by oxidation or nitrification, unless it is to be discharged into tidal waters or into the open sea.

If the Alberta "specification" had been a little more modest in its claims, and had termed itself a "Description of how to Avoid the Sludge Difficulty" instead of "Description of Aerobic Biological Purification of Sewerage," we should have had less to say on the subject.

The Massachusetts Experiments.

On January 1st, 1902, a new filter (No. 186) was experimented with. Slates were placed horizontally in the body of the filter, about one-half inch space between each layer of slate. We quote from the State Board of Health report as follows:—

"The idea was to provide as much surface as possible for the accumulation of suspended matter under the most favorable conditions. This new filter, called No. 186, was filled with regular station sewage in three doses, one hour apart, and allowed to stand two hours before draining. The plan of providing favorable conditions for the deposition of suspended matter was entirely successful, but the filter lost open space rapidly. The effluent was never of good quality. During May and June the **anaerobic** conditions noted with filters Nos. 173 and 174 became strongly marked, and the filter was discontinued at the end of June."

Most assuredly the Provincial Board of Health cannot be aware of this experiment, or else they would hesitate in many of the statements made in their "Live Earth" specifications.

The anaerobic conditions referred to in filters Nos. 173 and 174 were simply as follows:—

"Neither filters were successful in producing good effluents; anaerobic action ensued when the filters were filled with sewage and no nitrification occurred."

General Remarks on Claims made for the "Live Earth System."

(a) The "System" is practically the same as the "Contact Bed System." Recent experimental work in connection with contact beds at Hamburg, Massachusetts and elsewhere, has clearly shown that a contact bed during the period of contact is practically a septic tank, from which air is excluded by the action of filling the bed with sewage. During this period the action is anaerobic and not aerobic, and not as claimed for the "Live Earth System." Nitrification only takes place when the tanks are empty and air is admitted. (See Massachusetts Report, 1908, page 445, with reference to conclusions on contact filtration: "Putrefactive reactives abound, inasmuch as the entrance of oxygen is partly excluded.")

In all modern methods of sewage purification putrefactive reactives are avoided as far as possible.

(b) The difference between the use of concrete slabs and slates is one of **expediency** and not of **efficiency.**

(c) **A high degree of aeration during contact is claimed.**—No aeration is possible during contact; air is excluded, just as in the case of the septic tank.

(d) **The sludge is retained and rendered non-putrescible.**—Any results obtained in this connection are practically the same as with the septic tank.

(e) **The action is aerobic, due to bacteria and worms.**—No aerobic action takes place during period of contact; aerobic action only takes place when the liquid is withdrawn. The period of contact is so much waste time, and deleteriously affects the liquid sewage, making it more difficult to treat in oxidizing filters. The presence of nitrates in contact beds, the product of nitrification, can only be due to the action which takes place in the presence of air during the period when the bed is empty.

(f) **The effluent liquid is considerably purified, and can be disinfected if necessary.**—(See Massachusetts experiments with slate contact beds, where no nitrification took place and the effluent liquid was not purified.) It requires about from three to four times the amount of chlorine to disinfect a denitrified effluent than an nitrified one. Effluents which contain the products of putrefaction and are robbed of their oxygen, such as septic effluents, require considerably more chlorine than even fresh, strained sewage in order to complete satisfactory disinfection. (See Bernard E. Phelps on "Disinfection of Sewage Effluents.")

(g) **The sludge difficulty is entirely eliminated.**—All sewage disposal experts are agreed that the sludge difficulty still remains a difficulty. (See Massachusetts experiments with slate bed filter, which lost open space rapidly.)

The Summing Up of the Question.

The whole question may be summed up thus:—

It is an undisputed fact that if the solids in sewage, forming what is termed sludge, are allowed to accumulate, either on concrete or slate shelves, will in time become organically exhausted and form a residual similar to soil or humus. This action is due to putrefactive processes, and may be aided by worms, etc. In the septic tank this action takes place, and the residual sludge is generally referred to as humus, similar to garden soil or loam.

That worms play an important part in contact beds is well known, is remarked upon by the Royal (British) Commission on Sewage Disposal, and was observed in many of the contact filters in connection with the Massachusetts experiments.

In connection with Filter No. 103 the State Board of Health reports:—

"An interesting feature in the life of this filter has been the presence of large numbers of worms of a form similar to the ordinary earthworms, which made their home in the filtering material, practically covering the surface when the filter was filled with sewage and returning below when it was drained." Thus again the period of contact is shown to be useless, even to the worms.

The question, however, for answer is simply this: Shall this putrefactive process in connection with sludge be allowed to take place in the presence of the fresh sewage liquid? It is the old question which has been recently asked and answered in connection with septic tank action. The answer is a most decided **"NO."** All modern systems of any note are strenuously avoiding all septic sludge action in the presence of the fresh liquid sewage, looking, as they do, to a stable and non-putrescible liquid effluent, which is readily subject to disinfection by nascent oxygen obtained from hypochlorite or otherwise.

We cannot close this critique without reference to the uncalled-for slur upon the civil engineer which Mr. Owens considers necessary to his specification. The remark that the civil engineer's chief object is very often to dispose of sewage by the cheapest method possible without respect to its influence on the health of the public is uncalled for. This remark would have been more aptly applied to the municipal authorities who retain the services of the civil engineer.