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Carl Gustaf Mosander

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Mosander became through his discoveries of the new elements lanthanum (1839), didymium (1842), erbium and terbium (1842) a worthy successor of Berzelius. In 1831 Berzelius decided to withdraw from the professorship of chemistry and pharmacy at the Karolinska Medico-Chirurgical Institute in Stockholm, partly because of his desire as secretary of the Academy of Science to devote himself exclusively to his research work and partly in order to give his co-worker Mosander an opportunity to get a position as full term professor, which the latter then held for 26 years until his death in 1858.

Mosander was born in 1797 in the city of Kalmar. Like Scheele he started his career as a pharmacist. At the age of 15 he enlisted as an apprentice at the Owl's Apothecary in Stockholm and at 22 took up medical studies. In 1824 he was appointed as teacher in chemistry at Karolinska Institutet, the medical school in Stockholm under Berzelius and in 1832 he succeded him as professor of chemistry and pharmacy.

Although Mosander took over Berzelius' teaching at the medical school he did not share his teacher's devotion to physiological chemistry in its broadest sense. Mosander restricted his work mainly to the field of inorganic chemistry and mineralogy. In these fields he became the master's equal. He spent much of his time organizing the Collection of Minerals at the State Museum of Natural History.

Here follows an English translation of the history of Mosander's discoveries, written for the Swedish Academy of Science by A. Erdman in 1873.

"In 1803 Berzelius and Hisinger discovered a new metal in a mineral that had recently been found in the Bastnäs copper mine in the Skinnskatteberg district of the province of Västmanland. They called it *cerium*. The methods of reduction known at that time were not, however, sufficiently effective to enable them to obtain their new substance in a pure metallic state. — After a long interval of time this substance was examined again by Mosander and the success of his efforts is described in a paper in the proceedings of the Swedish Academy of Science for 1826. This paper describes a number of new or previously little known compounds of the metal cerium with other elements.

A few years later in 1829 Mosander made an important contribution to the knowledge of the composition of titanium compounds.

Previous experiments made at the end of the eighteen-twenties had led Mosander to suspect that cerium oxide contained some other substance but

he was unable to separate it. After he had obtained sufficient material, he took up the investigation again in the middle of the eighteen-thirties and in 1839 had the satisfaction of being able to announce to the scientific world that the number of known elements had been increased by one more to which he had given the name *lanthanum* from the Greek work *λανθανειν*, to conceal, because the presence of this substance in cerium oxide had long remained a secret.

Mosander's next task was a study of the properties of the new element or rather of the two separated elements, lanthanum and cerium. These investigations, which he pursued with all the perspicacity and clearsightedness that always marked his scientific activities, took up all the time left over from his official duties for several years. Some of the results he obtained led him to suspect that there was also a third element present, that in some experiments followed the lanthanum oxide and in others was distributed between the lanthanum and cerium oxides. This third substance he called *didymium* from the Greek *διδυμοι*, twins, since it followed cerium or lanthanum in cerium-containing minerals like a twin brother. It took a large number of experiments over a long period before Mosander finally ventured to announce the discovery of the oxide of another previously unknown metal at the second Scandinavian Scientific Meeting in Stockholm in 1842. This was nearly three years after he had first succeeded in separating it from lanthanum oxide — a striking instance of the praiseworthy care and reticence which Mosander always showed in such cases.

The very complex reactions characterizing the recently discovered lanthanum and didymium and the difficulties that arose in trying to prepare them in a completely pure state caused Mosander to make similar studies on the oxide yttria which often accompanies cerium in nature. These experiments soon led to a result that was just as unexpected as it was gratifying. As a consequence at the same time as he announced the discovery of didymium at the 1842 meeting, Mosander was also able to inform the meeting that the earth that hitherto had been named yttria, "ytterjord" in Swedish, was not a pure earth but was mixed with another of previously unknown properties. Continued investigations soon showed that Mosander had in no way allowed himself to announce any hasty conclusions to his scientific audience but was fully able to confirm his statement. He was able to announce before the end of the year that the old *yttria* which is one of the main components of the mineral gadolinite from the Ytterby feldspar works near Vaxholm in the Stockholm archipelago was *a mixture of three different earths*, two of which were new to science. He called the elements from which the two new ones derived *erbium* and *terbium* from parts of the name Ytterby. The element in the third earth was left with the old name *yttrium*.

The inscription on a medal struck by the Swedish Academy of Science in 1869 in honour of Mosander, 'Coacta disjungit semina terrarum' referred to all of these discoveries."

New findings were later added to those of Mosander. Thus Auer von Welsbach resolved in 1885 the earth didymia into two different oxides, *praseodymia* and *neodymia*. The names of the earths erbia and terbia were later interchanged. In 1878 Marignac dissolved the erbia from the gadolinite into *erbia* and

ytterbia, and from the latter Nilsson separated in 1879 a new element, *scandium*, the second newly discovered element which fitted into Mendelejev's periodic system on the place of ekabor. After removal of ytterbia and scandia from the erbia Cleve in Uppsala found in the same year another two new oxides *thulia* and *holmia*. As to the names of these two elements, the last ones in a series of 22 elements discovered between 1730 and 1879 in Sweden, Cleve suggested *thulium*, deriving from Thule, the ancient name of Scandinavia, and *holmium*, from the latinized name of Stockholm in whose vicinity occur so many minerals rich in yttria.

(*Vide* Findlay: A hundred years of chemistry, Duckworth 1948, and Helen Miles Davis: The chemical elements, Science Service, Washington 1952).

ELEMENTS DISCOVERED BY OLD SWEDISH CHEMISTS

Georg Brandt	Cobalt	Co	1735	
Axel Fredrik Cronstedt	Nickel	Ni	1751	
Carl Wilhelm Scheele	Fluorine	F	1771	Isolated by Moissan 1801
	Oxygen	O	1772	Priestley 1774
	Chlorine	Cl	1774	Isolated by S.
	Molybdenum	Mo	1778	Isolated by Peter Jakob Hjelm 1782
	Tungsten	W	1781	
Johan Gottlieb Gahn	Manganese	Mn	1774	Isolated by G., discovered by Bergman and Scheele
Anders Gustaf Ekeberg	Tantalum	Ta	1802	
Jöns Jacob Berzelius	Cerium	Ce	1803	Simult. with Klaproth
	Selenium	Se	1817	
	Thorium	Th	1828	
Johan August Arfwedson	Lithium	Li	1817	
Nils Gabriel Sefström	Vanadium	V	1830	
Carl Gustav Mosander	Lanthanum	La	1839	
	Didymium	—	1842	Divided by Auer v. Welsbach into Praseodymium, Pr and Neodymium, Nd in 1878
	Erbium	Er	1843	
	Terbium	Tb	1843	
	Yttrium	Y	1843	(Gadolin 1794)
Lars Fredrik Nilsson	Scandium	Sc	1879	
Per Teodor Cleve	Holmium	Ho	1879	Isolated by Holmberg 1911
	Thulium	Tm	1879	