be said also that, despite all theory to the contrary, it has, so far, been found absolutely impossible to so treat domestic sewage as to make the process pecuniarily remunerative.

As already stated, the percentage of purification, as shown by chemical or biological analyses, is generally taken as a measure of the degree of safety with which the effluent produced may be discharged into a stream of running water, and finally disposed of so far as the producers are concerned; but it is very necessary to bear in mind, in connection with this matter, that mere diminution in germ life and cessation of biological activity are of themselves insufficient evidence of permanent gain in purity; for the latter turns entirely upon the history of the process and the nature of the causes which may have led to an apparently satisfactory biological condition of any such effluent.

A mere sterilizing process, by means of antiseptics, may produce an effluent showing, in itself, marked freedom from germ life, which, nevertheless, when the antiseptic ingredients have become diluted by admixture with sufficient quantities of pure water, may permit a development of bacterial life, and a putrefactive condition which will sometimes compare unfavorably even with that of the original sewage.

A perhaps unjust and sweeping denunciation of most methods of chemical and mechanical sewage purification, as carried out 40 years ago, was pronounced by an English commission, appointed at the time to enquire into their efficacy, when it was declared that "As applied to sewage, disinfectants do not disinfect, and filter beds do not filter."

This last clause leads one to speak of the place of the sewage filter in connection with these matters. The passage of a fluid through a porous medium, for the purpose of purification by mechanical straining, is probably as old as mankind; it would be taught by a very superficial observation of nature. The Egyptian woman who fills her porous earthenware pitcher with comparatively clear water, by allowing the turbid waters of the Nile to filter through it is, no doubt, continuing a custom of the highest antiquity, but it is very lately, indeed, that anything has been recognized in the purifying action of a granular or porous filtering medium beyond a mere mechanical straining.

One of the earliest hints, to the general reader, of a recognition of anything more than this, appeared in the Encyclopædia Britannica not 25 years ago, when, in an article on the action of filtering media, the following fact was mentioned as but recently observed, viz: That the diminishing efficiency in the purifying action of a filter, arising from continuous uninterrupted use, might very frequently be quite arrested by simple rest and aeration of the filter. We have since learnt that the reason for this is a remarkable biological fact, and it is a part of the intention of this paper to refer very briefly to some highly important consequences of its discovery, with that of certain co-ordinate principles.

Purification of sewage, to be satisfactory, must involve the entire breaking-up and oxidizing of organic compounds and putrescible matter present, and their complete transformation into either harmless elements or stable compounds without any of the offensive and injurious consequences which attend the natural processes of ordinary spontaneous (and generally slow and imperfect), putrefactive decomposition. Now, it has been clearly shown that mere contact with the oxygen of the air is quite inadequate to effect this, and that the passage of sterilized air through sewage, produces no change in the oxidizable organic matter contained, and moreover, that subsequent decomposition of sewage, which has itself been sterilized, is invariably accompanied by offensive putrefaction.

Most of us know by experience that in the processes of agriculture and in the effects of soils and vegetation upon putrescible matter, the offensive accompaniments of decomposition are largely absent. A most important announcement, tending towards an explanation of this, was made in 1877 by Mr. R. Warrington, based upon investigations which he had been carrying on at Rothampstead in England, and Mr. Warrington was able conclusively to demonstrate that "the oxidizing and breaking up of organic compounds present in the soil, without what is commonly known as putrefaction, could never be accomplished by mere contact with air present in the soil (as had been supposed), but were entirely dependent upon the life processes of minute living organisms.

Since that time an immense deal of effort has been directed by individuals and by sceintific associations towards the bearing of this principle upon methods of sewage purification, and through the investigations of such as Mr. Dibden, Chief Chemist to the London County Council, members of the Massachusetts State Board of Health, Mr. Scott Moncrieff, and many others the world over, the fact has gradually been realized that "all sewage purification processes, to be successful, must be subordinated to the requirements of micro-organisms, by whose agency alone such purification can be completed."

This being the case, it becomes evident how directly opposed to Nature's law is any process, the essential features of which are attempts at a sterilization which would suspend, if not destroy, the agencies commissioned by nature to the work in hand.

Quite early in these investigations it was noticed that in the breaking-up of organic compounds by certain classes of bacteria, which need the constituents for their development and sustenance, the decomposition was accompanied by a process of liquefaction, and it was later on asserted by Mr. Scott Moncrieff that, on account of this, biological purification of sewage was fully possible without the previous removal of organic matter in suspension, and that a process properly carried out on this principle need not involve the tremendous difficulty and expense attendant upon the dealing with sewage sludge, a difficulty inseparable from any chemical or precipitation method of treatment.

It is found, moreover, that crude sewage invariably contains the germs of living organisms, to the development and life of which certain of the constituents of the decomposable matter present are a necessity. The activities of these organisms vary greatly with changes in environment, and Mr. Scott Moncrieff was probably the first to announce that the purification of sewage which went on under biological action consisted of two distinct consecutive stages, during which the operations of the bacteria upon decomposable matter were exactly opposite in character—the process being "Anærobic" during the first stage, and in the second stage, "Aerobic."

In the first, the micro-organism obtained for its nourishment and development its necessary supply of oxygen by the process of the breaking down of organic compounds, and of abstracting the necessary oxygen from these compounds themselves; hence, this process is possible out of contact with air; its results are accompanied by liquefaction of solids and a reduction in the complexity of the organic matter in solution.

This process will continue so long as a supply of oxygen is in this way available in the body of sewage and is available from no other source.

Upon the exhaustion of this internal oxygen supply the further life process of the micro-organism can only be carried on in the presence of air; but in its presence an oxidation and nitrification of albuminous and ammonia compounds in solution ensues as a direct consequence again of biological activity, which, under the latter condition, is accordingly termed "Aerobic." Moreover, it has been shown that the decomposition which takes place during both these stages will