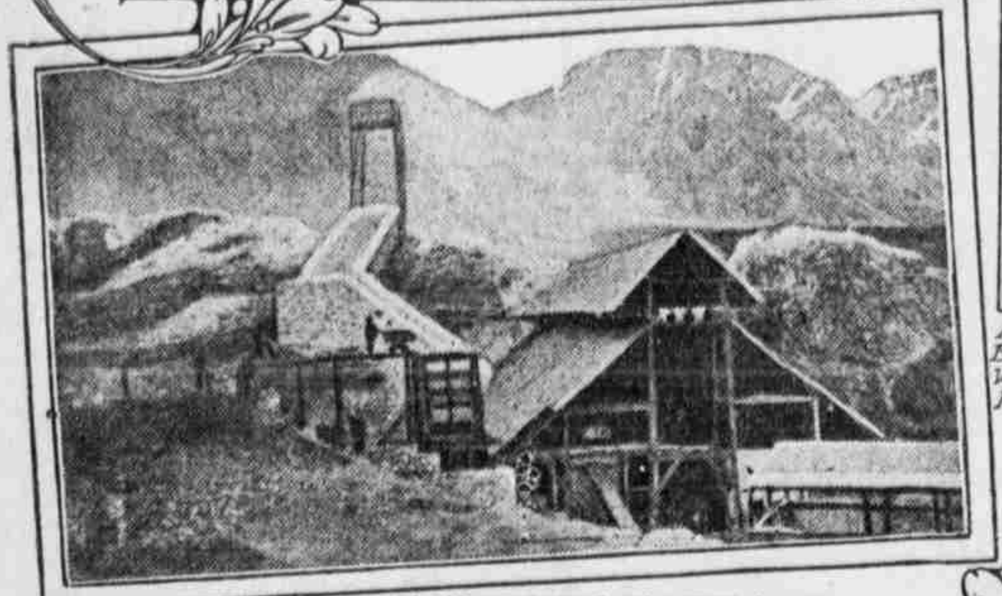
The DISCOVERY of VANADIUM



WORKS AT OPENING OF MINE SHAFT

A LOCOMOTIVE AXLE BENT COLD WITHOUT FRACTURE

SIDE RODS BENT COLD 180 DEGREES WITHOUT FRACTURE

AT THE FOOT OF THE MAIN ANDEAN RANGE, LOOKING BACK OVER THE PAMPAS

TUNNEL OPENING ON THE MAIN VEIN

PACKING ORE FOR TRANSPORT TO THE RAILWAY

THE credit for discovering the metallic element vanadium, almost, but not quite, belongs to Andres Manuel Del Rio, professor of mineralogy in the Royal School of Mines of the City of Mexico. The honor would be wholly his had he not himself repudiated his own discovery.

Del Rio was born in Madrid, November 10, 1764, and graduated from the University of Alcala de Henares in 1780. On account of his extraordinary aptitude in the natural sciences, and particularly in chemistry, he was pensioned and sent by the government to study in Germany, France, and England. He spent about twelve years in those countries, principally in the study of mineralogy and mining, and was associated with the leading scientists, among others Lavoisier. After his return to Spain he was named, in 1794, by royal order as one of the group of professors to establish the Royal School of Mines in Mexico City. The royal order named Del Rio as professor of chemistry, but on his request this was changed to mineralogy. The school was opened in April, 1795. In 1820 Del Rio was sent as deputy to the Spanish Cortes, where he championed the cause of Mexican independence. He returned to Mexico in 1824, but in 1829 on the expulsion of the Spaniards he went to the United States. He afterwards returned, and died in the City of Mexico on May 23, 1849. The district of Andres Del Rio, in the state of Chihuahua, where the city of Batopilas and the mines of the same name are located, is called after the distinguished scientist.

In 1801 Prof. Del Rio in examining some brown lead ores from the mines of Zimapan, in what is now the state of Hidalgo, believed that he had discovered a new element different from chromium and uranium and this he named erithronium. It was in reality what we now know as vanadium. The discovery was a genuine one, and had the matter rested there the name that Del Rio gave the new element would have been its name now, and he would have been the undisputed discoverer thereof. But unfortunately the Mexican professor was a little too much under the glamour of the French school, and so when Collet Descostils published an article in which he stated that Del Rio's erithronium was nothing more than impure chromium Del Rio accepted the French professor's judgment and in the Anales de Ciencias Naturales of Madrid in 1804 disavowed his former claim of discovery and stated that the substance was a lead chromate. Del Rio had been right and the French school wrong, for the element does not even belong in the chromium group. So the matter rested until in 1830 the Swedish scientist, N. G. Sefstroem, rediscovered the element among the slags of the Taberg iron ores and named it vanadium, which name it still bears. It is sometimes stated that the name chosen by Sefstroem was in honor of the Scandinavian goddess Vanadis. This is not strictly correct. In the Norse mythology the gods were divided into two stocks, Aesir and Vanir, or Asa and Vana. Njoerd, Frey and Freyja were of the stock Vanir, hence Vanadis. The word may be taken as the surname of a number of gods and goddesses, although perhaps most often used in connection with Freyja, the Norse Venus.

Neither Del Rio nor Sefstroem, nor later Berzelius, obtained the pure element, although Berzelius published what he thought to be its atomic weight, 137 and the formlae for its oxides. The English chemist, Sir Henry E. Roscoe, in 1868 demonstrated that Berzelius was incorrect; that he and other prior investigators had dealt with nitrides or oxides of the element; and that instead of belonging to the chromium group of elements vanadium should be placed in the group with arsenic and phosphorus.

Vanadium is a silver-white metal and readily oxidized. It has an atomic weight of 51.2, is nonmagnetic, has a very high electrical resistivity, and melts at about 1,680 degrees C. It is one of the most difficultly reduced and hardest of the metallic elements. Fortunately for its use in the arts, it is not necessary to reduce the metal to its pure state. Such a reduction would be too costly. It can be reduced, however, quite easily as an alloy, particularly as an alloy of iron, ferrovanadium, containing approximately one part of vanadium and two parts of iron. Again, fortunately, this alloy has a melting point 1,300 degree C. to 1,340 degrees C., sufficiently low to further alloy with molten steel, which would be difficult in the pure vanadium having a melting point over 300 degrees C. higher.

Vanadium is one of the most widely disseminated of all the elements, although commercially available deposits are comparatively rare. It is found in most of the rocks, in clays and shales, and in the ashes of plants. In addition to Mexico, where it was first discovered, vanadium has been found in Colorado, Utah, Oklahoma, Nevada, New Mexico, and other parts of the United States; in Peru, Sweden, Australia, Spain, England, Turkestan, Chili and Argentina.

The chief ores from which vanadium is or may be derived are patronite, carnotite, roscoelite, vanadinite and asphaltite. Coal is a source of vanadium. Ash from the Rockvale Colorado coal gave 27 per cent vanadium oxide. Coal from the Mendoza district in Argentina contains about five pounds of vanadic acid per ton. It is called rafaelite. At Talcuna, in the province of Coquimbo in Chili, vanadium is found as a yellow earth in connection with copper ore.

The principal and almost the only commercial source of supply of vanadium at present is from Peru.

There are numbers of asphaltite deposits in Peru, among the best known of which are those of Yauli. When burned, the ash from these deposits yields 24 to 40 per cent vanadium oxide. Other mines are located at Matucan and Casapalca, on the Central railroad of Peru near Callao, at Huari, and at Huancayo, but the greatest of all deposits, as now known and worked, are at Minas Ragra.

The Ragra mines are about fifty miles from the celebrated Cerro de Pasco copper mines and are in the same mining district. Minas Ragra had been frequently denounced and again abandoned as coal mines. The fuel was of so poor a quality as to be hardly worth the mining. Some years ago on the abandonment by C. Weiss & Co. of Lima, Senor Eulogio E. Fernandini, who was engaged in mining at Cerro de Pasco and who owned the Quisque hacienda, about six miles from Minas Ragra, denounced the mines anew. Senor Fernandini had a new process for making coke in which he proposed to use the output of Minas Ragra. Senor Antenor Rizo Patron was the technical director of the Fernandini works, and on his attention being directed to a mass of black mineral which accompanied the coal he became interested and made a chemical analysis. He thereby discovered that it contained vanadium in a greater proportion than any of the theretofore known ores of this metal. The material looks like a slaty coal, is very hard, with 30 per cent or more free sulphur, 14 per cent silica, 4 per cent iron sulphide, and about 1½ per cent each nickel and molybdenum sulphides, and about 40 per cent vanadium sulphide. After burning out the free sulphur the ore contains about 52 per cent vanadium oxide.

The distinguished Peruvian scientist, Senor Jose J. Bravo, made a very thorough examination of the locality and published the results in a bulletin of the Society of Engineers. The sulphide of vanadium, not having been theretofore known as a natural product, was named rizopatronite by Senor Bravo in honor of the original discoverer of the mineral. This name it still bears, although ordinarily shortened to patronite. Rizo-patronite, according to Senor Bravo, appears in the form of a compact mass, dark in color and some two meters thick (about 6 feet 6 inches), and in his opinion is disseminated over a large extent of country around Minas Ragra. The earth surrounding the rizo-patronite veins is highly impregnated with vanadium solutions, and in small catch basins this impregnated earth is being extensively worked.

Until the recent development of vanadium in the steel industry its commercial use was more or less confined to ink making and coloring fabrics and leather. The ink is made of a mixture of neutral solution of ammonium vanadate, gum water, and a solution of gallic acid. This ink is not destroyed by acids or alkalines, nor can it be bleached out with chloride. The ink, however, is not very permanent. It dyeing fabrics vanadium chlorides combined with analine hydrochloride form a brilliant and permanent black. In coloring leather a 1 per cent solution of neutral ammonium vanadate is used with leather which has been tanned with nutgall.

The first recorded use of vanadium in steel was in 1896, in France, in the production of armor plates. Tests of theses showed that they were much tougher and more highly resistant than like plates made without the use of vanadium. No immediate results, however, followed the French tests, owing perhaps to the fact that at this time no adequate supply of vanadium was in sight. About four years later Prof. J. O. Arnold of Sheffield in an address before the British Iron and Steel institute declared that vanadium was the master weapon of the steel metallurgist. At this time price of vanadium alloy was very high and the supply uncertain. The greatest advances, however, made in the use of vanadium in the steel industry have followed the experiments and practical applications of J. Kent Smith of Liverpool. Mr. Smith's work has been principally in the production of the various grades of vanadium alloys, and he has supervised personally the initial use of vanadium in most of the leading steel mills of England and the continent and some in the United States.

About 1905 the supply of vanadium began to increase to a large degree, due to the purchase of the Minas Ragra deposits in Peru by the American Vanadium company, also to the development of mines in other parts of Peru, Spain and elsewhere. From having been a rare metal, owing to the large output, it became available in quantities claimed to be unlimited, as a steel-making element. The claims made by its users are that it has accomplished wonders in crucible steel and in open-hearth steel, that it gives cast iron greater strength and endurance, and that copper and aluminum are remarkably improved for certain purposes by its addition. It is used in steel for engine axles and frames, in transmission shafts and gears, in wire springs, in piston rods, hydraulic cylinders, tires, tools, boiler plates, bolts, gun shields, projectiles, armor plates, gun barrels, watch springs, and in castings and forgings generally.

The claim is made that in steel making it unites with the nitrides and oxides, and carries them into the slag. The quantity of vanadium that will remain in the slag is in proportion to the amount of scavenging thus done by it. In well-deoxidized steel it is said that the scavenging will consume about one-fifth of the vanadium.

The alloy, ferrovanadium, is introduced into the steel by a very simple process. In the crucible process the alloys are broken into small bits and put into the charge with the second addition of the manganese. In the acid open-hearth process the alloy in larger pieces is dropped into the bath when the flame has been blanketed. In the basic open-hearth practice the alloy, broken small, is run through a spout that empties into the ladle in which the molten steel is being poured. A similar method is followed in the Bessemer and Tropenas practice and also in the cupola process for cast iron. In the latter, the alloy is crushed quite fine.

It is claimed that vanadium increases largely the resistance of metals to vibratory disintegration, that the steel is stronger and tougher and tempers more uniformly and to a greater depth than steel without vanadium. One of the principal advantages in the use of vanadium steel in the future will no doubt be that it will enable the steel man to reduce weight in such constructions as locomotives, cars, machinery, etc., through the use of a smaller amount of the stronger and tougher steel. The question of weight has become serious not only in locomotives but in other forms of machinery. Another great economy claimed for vanadium steel is its greater durability. If this can be established, it would of itself more than justify its more extensive use.

PAW'S EXPERIENCE.

Little Lemuel—Say, paw, does every man have a bump of wisdom?

Paw—He does before he gets married, son. After that the bump becomes a dent.

THE REVERSE.

"A doctor reverses the usual order."

"How?"

"He must exercise resignation when he lacks patients."

CAUSE AND EFFECT.

Hyker—Old Swiggs has stopped drinking.

Pyker—Well, that is certainly to his credit.

Hyker—Don't you believe it. It's due to his lack of credit.

A SURE CURE.

"Physicians have demonstrated that rattlesnake venom does not cure epilepsy."

"It will cure it all right if the physicians will permit the rattlesnake to administer it."

In the PUBLIC EYE

YOUNG MAN HAS OLD JOB

One of the youngest officials of the Wilson administration is at the head of the oldest scientific department of the government, and his appointment was not the result of luck, accident or political influence, but the recognition of remarkable qualifications which fitted him for the position.

It was on the fifteenth of April, the day following his thirty-ninth birthday, that Dr. E. Lester Jones became superintendent of the coast and geodetic survey, the service which, according to Secretary Redfield, "deals first with humanity and second with commerce."

Perhaps no one in the survey, no matter how long he has been in the service, has spent more of his life in the open than has Doctor Jones. Indeed, it would seem, that by environment, training, education and temperament, he had been qualifying for the superintendency of the coast and geodetic survey all his life. He was born in Orange, N. J., and as a small boy was the companion of his father, himself a scientist and a student of nature.

Doctor Jones was educated at Princeton and Heidelberg; in Germany he hunted, fished and studied in the Black forest and specialized in zoology. For five years he was connected with the New Jersey fish and game commission, and his first service in the national government was as deputy commissioner of the bureau of fisheries.

BRUCE ISMAY, RECLUSE

There is one man in the British isles, at least, to whom the memories of the Titanic disaster are a dread and ever present reality. That man is Bruce Ismay. He was managing director of the White Star line at the time of the Titanic disaster, and was among those saved when the liner sank.

He has voluntarily withdraw himself into almost complete seclusion. He is a tragic figure whom care and premature age have marked for their own. A great part of the year he passes, oftentimes alone, in Costelloe, one of the most remote, most unfrequented and desolate spots on the west coast of Ireland. Here his sole employment is fishing for days and weeks on end, occasionally with a friend, or perhaps two, but for the greater part of his time accompanied only by his servant.

Ismay is very popular among the cottagers around. He found them sympathetic and friendly, and he has given them employment in many ways in connection with the fishing and his lodge. In fact, whatever drove Bruce Ismay to this remote, inhospitable shore, it was a blessing in disguise to those poor people, and they appreciate his presence very keenly. They don't care whether or not his escape from the Titanic aroused a storm of criticism; for that matter they take no stock in the Titanic story anyway.

WORKING HIS WAY UP

At the 1915 commencement exercises of Columbia university Ensign Louis Randolph Ford, U. S. N., received the degree of master of arts. That was only one incident in the determined fight this young naval officer is making to achieve his childhood ambitions, which ambitions, it may well be, do not stop short of the insignia of a rear admiral.

As a barefooted lad in Texas, where he was born thirty-two years ago, Louis Ford made up his mind to enter the navy, but his parents were not able to send him to college and the influence to obtain an appointment to the naval academy was lacking. So at the age of fourteen Louis went to work on a Sabine river tugboat, and three years later became an apprentice in a machine shop. In two years more he was a full-fledged machinist and enlisted as such in the navy. Starting in at Mare Island, he worked his way steadily up to the rank of chief machinist, and in 1912 he took the examination for an ensign's commission, passing with the highest marks ever made by a warrant officer. Service on various vessels was followed by a post-graduate course at Annapolis, which included radio engineering, structural engineering, naval construction, ordnance and gunnery. Then came the welcome order to enter Columbia, where, as one of the professors said, he "worked his head off." Ford is now attached to the New York navy yard and eventually will devote himself to the designing of all sorts of naval machinery and the organization of the shops in the yards.

KENT TELLS A NOME STORY

Representative William Kent of California has many quaint tales of the north country. One of them deals with the early days in the Nome region, when gold was plentiful and everything else was decidedly scarce. One of the residents, the story runs, wandered into a rough, ready-made saloon and beheld four bewhiskered, rough-looking individuals.

They were deeply dejected. They sat far back in their chairs, hands in pockets. Occasionally one of them sighed or swore. In front of them were stacks of chips representing several thousand dollars in gold.

"What's the matter?" asked the visitor.

"This here poker game is busted up!" was the reply.

"Busted up?" repeated the visitor, in astonishment. "Why, you've got enough money there to play for a week!"

"Yep, stranger," agreed the bewhiskered man, moodily, "we got that, but somebody's lost all the aces and two jacks in the deck!" and resumed his stare at the useless chips.