Mexico he lived for a time in the United States, but returned to Mexico and died there in 1849.

A district in the State of Chihuahua, where so many great mines are located, is named after this pioneer of learning in Mexico. In 1801 when examining some lead ores from the mines at Zimapan in the State of Hidalgo, Del Rio thought he detected a new element, and he called it erythronium, from a Greek word for red, since its salts with certain chemicals gave a bright red color. He thought it was allied to chromium, and had he left well enough alone erythronium would be its name today and Del Rio alone would be hailed as its discoverer. Unfortunately Del Rio bowed to authority and when Collet Descotils, the great French analyst, published an article calling Del Rio's erythronium merely impure chromium, Del Rio accepted his decision and in the Annales de Ciencias Naturales, Madrid, 1804, disavowed his former claim and stated the substance to be a lead chromate. So the matter rested till 1830, and we might very appropriately call the vanadium "the element that got lost" for during this long period nothing was heard of it at all.

In 1830 Sefstroem, a Swedish metallurgist, found a new constituent in the slags of the famous Swedish iron of Tabberg. Not knowing of Del Rio's discovery he thought he had a new element, and he named it after a Norse divinity, calling it vanadium, from Vanadis, the surname of the goddess "Freya." In the same year Woehler proved the identity of vanadium and erythronium, and the next year the great chemist Berzelius made an exhaustive study of the element and its compounds. Although full of mis-statements which have since been corrected, and which were inseparable from the work on account of the newness of the subject, this treatise of Berzelius's remained the source of most of the information about this element till 1867 when Sir H. E. Roscoe made a thorough and accurate study of the chemistry of vanadium, Roscoe's pioneer work has been the starting point of most of the subsequent researches on the subject.

The chief error made by Berzelius was the mistaking of the lowest oxide of the element for the element itself, which threw out all his other formulae. This also led to his classing the element with chromium and molybdenum, in which opinion Woehler concurred. On account of the prestige of these two great names it was so regarded without a doubt till Schabus and Rammelsberg showed the perfect analogy between vanadinite, apatite and pyromorphite, and, mineralogical ideas carrying great weight just at that time in chemistry, this disturbing factor opened the minds of the chemical world to a change, and as a result of Roscoe's work it was placed where it is now known to properly belong, in the fifth group of Mendeleeff's Table, along with niobium and tantalum, forming a sub-group closely related to nitrogen, phosphorus, arsenic, etc. At present the analogies between vanadium and phosphorus and arsenic are more striking than those between vanadium and the other elements of its own group, but when the compounds of niobium and tantalum are further investigated this will be cleared up. The salts of the per-acids of vanadium, niobium and tantalum, which have recently been investigated by Melikoff and Pissarjewsky in Russia, are, however, quite analogous, and no doubt many other similarities will be found.

Early uses.—Early in the sixties vanadium began to play a certain role in industry and it was discovered that it was a remarkably efficient agent for the formation of aniline-black from aniline. At this time all the world's vanadium was obtained from the slags of the Creusot steel works in France. Later as slightly more was used it was extracted from lead vanadates mined in Spain by a process due to Herrenschmidt. In this process the ore was roasted with soda and charcoal, giving lead which carried a good deal of silver and a slag from which vanadium was worked up in the form of a solution of sodium vanadate. From this ammonium vanadate was precipitated and this was roasted and the oxide prepared and sold. Later iron and nickel vanadates were precipitated from the solution and these reduced aluminothermically, but in no case was the price of vanadium much reduced. The process was not at all efficient, 2 per cent. of the vanadium being left in the slag and arsenic, which was objectionable, being carried into the finished product. Inventions were made to get around both these difficulties, but soon after this more easily worked ores and better processes were invented and no commercial vanadium is now prepared in this way.

About 1910 the usefulness of vanadium in steel was demonstrated beyond a doubt by French investigators. Choubley in 1896 seems to have been the first to make this important discovery. Choubley was director of the steel works at Firminy. Neither his researches nor those of Helouis the next year were very successful and the first real advance in this direction was made by Arnold in England in 1900. Immediately a large demand was created for vanadium and mines being opened up in various parts of the world its price fell from the very high one it had formerly remained at, to that of a commercial product. Curiously enough, German chemists, usually so much to the front, played little or no part in the development of vanadium, France, America and England leading in the order named. Moissan was the first to prepare pure vanadium in the electric furnace and Gin made a fairly good grade of ferro-vanadium by the aluminothermic method. The process for the treatment of the ore and the production of vanadium products on a large scale has been worked out in America, but to the French and English we owe most of our exact knowledge of the structure and metallography of the steels to which vanadium is added, Guillet in France and Arnold in England being the chief workers on the subject.

Occurrence of Vanadium.—Vanadium is a singularly widely distributed element, but in most places where it is found it is in quantities so small as to be of no practical importance. It occurs in the sun, in almost all rocks both igneous and stratified, in sea-water, in coal, in petroleum and in plants. Many commercial products such as alkalies, acids and pig-iron contain some vanadium.

A large number of vanadium minerals of well-defined composition and form are known, but only a few are of either academic or commercial importance. Vanadinite is described in all text-books as the chief vanadium mineral, and until a few years ago it was so. It is isomorphous with pyromorphite and apatite and has the composition $(PbO)_3.V_2O_5.PbCl_2$. It is found in many parts of the world. It is generally of an orange or red color and occurs in hexagonal prisms. When the lead is partly replaced by zinc the mineral is known as dechenite areoxene or eusynchite according to the extent of the substitution. When there is no chlorine present it is known as descloizite, which crystalizes in the orthorhombic system, and can be considered a lead pyrovanadate Cuprodescoizite, brackebuschite, ramirite, tritochorite and psittacinite are all varieties of this mineral containing various admixtures of copper and zinc. The volborthites and calcovolborthites are copper vanadates discovered in Europe. Pucherite is a vanadate of