ARTIFICIAL STONES.*

The various compositions that have been invented from time to time to replace natural stone, by substances cheaper, more convenient, or more durable than any that can readily be obtained on the spot where the stone is required, are so numerous that it would be impossible merely to name them without occupying much time, and a mere enumeration could have little or no interest. My object in the present communication is to direct the attention of the section to the different classes of material that have been found available; to point out the principles involved in each, and the special advantage and disadvantage each possesses; to refer to a new, and, I believe, an important material, and to suggest the bearing of the whole subject on that of the preservation of stone from decay. Having for several years, and especially during and since the Exhibition of 1851, taken great interest in the subject of constructive material and the preservation of stone, and having lately been one of a Committee of Inquiry concerning the state of the stone of the Palace at Westminster, I have learnt from experience how little the whole subject is understood, how vague are the notions of intelligent practical men—builders as well as architects—and how difficult, if not impossible, it is for architects, engineers, and builders to determine, by any series of experiments lasting only for a short time, whether a method proposed is likely to have any practical value when applied on a large scale.

The artificial stones hitherto used may be grouped under one of three heads; they are either (1) terra cotta, or manufactures of plastic clay burnt in a kiln; (2) cements, manufactured from a certain kind of limestone, containing foreign ingredients of such a nature that, when converted into lime by burning, the lime thus made possesses the property of setting very rapidly and firmly when wetted; (3) siliceous stone, obtained by burning in a kiln sand and other substances moulded with a solution of silicate of soda, which is converted into a kind of glass firmly connecting the particles. I omit plasters, as rarely exposed to the weather.

Terra Cotta.

The advantages of this material are (1) its cheapness, and the abundance and universal distribution of the clays of which it can be made; (2) the facility with which it can be moulded to any required form; and (3) the pleasant colour of the material when uninjured by long exposure to weather. The work recently executed at the Horticultural Gardens at South Kensington is a favourable specimen. The disadvantages of terra cotta are (1) the uncertainty of the result, owing to the great and unequal contraction of all clays in burning; (2) its want of power to resist damp and frost whenever there is the slightest flaw, whether produced before or after burning; (3) its brittleness and want of strength; (4) its exposure to a disagreeable green vegetation in damp air after a few years' weathering. Terra cottas are better adapted to a dry than a moist climate.

Cement.

Whether of the kind called Puzzolana, Roman, or Parker's, or Atkinson's, or any modification of these, all the cements are similar in their nature. The advantages of cement used as an artificial stone are (1) its cheapness where made, and its ready transport; (2) its not requiring the kiln, but setting at once without contraction; (3) the facility of moulding and making up the material from the manufactured cement supplied; (4) its great strength when well made. The disadvantages are (1) that it cracks and peels badly when exposed to frost and damp air; (2) that it is very irregular, some samples yielding a much harder, better, and more lasting stone than others, without apparent reason; (3) that it is subject to a green vegetation, like terra cotta. These disadvantages do not all apply to its use in making concrete, for which it is admirably adapted.

Siliceous Stone.

This is manufactured under a patent by Mr. Ransome. It attracted attention at the Exhibition of 1851, and has since been much used. Its advantages are, (1) the extreme uniformity of its texture; (2) the almost entire absence of contraction, and its freedom from cracks and flaws produced during burning; (3) its complete resistance to all kinds of weathering, to which may be added (4) its pleasing colour and tint.

On the other hand, among the disadvantages are (1) its cost, which is greater than for either of the other kinds of artificial stone; (2) its being subject to a white efflorescence of salt and a green stain from damp, both of which take away from its value for ornamental purposes, for which it is otherwise admirably adapted.

The mechanical and chemical principles involved in these different contrivances are as follows:—In terra cotta the material is a kind of clay purer and more free from foreign substances than common clay, and mixed with dust from pottery already made. The manufactured article is thus a superior fire-brick. The burning produces little chemical change or metamorphosis, but the condition after burning is so far different that ordinary exposure will not bring back the original texture of clay. Of closer texture than brick, there is less absorption from the surface; but in ornamental work there are always flaws enough to render frost following rain dangerous and injurious. In other respects the material itself is little more liable than brick to injury from exposure.

In cement the raw material is carbonate of lime, with a certain but variable proportion of foreign substances, of which clay or silicate of alumina is an important and even an essential part. All the varieties of cement stone, such as the stones called septaria and other nodules, in the London clay at Harwich, or the Kimmeridge clay in Dorsetshire, or the Lias in the Midland Counties and the north, or the mud of the Medway and Thames, agree in this. On burning this material the limestone is converted into lime, and the condition and proportion of the foreign material determine the value of the resulting cement. It is called *hydraulic cement*, as setting with almost any required rapidity when properly mixed with water, and this in damp air, during rainy weather, and even under water, absorbing no more water than is necessary for consolidation. Under various names, *pozzuolana*, Roman cement, Parker's cement, Atkinson's cement, &c., this valuable material has been used from

* By Professor D. T. Ansted, M.A., F. R. S.