animal oil in its composition it would be apt to appreciably affect concrete exposed to it. On the other hand, the action of the black oil seems strange in view of the fact that it is a straight mineral product. All of these briquettes had absorbed considerable oil, the actual gain in weight of each set at the end of the year being as follows:—

In engine oil	10.6 per cent.
In cylinder oil	10.0 per cent.
In black oil	12.0 per cent.

Table VIII.—Action of Lubricating Oils on Concrete.

Age in Oil	Tensile Strength, lb. per sq. in., of briquettes kept in Air	Engine Oil	Cylinder Oil	Black Oil
7 days*	218	252	235	234
28 days	233	240	273	222
3 months	287	251	221	181
6 months	303	232	209	131
1 year	293	231	203	Broke in clips

* The briquettes were aged 14 days in air before immersion.

The briquettes in the black oil had not swollen perceptibly and seemed merely to be weak.

The experiments given above were all made upon very small test pieces and hence the action of the solutions upon them were much more rapid than they would be upon a large mass of concrete.

The paper was followed by lengthy discussion, Dr. Allerton S. Cushman, of the Institute on Industrial Research, Washington, stating that his experiments largely corroborated those of Mr. Meade. As a probable cause for the disintegration of concrete in alkali waters, discussion tending to show that chemical changes cause undue expansion, and that the best protective methods of preserving concrete where used in localities having black alkali waters, as is the case in many parts of the west, were by the use of coal tar oil. Experiments have also shown that briquettes tempered with copperas have never shown signs of rupture nor have they cracked when submerged in alkali water, and that after having been submerged in this water, they get very hard. Others have shown that concrete in waters carrying sulphates almost invariably change the calcium hydroxide to calcium sulphate, and that this chemical change, demanding more room for increased expansion, disrupts the concrete, and in but a comparatively short time causes disintegration. Tests also showed that in using black oils for waterproofing, trouble might be caused and disintegration follow if the oil used contained even a trace of sulphuric acid. The author of the paper stated that the oil used in the tests as referred to in his paper was a residual oil as used only for the lubrication of very heavy machinery, and that the very slight flaking or sloughing off was on the surface of the foundation only, and did not continue into the concrete, although considerable oil was absorbed by these foundations.

Reference was made then to a method of waterproofing cement used in construction in sea-water. This method is credited to Arthur Rea, of France, and consists of adding a small percentage of gypsum, say, 5 to 20 per cent., to accelerate action, and to add to the concrete finely crushed marble. So far as is known, this method has proven very satisfactory in that country, although experiments made along these lines in Boston harbor, using six representative brands of cement, showed various results with these different cements. At the end of six months all briquettes tested had been slightly reduced with the exception of those made of one brand of cement. In adding waterproofing materials, it was stated in this discussion that the action of a solution of some salts, if added while plastic, will cause the concrete to expand unusually, while one or two others may show no such effect, but when added after the concrete has set, some of these solutions may cause the concrete to disintegrate. Many cases are in existence where concrete in sea-water along the Atlantic coast shows clean sharp edges after having been subject to this water for five years.

AMOUNT OF CEMENT FOR CONCRETE.

Mr. Stanley Macomber, city engineer of Centralia, Wash., in an article in the the Iowa "Engineer," states that a number of engineers in Washington are using clauses similar to the following in connection with their specifications for concrete work:—

Every cubic yard of concrete 1:3:6 mixture shall contain at least 4 sacks of cement.

Every cubic yard of concrete 1:3:5 mixture shall contain at least 4½ sacks of cement.

Every cubic yard of concrete 1:1:1 mixture shall contain at least 12 sacks of cement.

Every 2 cu. ft. of top mixture 1:2 shall contain at least 1 sack of cement.

For cement over this amount nothing will be paid the contractor.

For every sack of cement under the above amount the regular price shall be deducted from the total sum due to the contractor.

The contractor to figure on the above amounts rather than on the direct mixture.

Arrangements must be made with the city engineer for the proper inspection of the amount of cement used.

It is also stated that during the day the inspector tries to keep the mix as near correct as possible, and at night the empty cement sacks are counted and a material slip filled out, signed by the inspector and the contractor. A copy is given the contractor and a copy put on the file in the office. When it comes to final settlement these slips are taken as receipts for the amount of cement used. The amount of cement hauled on to a job is also kept in this manner as a check.

The area and mileage of street paving of various classes in the city of Philadelphia is given as follows in the annual report of the Bureau of Highways, of which Wm. H. Connell is chief:—

Character.	Sq. yards.	Miles.
Granite block	6,653,532	352.99
Asphalt (sheet)	6,959,656	472.35
Asphalt (block)	72,532	7.49
Vitrified brick	2,376,224	163.63
Cobble	162,775	14.02
Rubble	93,182	6.69
Slag block	78,071	8.13
Cement and granolithic	54,242	11.03
Wood block	121,505	4.06
Totals	16,571,719	1,040.39
Bituminous macadam roads	312,104	29.01
Waterbound macadam roads	3,035,429	261.31
Total macadam roads	3,347,533	290.32
Grand total (improved pavements and macadam roads)	19,919,252	1,330.71
Earth roads	.....	179.06