CEMENTS.

It is one of the popular errors of the day to suppose that the mortars used by the builders of former centuries were more enduring than those of the present age. Such is not the case, and no proof of it is furnished by any existing or historical evidence. The ancients used bitumen for cementing together bricks and stone in their masonry construction. Bitumen was used in building the Tower of Babel, and the walls of Babylon were composed of bricks united together with hot asphaltum. An analysis of some of the mortar taken from one of the Pyramids shows that the Egyptians used a mixture of lime and sand, proportioned about like the common lime mortar of the present day. The aqueducts of ancient Rome were built with a mortar of a similar character. A step in advance was the use of the Italian pozzuolanas, or volcanic ashes, a material which has been extensively employed throughout Italy and some parts of France, from the times of Pliny and Vitruvius down to the present century. In the Netherlands, what is known as Dutch trass, a material made from a soft rockstone, and in its properties closely resembling the Italian pozzuolanas, has long held an important place among building materials. Until about the beginning of the present century this class of materials, comprising, besides those above named, some of the ocherous earths, granites, schists and basalts, various sands, and sometimes furnace slags and burnt clay, were depended upon throughout the civilized world for conferring, in a feeble degree, the hydraulic property upon mortars.

The discovery of the natural cements was a second step in advance. That event was regarded at the time as only the re-discovery of a lost art, and hence to the article first produced was given the name of Roman cement, a name now generally applied to all natural, quick-setting cements. The Roman, or natural, cements gave such satisfaction that attempts to manufacture them, by burning an artificial mixture of chalk and clay, soon followed, finally culminating in the production of what was called Portland cement, which has been in general use from that time to the present, and which is now manufactured extensively in England, on the Continent and in the United States. With Portland, or hydraulic cement we are able to produce a mortar of greater strength and hardness than any that the researches of antiquarians have ever brought to light. The examples we have of ancient masonry are restricted mainly to aqueducts, sewers and other subterranean works that have not been exposed to the disintegrating action of the elements. Nearly all the specimens extant have been found accompanied by conditions extremely favorable to their indefinite preservation. Mortar made with the hydraulic cement of the present day possesses, when but a few months old, more of the acknowledged characteristics of durability than anything that has ever been discovered.

Roman, or natural, cements usually take the name of the place of manufacture. They are produced by burning, at a heat just sufficient in intensity and duration to expel the carbonic acid, certain argillaceous or silicious limestone, containing less than 77 per cent. of both carbonates, and afterward grinding the product to a fine powder between millstones. They can be produced artificially by burning a mixture of lime, or carbonate of lime, and clay. Prior to the discovery of the process for making Portland cement, Roman cements were made in both France and England, by slightly varying the proportions of the ingredients and burning the mixture at a high heat. The superior qualities of Portland cement, however, and its greater economy, gradually drove these quick-setting artificial cements from the market. Their manufacture soon ceased, and has never been resumed. But it is not to be expected that the use of these natural cements will be entirely superseded by that of the Portland. For certain purposes they are as necessary, not to say indispensable, at present as they were when their introduction revolutionized the former methods of executing submarine constructions in masonry. They possess sufficient strength for the purposes to which they are usually applied, viz., for massive concrete foundation, for the concrete hearting and backing of thick walls faced with brick or ashlar, and as the means of conferring the hydraulic energy upon mortar for ordinary stone and brick masonry. Nevertheless, it is true that for similar purposes good Portland cement, suitably diluted with common lime, in order to reduce it to the strength of the quick-setting natural cements, is in most localities the less costly of the two. Portland cement produces a mortar possessing about four times the strength, at less than twice the cost, of the quick-setting artificial cements.

For concrete foundations laid green in water, Roman cements are almost invariably to be preferred, in the hands of ordinary workmen, to those which set more slowly. Most of them not only hold the sand, by their unctuous and adhesive properties, more tenaciously than the Portland cement, but their prompt induration or hardening arrests the washing effects of the water, and prevents the progressive separation of the sand and cement before it has had time to proceed far enough to produce serious injury to the concrete.

Portland cement was named from its resemblance in color to the English Portland stone. In contradistinction to the Roman, or natural, quick-setting cements, it is described as a heavy, slow-setting cement, produced at a high heat. There are several processes in use for making this cement, dependent in some measure, so far as they differ from each other, upon the locality and the special characteristics of the materials employed. In general terms, Portland cement is produced by burning, with a heat of sufficient intensity and duration to induce incipient vitrification, certain argillaceous limestones or calcareous slags, or an artificial mixture of carbonate of lime and clay, or lime and clay, and then reducing the burnt material to powder by grinding. This cement was discovered and first manufactured in England, soon after the beginning of the present century. Factories were shortly established in certain districts of France and in other parts of the Continent of Europe. The United States being plentifully supplied with the argillo-magnesian, and to some extent with the argillaceous limestones, suitable for making Roman cement of good quality, and having had a large capital invested in this industry since about 1830, were slow to adopt the Portland cement. It was not until after the close of the civil war that the importation of Portland cement received any encouragement. It was first used here upon government works, and afterwards in the manufacture of artificial stone. Its consumption soon, however, assumed large proportions. In the years 1874 and 1875, the importations amounted to 100,000 barrels of 400 pounds each year. Since that period, Portland cement works have been started in different parts of this country, and have supplied the home demand to such an extent that the importation of foreign Portland cement has very much fallen off. It is probable that in a short time very little, if any, Portland cement will find a market in the United States except upon the Pacific coast, where it will be procured by direct importation.

SECULAR CHANGES IN THE EARTH'S FIGURE.

An interesting hypothesis has been promulgated before the French Academy by M. Faye. It has long been known from geodetic surveys and pendulum experiments that continents and mountain ranges do not exert this attraction on the pendulum which might be expected of them, judging from the observed attraction of such isolated masses as Mount Schehallion in Scotland, or the great pyramid. In fact the deficiency of mountains in this respect is so striking that in order to account for it, geologists and astronomers have imagined that there are vast cavities underlying continents and mountain chains. A somewhat different explanation on the feeble action of the Himalayas on the pendulum has been offered by Sir George B. Airy, who supposes that the attraction of the mountains is counteracted by still fluid lakes of rock below them. But this suggestion does not meet the fact, elicited by M. Saigey, that the attraction on islands of the sea is greater than it ought to be. It appears to be clear, however, that there is a relative lack of matter under continents, and an excess of it under the oceans. The hypothesis of M. Faye would seem to solve the problem in a very simple and reasonable manner. He holds that under the sea the earth's crust has cooled much more quickly than under dry land, and hence the solid sea-bed is denser and thicker than the sub-continental mass. Water is a good conductor of heat as compared with rock, and being liquid it is also able to convey heat from its underlying basin. Geodesy shows that the present figure of the earth is an ellipsoid of revolution ; but if M. Faye's hypothesis is correct it has not always been so. At first it was an ellipsoid, but the unequal cooling of the earth due to the liquid mantle covering it, led to unequal stress and the elevation of continents where the crust was thinner. These continents according to M. Faye, surrounded the north pole, and the level of the ocean over our hemisphere was raised ; thus bringing the earth to a more spheroidal form. Finally, as the cooling continued, the austral continents attracted the oceans and the figure became once more ellipsoidal as it is to-day. If this ingenious speculation were the true one, it would unquestionably help geologists to explain the origin of the glacial period. *Engineering.*

THE Chinese workmen introduced by the manufacturers of North Adams, Mass., are leaving the place, many of them returning to China.