VANADIUM AND ITS MANY USES.

An account of the occurrence and uses of vanadium, especially in its application to steel making.

BY J. FOREST LEWIS.

A metal of comparatively recent discovery that is rapidly assuming scientific and commercial value, is vanadium. While discovered a little over a half-century ago, when it was classed as a rare metal, it is only within the last few years that its possibilities have become realized, and experiments have been taken up and are now in progress that may, in the near future, prove this metal one of many valuable qualities.

Sefstrom, a Swedish scientist, is given the credit for the original discovery of vanadium, which took place while he was analyzing an iron in Taberg, Sweden. After Sefstrom, Berzellus, in making an exhaustive investigation, came to the conclusion that vanadium was analagous to chromium, forming, like the latter, an acid trioxide.

The early history of vanadium is concerned chiefly with experiments and theoretical deductions, no attempt being made, it would seem, to put it to worldly or commercial usage until a few years ago, when its adaptability to steel manufacture was demonstrated, and, like molybdenum, uranium and tungsten, it has since been the object of careful study, with every effort made to determine its possibilities. While all these metals have proved to be the possessors of steel-hardening properties, all present an opportunity for further study with respect to their relative advantages, as to what each is specially valuable for, their cost of production and economy in application, compared to nickel and chromium. There is an increasing demand for these metals for use in the manufacture of ferro alloys, such as ferro-uranium and ferro-vanadium, and also for the manufacture of salts of these metals.

Many special advantages are claimed for vanadium in the process of steel hardening, as a result of late progress made in establishing its qualifications. Vanadium steel is one of the latest productions; and while there may be much to determine as to its qualities, it is considered now one of the highest grades of steel turned out. The specific gravity of pure vanadium is 5.5; its atomic weight is 51.2, and its melting point is 3,640° F. Pure vanadium is of a silvery white color, but the expense of purification prohibits its use commercially.

Geologists and chemists have determined the occurrence of vanadium in vanadinite, a mineral containing a high percentage of lead, vanadic oxide in varying percentages, and some silver, with iron and silica as other ingredients. This mineral was first obtained in Spain, but deposits are now known to exist in Arizona, where it is said a process has been perfected for the extraction of vanadium oxide. It also occurs in the vanadiferous sandstones of Colorado, and in the vanadiferous deposits of South America. Extensive development work has taken place on the deposits on La Salle Creek, southwest of Paradox, in Montrose county of this state, while the vanadium mill now in operation at

Newmire, near Telluride, is turning out an exceptionally fine product, which finds its way to Paris, France, where steel manufacturers are finding it a most useful, economical, and satisfactory factor and have recently concluded contracts with the Colorado producer for many tons.

As an alloy of steel, vanadium is said to create a product of very high tensile strength, capable of standing the most severe tests. The high point at which it fuses prohibits its direct use in steel, but an iron alloy containing from thirty to forty per cent of vanadium fusing at a much lower point than ordinary steel, enables steel makers to produce an open hearth product. The proportionate amount of this alloy required, as compared to other steel-hardening substances, is quite small, and in this instance, the cost of its use is considerably below that of others, while the ease with which fusion is brought about, of course eliminates the necessity of much of the machinery in use where other alloys are used. The time required for fusion is reduced, and many details are disposed of that lessen expense, the vanadium readily permeating the steel without recourse to mixing processes.

There are said to be extensive deposits of mineral throughout the world with a vanadium content; and while chemists have for some time vaguely realized its possibilities, there has been some difficulty in securing a market and in arriving at satisfactory methods for extraction.

American steel manufacturers, while noticeably interested in this metal, have not undertaken to install new steel manufacturing equipment, such as the use of the metal in their work requires, for although cognizant of its advantages, they have expressed some fear as to the maintenance of supply. However, it is stated that they have not overlooked the important matter of obtaining control of areas containing the metal, and constant investigation is being carried on with respect to determining various sources and supplies, and indications point to the adoption on their part of methods already introduced by European competitors, particularly those of France. The greater part of the vanadium product of both North and South America is being exported.

The United States government is manifesting much interest of late in vanadium, and vanadium steel is the latest naval experiment, the various naval yards and gun ships having taken steps to ascertain the peculiar qualities of this new alloy. The experiments being conducted are watched with keen interest. The claims advanced to the effect that it is the toughest and hardest of steels and that it can be wrought out under hammer and in rolls like soft Swedish iron, are of particular moment to the Navy Department, because of the possible perfection and the evident minimum of economy. So far, it is said that an alloy has been produced so hard that no ordinary tool may touch it, and it is hinted that a most superior article for armor plate has been found, though some defects are present, requiring further study and improvement. It is also stated that the government has been promised an abundant supply at low figures.

Some chemists and steel makers say it is liable to supersede nickel, tungsten and molybdenum steels.—*Ores and Metals.*