units of power. Thus, an agent of one horse power can do 7,458,000,000 ergs per second, and we can always determine the H.-P. at which any agent is working by dividing the number of ergs done in a second by 7,458,000,000, or, with sufficient accuracy for most purposes, by dividing by 7,460,000,000. The rate of doing work equivalent to 10,000,000 ergs per second is called a *watt*.

(To be Continued.)

THE ADMIXTURE OF LESS VALUABLE INGREDIENTS WITH PORTLAND CEMENT.

(Transaction of the German Association of Cement makers, March, 1883.

It had been already laid down as a proposition, at a previous meeting of the Association, that the sale of cement containing an admixture of foreign ingredients, added after the burning, was a fraud on the consumer, leaving out of the question how far the quality of the cement was impaired by such additions. A large number of makers had agreed to this decision (though others, secretly or openly, resisted it), and steps were taken to enforce its general acceptance throughout the trade. Apart from the moral considerations of fair dealing, the authorities of the Association felt bound to investigate whether or not the addition of silicates, ground slag, and other materials, had an injurious effect on Portland cement, and they therefore caused enquiry to be made as follows:—(*a*) Concerning the influence on the quality of the cement of such additions being made during or after the burning; and (*b*) The discovery of some simple tests to indicate with certainty the existence of impurities in the cement. Various members of the Association conducted experiments bearing upon these points, and some of the results laid before the meeting were of much importance. Mr. Dyckerhoff undertook the following tests to prove the influence of various mixtures upon the quality of such cement:—(*a*) An examination of the strength of pure cement, and of cement mixed with powdered slag, limestone, lime and fine sand. (*b*) Of mixtures of slacked lime and sand, to which powdered slag, trass, and ultramarine were added. (*c*) Of mixtures of cement with trass and ultramarine. (*d*) Of cement lime-mortar, where the cement is pure or mixed with powdered slag. Tables are given of the breaking weights of test briquettes of samples of these different mixtures in various proportions; the tests were mainly made after twenty-eight days, but some samples were kept for half a year before being broken. The general results proved that, with the sole exception of ultramarine, all such addition to Portland cement impaired its strength.

Other investigations of a similar nature were undertaken by Drs. Hurzog and Delbrueck, and Messrs. Bernoully and Heyn, Dr. Hurzog made three series of experiments; the first intended to demonstrate the effect of various proportions of powdered slag, the second the influence of plaster of Paris upon mixtures of cement and ground slag, and the third the special relations which exist between the ground slag and the plaster. From the first series of experiments he arrived at similar conclusions to those of Dyckerhoff, namely, that all additions of ground slag are injurious to the strength of the cement, and that the reduction in strength is directly proportionate to the amount of slag employed. The result of the second series of tests proved that the addition of plaster of Paris improved the quality of cement mixed with slag, but that the amount which could be so used with safety varied with each particular mixture, and that a maximum limit was soon reached. The third set of experiments indicated that in order to obtain the best results, the amount of plaster used must be proportionately increased in accordance with the quantity of ground slag employed.

The experiments undertaken by Dr. Delbrueck proved that the results of the admixture of foreign ingredients depended mainly on the fineness with which the cement was ground, or the extent to which the added material lent itself to improve the mere physical qualities of the mixture, in point of adhesion and cohesion. If to a cement, which is a mixture, in certain proportions, of fine and coarse particles, a foreign material in a very fine state of subdivision is added, the result may be, owing to the more complete filling up of the interstices between the cement particles, that a denser, and therefore a stronger, mortar is formed. This points to the fact that normal sand, or one from which all the finer grains have been removed, is likely to give unreliable results when employed with adulterated cements. From a second set of tests Dr. Delbrueck proved that a mixture of finely-powdered slag had a corresponding effect on the cement mortar to that which would result from the addition to the mortar of an increased amount of sand; and the same held good with other materials used for degrading the cement. Mr. Bournoully arrived at identical conclusions from a set of independent tests, and he found also that plaster of Paris had a beneficial effect. He noticed that the cement to which ground slag had been added required more than the standard volume of 10 per cent. of water on making from it the normal test-briquettes. Mr. Heyn's experiments were partly favourable, partly adverse to the addition of slag; they tended to prove that particular qualities of ground slag had, in some cases, a beneficial effect on certain kinds of cement. Mr. Blankenstein pointed out that mixtures of cement and powdered slag gave bad results when used for stucco. In addition to the facts adverse to adulteration, the instances in favor of this precedure are noticed. One firm have, they state, for years blended their cement with certain quantities of selected silicate of lime and other minerals, with the effect of considerably improving its strength.

With respect to the investigation of methods for detecting the use of adulterating materials, Dr. Schumann states that the specific gravity of genuine, pure Portland cement never sinks below 3·11 whereas, out of seventeen adulterated cements examined by him, not one attained to this amount. Many plans were presented to the authorities for ascertaining the presence of ground slag, both quantitatively and qualitatively, but they deemed it expedient to withhold their publication, as if simple means were pointed for indicating the existence of this class of adulterants, fraudulent manufacturers would merely be induced to seek for other materials for sophistication. It came to the knowledge of the meeting that adulteration was not only undertaken by the manufacturers, but that the middlemen and dealers were also answerable for this practice, and that in some cases samples of cement had been met with which contained, no less than 50 per cent. of foreign ingredients. As the result of the debate, the following six articles were adopted by the meeting:—

1. Portland cement is a material resulting from an intimate admixture of lime and clay, as its essential components, calcined to incipient vitrification and reduced to a fine powder.

2. Every product formed in a different way, or to which foreign ingredients are added during or after the calcination, is not to be considered as Portland cement. This is not, however to exclude the addition of not more than 2 per cent., of plaster of Paris.

3. The sale of cements, containing no admixture of foreign foreign materials, under the designation of Portland cement is therefore to be considered as a fraud on the consumer.

4. Good Portland cement is not improved by the admixture of foreign ingredients; as, for instance, silicates of lime (powdered blast furnace slag, &c.), trass, ground clay-shales, limestones, &c.

But even if, in certain cases, it were possible to adduce results showing that an improvement could be effected by such mixtures, the manufacturer is not to be allowed to adopt them, because the consumer has no means of so far checking the amount and the quality of such additions as to be able to protect himself against abuses.

5. Every addition to the cement is to be regarded as the commencement of its employment for mortar, and can therefore never be considered to be the business of the manufacturer, but must be undertaken by the consumer.

6. As the normal test, at the period when it was adopted, was introduced for the testing of Portland cement, unmixed with foreign ingredients, and, as the specific character of Portland cement is changed by such mixtures, the normal tests cannot be employed for the comparison of adulterated with unmixed or pure cements.—*Tr. Ins. C. E.*

G. R. R.

THE COLOURED CURTAIN IN THE EYE.

BY WILLIAM ACKROYD.

This ring like curtain in the eye, of grey, green, bluish-green, brown, and other colours, is one among the very many remarkable contrivances of the organic world. The eye cannot bear too much light entering into it, and the coloured curtain