A

SYSTEM

OF

# MINERALOGY.

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# DESCRIPTIVE MINERALOGY,

COMPRISING THE

MOST RECENT DISCOVERIES.

BY

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AIDED BY

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*"Hæc studia adolescentiam pervigilant.... rusticantur."*

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(l. c.); 26–28, Wachtmeister (l. c.); 29, Klaproth (Beitr., ii. 22, v. 131); 30, W. Wachtmeister (Jahresb., xxv. 364); 31, Bahr (ib.); 32, Besnard (Jahresb., 1849, 745): 33, 34, Mallet (J. G. Sci. Dubl., Ramm. 5th Suppl., 125); 35, W. J. Taylor (Am. J. Sci., II. xix. 20); 36, C. A. Kurlbaum (ib.); 37, Kjerulf (J. pr. Ch., lxv. 192); 38, 39, T. Wachtmeister (l. c.); 40, Moberg (J. pr. Ch., xliii. 122); 41, Pützer (Ramm. Min. Ch., 695):

| | Si | Al | Fe | Fe | Mn | Mg | Ca | |
|---|---|---|---|---|---|---|---|---|
| 20. | Fahlun, *Almand.* | 39·66 | 19·66 | —— | 39·68 | 1·80 | —— | ——=100·80 Hising. |
| 21. | Zillerthal, *bn.* | 39·12 | 21·08 | 6·00 | 27·28 | 0·80 | —— | 5·76=100·04 Kobell. |
| 22. | Hungary, *prec.* | 40·56 | 20·61 | 5·00 | 32·70 | 1·47 | —— | ——=100·34 Kobell. |
| 23. | Zillerthal, " | 39·62 | 19·30 | —— | 34·05 | 0·85 | 2·00 | 3·28=99·10 Karsten. |
| 24. | Ohlapian | 37·15 | 18·08 | —— | 31·30 | 0·30 | 10·15 | 0·36=97·34 Karsten. |
| 25. | Greenland | 39·85 | 20·60 | —— | 24·85 | 0·46 | 9·98 | 3·51=99·20 Karsten. |
| 26. | Engsö, *dull red* | 40·60 | 19·95 | —— | 33·93 | 6·69 | —— | ——=101·17 Wacht. |
| 27. | N. York | 42·51 | 19·15 | —— | 33·57 | 5·49 | —— | 1·07=101·79 Wacht. |
| 28. | Norway | 52·11 | 18·04 | —— | 23·54 | 1·74 | —— | 5·78=101·20 Wacht. |
| 29. | Oriental | 35·75 | 27·25 | —— | 32·33 | 0·25 | —— | ——=95·58 Klapr. |
| 30. | Garpenberg | 39·42 | 20·27 | —— | 24·82 | 7·51 | 3·69 | 2·68=98·34 Wacht. |
| 31. | Brena, Westm. | 37·16 | 19·30 | —— | 37·65 | 3·19 | 2·03 | 0·90=100·23 Bahr. |
| 32. | Albernreit, *bnh.-r.* | 38·76 | 21·00 | —— | 32·05 | 6·43 | 3·95 | ——=102·19 Besn. |
| 33. | Wicklow, *black* | 35·77 | 19·85 | —— | 38·07 | 5·04 | —— | ——=98·73 Mallet. |
| 34. | Killiney, *brown* | 37·80 | 21·13 | —— | 34·83 | —— | 4·46 | 1·53=99·75 Mallet. |
| 35. | Yonkers, N. Y., *trp.* | 38·32 | 21·49 | —— | 30·23 | 2·46 | 6·29 | 1·38=100·17 Taylor. |
| 36. | Delaware Co., Pa., *trp.* | 40·15 | 20·77 | —— | 26·66 | 1·85 | 8·08 | 1·83=99·34 Kurlbaum. |
| 37. | Oravitza | 37·52 | 20·01 | —— | 36·02 | 1·29 | 2·51 | 0·89=98·23 Kjerulf. |
| 38. | Hallandsaos, *dull red* | 41·00 | 20·10 | —— | 28·81 | 2·88 | 6·04 | 1·50=100·33 Wachtm. |
| 39. | " " | 42·00 | 21·00 | —— | 25·18 | 2·37 | 4·32 | 4·98=99·85 Wachtmeist. |
| 40. | Abo, *rdh.-bn.* | 40·19 | 20·17 | —— | 35·27 | 0·99 | 4·98 | 0·50=102·10 Moberg. |
| 41. | Brazil, *massive* | 37·23 | 15·22 | 6·73 | 26·76 | 3·40 | 3·14 | 4·31=96·79 Pützer. |

In anal. 26, G.=4·236; anal. 27, 3·90; anal. 33, 4·196; anal. 38, 4·188; anal. 39, 4·043; anal. 40, 3·86.

D. *Manganese-Aluminagarnet;* SPESSARTITE. (Granatförmiges Braunsteinerz (fr. Spessart) *Klapr.*, Beitr., ii. 239, 1797=Braunsteinkiesel (near Garnet) *Karst.*, Tab., 20, 69, 1800. Manganesian Garnet (fr. Haddam) *Seybert*, Am. J. Sci., vi. 155, 1823. Mangangranat *Germ.* Broddbogranat *Berz.* Spessartine *Beud.*, 52, 1832.) Color dark hyacinth-red (fr. Spessart), sometimes with a shade of violet, to brownish-red. G.=3·7—4·4; fr. Spessart 3·6, Klapr.; fr. Haddam 4·128, Seybert; fr. Broddbo 4·575, d'Ohsson; fr. Miask 4·38, Lissenko.

Analyses: 42, H. Seybert (Am. J. Sci., vi. 155, 1823); 43, Rammelsberg (J. pr. Ch., lv. 487); 44, d'Ohsson (Schw. J., xxx. 346); 45, Lissenko (Koksch. Min. Rusel., iii. 230); 46, Klaproth (Beitr., ii. 244):

| | Si | Al | Fe | Mn | Mg | Ca | |
|---|---|---|---|---|---|---|---|
| 42. | Haddam, Ct. | 35·83 | 18·06 | 14·93 | 30·96 | —— | ——=99·78 Seybert. |
| 43. | " | 36·16 | 19·76 | 11·10 | 32·18 | 0·22 | 0·58=100 Ramm. |
| 44. | Broddbo | 39·00 | 14·30 | 15·44 | 27·90 | —— | —— Sn 1·00=97·64 D'Ohsson. |
| 45. | Miask | 36·30 | 17·48 | 14·32 | 30·60 | —— | 0·51=99·21 Lissenko. |
| 46. | Spessart | 35·00 | 14·25 | 14·00 | 35·00 | —— | ——=98·25 Klaproth. |

In anal. 42, G.=4·128; anal. 43, 4·275; anal. 45, 4·38.

E. *Lime-Irongarnet;* ANDRADITE. (Common Garnet, pt. Allochroite (from Drammen and Feiringen, Norway) *d'Andrada*, J. de Phys., li. 243, 1800, Scherer's J., iv. 32. Black Garnet; Melanit (fr. Frascati) *Wern.*, 1800, Ludw. Wern., i. 48, 64, 1803. Aplome *H.*, Tr., iv. 289, 1801. Kolophonit *d'Andrada; Simon*, Geïl. J., iv. 405, 1807. Grénat résinite=Colophonite *H.*, Cours 1804, *Lucas*, Tabl., 265, 1806; Pech-Granat *Karst.*, Tab., 32, 89, 1808. Topazolite (fr. Ala) *Bonvoisin*, J. de Phys., lxii. 1806. Pyreneit (fr. Pyrenees) *Wern.*, 1811–12, Hoffm. Min., ii. 373, 1815. Kalkgranat *Berz.*, Löthr. Granat v. Longban *Rothoff*, Afh., iii. 329, 1810; Rothoffite *Berz.*, N. Syst. Min., 218, 1819. Polyadelphite (fr. Franklin, N. J.) *Thom.*, Min. i, 154, 1836. Jelletite (fr. Mt. Rosa) *Apjohn*, J. G. Soc., Dublin, v. 119, 1853. Yttergranat (fr. Norway) *Bergemann*, Sitz. Ges. Bonn., July, 1854.) Colors various, including wine-, topaz-, and greenish-yellow (topazolite), apple-green; brownish-red, brownish-yellow; grayish-green, dark green; brown; grayish-black, black. G.=3·64—4.

Named *Andradite* by the author after the Portuguese mineralogist, d'Andrada, who described and named the first of the included subvarieties, Allochroite. The included kinds vary so widely in color and other respects that no one of the names in use will serve for the group.

Chemically there are the following subvarieties: 1. Simple *Lime Irongarnet*, in which the protoxyds are wholly or almost wholly lime. Includes: (*a*) *Topazolite*, having the color and transparency of topaz, and also sometimes green; although resembling essonite, Damour has shown that it belongs here. (*b*) *Colophonite*, a coarse granular kind, brownish-yellow to dark reddish-brown in color, resinous in lustre, and usually with iridescent hues; named after the resin *colophony*. (*c*) *Melanite* (named from μελας, *black*), black, either dull or lustrous; but all black garnet is not here included. *Pyreneite* is grayish-black melanite; the original afforded Vauquelin 4 p. c. of water, and was iridescent, indicating incipient alteration. (*d*) Dark green garnet, not distinguishable from some allochroite, except by chemical trials. *Jelletite* is green garnet, light or dark, and yellowish-green, from the moraine of the Findel glacier near Zermatt, Mt. Rosa; named after Jellet, one of the describers of it.

*Calderite*, a mineral from Nepaul, India, is said to be nothing but massive garnet; but whether belonging to this group or not is not stated.

2. *Manganesian Lime-Irongarnet.* (*a*) *Rothoffite.* The original *allochroite* was a manganesian irongarnet of brown or reddish-brown color, and of fine-grained massive structure. The *Rothoffite*, from Longban, first analyzed by Rothoff, is similar, with the color yellowish-brown to liver-brown. Other common kinds of manganesian irongarnet are light and dark, dusky green and black, and often in crystals. Thomson's *Polyadelphite* was a massive brownish-yellow kind, from Franklin, N. J. (anal. 66, 67). The same locality affords another in dark green crystals, containing still more manganese.

(*b*) *Aplome* has its dodecahedral faces striated parallel to the shorter diagonal, whence Haüy inferred that the fundamental form was the cube; and as this form is simpler than the dodecahedron, he gave it a name derived from ἁπλόος simple. Color of the original aplome (of unknown locality) dark brown; also found yellowish-green and brownish-green at Schwarzenberg in Saxony, and on the Lena in Siberia.

3. *Yttriferous Lime-Irongarnet; Yttergarnet.* Contains several p. c. of yttria (anal. 75); G.=3·88, Bergemann; B.B. infusible.

Analyses: 47, Hisinger (Jahresb., ii. 101); 48, Seybert (Am. J. Sci, v. 118); 49, Karsten (l. c.); 50, Bredberg (Ak. H. Stockh., 1822, i. 63); 51, Bucholz (Scherer's N. J., iv. 172); 52–57, Wachtmeister (l. c.); 58, Thomson (Ann. Lyc. N. Y., iii. 9, 1829); 59, Vauquelin (J. de Phys, l. 94); 60, Klaproth (Beitr., v. 168); 61, Karsten (l. c.); 62, Damour (L'Institut, No. 1198, Dec. 1856); 63, Ebelmen (Ann. d. M., IV. vii. 19); 64, W. Fisher (Am. J. Sci., II. ix. 84); 65, Bahr (J. pr. Ch., liii. 312); 66, Weber (Ramm. 5th Suppl., 193); 67, Baumann (ib.); 68, D. Forbes (Edinb. N. Ph. J., II. iii.); 69, 70, N. v. Ivanof (Koksch Min. Russl., iii. 79); 71, Tschermak (Jahresb., 1860, 766); 72, E. K. Granqvist (Koksch. Min. Russl., iii. 32); 73, A. Stromeyer (Jahresb. Hanover, xiii. 23, 1864); 74, Rose (Karst. Tab., 33); 75, Bergemann (Sitz. Ges. Bonn, July, 1854); 76, Wright (J. G. Soc., Dublin, v. 119, Ann. d. M., V. iii. 707); 77, Damour (l. c.); 78, v. Merz (Nat. Ges. Zurich, vi.); 79, Karavaief (Koksch. Min. Russl., iii. 34):

| | Si | Al | Fe | Fe | Mn | Mg | Ca | |
|---|---|---|---|---|---|---|---|---|
| 47. Westmanland | 37·55 | —— | 31·35 | —— | 4·70 | —— | 26·74=100·34 | Hisinger. |
| 48. Willsboro', *Coloph.* | 38·00 | 6·00 | 28·06[a] | —— | —— | —— | 29·00, Ḣ 0·33=101·39 | Seyb. |
| 49. Schwarzenberg, *gn.* | 36·85 | 4·05 | 25·35 | —— | 0·95 | —— | 32·32=99·52 | Karsten. |
| 50. Sala | 36·62 | 7·53 | 22·18 | —— | —— | 1·95 | 31·80=100·08 | Bredberg. |
| 51. Thuringia, *brown* | 34·00 | 2·00 | 27·84 | —— | 3·15 | —— | 30·75, Ḣ, Ċu 4·25 | Bucholz. |
| 52. Longban, *yw.* | 35·10 | —— | 29·10 | —— | 7·08 | —— | 26·91, K̇ 0·98=99·17 | Wacht. |
| 53. Altenau, *Aplome* | 35·64 | —— | 30·00 | —— | 3·02 | —— | 29·21, K̇ 2·35 | Wacht. |
| 54. Hesselkulla, *bn.* | 37·99 | 2·71 | 28·53 | —— | 1·62 | —— | 30·74=100·59 | Wacht. |
| 55. " *gn.* | 38·13 | 7·32 | 19·42 | —— | 3·30 | —— | 31·65=99·82 | Wacht. |
| 56. Arendal, *bnh.-bk.* | 40·20 | 6·95 | 20·50 | —— | 4·00 | —— | 29·48=101·13 | Wacht. |
| 57. Vesuvius, *bn.* | 39·93 | 13·45 | 10·95 | 3·35 | 1·40 | —— | 31·66=100·94 | Wacht. |
| 58. Franklin, N. J., *bn.* | 33·72 | 7·97 | 17·64[a] | —— | 16·70 | —— | 25·88, Ḣ 0·08=101·99 | T. |
| 59. Frascati, *black, Mel.* | 34·0 | 6·4 | 25·5 | —— | —— | —— | 33·0=98·9 | Vauquelin. |
| 60. " " | 35·5 | 6·0 | 26·0[a] | —— | —— | —— | 32·5, Mn 0·4=100·4 | Klapr. |
| 61. " " | 34·60 | 4·55 | 28·15 | —— | —— | 0·65 | 31·80=99·75 | Karsten. |
| 62. " " | 35·84 | 6·24 | 23·12 | —— | —— | 1·04 | 32·72, Ṫi 1·04=100 | Damour. |
| 63. Beaujeu " | 36·45 | 2·06 | 29·48 | —— | 0·28 | 0·06 | 30·76, ign. 0·96 | Ebelmen. |
| 64. Franconia, N. H., *bk.* | 38·85 | —— | 28·15 | —— | —— | —— | 32·00=99 | Fisher. |
| 65. Gustafsberg, G.=3·6 | 37·80 | 11·18 | 15·66 | 4·97 | 0·13 | *tr.* | 30·28=100·02 | Bahr. |
| 66. *Polyadelphite* | 34·83 | 1·12 | 28·73 | —— | 8·82 | 1·42 | 24·05=98·97 | Weber. |
| 67. " | 35·47 | 3·10 | 28·55 | —— | 5·41 | 2·13 | 26·74=101·40 | Baumann. |
| 68. Stoköe, *green* (⅔) | 34·40 | 9·46 | 20·43 | —— | 2·40 | *tr.* | 31·38, Na & loss 1·93=100 | F |

[a] Determined as protoxyd.

| | Si | Al | Fe | Fe | Mn | Mg | Ca |
|---|---|---|---|---|---|---|---|
| 69. Schischimsk Mts. | 35·21 | *tr.* | 34·11 | — | *tr.* | — | 30·96=100·28 Ivanof. |
| 70. Achmatovsk | 37·22 | 6·04 | 24·81 | — | *tr.* | 0·49 | 31·07=99·63 Ivanof. |
| 71. Dobschau, *green* | 38 | 3 | 28 | — | — | 2 | 30·=101 Tschermak. |
| 72. Pitkäranta, *bnh.-gn.* | 37·79 | 12·39 | 21·45 | — | 0·83 | — | 30·78=103·24 Granqvist. |
| 73. Arkansas | 31·25 | — | 31·80 | — | — | 0·46 | 33·30, Ti 3·19=100 Strom. |
| 74. Drammen, *Allochr.* | 37·00 | 5 00 | 18·50 | — | 6·25 | — | 30·00=96·75 Rose. |
| 75. Norway, *bk., yttrif.* | 34·94 | *tr.* | 30·01 | — | 1·09 | 0·50 | 26·04, Y 6·66=99·24 Berge. |
| 76. Mt. Rosa, *Jelletite, gn.* | 38·09 | — | 33·41 | — | — | — | 28·61=100·11 Wright. |
| 77. Zermatt, " *bottle-gn.* | 36·03 | 1·24 | 30·05 | — | — | 0·54 | 32·14=100 Damour. |
| 78. " " *light gn.* | 36·24 | 0·56 | 30·53 | — | — | 0·35 | 32·38=100·06 Merz. |
| 79. Bosgolovsk, *ywh.-bn.* | 35·37 | 0·53 | 31·49 | — | 0·29 | 0·54 | 32·50=100·72 Karavaief. |

In anal. 52, G.=3·965; anal. 53, G.=3·871; anal. 56, G.=3·665; anal. 68, G.=3·64, from the Brevigfiord with brevicite; anal. 69, G.=3·798; anal. 71, G.=3·72, in serpentine; anal. 73 was made on a mineral erroneously called schorlamite; anal. 75, G.=3·88, H.=5; anal. 77, G.=3·85.

F. *Lime-Magnesia Irongarnet;* BREDBERGITE. A variety from Sala, Sweden, is here included. Formula $(\frac{1}{3}\dot{Ca}^3+\frac{1}{3}\dot{Mg}^3)^3\ddot{Si}^3+\dot{Fe}^3\ddot{Si}^3$=Silica 37·2, peroxyd of iron 33·1, magnesia 12·4, lime 17·3 =100. It corresponds under Irongarnet nearly to aplome under Aluminagarnet. Analysis by Bredberg (Ak. H. Stockh., i. 63, 1822):

| | Si | Al | Fe | Mg | Ca |
|---|---|---|---|---|---|
| 80. Sala | 36·73 | 2·78 | 25·83 | 12·44 | 21·79=99·57 |

G. *Lime Chromegarnet;* OUVAROVITE. (Uwarowit *Hess.*, Pogg., xxiv. 388, 1832.) A silicate of lime and sesquioxyd of chromium. Formula $(\frac{1}{3}\dot{Ca}^3+\frac{1}{3}\dot{Cr})^3\ddot{Si}^3=(\dot{Ca}^3)^3\ddot{Si}^3+\dot{Cr}^3\ddot{Si}^3$.

In the Ural variety, a fourth of the oxyd of chromium is replaced by alumina; that is, Al : Cr =1 : 3 nearly. Color emerald-green. H.=7·5. G.=3·41—3·52. B.B. infusible; with borax a clear chrome-green glass. Named after the Russian minister, Uvarof. Analyses: 81, Komonen (Verh. min. Ges. St. Pet., 1841, 55); 82, Erdmann (Jahresb., xxiii. 291, Ramm. Min. Ch., 697); 83, Damour (L'Institut, 1856, No. 1198); 84, T. S. Hunt (Rep. G. Can., 1863, 497):

| | Si | Al | Fe | Cr | Fe | Mg | Ca |
|---|---|---|---|---|---|---|---|
| 81. Bissersk | 37·11 | 5·88 | — | 22·54 | 2·44 | 1·10 | 30·34, H 1·01=100·42 K. |
| 82. " | 36·93 | 5·68 | 1·96 | 21·84 | — | 1·54 | 31·63, Cu *tr.*=99·58 E. |
| 83. " | 35·57 | 6·26 | — | 23·45[a] | — | — | 33·32=98·50 Damour. |
| 84. Orford, Can. | 36·65 | 17·50 | — | 6·20 | 4·97 | 0·81 | 33·20, H 0·30=99·63 H. |

[a] Includes some $Fe^3O^3$.

Garnet usually contains no water, or only a trace of it, and thus differs from the related idocrase. The grossularite from Wilui afforded G. Magnus only 0·12 p. c.; the cinnamon-stone of Ala, 0·25—0·34; the almandine of Slatoust, none (Pogg., xcvi. 347).

In jewelry, the lighter clear garnets are often called hyacinth. The yellowish is the *Jacinta la bella;* a yellowish crimson, the *Guarnaccino;* and another very similar, *Vermeille*, or *Hyacinth-Garnet;* the red, with a violet tinge, *Rubino-di-rocca*, and also *Grenat Syrian* (from Syriam in Pegu), and probably the *Amethystizontes* of Pliny. The deep and clear red, like Burgundy wine in shade, is the true *precious garnet*, which is either pyrope or almandite. The ancient name ἄνθραξ, meaning *a burning coal*, alludes to the internal fire-like color and reflection, and was applied also to some ruby. The Latin name *carbunculus*, from *carbo, coal*, has the same signification.

**Pyr., etc.**—Most varieties fuse easily to a light-brown or black glass; F.=3 in almandite, spessartite, grossularite, and allochroite; 3·5 in pyrope; but ouvarovite, the chrome-garnet from Canada (No. 84 included), is almost infusible, F.=6. Allochroite and almandite fuse to a magnetic globule. Reactions with the fluxes vary with the bases. Almost all kinds react for iron; strong manganese reaction in spessartite, and less marked in other varieties; a chromium reaction in ouvarovite, and in most pyrope. Some varieties are partially decomposed by acids; all except ouvarovite are after ignition decomposed by muriatic acid, and generally with separation of gelatinous silica. Decomposed on fusion with alkaline carbonates.

A brownish-red Arendal garnet, having G.=4·058, was reduced by heating to G.=4·046, and by fusion to 3·596—3·204, Church; and a Ceylon essonite, having G.=3·666, had G.=3·682 after heating to incipient fusion, Church.

**Obs.**—Garnet crystals are very common in mica schist, gneiss, syenitic gneiss and hornblende,