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HISTORY OF MAGNESIA

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Magnesia alba, otherwise known to alchemists as white magnesia or mild magnesian earth, is known today as magnesite or magnesium carbonate, $MgCO_3$. *Magnesia nigra*, however, refers to black manganese oxide, MnO_2. Both of these names are derived from Magnesia, Μάγνήσιά, which is a prefecture in Thessaly, Greece. Manganese and magnesium, as well as iron, are abundant in the form of oxides and carbonates in this region, and these minerals were referred to as "stones from Magnesia." The iron oxides present in magnesia were in the form of magnetic magnetite or lodestone, and both *magnesia alba* and *magnesia nigra* contain large amounts of magnetite, thus making them magnetic. This explains why magnesium and magnet are both derived from the place name Magnesia.

In alchemical terms, magnesia meant "a stone shining like silver" and was purported to be an ingredient of the philosopher's stone. In the more modern sense of the word, it is thought to have originated from *magnes carneus*, which means flesh magnet from the way it stuck strongly to the lips. Bergman's essay (Bergman et al. 1784–1791) "De Magnesia" claimed that the Roman Count di Palma prepared a white powder that he claimed was a panacea for all diseases. The white powder was called "*magnesia alba*," or Count Palma's powder, and its origin was a closely guarded secret.

The Chemistry and Technology of Magnesia, by Mark A. Shand

In 1701 M.B. Valentini (Valentini, 1707) prepared *magnesia alba* by the calcination of the residue remaining after evaporating the mother liquor to dryness from the preparation of niter or potassium nitrate. To add even more to the confusion, it is apparent that at least three minerals of different chemical composition were called magnesia: (1) *magnesius lapis*, which referred to magnetic magnetite, (2) *magnesia nigra*, which refers to pyrolusite (MnO_2), and (3) a silver-white mineral that was probably steatite or talc.

At the beginning of the eighteenth century the term *manganes* was employed for the manganese mineral and *magnesia* for the white mineral. However, the difference between *magnesia nigra* and *magnesius lapis* was not demonstrated until the middle of the eighteenth century. Hoffman (Hoffman, 1729) was the first to recognize the differences between magnesia and lime. He stated that an alkaline earth prepared by the reaction of a bitter salt (Epsom salts) with a fixed alkali differed from lime. Whereas lime gave a sparingly soluble salt with sulfuric acid that was nearly without taste, *magnesia alba* gave a bitter soluble salt.

However, it was not until 1754 that magnesia was finally distinguished from lime by Joseph Black. Black was the first person to recognize that magnesium was an element. Black, a prominent professor of anatomy and chemistry at Edinburgh, showed that *magnesia alba* (magnesium carbonate), when heated, evolved "fixed air" (carbon dioxide). The residue from this heating, calcined magnesia (magnesium oxide), was lighter and more alkaline than the basic carbonate. Limestone (calcium carbonate) was found to behave in the same manner. Black also demonstrated that *magnesia alba* produced a soluble sulfate in contrast to lime. He gave the alkaline earth the name *magnesia*. Black's thesis (Black, 1777) presented in June 1754, "On the Acid Humour Arising from Food and Magnesia Alba" dealt primarily with the value of magnesia as an antacid.

In 1808 Humphrey Davy (Davy, 1808) proved definitively that magnesia is the oxide of a metal, which he named magnium. At this juncture, the term *magnesium* was being used by some to define metallic manganese. Davy's technique involved mixing moistened alkaline-earth oxide with mercuric sulfide (cinnabar) and placing the paste onto a platinum plate. A drop of mercury was dropped into a depression made in the paste and the whole covered with naphtha. The platinum plate and drop of mercury were then connected to the poles of a voltaic pile. The resultant amalgam that formed on the mercury pole was then transferred to a glass tube and the mercury distilled off. Davy described the characteristics of magnesium as follows (Davy, 1808)

> The metal from magnesia appears to react with the glass, especially before all the mercury has distilled off. In one experiment, in which I interrupted the distillation before the mercury had been completely removed, the metal appeared

> as a solid body, which exhibited the same white color and the same luster as the other metals of the alkalide-earths. It immediately sank to the bottom of the water although surrounded by gas bubbles, formed magnesia. It changed quickly in the atmosphere, a white crust forming, and finally it disintegrated into a white powder, which proved to be magnesia.

Eventually, much to the consternation of Davy, the name magnesium was adopted for the metal in *magnesia alba* and manganese for the metal in pyrolusite. Michael Faraday produced magnesium metal in 1833 by the electrolysis of fused anhydrous magnesium chloride.

The mineralogical term *magnesite* was first applied to a series of magnesium salts (carbonate, sulfate, nitrate, and chloride) by J.C. Delaméthrie (Delaméthrie, 1795) in 1795. The same term was also being applied to magnesium carbonates and silicates by A. Brongniart (Brongniart, 1807). Deposits of natural magnesium carbonate were discovered at Hrubschütz in Moravia, which is now Hrubšice in the Czech Republic, and named *Kohlensaurer Talkerde* by W.A. Lampadius in 1800 (Lampadius, 1800). C.F. Ludwig described these minerals as *talcum carbonatum* in 1803. The use of the term magnesite was first restricted to the carbonate minerals by D.L.G. Karsten in 1808 (Karsten, 1808). The name magnesite gradually grew in acceptance.

Deposits of magnesite were found in Austria and Greece during the later half of the nineteenth century, and around the same time magnesite mines were opened in Canada. In 1886 magnesite was discovered in California and commercial mining commenced around 1900, and in 1913 production of magnesia commenced in Pennsylvania. The development of the magnesite industry was accelerated in 1914 by the outbreak of World War I as supplies from Austria and Greece were cut-off by the blockade of central European powers. Magnesite was found in Stevens County, Washington, in 1916 and mining started in 1917. During World War I, California magnesite came from small deposits in the Porterville district, which were operated in a crude fashion by small owners or contractors. The deposits situated at Magnesite, California, which is a short distance from Portersville, were developed in a more systematic manner, and after the war formed the nucleus of a sound mining and production operation. However, much of the early magnesite technology was developed in the Portersville district, such as the mechanical beneficiation of magnesite and the calcining of magnesite to develop a product with specific and controllable characteristics. It was also at Portersville that the first high-purity crystalline magnesium oxide was produced in a rotary kiln. Commercial production of refractory-grade magnesia was also in operation in the Livermore district of California by Western Mine and the Bald Eagle mine operation by Westvaco Chlorine products in Stanislaus County, California.

An immense deposit of medium- to low-quality magnesite exists in Steven County, Washington, which was exploited by the Northwest Magnesite Company during World War I. Operations were centered on the towns of Chewelah and Valley. It was here that the first use of froth flotation to beneficiate magnesite was employed to reduce silica and lime content.

A very large deposit of dolomite, magnesite, and brucite in the Paradise Range, Nye County, Nevada, has been known since about 1927 when brucite was discovered by Harry Springer. Drilling by U.S. Brucite in 1930 and 1931 revealed the presence of considerable quantities of magnesite adjacent to the brucite. From 1931 to 1933, the U.S. Geological Survey mapped the deposit and estimated that there were 71 million tons of magnesite and brucite bearing rock. Both magnesite and brucite were mined by Basic Ores, Inc., and the Sierra Magnesite Company. Currently, the only magnesite deposit being exploited in the United States is the one at Gabbs, Nevada.

BIBLIOGRAPHY

Black, J. (1777). *Experiments upon Magnesia ALBA, Quick-Lime, and other Alkaline Substances*. W. Creech: Edinburgh.

Bergman, T. O., Cullen, E. and Beddoes, T. (1784–1791). *Physical and Chemical Essays*. J. Murray: London.

Brongniart, A. (1807). Traité Élémentaire de Mineralogic, *2*. 489, Paris.

Davy, H. (1808). Electro-chemical researches on the decomposition of the Earths; with observations on the metals obtained from the alkaline Earths, and on the amalgam procured form ammonia. Philosophical Transactions of the Royal Society of London, *98*, pp. 333–370.

Delamétheric, J. C. (1975). Théorie de la Terre, *2*. 93. Paris.

Greenberg, A. (2000). *A Chemical History Tour: Picturing Chemistry from Alchemy to Modern Molecular Science*. Wiley-Interscience: New York.

Hoffman, F. (1729). Dissertationum physico-chymicarne Haloe Magdeburigicae.

Karsten, D. L. G. (1808). Mineralogische Tabellen, *48*. 92, Berlin.

Knibbs, N. (1924). *Lime and Magnesia*. D. Van Nostrand: New York.

Lampadius, M. A. (1800). Sammlung Praktisch-Chemischer Abhandlungen, *3*. 241. Dresden.

Mellor, J. W. (1960). *A Comprehensive Treatise on Inorganic and Theoretical Chemistry, Vol. IV*. Wiley: New York.

Seaton, M. Y. (1942). Production and Properties of the Commercial Magnesia. *Mining Tech.*, 1496.

Valentini, M. B. (1707). *Relatio de Magnesia alba, novo, genuino, polychresto et innixio pharmaco purgante Roma nuper advecto*. Giessa Hassoram: Italy.

Weeks, M. E. (1968). Discovery of the Elements. *J. Chem. Ed.*, 7th ed. 495–502.