Mineralogy & Metallurgic Chymistry

(1805

Gellert

Our two last lectures have been of mineralogy, or the doc-trine of minerals, or fossils. Mineralogy is a science of great national importance. This country abounds in ores & other fossil bodies; but these recesses of wealth have not yet been entered; so that we Americans are absolutely dependent on foreign countries for riches that lay under our feet!

It is seldom that a people search the earth for mine-rals till after the woods & forests are cut off, when they are com-pelled to dig coal for fuel. England & the northern nations of Europe, have long since cultivated that science. In some of these colleges have been instituted for teaching mineralogy merely, and France & Spain have lately followed their example. In a few generations more & we shall do so likewise. In the mean time it may be profitable to sow the seeds of the science of minerals. Should they spring up & produce thrifty plants, they may, like Botany, excite the fostering hand of public pa-tronage. In monarchical governments, he who sows most commonly reaps; but ~~[illegible]~~ it is not always so in scrambling republics. ~~[illegible]~~

In some countries an individual may dig the clay, form it into bricks, and burn them, and with them build an house to shelter him in old age, but when completed & furnished, he may be compelled to relinquish it to another. ~~Such is the sordid spirit of speculation in Democratic~~

Comes from the atmosphere see Thompson Vol III

governments where finess & intrigue corrode, and eat out noble sentiments of honor. Aldrovandus, who wrote 13 volumes folio on Natural history; and to whom the splendid Buffon is in-debted for the most solid parts of his celebrated writings — this laborious Aldrovandus, labored without patronage, exhausted all his little property and expired in an almshouse. Such is too often the fate of the pioneers in every new branch of science; they exhaust their strength in breaking a new road, and leave to some fortunate successor the easy task of smoothing it. — But the greatest object was once in embryo —

We s^d that a metal was composed of an earthy basis & a certain inflammable principle called by some phlogiston; and by some others oxygen. We s^d that metals were usually found in a state of combination with sulphur, or with arsenic, or in a state of calx, ashes or mouldering powder; and that gold & silver were commonly found in a pure, metallic, or native state.

We s^d that the operation by which metals were seperated from their ores was called smelting, when in very large quantities; and we shewed you parts of a very large apparatus for smelting. When seperated in small quantities, merely for sake of know-ing, by the experiment the quality of the ore it is called assaying, and we exhibited a small, compact apparatus for that purpose. Such an apparatus may be taken on a journey, in a carriage, & with the

addition of a small writing desk, completely equips the travelling Mineralogist.

It is not uncommon to bestow an intire lecture on a single mineral; while we endeavour to give you a general view of the whole science in three or four lectures. He who wishes to pursue the Subject at full length should commence with Cronstedts mineralogy in 2 volumes. Then he may take Kirwans Mineralogy. As to the art of seperating, & assaying minerals, I would recommend Gellerts metallurgic chemistry in one volume. — Waller has treated the Natural history of fossils in a neat & Systematic manner. As this Branch of Natural history would demand a whole course of lectures to do it justice, we shall endeavour to condense the leading doctrines of it in a few aphorisms.

A Mineral is any matter dug out of a mine. All metals are minerals, but all minerals are not metals. — We use the term fossile & mineral indiscriminately: for by fossil we understand bodies formed within the earth, & for which we are obliged to dig: we nevertheless use it for bodies found on the surface, & sometimes in water. A mineral or fossil is of a plain and simple structure, in which there is no visible difference of parts, no distinction of vessels, but every portion is similar to and perfect as the Whole.

All

All natural bodies are divided into 3 kingdoms, 1st. Vegetables — 2d. Animals — and 3d. Minerals or Fossils.

Fossils are generated in the bowels of the earth, or on its surface. The parts entering their composition are so intimately blended together, that neither the strictest observation, nor the closest examination with the best microscopes have hitherto been able to discover their combination; but each and every one of the minutest particle seems perfectly similar to the whole; yet the fluid & solid parts of each fossil must have been effected by some very particular mixture

Metallurgic chemistry teaches how fossil bodies may be changed, by proper agents, and so seperated, that we may discover the several particular parts of their composition. — In general these bodies are to be altered by the art of chemistry; by such change a compound substance is divided into its several constituent parts.

The alteration of a fossil cannot be effected but by the intervention of some other agent. Of these agents Fire is the chief; the next is Air; the next water; and the last certain menstrica, or dissolvents. These justly understood and properly applied constitutes the Docemastic art, or the art of ~~treating~~ assaying; to succeed in this art it is necessary to know the laws of chemical attraction. all

All known fossils may be comprised under eight heads, or classes 1st. Earths — 2d. Stones — 3d. Salts — 4th. Sulphurs 5th. metals — 6th. semi metals — 7th Ores — & 8th mineral waters.

Earths consist of very minute & almost impalpable particles cohering very slightly; they are not malleable; nor will they burn nor are they soluble in water.

Stones are only harder, compact & ponderous earth. They are by turns converted into each other; earth may in time become a Stone, and Stone moulder into earth. It is needless to say that Sand is nothing else than small stones; and that gravel is only large Sand; so that they may all be comprehended under one head viz Earths; and all earths are ranked under five orders, — 1st Calcareous Earths — 2d Ponderous Earths — 3d Magnesian earths — 4th Siliceous earths [under w.ch is ranged the Diamond — Ruby — Sapphire — Topaz, — Chrysolite — Emerald and all the other precious stones] 5th Argillaceous earths.

The next general head or class comprises Salts. —
Salts or "saline bodies are substances that give a taste, are
" mixable with water, & not inflammable." Of Salts there are three kinds — 1st. acid — 2d. alcaline & 3d. neutral.

The 4th class of natural bodies, are denominated inflammable sub-stances. The older chemists called all such bodies Sulphur, and some used for the same thing the term phlogiston; While still more recent chemists

chemists call them phosphoric or inflammables.
By all these terms we mean that inflammable principle in the three kingdoms of Nature, by which bodies burn. It is even found in the air. It is found in the various combinations of sulphur with metals; in fat, in oils, in resins, and in coals in the fossil kingdom, and is called oxygen by the chemists of the present day.

The next general head is Metals; these are compact, opake bodies, more ponderous than other fossil substances, fusible in certain degrees of fire, & malleable, i.e. capable of being extended every way by the hammer. Metals are divided into perfect & imperfect; or noble & base metals. The noble metals are gold, Silver, & Platina. (Mercury) The base metals are copper, lead, tin, iron; in their brilliant or calciform state. These metals are variously mixed & combined with one another, and assaying is the art of seperating & refining them. The most common mineralizers are sulphur. arsenic - and fixed air, or aëriae acid - Those w.c are mineralized by aëriae acid are called calciform ores.

The 6.th general head or class comprises the Semi-metals These differ from metals principally in their want of malleability; and of fixity in the fire; for they are brittle under the hammer, and become volatile, or fly off in a great heat. Zinc - Bismuth - Reg. of Antimony, Arsenic & Cobalt are Semi-metals; together with the Some others whose characters are not fully established.

necessary to examine the [illegible]

Ores form the 7th grand division or class of fossics.
Ores are mineral bodies w.c consist of metals, semi-
- metals, and of sulphur, and arsenic, or of both together.
Sometimes they are mixed with stones & earth. & In pur-
chasing ores for a Cabinet we are sometimes imposed on
by certain cheats who compose artificial ores, and wile
cement pieces so artfully together that it is not very
easy to detect the fraud. You may :: by putting them in
brandy or hot water dissolve the cement & discover the
cheat.

Ores are divided, with reference to the effects of fire on
them, into fusible — stubborn — refractory, and ra-
- pacious. A rapacious ore is, when involved in some
corrosive or destructive matter, the metalline particles
of the ore are carried away ~~by the~~ in fumes or vapor, or
else is converted into an irreducible dross.

The 8th & last division of Mineral bodies comprehends
Mineral Waters. Water by passing through the earth be-
- come impregnated with various substances, more especially
saline substances, or pyritous substances that are in a state of de-
- composition. But mineral waters properly so called are those
w.c are impregnated with gasseous, sulphurious & metallic substances
They are sometimes called Medicinal waters. —

(1809 -

Analysis of Minerals - from Accum -

The art of examining minerals by the application of chemical agents, so as to acquire a knowledge of all their constituent parts, forms a part of practical chemistry called the analysis of minerals. And this is not so intricate a business as many may imagine. The analysis of Mineral waters is one of the most difficult processes in chemistry, but the analysis of minerals may be accomplished, with tolerable accuracy, by persons not deeply skilled in chemical pursuits —

The methods employed for this purpose consists in subjecting the mineral to the action of certain bodies w.ch are capable of producing some positive changes amongst its constituent parts. The substances employed are called chemical Tests or Re-agents. These bodies when properly applied quickly produce a change striking to the senses, from which we infer the presence or absence of certain bodies.

The Apparatus made use of is a Furnace, made of a peculiar kind of brick. [These were imported from England & are you see circular.] There are Muffles for roasting of the ore; and Pots of a peculiar form for the like purpose. Then there are Crucibles, from the size of a wine glass to a size capable of holding 300 cc of metal. Here also are Retorts made of Cadledgewoods indestructible clay.

Here

also a set of vessels called cupels, made of the Earth of calcined bones, for the expres purpose of assaying Gold. These were a present from the Assay master of the Tower of London. — All these vessels are for melting & assaying large quantities of metal, and require a building to be erected for containg them. These therefore are for assaying metals in what is called the Larger way; But all the operations of analysis may be performed in the small way by the help of a few instruments in the Closet or study of the amateur of the Science; even all the apparatus, tests, or reagents, and other articles of experiment, necessary for the analysis of the minerals may be comprized in a convenient travelling chest.

Solution is the most general process of analysis. This process consists in affusing upon the substance to be desolved, a fluid employed as a solvent — [Such as the Sulphuric acid - Nitric Acid - Muriatic acid - Phosphoric acid - Boracic acid & the like)

These Solutions should be performed in glass vessels, as Florence Flasks, &c. may be heated over the Lamp furnace or it may be done better in small glass retorts. — Fusion

Fusion is another mode of analysis, viz the conversion of a solid into a fluid, by the application of heat. A small quantity of a mineral may be fused by the flame of a Lamp urged on it by the blow pipe. — The substance to be fused must be placed upon a piece of charcoal or held in a spoon made of pure silver, gold or platina. — The quantity of the substance examined by the blow pipe, should not exceed the size of a pepper-corn. If larger quantities of substances be intended to be fused, the vessels in which the operation is to be performed, are called crucibles —

Hail, adamantine Steel! magnetic Lord!
King of the prow, the plough-share, and the sword!
True to the pole, by thee the pilot guides
His steady helm amid the struggling tides,
Braves with broad sail the immeasurable sea,
Cleaves the dark air, and asks no star but Thee. —

Darwin's Botan. garden 79.

Auriferous Native Silver —
Colour between silver & gold. It is a natural alloy of silver and gold. We have an uninterrupted transition from common native silver to native gold; and in this transition series, the goldish-silver holds the middle place (Jameson V. 2. p. 441.

H.M.S. c 16. 4