chief causes of this difficulty are want of fall on the floor and lack of ample subdrainage. In a very large number of cases the slope of the floor is barely sufficient to allow clean water to flow freely to the outlet even if there were no material in the bed, and it is totally inadequate for the complete discharge of an effluent which is more or less charged with suspended matter. If to this is added the obstruction caused by the filtering material laid in close contact with the floor, there is little wonder that the suspended matters are arrested and retained in the material, and thus rapidly choke the interstices. Percolating filters require that the suspended matters which pass away in an effluent shall have a free outlet, and for this purpose false floors are provided, as well as a good fall on the floor. It should be recognized that the same condition is necessary in the case of contact beds, and if this condition were observed, there would seldom be any cause for complaint as to the choking of contact beds. On the other hand, the volume of sewage which can be satisfactorily treated in contact beds is limited to about one filling per day in dry weather and at the most three fillings per day with a diluted sewage in wet weather. It is true that when dealing with a good effluent from chemical precipitation tanks, contact beds may be filled as often as six times per day for considerable periods, but the fact remains that the necessity of securing ample periods of rest empty for oxidation, in addition to the time occupied in filling and discharging contact beds, limits the volume that can be properly purified by this method. Percolating filters, on the contrary, have no such limitations, but can be operated continuously and, where the sewage is weak in character or of average strength, percolating filters have an advantage in this respect over contact beds. Where the fall available for the disposal works is limited to 5 ft. it is difficult to apply percolating filters with success, but it is quite possible to introduce a set of double contact beds, and under these conditions it would be advisable to consider their adoption, especially if by that means the annual expense of pumping can be avoided. In the author's opinion the system of contact beds is not yet obsolete, and may be adopted with advantage under certain conditions. Further, he considers that where contact beds have failed to fulfil expectations the causes may be found in faulty design, and a want of knowledge of the proper conditions required to secure the best results. It may therefore even now be of some value to endeavor to define the ideals which should be aimed at in the design of these beds, and it may be observed that if the following details of construction and operation are rigidly adhered to it will be found that there will be very much less reduction in the liquid capacity of the material and a more correspondingly longer life of the beds.

In the first place, the beds must be absolutely watertight. The gradient of the floor must be such that it will give a self-cleansing velocity towards the outlet. (This point has received very little consideration in the past, and in a number of cases the floors have been laid with no fall whatever.) The whole area of the floor should be covered with a perforated false floor, so that the filtering material does not rest on the floor of the bed itself. The filtering material must be carefully selected—not liable to disintegrate, but vesicular in form—(hard-burnt vitrified furnace clinker is undoubtedly the best), and carefully graded. For primary course beds the grading must be adapted to the character of the tank effluent, but the size of the particles for the fine beds should never exceed ½ in. in diameter, with a minimum of ⅛ in. The time occupied by the periods of filling, standing full and discharging each bed should in no circumstances exceed four hours, and the beds should never receive more than one filling per day in dry weather when charged with sedimentation or septic tank effluents.

MATERIAL FOR PERCOLATING FILTERS.

With regard to percolating filters the ideal for the material is the same as for contact beds, but there is considerable difference in opinion as to its size. On this point much depends upon the amount of suspended matter present in the tank effluent. Fine-grained material will produce better results than coarse, but it rapidly becomes clogged if there is much suspended matter in the tank effluent, and in that case a coarser grained material will prove more efficient in the end. On the other hand, a coarse material will discharge a larger amount of suspended matter with the effluent in the form of humus, and it becomes necessary to decide whether the suspended matter shall be arrested on the surface of the filter by using fine material or, by using coarse material, allowed to find its way into the filter and pass out in the final effluent. In the author's opinion it is much less trouble to settle out the humus in the effluent than to attempt to remove it from the surface of the filter by using fine material. In some cases a considerable amount of trouble is taken to grade the material in successive layers, but there is usually very little justification for the extra labor involved. On the other hand, it is even more important not to mix fine and coarse material together in the body of the filter, as the smaller particles have a tendency to be washed down and close the interstices between the large pieces, thus preventing the free access of air which is so essential to the continued efficiency of the filter. In the author's opinion the best method to adopt is to have the whole of the material, with the exception of the bottom layer, of large pieces immediately over the false floor, as nearly as possible of one grade.

FLOORS.

The recommendations as to the necessity of providing a perforated false floor over the whole area of the filter and constructing the floor with a suitable slope, previously made in connection with contact beds, apply with equal force to percolating filters.

DEPTH.

With reard to the depth of these filters, much depends upon the character of the sewage to be treated, upon the nature and grading of the material, and, above all, upon the method of distribution. Within certain limits, however, it is generally found that the same quantity of sewage can be satisfactorily treated per cubic yard of material whether it is in the form of a shallow or deep filter.

DISTRIBUTION.

The question of distribution is of prime importance, but it would need an entire paper of this length to deal fully with the various methods in use, and their advantages and defects. On this occasion it must suffice to say that the ideal method is one that produces the nearest approach to perfection in uniformity of distribution above the surface of the filter, and that the greatest efficiency is secured by a slow continuous rate of distribution rather than by intermittent doses at higher rates. In cases where the rate of flow varies to such an extent that it is insufficient, at times, to provide the necessary motive power to rotate the distributor, a dosing arrangement is essential. The opinion is held in some quarters that an intermittent supply is desirable in any and all circumstances in order to provide intervals for aeration. It has apparently been overlooked that with distributors having four arms the ratio of the period of actual discharge per foot of travel to the interval of rest for aeration is, on the average, as 1 to 30. When operated continuously at the rate of, say, 300 gallons per square yard per day the actual rate per minute is 0.25 gallons. If an equal