 407) R.....	4.29	5-6
Aphthitalite (p. 523) R.....	2.64	3-3.5	Parisite (p. 364).....	4.36	4.5
Quartz (p. 324) R.....	2.65	7	Smithsonite (p. 360) R.....	4.30-4.45	5
Beryl (p. 405).....	2.64-2.7; 2.80	7.5-8	Beudantite (p. 516) R.....	4-4.3	3.5-4.5
Eucryptite (p. 410).....	2.67		Plumbogummite? (p. 514).....	4-4.9	4.5
Alunite (p. 537) R.....	2.67	3.5-4	Cappelenite (p. 407).....	4.41	6-6.5
Penninite (pseud.) (p. 474) R.....	2.6-2.85	2.25	Greenockite (p. 294).....	4.9-5.0	3-3.5
Calcite (p. 354) R.....	2.71	3	Hematite (p. 334) R.....	4.9-5.3	5.5-6.5
Alumian (p. 530).....	2.74	2-3	Xanthoconite (p. 315) R.....	5-5.2	2
Catapleite (p. 407).....	2.8	6	Zincite (p. 332).....	5.4-5.7	4-4.5
Dolomite (p. 357) R.....	2.8-2.9	3.5-4	Proustite (p. 311) R.....	5.6	2-2.5
Martinite (p. 510) R.....	2.89		Iodyrite (p. 319).....	5.6-5.7	1-1.5
Eudialyte (p. 407) R.....	2.91-2.93	5.5-5	Fluocerite (p. 322).....	5.7-5.9	4
Ankerite (p. 358) R.....	2.95-3.1	3.5-4	Pyrrargyrite (p. 311) R.....	5.85	2.5
Phenacite (p. 423) R.....	2.97-3.0	7.5-8	Penfieldite (p. 322).....		
Tourmaline (p. 447) R.....	2.98-3.20	7-7.5	Barysilite (p. 408).....	6.11	3
Magnesite (p. 358) R.....	3.0-3.12	3.5-4.5	Tysonite (p. 321).....	6.13	4.5-5
Pyrosmalite (p. 424) R.....	3.06-3.19	4-4.5	Pyromorphite (p. 499).....	6.5-7.1	3.5-4
Friedelite (p. 424) R.....	3.07	4-5	Vanadinite (p. 500).....	6.66-6.86	3
Spangolite (p. 530) R.....	3.14	2	Mimetite (p. 500).....	7.0-7.25	3.5
Apatite (p. 497).....	3.17-3.23	5	Cinnabar (p. 293) R.....	8.0-8.2	2-2.5

* Some pseudo-hexagonal species are included.

B. LUSTER METALLIC (AND SUBMETALLIC).

Table with 6 columns: Mineral name, Specific Gravity, Hardness, Mineral name, Specific Gravity, Hardness. Includes Graphite, Chalcophanite, Ilmenite, Covellite, Pyrrhotite, Molybdenite, Långbanite, Hematite, Millerite, Arsenic, Pyrargyrite, Tellurium, Allemontite, Antimony, Tetradyomite, Niccolite, Breithauptite, Cinnabar, Bismuth, Iridosmine.

IV. CRYSTALLIZATION ORTHORHOMBIC.

A. LUSTER UNMETALLIC.

Table with 6 columns: Mineral name, Specific Gravity, Hardness, Mineral name, Specific Gravity, Hardness. Includes Teschemacherite, Thermonatrite, Carnallite, Struvite, Epsomite, Mascagnite, Nesquehonite, Goslarite, Morenosite, Sulphur, Lindackerite, Newberyite, Niter, Sideronatrite, Fluellite, Natrolite, Okenite, Felsöbanyite, Thomsonite, Wavellite, Hambergite, Pirssonite, Sulfoborite, Fischerite, Peganite, Elpidite, Howlite, Prehnite, Anhydrite, Aragonite, Spodiosite, Leucophanite, Danburite, Tyrolite, Harstigte, Reddingite, Bertrandite, Lanthanite, Iolite, Thénardite, Hopeite, Phosphosiderite, Talc, Beryllonite, Haidingerite, Strengite, Lawsonite, Humite, Anthophyllite, Andalusite, Enstatite, Autunite, Monticellite, Eosphorite, Childrenite, Sillimanite, Scorodite, Lossenite, Forsterite, Dumortierite, Kornerupine, Zoisite, Dufrenite, Chrysolite, Warwickite, Euchroite, Astrophyllite, Diaspore, Natrophilite, Cenosite, Gerhardtite, Hypersthene, Uranospinite, Guarinite, Calamine, Lithiophilite, Topaz, Langite, Uranocircite, Triphylite, Epididymite, Mazapilite, Hemafibrite, Chrysoberyl.

A. LUSTER UNMETALLIC.

Table with 6 columns: Mineral name, Specific Gravity, Hardness, Mineral name, Specific Gravity, Hardness. Includes Ardennite, Libethenite, Stauroilite, Strontianite, Bromilite, Atacamite, Uranophane, Flinkite, Serpierite, Brochantite, Brookite, Pinakiolite, Celestite, Ludwigite, Knebelite, Tephroite, Carminite, Göthite, Fayalite, Olivine, Witherite, Adamite, Barite, Derbylite, Pseudobrookite, Euxenite, Cerite, Aeschynite, Polycrase, Cotunnite, Valentinite, Samarskite, Yttrotantalite, Melanotekite, Ännerödite, Phoenicochroite, Tellurite, Descloizite, Kentrolite, Anglesite, Pucherite, Caledonite, Daviesite, Laurionite, Cerussite, Nadorite, Ochrolite, Mendipite.

B. LUSTER METALLIC (AND SUBMETALLIC).

Table with 6 columns: Mineral name, Specific Gravity, Hardness, Mineral name, Specific Gravity, Hardness. Includes Brookite, Ivaite, Sternbergite, Manganite, Enargite, Stibnite, Famatinite, Klaprotholite, Wittichenite, Euxenite, Chalcostibite, Pyrolusite, Polymignite, Stylotypite, Marcasite, Aeschinite, Zinkenite, Andorite, Sartorite, Columbite, Sundtite, Dufrenoyite, Chalcocite, Yttrotantalite, Jamesonite, Ännerödite, Melanotekite, Bournonite, Boulangerite, Hielmite, Diaphorite, Glaucodot, Arsenopyrite, Kentrolite, Aikinite, Stromeyerite, Stephanite, Guanajuatite, Geocronite, Wolfchite, Emplectite, Meneghinite, Bismuthinite, Schapbachite, Alloclasite, Cosalite, Nagyagite, Rammelsbergite, Safflorite, Tantalite, Löllingite, Acanthite, Krennerite, Dyscrasite.