of the six-inch cubes which were tested. The notable feature of this photograph is the large percentage of void space, also the absence of any bond between the mortar and the round pebbles. Both of these conditions result from too much water.

The concrete in the sub-base on Richmond Street and Beaconsfield Avenue, has not been tamped. Instead, the concrete seems to have been mixed very wet and then raked to the grade required. The raking process accumulated the larger pebbles, which were raked to one point in the pavement. Numerous instances of this were seen. Some spaces were as great as four square feet in area. This is a serious defect in the sub-grade, as this would give a weak concrete on account of the lack of mortar. The traffic and water will soon cause a hole in pavement at these places. To plaster mortar over these spaces is not a remedy, as the new mortar unfortunately does not adhere to the old concrete.

One sample of concrete taken from the roadway showed a condition of bridging. Mortar had been raken along the sub-grade, then stones segregated on top, and then mortar placed over top of that again, as shown in Fig. 2. The result of this treatment was that between the two layers of mortar, less than 1⅓ inches in thick-

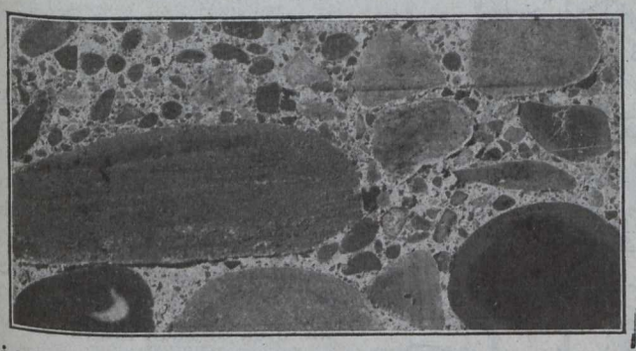

Fig. 4.—Sectional View of Sawed Block. Note Cavities Under Large Stones Due to Excess of Water

ness, there was a space without any mortar between the stones. It is impossible to go over the pavement and pick out such places, as they are hidden from view. The cause of this trouble is evidently lack of rigid inspection during the laying of the concrete. To illustrate the effect of segregating the large stones a photo (Fig. 3) was taken of the fractured surface of one of the six-inch cubes. This shows the lack of adhesion of the mortar to the stone and also why this cube withstood a lesser stress than the others tested.

The gravel, when it is delivered on the work, is dropped on the sub-grade without any effort being made to prevent the gravel and sub-grade from being mixed. With a clay sub-soil this may lead to trouble, as the sub-soil will get mixed with the concrete. From the contractor's point of view it is more economical to have his men shovel off boards than off the ground. Specifications should therefore insist upon planks being used in order to insure the concrete materials being kept clean.

It is therefore recommended:—

1. On account of the uncertainty which exists between the sand and stone proportions, it becomes of prime importance that the sand and stone should be separated by screening. But before the material is screened, it should also be run through a crusher, set for 2-inch material. The crushing reduces the stone to uniform grade, and eliminates the large stones, which gives the best concrete stone. It also adds crusher dust from the broken stone and pulverizes some of the sand particles to supply the finer material necessary to the sand; and it tends to complete the breaking up of the sandstone, shale and granite pebbles which are in a semi-decomposed state. The screening should be done without water if possible, as the water would tend to take out the fine material that it is advisable to retain.

2. The concrete should be mixed for at least one minute, such time to be taken as the time that concrete is actually in the mixer.

3. Only enough water should be added to give a concrete which is clammy and on no account should concrete be used which will flow in the spout when the spout is inclined at less than 60 degrees to the horizontal.

4. It is necessary that all concrete should be thoroughly tamped, as the tamping helps to work out any excess water and improves the density and strength of the concrete. Tamping will also help to eliminate the bridging.

5. The specifications in use should be rewritten to incorporate the changes recommended, and all indefinite phrases such as "properly protected" and "proper intervals" should be given a definite meaning, explicitly stating the degree of protection required and the intervals at which the pavement should be sprinkled. Every indefinite point in a specification means that it becomes increasingly difficult for an inspector to enforce such clauses.

6. Nearly all of the defects which have been mentioned in the pavement could have been avoided by rigid inspection during the laying of the concrete. The excess of water, the mixing, the segregation of the stone and the tamping are all defects that a good inspector would never have permitted. The recommendation is made, therefore, that the inspection of all concrete pavements should be systematized and made rigid.

7. Every carload of cement should be tested and considered as a unit; it is no hardship to ask a contractor on a piece of work like the Richmond Street pavement to provide his cement in carload lots so that it may be tested. The sand also should be tested regularly, and a record kept of all such tests. Test blocks could be made up from each day's mixing and kept as a part of the progress record. These could be stored and tested and if trouble were to occur, they might prove very valuable, or if a daily check on the concrete were desired, they could be tested at the end of seven days.

8. All material should be dumped on planks and kept securely separated from the sub-grade soil.

9. The materials used should be accurately proportioned by measuring, either in a box or a wheelbarrow.

The following six railroad lines are under course of construction in Argentina: Pichinal to Oran, Province of Salta, 17.4 miles; Nare to San Javier, Province of Santa Fe, 45 miles; Catamarca to Tucuman, 115 miles; Talapampa to Alemania, Province of Salta, 6.8 miles; Metan (Province of Salta) to the east, 150 miles; and Milagro (La Rioja) to Quines (San Luis), 85.6 miles.

A company has recently been formed in New Zealand, with a capital of $340,000, with the object of producing iron and steel from magnetic and titaniferous iron sand, of which there is a large deposit on the coast at Taranaki, near New Plymouth, where the works are to be erected. The initial plant will be capable of dealing with 70 tons of iron sand weekly, but plans have been drawn up for the installation at a later date of an additional furnace capable of dealing with 200 tons weekly. The production of steel is also contemplated, and it is intended later to form a new company to carry out this development.