Jean Baptiste Boussingault and Platinum

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Although initially trained in mining and metallurgy, at the Ecole des Mines de Saint-Etienne, Jean Baptiste was later to pioneer and devote much of his life to agricultural chemistry. Yet his interest in metallurgy never ceased as when, for personal and family reasons, he left his experimental farm in Alsace in 1867 to initiate a series of investigations on iron and steel at his son-in-law's factory, that of Jacob Holtzer et Cie at Unieux, near Saint-Etienne. If iron and steel were topics subsidiary to his agricultural pursuits the metal platinum was an obsession, and this is not altogether surprising because the first of his many published papers concerned a silicide of platinum which he had prepared in 1820 (1). Having found significant percentages of silicon in the steels manufactured at a neighbouring foundry, he suggested a theory, since found untenable, that the properties of steel were due, not to the presence of carbon as was generally believed, but to the silicon content.

The Silicide of Platinum

Ancillary to the main research on steel was an attempt to produce a platinum-carbon alloy, or a platinum carbide, analogous to steel, by heating thin leaves of platinum with wood charcoal in a clay crucible. The

Jean Baptiste Boussingault
1802–1887

Following the formation of the Republic of Colombia from the former Spanish colony of New Granada, a small team of scientists were recruited to investigate the economic potential of the country. Boussingault, a Frenchman who had trained in mining and metallurgy and was later to become a pioneer in agricultural chemistry, was one of this group and was responsible for locating the reef which was the source of the alluvial platinum deposits in the Choco district

occasion was almost catastrophic, as can be gathered from a letter to his father in Paris:

> Since my last letter I have seen my cousin, Fouché-Séguimard, I have set fire to the school and I have melted a metal (platinum) which was believed to be infusible.
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> My cousin came to see me the very day my furnace was lit; he spent several moments with me in the laboratory with a local gunsmith and M. Beaunier who had come to see me at work. The heat of the furnace was extraordinary and, according to M. Beaunier, was greater than that found in his steelworks. After three hours firing I drew the fires of the furnace, closed all the dampers of the flue and left. The next day, impatient to know the result of my experiments, I was in the laboratory at five o'clock. I met a teacher who said he had smelt an odour of burning throughout the night. We entered the lecture room and hardly had we opened the door when flames were seen in the midst of the smoke which filled the room. I at once called the caretaker, gathered together the student miners and in two hours we had mastered the fire, and the insurance company paid for the damage.
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> The cause of the fire was that the flue had not been constructed for a fusion furnace, and a beam which supported the floor of the first floor, being too near this weak flue, caught fire in the night. Fortunately the door of the lecture room was closed, and more fortunately I had taken the trouble to close the furnace before leaving, otherwise it is certain that the mining school would no longer exist.
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> As soon as the fire was extinguished I went to look for my crucibles, and had the satisfaction of seeing that my platinum had melted; in another crucible I found that the platinum had combined with carbon and formed a casting similar to an iron casting. Since then, in support of these results I have cemented two pieces of platinum as one cements iron, and thus succeeded in making platinum steel (2).

His enthusiasm, however, had bounded ahead of the facts. First, platinum had been melted as far back as 1758 by Macquer and Baumé; also, he was to find subsequently that he had prepared, not a platinum-carbon alloy, but a silicide of platinum which was more fusible than the metal. Erroneously he ascribed the formation of a silicide to the presence of silica ash in the wood charcoal.

The Origin of the Silicon

After fifty-six years Boussingault returned to this investigation and we can only surmise that interest in platinum had been rekindled by the work of the Commission Internationale du Mètre established by the French government in 1869 (3). After a delay, due to the Franco-Prussian War of 1870–71, the first metric bars of iridium-platinum were produced in 1874 under the direction of Henri Tresca, professor of mechanics at the Conservatoire des Arts et Métiers where Boussingault occupied a chair of agriculture. Whatever the reason for this renewed interest, Boussingault found, by repeating his 1820 experiments in both clay and platinum crucibles, that the silicon in his platinum silicide came not from the siliceous ash in the charcoal but from the silica in the walls of the crucible; but without the intervention of carbon no combination would take place between platinum and silicon (4).

The Platiniferous Region of the Choco

On leaving the Ecole des Mines de Saint-Etienne in 1820, Boussingault managed a lignite mine in Alsace but soon joined a small group of scientists recruited by Alexander von Humboldt in 1822 at the behest of Simon Bolivar who required them to investigate the mineral and agricultural potential of newly liberated Colombia. Boussingault was originally appointed as a professor at the Escuela Nacional de Mineros en Bogotá, but like the others in his team he was given assignments which took him to various parts of the country as mine inspector, prospector, assayer and surveyor. Colombia was his home from 1822 to 1832, when he returned to France.

In a letter to his mother in 1823 Boussingault expressed the hope that he would be sent to the platiniferous region of the Choco which is the north-western portion of Colombia with a seaboard on the Pacific Ocean. The presence of platinum in this region was first reported by two Spanish naval officers, Jorge Juan and Antonio de Ulloa who travelled to South America in 1736, although rumours of a mysterious metal, hard and infusible, were known in the sixteenth century and said to be found in Mexican gold mines. Juan and

The finding of the reef which was the source of the Choco alluvial platinum was first recorded by Boussingault in 1826 (7)

C'est dans l'or en poudre provenant d'un de ces *filons* que j'ai reconnu des *grains de platine*. Ces grains étaient semblables, par leur forme et par leur aspect, à ceux qui viennent du Choco. Ce fait du gisement du platine dans un filon de fer oxidé, me semble pouvoir jeter quelque jour sur l'origine du platine qui se rencontre dans les terrains d'alluvion, origine qui jusqu'à présent a été fort problématique.

Alloa accompanied the French scientists Charles Marie Condamine and Pierre Bouger who were sent to Peru to measure a degree of the meridian. South America was then closed to foreign visitors by the Spanish government, and the presence of the two Spaniards was to demonstrate that the King of Spain approved of the expedition. Juan and Ulloa provided the first description in Europe of alluvial gold-mining in the Choco, and indeed this was the first literature on platinum which found its way to Europe. They described the difficulties of separating gold from the adhering platinum for which there was little use except as small shot, or for small bags which when filled were used as clock weights, or even for making garden paths. Otherwise it was thrown away and mines whose ores contained excessive amounts of platinum were often compelled to close down (5).

The platiniferous area of the Choco is situated in the river basins of the rio Atrato and the rio San Juan, the Atrato flowing north to the Caribbean Sea and the San Juan flowing south to the Pacific Ocean. Their sources were so close that Boussingault mentions the work of a priest at Novita who, in 1788, encouraged Indians to dig a canal connecting the two rivers and thus providing a link for small craft between the Pacific and Atlantic Oceans. The Choco in Boussingault's day was a malarial area of almost continuous rainfall, plagued by mosquitoes and known for its impenetrable forests where communication was only possible by river. The alluvial deposits, owned by Spaniards, were worked by negro slaves whose rations consisted of salted meat, dried bananas and maize biscuits brought from the fertile Cauca valley on the backs of porters, for attempts at crop cultivation and ranching had failed. When Boussingault visited the Choco in 1829 the negro slave population had decreased considerably as a result of an 1816 Act of the Colombian Congress which granted them their freedom, thus anticipating the act of 1833 which abolished slavery in the British Empire.

Boussingault's Journey in the Choco

Boussingault left Anserma, in the department of Caldas, in February 1829 accompanied by the botanist Goudot and several bearers. The Spaniards appear to have maintained some degree of social life for at the first town, Tamana, they attended a ball at which an uninvited guest was a jaguar. To Novita they travelled down the rio Tamana in hollowed-out tree trunks and from there they journeyed to Tado, the centre of the platiniferous region. There, the priest informed the incredulous Boussingault that platinum could be found locally, mixed with an insignificant amount of gold. He was taken to the priest's garden where a negress was washing the garden soil in a batea, a wooden dish used for panning, during which the heavier gold and platinum particles sink to the bottom of the batea. The negress was obtaining platinum with only a

few grains of gold, for the garden had been a washing place where platinum had been removed from what was then the more precious gold. Further from the rivers, platinum- and gold-bearing ores were crushed and washed with water, after which the powdered ore underwent sedimentation in trenches which effected a rough separation of the precious metals, the final separation being accomplished in a batea. Deplatinisation of the gold was then carried out at Novita by use of mercury which forms an amalgam with gold but not with platinum, and finally the deplatinised gold was sent to the Mint at Bogotá (6).

The origin of the alluvial platinum of the Choco had been a subject of speculation since 1785 when it was observed that whereas only fine particles of platinum were to be found in the plains, larger particles were found nearer the mountains. With a hint from Humboldt, who knew the country as a result of his explorations of 1799–1804, Boussingault discovered the source of the alluvial platinum in a reef which he studied at Santa Rosa in the Cauca valley of Antioquia in 1825 where, in the Cordilleras, he found grains of gold and platinum in the rock syenite (7).

The Bolivar Statue; A Lesson in Diplomacy

The discovery of the platinum reef coincided with the zenith of Bolivar's career in 1825 and this may have been the reason for the Colombian Congress voting for an equestrian statue of Bolivar in platinum, but let Boussingault tell the story.

> I was at Bogotá busy with the map of Colombia when Congress decided to erect in the Plaza Mayor of the capital an equestrian statue of General Bolivar in platinum as a lasting national tribute to the man to whom they owed their liberty. Several days afterwards I received from the Ministers of War and Finance an official letter appointing me to superintend the casting and the erection of an equestrian statue in platinum of the Liberator. The letter was received through the official channels, i.e., through Colonel Lanz. I had to reply to the Minister of Finance. I replied politely that I could not undertake the work which had been entrusted to me; that the necessary quantity of platinum was so great (I stated the weight) that all the mines in Columbia could not produce it in the course of a century; concluding where I should have started, by saying that since platinum was infusible by the usual technical processes it would not be possible to cast a statue in this metal.
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> Lanz said to me that all this was correct but in view of my position my letter lacked common sense because it proved that Congress and the Ministers were ignorant which was inexcusable even if I was right. Write this, he added, I shall dictate the reply which you should make.
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> I thanked the Minister for wishing to entrust me with so important a work, adding that I would spare no effort to assure its success. Before signing I again told Colonel Lanz that success was impossible since the fusion of platinum was impracticable. It doesn't matter, he replied, you have promised to make every effort. Besides, you know that you will never have enough metal. It will be forgotten and you have offended nobody. It happened as Lanz had said; the Minister was delighted and thanked me for the enthusiasm which I had shown, then it was forgotten. Altogether I received two kilograms of platinum which was used to construct several pieces of apparatus in the laboratory (8).

If Boussingault's adventures engender a nostalgia for the world as it was, no doubt today's pioneers are equally resourceful in their search for uranium ores, and those of tomorrow may even revel in the location of platinum on another planet.

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