CHAPTER I.

Examination of substances brought from home. As an introduction to this course of Elementary Chemistry, the pupils should be asked to bring specimens of solid substances which are in common use at home. A list of the materials brought should be written by the teacher on the black-board. This list will probably include salt, sugar, flour, rice, coal, wood, tea, coffee, washing-soda, sal-ammoniac, saltpetre, alum, whitening, bath-brick, sulphur, beetroot.

A description of each substance brought by the children should be written in the class-book. The effect of heating the substance in an open crucible should then be tried, and the change of appearance, if any, noted. From these experiments a classification of the substances into those which char, and those which do not char, will naturally suggest itself. By collecting the class results, writing them on the blackboard, and getting the children to suggest the origin of each substance, it will be discovered that those which char have been derived from living matter, and hence are called *organic* (organism, a living being); the other substances on the list which are obtained from non-living matter are termed *inorganic*.

This classified list should be entered into the note-book of every member of the class and kept for reference.

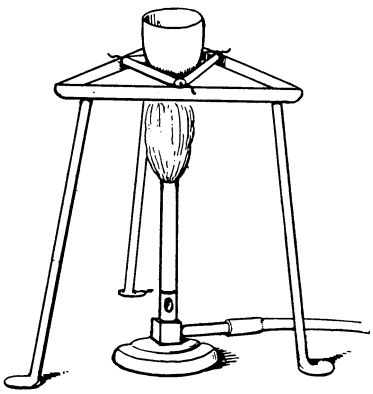


FIG. 1.

The children will also find that salt, bath-brick and whitening do not change in appearance when heated. Washing-soda and alum first liquefy, but on further heating leave a white solid residue in the crucible.

Nitre fuses and seems to boil, but solidifies when cooled. Sulphur melts, darkens in colour and burns with a blue flame, leaving no residue, while suffocating white fumes are given off. Sal-ammoniac sublimes.

Sugar melts, blackens and takes fire, and seems to disappear. Wood chars, burns, diminishes in quantity until finally only a small quantity of white ash is left, which does not change on continued heating. When beetroot is heated for some time, only a small quantity

of white ash is left. This ash must be kept for future investigation.

When the coal is examined, some pieces will be found to contain gold-coloured flecks, and if these are removed with a penknife and heated separately, they will be found not to change unless heated strongly, although the coal itself takes fire and burns. These flecks are the substance called iron pyrites.

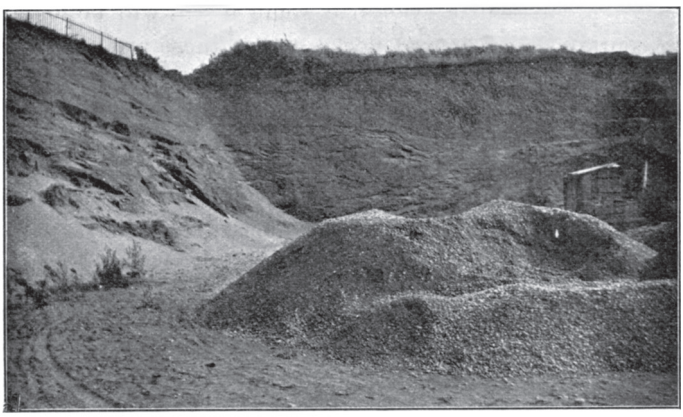
NOTE. It is advisable to select beetroot as the typical vegetable because the ash contains a large quantity of potassium salts.

Examination of building materials. The class must next be asked to bring specimens of materials used in building houses, and it will be found that an average class will bring the following substances:—sand, sandstone, flagstone, marble, slate, iron, zinc, lead, copper, brick and lime.

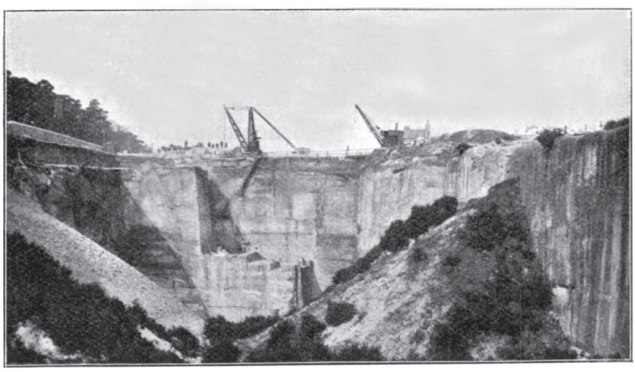
This list will naturally vary very much according to the locality of the school, and this part of the work is open to considerable variation. In many parts of England the children can now be made acquainted with ores, can be taken to see quarries and mines, and the work correlated with the geography lessons. In a London school, where there are many difficulties in getting specimens and going on expeditions, the substances can be studied in the following order:—

Sand. The appearance, colour and properties of the sand should be carefully noted, and then the localities in which it is found discussed. The children will all know that sand is found on the sea-shore, and by consideration of the other materials found there, such as pebbles and

pieces of rock broken off the cliffs, they can be led



Sand-pit.



Sandstone Quarry. Higher Bebington.
[*By kind permission of Mr Wells.*]

to suggest the origin of sand, *i.e.* that the rocks have been worn away by the action of waves and weathering.

Further questioning will elicit the information that sand is also found inland, and that it is dug out of sand-pits which the children may have seen and of which photographs may be shown. The class will then be led to consider what would be the effect of pressure on such beds of sand, especially if the grains become cemented together, and to suggest that sandstone would be formed. Sandstone should then be examined to see if it does consist of sand particles cemented together, and pieces of paving-stone examined and compared with the sandstone. The localities from which sandstone and paving-stone are obtained should then be found out by the class, the children being allowed to consult books and ask questions at home.

At the next lesson the information brought by the children should be tabulated on the blackboard by the teacher and photographs or pictures of large sandstone and flagstone quarries should be shown, while each child should colour on a sketch-map the sandstone districts of England.

The sandstones and flagstones constitute a numerous family and as old shore sediments occur in almost every geological formation:—the Old Red Sandstone, Carboniferous; New Red Sandstone, Jurassic and Wealden.

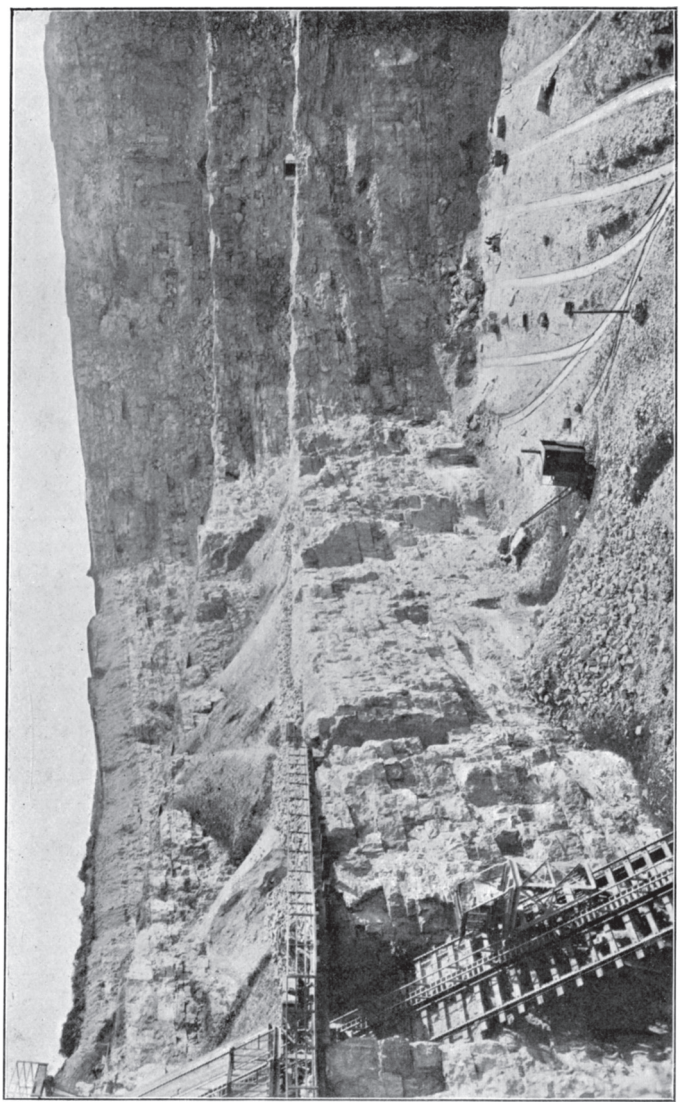
For the most part they consist of grains of sand consolidated by pressure and cemented by silica, carbonate of lime, or oxide of iron. The localities from which sandstone is obtained for building purposes are very numerous; the following being a short list:—Carboniferous sandstones in many parts of Yorkshire, Derbyshire, Lancashire, Durham, Northumberland, Gloucestershire, Glamorganshire, etc. New Red Sandstones in Cheshire, Staffordshire and Worcestershire. The oolitic sandstone of Whitby and the Wealden sandstone of Tunbridge Wells are also used.

The following are some of the better-known sandstone quarries :— Appleton (near Huddersfield), Darley Dale (Derbyshire), Forest of Dean (Gloucestershire), Gazeby (Yorkshire), Mansfield (Nottinghamshire), Matlock (Derbyshire). Much of the sandstone known in London as "York stone," which is used for steps, landings, etc., comes from the South Owram Quarry in Yorkshire.

Lime. This substance is used with sand for making mortar, and should therefore be examined next, but care must be taken in handling it. Its appearance should be noted by the class, as also the effects of adding water to it, such as difference in temperature, absorption of water and increase in bulk, thus getting the pupils to realise the physical difference between "quicklime" and "slaked lime."

The children should be encouraged to notice how workmen prepare slaked lime and the mortar for building purposes, and to write an account of what they have seen. Most children will know that lime is made by calcining limestone or chalk in a lime-kiln, so they can examine pieces of limestone and chalk (whitening) and compare them with lime, and if time permits they can themselves try the effect of strongly heating a piece of limestone to see whether they do get a substance formed that behaves like lime when treated with water.

Marble can also at this stage be examined and described, but the class will not realise that there is any connection between limestone, chalk and marble. The children should be encouraged to find out from what parts of England limestone, chalk and marble are obtained, and should mark these districts in their sketch-maps. Photographs of limestone quarries, marble quarries, and chalk-pits or chalk cliffs should be shown.



Limestone Quarry at Llandulas.

The limestones are all of sedimentary origin, formed either from the remains of organisms or by mechanical deposition in deep sea or lake basins, or in certain cases by chemical precipitation. They vary in compactness from the softness of powdered chalk to the hardness of dense marble. The oolitic limestones are composed of spherical grains cemented together, and they are extensively used for building purposes. Almost all important buildings in London from the beginning of the 17th century until the present time have been built of Portland stone, one of the oolitic limestones. Limestones for building purposes are obtained from Carnarvonshire, Derbyshire, Devonshire, Dorsetshire, Gloucestershire, Northamptonshire, Rutlandshire, Somersetshire, Wiltshire, Yorkshire.

Lime, in addition to its use for making mortar, is used in the preparation of whitewash, which is formed of quicklime, mixed while hot with plenty of water.

Whiting, or whitening, is a name for levigated chalk which has not been calcined. In order to prepare this substance for use, six pounds of the powder is covered with water, left for six hours, and then mixed with a pound of double size and left to stand until it becomes like jelly. Later it is diluted with water and is then ready for use. Putty is made by mixing dried and finely-ground whiting with raw linseed oil.

Slate. Pieces of slate should next be examined by the children, the colour, lamellar fracture and relative softness noted.

When a piece of slate is breathed upon, a peculiar clayey odour is noticed; this property and the appearance of the slate will lead the children to infer that slate is hardened clay, and therefore hardened mud. Slate, however, has also been subjected to lateral pressure, so that it does not split along the planes of the original bedding.

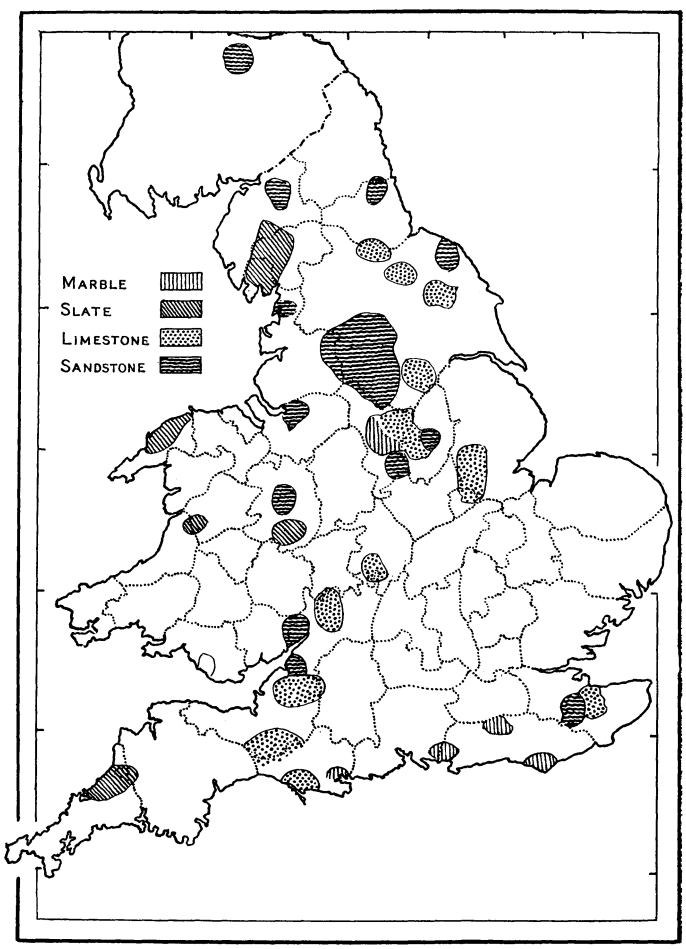


FIG. 2.