# USES OF VANADIUM STEEL

## Will Work Great Changes, Say the Modern Metallurgists.

## HOW CHEMISTRY AIDS METAL WORKERS

**New Alloy Possesses Greater Ductility and Tensile Strength—Once Rare Metal Found in Great Quantities.**

The steel trade has taken up vanadium, a rare element, as an alloy, and it has found that its use in small quantities makes a steel that increases tensile strength and elongation about 90 per cent. There is no question as to these results. The one problem is to get the vanadium cheap enough.

The problem used to be to get enough of the metal itself. It was supposed to be one of those rare things like radium and other elusive metals, but all that has been overcome and it can be found in great quantities in this country and is no harder to mine than copper.

The treatment of the metal, so as to prepare it for alloy purposes, is the only expensive feature. The steel trade has practically overcome that now and those who are expert in such matters declare that the period of vandium steel has come and that it will occupy a more important place in the world than did nickel steel.

**Curiosity for Years.**

Vanadium has been known since 1801. For eighty years it was looked upon as a chemical curiosity. Humboldt mentions it in his "Cosmos." In the early nineties it was used for dyeing purposes, in making aniline black, and to form enamels on glass, pottery and porcelain, chiefly in greenish gold colors. Since 1898 the steel trade has waked up to its possibilities as an alloy. Sir Thomas Lipton made use of it for the spars of Shamrock III and it was also used for the spars of the German emperor's American made yacht Meteor. Just now the automobile men have taken up the metal and the auto makers say it is bound to bring about a revolution in the manufacture of their vehicles. Tougher, stronger steel can be used in the machines than formerly, with even some lessening of weight.

Any process that will make steel nearly 100 per cent more ductile and thus lessen the breaking quality is bound to receive consideration from the makers of rolling stock, whether it be railway cars or autos or bicycles. The makers of bridges also welcome any alloy that will increase the strain capacity, while the manufacturers of tools of all kinds say that vanadium offers a great superiority over all other steel hardening metals.

**Its Use in Naval Warfare.**

The use of this alloy, the experts declare, is bound to have an important influence on national development in other than commercial ways. It will mean a new kind of armor plate and will be used extensively in guns, increasing their elastic qualities and preventing that most dangerous form of wear and tear on guns known as erosion. Indeed, it is already being used by the Vickers-Maxim people, it is declared. Togo had Vickers-Maxim guns on his ships and vanadium had been used in them as an alloy. The Russian guns were not made of vanadium steel. Those guns on ships taken by the Japanese were largely incapacitated because of erosion. The Japanese guns were not affected in this way.

It used to be thought that the only place where vanadium could be secured in marketable quantities was high up in the mountains of Peru. The cost of getting it out and preparing it as an alloy ran to several hundreds of dollars a pound. Freight to England or the United States was also another tremendous handicap. Within ten years, however, it has been found that there is practically no limit to the amount of the metal in the United States. Great deposits have been found in Colorado, Utah, New Mexico and California, and it also exists plentifully in other states. It can now be produced at about $2.50 a pound, but it is declared that it soon can be made fit for use as cheap as 25 cents a pound, and when that day comes vanadium steel will rule the metal world. The quality of brittleness will then be removed from steel.

**Compared With Nickel.**

It has already been found that 1 per cent of vanadium is equal to 10 per cent of nickel, in adding ductility and tensile strength to steel. Already several mines are being operated in this country. There is one seam of sandstone in Colorado that has from 4 to 5 per cent of vanadium, and the miners say it is as easy to mine as copper.

Although the metal was discovered in 1801 and its use as an alloy for steel has come before the steel world prominently only in the last decade, it was known as an alloy in 1850, and then was allowed to drop out of sight. This came about in a peculiar way. It was discovered in 1830 that the iron ore from the Taberg mines in Sweden were producing a metal that had greater ductility than any other iron ore known.

The Swedish scientist Seftrom started an investigation, and although it was known that a rare metal known as vanadium had been discovered in 1801 it was then rediscovered through Seftrom. Large deposits were found in the lead ores of Zimapan, Mexico, by Del Rio. Once more vanadium secured a new lease of life, but the great difficulty of extracting the metal and of making its use practical served to put it on the shelf again.

The revival of the use of vanadium has been due to thirty years of research and at a cost of fully $150,000 of his private fortune on the part of Dr. J. Baxeres de Aizugaray, a native of Argentina, and now a resident of New York City. Dr. Baxeres's father experimented with the metal years before the son took hold of it. Working over the metal became a matter of family tradition. The elder Baxeres owned the Santa Marta mines, which had the largest lode of lead vandate, as the compound was known in its original state, then known. The younger Baxeres worked for nearly a quarter of a century and his efforts led to the erection of a plant for the manufacture of vanadium products in Llanelly, South Wales, in 1898, where ferro-vanadium and its alloys are now being made.

**Must Be Pure.**

In the early days of experimenting with vanadium as a steel alloy unsatisfactory results were obtained in many cases because the vanadium was not pure. It contained copper, carbon, silicates, aluminum and other metals obnoxious to the production of good steel. These experiments, while showing increased tensile strength and elastic limit, showed decreasing ductility and were regarded as failures. Dr. Baxeres kept on with his studies. He tried to fuse the ore with soda carbonate and coal, but that process was abandoned because of its great expense. The acid sulphate process was cheaper and more practical and has since been improved greatly.

Electrolysis was found to be the best method, and work has gone on along that line until now Dr. Baxeres says it will be possible to produce the alloy as cheap as 25 per cent a pound, instead of at $2.50, a good commercial rate at present.

The effect of vanadium as an alloy is shown in numerous tables that the experts have produced after prolonged investigation. Crucible steel, for example, when mixed with vanadium, has produced a metal with a breaking strain of 61.57 tons to the square inch and an elongation of 23 per cent. Before vanadium was added the steel broke under a load of 31.14 tons to the square inch and the elongation was only 16 per cent. Cast iron, with a breaking strain of seven and one-half tons to the square inch, was treated with 5 per cent of vanadium and the breaking strain rose to thirteen tons. Ingots of iron with an ultimate stress of 55,614 pounds have been raised to an ultimate stress of 84,024 pounds by introducing 0.5 per cent of vanadium. The increased elongation is about 10 per cent. Steel containing about 1.15 per cent of carbon, with an elastic limit of about thirty tons and an ultimate stress of about sixty tons, has been raised seven tons in ultimate stress through the introduction of 15 per cent of vanadium.

At first the pure vanadium was introduced in the molten steel. It was soon found that owing to its high melting point it was not dissolved. Then it became necessary to make ferro-vanadium alloys of a lower melting point, and soon the first ferro-vanadium alloy of 10 per cent was made. Since then it has been shown that the proportion of vanadium could be increased to as high as 20 per cent, but Dr. Baxeres has said that the 10 per cent mixture is the best.

**Another Revolution Impends.**

In speaking of vanadium the other day, Dr. Baxeres said: "I veritably believe another revolution in the steel industry is at hand. The fact that the automobile men have taken up the use of this alloy is sufficient to establish its worth. It is only a step to bring it into general use. Tools, vehicles, bridges, in fact, all kinds of structures and utensils, will be transformed. It will also mean a great change in ship construction. It will change armor plate. Indeed, that is already under way. With vanadium the face of armor plates will be hardened a great deal more than at present. The plate itself will be more ductile and in a general way softer. The result will be that if a projectile pierces the plate it will be buried in the softer material on the back and will not splinter the plate to the extent that piercing shots do now. It will probably mean a lessening of weight in armor plates, and any one who knows about warship construction will realize what that will mean to the navies of the world. Vanadium will also improve gun manufacture and bring a great change in that industry. All this means a great change in that industry. All this means a great change commercially in the world."

"The best part of it all is that the United States has extensive deposits of this metal. Why should the country go to Peru or Mexico or to Europe when it has an unlimited supply at home? I have spent a lifetime practically in making researches that will make this possible. I have no direct interest now in the production of the metal. If, when the revolution that I predict comes about, my name shall be remembered as a benefactor in the transformation in the uses of the greatest metal the world has ever known, I shall be content."

## Weidensall's Letter

(Continued from Page One.)

ing was held. It was well attended. I was asked to address it, which I did for a short time. I had frequent interviews with Mr. M. Rideout upon his work and upon the association work in Europe in many particulars. He is a choice man and true, and is doing good service.

I reached Bordeaux, France, on December 12, 1906, and spent two days there. On my arrival I met the general secretary of the association, Mr. Emil Pouresy, who heartily welcomed me. I had an interview with him on things pertaining to the work of the secretary and other association matters, in which he had more or less difficulty. At a meeting of representatives of the association called to meet me I presented greetings I had with me from different parts of the world, then spoke to them of the great importance of the association work and that true association work could not be over estimated. I spoke particularly of their part in the work. Many questions were asked me, which I answered the best I could. All my suggestions were very kindly received. I think I made clear some things that were not as well understood as they should be. National Secretary Sautter was present and emphasized what I had said and thanked me for it. I appreciated this very much, for he is very clear in his association knowledge. I met also the national student secretary, Mr. Chr. Grauss, who was in Bordeaux at this time, and had different personal interviews with him. I had other interviews with the local general secretary, Mr. Emil Pouresy, who is a good and faithful man.

I arrived at Marseilles, France, in the night of December 28, 1906, and spent two full days there. I called at the rooms of the association. The general secretary was not in. He left a note for me that he was to leave Marseilles for Cannes to attend a convention and his president was to leave also, and nothing was appointed for me to do. This made it impossible for me to do anything for the association. This was about the only real miss I had made in my world trip, where I had expected to do something. The general secretary afterwards wrote me a letter and gave satisfactory reasons for what he had done. This afforded me a greater opportunity to see the city of Marseilles.

I arrived in Paris from Marseilles at 10 p. m. December 31, 1906. I had calculated to do many things during this visit in Paris, but the weather was so wretched that I was caught by the grippe or influenza, which prevented me from doing much of anything I had intended to do. However, I had frequent interviews with National Secretary Sautter, Special Secretary Rideout, with the president of the French association and with others. But I had to take care of myself. All in all, I had a good time in France. I was sure I had afforded the French association real help, which was appreciated and so expressed in word and letter. I learned more fully their methods of work.

The national committee and secretary are doing a noble work upon the true association basis, winning young men to Jesus Christ as their personal Saviour. The national work is well organized. Paris is the headquarters of the national committee, which consists of nineteen persons, nine on the executive headquarters committee in Paris, nine others representing different parts of France and one representing the student work. The country is divided into nine districts, not political divisions; each district has its own committee of from five to seven members to plan the work for the district and provide for its support. There are now three paid district secretaries and more will be added as fast as good men and their support can be secured. Every association must first become a member of the national alliance and is then assigned to a district. A formal adherence to the Paris basis is essential to entering the alliance. There are now 120 associations belonging to the alliance. There are eight college associations. Five cities with paid general secretaries, some of them with assistants. The national force consists of National Secretary Emil Sautter and two assistants, Mr. Ch. Schneider and Mr. S. Williamson, also Mr. Chr. Grauss, the student secretary.

ROBERT WEIDENSALL.

On Board the Baltic, Atlantic Ocean, February 6, 1907.