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The never-silent presses

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1. Cardarelli and Cahn

So carried away was I in my last book review by a cadre of his book on its that I and his beat in the Aegean with his materials Handbook, a concise and desktop reference also although not so captivating as the earlier book, no doubt because it lends itself is readily to a sitting duck missions, that he has handled issues for an error but completion. Balls of it consists of separate chapters on foot in classes of materials, full of lists and tables and sort it out of any information about array could not resist it would. In a "as materials of a Allah's", Bristol, has a section on "I am making is that, from July and not anyhow paganism me for my iron ore, Alastair and a Coke are also at a glass furnace as is a ban on Sunday hearth, a Bosch, yeah, Basle and a threat."

The first few lines of the following text (down to "throat") as typed by a voice recognition tool.

So carried away was I in my last group review by F. Cardarelli's book on units [1] that I unhesitatingly begin with his *Materials Handbook, a concise desktop reference* [2]. Although not so captivating as the earlier book, no doubt because the subject lends itself less readily to entertaining digressions, the *Materials Handbook* is a useful and erudite compilation. It consists of separate chapters on 14 classes of materials, full of lists and tables and the sort of out-of-the way information that Cardarelli could not resist including. In 'Ferrous metals and their alloys', for example there is a subsection on 'Iron making' from which we learn not only how pig iron is made from iron ore, limestone and coke but also that a blast furnace consists of a parallel-sided hearth, a bosh, tuyères, a barrel and a throat. (I have no doubt that F. Cardarelli knew that the everyday use of 'bosh' comes from the Turkish word for 'empty' but even he did not venture to digress so far from his theme.) The other classes of materials discussed are nonferrous metals, semiconductors, superconductors, magnetic materials, insulators and dielectrics, miscellaneous electrical materials, ceramics and glasses, polymers and elastomers, minerals, ores and gemstones, rocks and meteorites, timbers and woods and finally, building and construction materials. This list made me realise that I did not know the difference between timber and wood and the dictionary suggests that they are distinguished principally by usage—thus "wood" cannot be substituted for "timber" in such interjections as the lumberjack's "Timber!" or the nautical "Shiver my timbers!" And in bowls, one could not refer to "the timbers".

In each of the 14 chapters, F. Cardarelli tells us everything that he has been able to discover about the substances in question. Among the less-common nonferrous metals, for example, we final titanium and as usual, the section opens with 'Description and general properties': "Titanium

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[7440-32-6] is the first metallic element in group IVB(4) of Mendeleev's periodic chart with the atomic number 22 and a relative atomic mass (atomic weight) of 47.867. It has the chemical symbol, Ti, and is named after the latin word [sic], Titans, the names of the powerful mythological first sons of the Earth goddess. Titanium is a hard, lustrous, gray silvery and light metal with a low density 4540 $kg\,m^{-3}$, which falls between those of aluminum and iron and gives very attractive strength-to-weight ratios. For instance, the yield strength 0.2% proof of titanium and titanium alloys ranges between 470 to 1800 MPa. However, highly pure titanium (e.g., obtained by molten fluoride electrolysis or from the iodide processes) is ductile, owing to the very low concentration of interstitial alloying elements (i.e., H, C, O, N). The metal has two allotropes; the alpha phase corresponds to a low temperature crystal structure which has a hexagonal close-packed (hcp) crystal lattice. When the metal reaches the transition point of 882°C, the crystallographic structure changes slowly to high-temperature beta phase which is body-centered cubic (bcc). Like many other elements, this behavior is strongly influenced (i.e., raised or decreased) by the type and amount of impurities or alloying elements." And this is only an excerpt. (Incidentally, a code, of which "[7440-32-6]" is typical, follows each chemical element; I had no idea what this signified and sent a message to the e-mail addresses for Cardarelli given in his books to ask him—but neither address is correct so I remain in ignorance.)

After dealing with corrosion resistance, we come to "Cost (1998)—titanium sponge is roughly priced at 8.81$US kg^{-1} (4.00$US lb^{-1}). ... According to Roskill Information Services Ltd., titanium metal production in 1997 reached 98,000 tonnes per year." Then comes 'History'; "It was almost two hundred years ago that titanium was first isolated and named in 1791 by Rev. William Gregor (1761–1817), Bishop of Creed (Cornwall, UK) and amateur chemist. After examination of the minerals found in alluvion sands from the Helford river, he separated with a permanent magnet a dense black mineral (ilmenite). After dissolution of the ilmenite crystals in concentrated boiling hydrochloric acid in order to remove iron, he obtained an insoluble powder which was the first impure titanium dioxide. Independently, in 1795 in Berlin, the German chemist M.H. Klaporth [sic] discovered the same oxide prepared from rutile ores. Titanium metal was first isolated in an impure form by J.J. Berzelius in 1825 in Stockholm (Sweden) and later by Nilson and Pettersson in 1887. However, pure titanium was first prepared by metallothermic reduction in 1910 by Hunter, by heating $TiCl_4$ with sodium in a steel bomb. This slow progress in the production of the pure metal is the result of the strong chemical reactivity of the element for oxygen, which requires complex and energy-intensive processes to win the pure element from highly stable compounds. From 1930 and 1950 [sic], the only method allowing the metal to be processed into useful shapes was the powder-metallurgy technique applied to titanium sponge. Hence, it was not until 1947 with the development by Dr. Wilhem Justin Kroll of the metallothermic reduction of $TiCl_4$ with magnesium at the US Bureau of Mines that it began to be available as a commercial material. Moreover, improvement of melting methods was a compulsory step to overcome in order to provide homogeneous structural material. In the 1950s, the first melting techniques were resistance, induction and tungsten arc heating, but the development of skull melting by the US Bureau of Mines allowed the production of large quantities of low-interstitial titanium as ingots or complex shapes. Hence, the industry as we know it today is over 40 years old. This was initially stimulated by aircraft applications. Although the aerospace industry still provides the major market where titanium is most commonly associated with jet engines and airframes, titanium and titanium alloys are finding increasingly widespread use in other industries, such as desalination plants and chlorine production. The most recent media attention has been given to equipment in the chemical process industries and to fitting for prosthetic devices and an artificial heart."

In 'Natural occurrence, minerals and ores', we learn that titanium is the ninth most abundant element on Earth (5.65 $g\,kg^{-1}$ of the Earth's crust) and is also to be found in seawater, ash coal, plants and the human body. We are told which minerals contain it and where they are to be found. From 'Mining and mineral dressing', we learn that "first black sand is mined and excavated from beach deposits using front-end loaders, or sand dredges. Typically, the overburden is bulldozed away, the excavation is flooded, and the raw sand is handled by a floating sand dredge capable of dredging to a depth of 18 m. The material is broken up by a cutter head to the bottom of the deposit and the sand slurry is pumped to a wet-mill concentrator mounted on a floating barge behind the dredge. Secondly, sand is wet-concentrated by the classical mineral dressing operations using screens, Reichert cones, spirals, and cyclones in order to remove the coarse sand, slimes, and light density sands to produce a 40 wt% heavy mineral concentrate. The tailings are returned to the back end of the excavation and used for rehabilitation of worked-out areas. The concentrate is then dried and iron oxide and other surface coatings are removed by means of various operation units such as dense media or gravity, magnetic, and electrostatic separation." Later sections deal with 'Processing and industrial preparation' ("crude $TiCl_4$ [is] called "Ticle" by titanium producers"), 'Commercially pure titanium', 'Titanium alloys', 'Titanium metalworking', 'Titanium machining', 'Titanium joining' 'Titanium etching, descaling and pickling', 'Industrial uses and applications' and ' Titanium metal world producers'. In addition to all these, there are tables of pyrophoric properties, of physical and crystallographic properties ("Electronegativity χ_a (Pauling)", natural isotopes, crystal structure, Strukturbericht designation, space group (Hermann–Mauguin) and Pearson's notation, Young's modulus, the Mohs, Vickers and Brinell hardnesses, Poisson's ratio, mass magnetic susceptibility and lots of others), of corrosion rates (uniformly poor except in aqua regia), of the chemical composition of CP titanium grades and the designations of CP titanium in the USA, NATO, Germany, the UK and France with tradenames. Further tables list selected physical properties (among which the Charpy V-notch impact, measured in J^2, was new to me) of the various CP grades, phase stabilizers, the chemical composition of ASTM alloy grades and uses of common alloys.

Not every element is given quite such full treatment but a great many are and everywhere, F. Cardarelli spices all this invaluable but rather dull information with delightful asides: niobium "is named after the Greek, Niobe, goddess of tears and the daughter of Tantalus because tantalum is closely related to niobium in the naturally occurring ores and minerals." For many years, it was called niobium by some and columbium by others. "The name niobium was adopted in 1949 by the International Union of Pure and Applied Chemistry (IUPAC) held in Amsterdam (Netherlands), after 100 years of controversy. Today, many leading US chemical societies and government organizations refer to it by this name. However most metallurgists, leading US commercial producers, however [sic], still refer to the metal as its American name columbium and its symbol Cb."

The coverage is very uneven, 'Timbers and woods' occupying only eight pages, five of which are Table 13.1, which lists properties of about 70 trees, from afromosia *(Pericopsis elata)* to willow (*Salix nigra*). 'Building and construction materials' is allowed a paltry nine pages and is mostly devoted to Portland cement (invented by Joseph Aspdin in 1824), with a few lines on aggregates, mortars and concrete and building stones. There is also a table that provides the density, specific heat and thermal conductivity of a large number of types of brick and some other building materials, such as granite, marble and vermiculite. Although there is no mention of clunch and lath-and-plaster, there are eight different soils (clay, loam, sandy and so on) so anyone who is reading this in a mud hut may find useful information about his dwelling. More than 50 pages of appendices and a bibliography conclude the book, from which we can learn that lutetium used to be called cassiopeium and ekaaluminium has become gallium (definitely an improvement). The same table told me that the element astatine used to be called alabamine; slightly embarrassed to discover that there was an element that I have never heard of, I turned to Appendix 15.1, ' Periodic chart of the elements', only to find no entry for At. A closer examination