have withstood any reasonable strain that might have been put upon them. The writer has in his yard a large concrete flower vase about 20 years old, and probably made of imported cement. The surface shows no sign of disintegration, but the hollow pedestal is cracked vertically. This is another instance of lack of reinforcement, for a few rings of heavy wire in the concrete would have prevented this. In Germany, where the use of reinforced concrete has been more developed than here, concrete poles 50 feet or 60 feet high, for telegraph and power transmission purposes, are becoming quite common, and have been found practically indestructible and much cheaper than wood. They are reinforced with steel rods to withstand bending.

Some discussion has arisen recently as to the effect of sewage, sewer gases and percolating water on concrete. The arguments are, of course, directed against the cement itself, not the aggregate. Now Portland cement is only one of a family of high lined substances used as binders in mortar. The most common mortar is that made with slacked lime. Any argument as to solubility directed against cement must have greater force against slacked lime, for this is chemically the most active and soluble form of lime. If lime were soluble to any extent in sewage, or affected by sewer gas, the thousands of brick sewers throughout the country that are laid with lime, natural cement or Portland cement mortar are doomed to destruction by disintegration of the mortar. What are the facts? In our eastern cities many old brick sewers laid in lime mortar fifty to seventy years ago have been dug up to make room for larger ones and have been found in perfect condition. This should dispose of any argument that sewage has a deleterious influence on cement construction.

FREE LIME IN CONCRETE.

Another argument that has been used to show that cement will disintegrate is that it will give up lime to water with which it is in contact. On the face of it, this looks serious, but those who use this argument lose sight of the fact that the setting free of lime is an essential part of the chemical reaction that we call the setting of the cement. Portland cement consists essentially of di-calcium silicate 2CaO, SiO2, with an additional molecule of lime in solid solution. This is equivalent to the formula 3CaO, SiO2, though as stated, this latter substance is not a true component, but a solid soltuion of CaO in 2CaO, SiO2. Now Le Chatelier has worked out the reaction that occurs when this solid solution is brought into contact with water as follows:—

$3CaO, SiO_2 + 4\frac{1}{2} H_2O = CaO, SiO_2\ 2\frac{1}{2}\ H_2O + Ca(OH)_2.$

It will be seen that two molecules of free slacked lime are set free by this reaction, and it is the solution of a small portion of this lime in water that has caused some people to predict that cement work will not be permanent.

This free lime, in fact, plays a very important part in hydraulic work, but its action is beneficial. When it comes into contact with the air, or with carbon dioxide dissolved in water, it is changed to carbonate of lime or practically common limestone. In this form it actually fills up the pores of the concrete and helps very greatly to make it water tight. For this we have the testimony of one of the largest builders of concrete dams in this country, whose reputation depends on the permanency of his work. He says that a concrete dam when just completed is slightly porous, but the lime carried by the seepage water is soon deposited in the pores, making the dam water tight. That this must be so is shown by the fact that in some cases they put the electric power machinery in chambers built in the dam itself, and it is well known that electric machinery cannot be well operated in a damp place.

The use of concrete for farm tile is gaining favor rapidly. It has been claimed that the porosity of the tile would permit the cement to be leached out. In the light of the foregoing such a possibility is very remote if the tile are well made. The writer can see no object in insisting that a farm tile shall be porous. They are laid end to end with no cement on the joints, and the joints can admit as much water as a run of tile of any length can carry. They should be made of sand containing particles of all sizes, so as to make a strong tile, and should contain enough cement to merit the name of concrete.

SUMMARY.

In conclusion, it may be well to summarize the foregoing for the benefit of the man who is about to engage in concrete work.

1st. Purchase a reliable brand of cement.

2nd. Use clean sand that contains particles of all sizes, as it will make a denser concrete with the same amount of cement.

3rd. If you use crushed stone, see that it is free from dust and is not of a kind that will disintegrate when exposed. Clean gravel, limestone or trap rock is the best.

4th. See that the materials are well mixed dry, so as to distribute the cement evenly. If this is not done the cement will form lumps when wet that will be difficult to break up.

5th. Careful mixing after wetting and thorough tamping are essential.

6th. Use reinforcement if the article is to withstand bending, tensile or shearing stresses.

7th. Fight shy of the man that says that 8 to 1 is a good mix. 4 sand to 1 cement is none too rich, and if using stone, 4 stone to 2 sand to 1 cement is the best mix for small articles.

Some Practical Ways to Reduce Fire Losses

BY F. W. FITZPATRICK, WASHINGTON, D.C., EXECUTIVE OFFICER INTERNATIONAL SOCIETY OF STATE AND MUNICIPAL COMMISSIONERS AND INSPECTORS.

But a few years ago a doctor was called in only in case of illness, and then was invariably expected to give medicine. And the nastier the medicine, the greater was the chance of recovery. At least, so thought the average layman. To-day our doctors are expected to, and actually do, a great deal to keep people well, and the best of them give mighty little medicine, prescribing, rather, sane and hygienic living and diet. So with fire; twenty years ago our fire departments existed solely to put out fires when they occurred, and the more water that could be thrown on, in spite of the damage it did, the more effective was considered the department. To-day our people look to the fire departments not only for fire extinguishing, but for advice and help in the prevention of fire, the minimizing of its dangers. Why, the very titles of the papers that have been and are to be read to you during this meeting, and the subjects that are up for discussion, tell the whole story of the wonderful progress, the modernizing of the methods, the widening of the scope and the marvellous efficiency of your several departments.

No one in this organization has the idea that the fire department is of minor importance in a city's affairs, but some of you perhaps have an inadequate idea of what fire means in the aggregate to the country. Only the biggest of figures can tell the story. Think of it, just one conflagration in San Francisco wiped $320,000,000 out of existence; another meant devastation to the tune of $90,000,000, and the conflagrations, or even individual fires of a million or two, are, alas, far from uncommon. Six hundred thousand dollars a day is our average. Last year, one in which there were no extraordinary fires, $215,000,000 was our total. This year, in January, we allowed $24,000,000 of property to burn. That amount represented more by far than was done in the way of new buildings and repairs in the same period, for this work during the entire month only totalled $16,000,000. A destruction of more than is produced means that, if unchecked, ultimate bankruptcy stares us in the face. Over and above what fire costs us in actual combustion, remember that your departments, the installation of high pressure water service, and all that sort of thing, the incidentals of fire, as it were, costs us another $300,000,000 a year. Then, plus all that, we go to work and spend $195,000,000 in buying insurance, an alleged protection that pays us back barely $95,000,000 of that amount in adjusted losses per year. In fine, the aggregate of fire's actual havoc and of what we spend in fire fighting amounts to just about $600,000,000 per year. It may not be amiss to add that the biggest year of our building history shows a record of about $600,000,000 expended in new buildings and repairs! Eliminating all the incidentals, our actual fire loss is about $2.30 per capita per year—a pretty heavy tax—while the same tax in the average of European countries is less than 33 cents per capita.

Over 99 per cent of the fires you are called upon to preside at occur in buildings. They, then, are the great basis of trouble. We have pretty nearly 12,000,000 of them, and their value is approximately $15,000,000,000. The