fine charcoal, etc., made by the Jaggers' kilns from towns' refuse or other suitable material.

Where it is necessary for the roughing filter to work by an upward flow to save pumping, and where there is under 10 feet of depth to work on, it will require an apparatus to clear the sludge settling at the bottom of the tank. Candy invented a revolving pipe to suck it out, which is clumsy, and expensive, and soon disarranged. There is another method simpler, cheaper and more efficient.

Every system of purifying sewage depends largely on the qualification of the manager and attendant for its efficiency. To properly manage a sewage disposal works requires a man with a thoughtful and creative mind, wellinformed on most technical subjects, one who will sift things to the bottom, and who will take a lively interest in his work.

The judgment used in selecting employees for such important and responsible positions, means the saving or the wasting of a large amount of money, and the improve ment or decline of the general public's health. In fact, the success or failure of many costly sewage works is due to the personal qualities of the manager.

We now come to the precipitants, and my experience with regard to them is that there is considerable humbug in connection with them. There is a great variety of sewage; one is dye-polluted water, that is permeated by strong chemicals. The chemicals and colors having got a good grip on the dye water, then a chemical or other substance must be employed to compel them to let go their hold, and allow the water to return to its pure state. There are at least one hundred different kinds of precipitants used in Great Britain, and I believe that in half the cases powdered clay would answer for the purpose of dividing the solids from the water better than the more expensive precipitants. Clay has been successful when the chemicals would not make any impression. If many of the marketed precipitants that have high-sounding names are examined, powdered clay, and sometimes charcoal, will be found to form a part of the mixture.

The art of purifying sewage is now being revolutionized, and if it were not that the British people are very slow to take up a new idea, the general use of precipitants in England would have been a thing of the past some time ago.

The Messrs. Jaggers showed the officials their invention of carbonizing town refuse and afterwards using the product for purifying sewage, and proved that they could secure the best effluent, but the Local Government Board refused to permit works to be constructed without using irrigation land for the final process of filtration. And as the towns did not wish having two methods, they were compelled to obey orders (except a few like Baildon, which risked having their own way), and take the method of land irrigation, and to prevent the land from getting too fat or dirty, they are compelled to clarify the sewage in settling tanks, using precipitants to be able to handle it quickly-which, when the cost is placed alongside the cost of the new idea, is often about 75 per cent. more. Strange to say, we find that those towns which have lately got sewage works in Canada have selected a system or a mix up of the parts of several systems that can hardly do good work. The effluent discharged from them is probably dangerous.

An effluent may appear clean after clarification and the solids have been extracted by settling tanks and precipitants, but they have only taken out what is chiefly offensive to the eye, viz.: manurial, fœcal. and heavy substances that do little harm until allowed to putrefy, but the

(1

chief reason for needing purification is still in the sewage water, held in suspension, viz. : albuminoids, ammonia, free ammonia, chlorine. alkalies, etc, which are all good in their proper place, but are decidedly in the wrong place when they are in water that may be used to water cattle and promote fish life.

There is a kind of sewage discharged by slaughter houses, wool and skin washers, and by large hotels or restaurants, that is heavily charged with blood, grease and fat. By using a precipitant of bisulphide of carbon it may be made to settle down; but when the sludge is put into a press only 23 per cent. of the moisture can be extracted and the sludge still remains a liquid. If it could be pressed clear of the moisture and made into a cake, it would be valuable for fuel and gas making. Even after clarification the whole of the fat is not removed, and when it passes to the filters, stops up the air cells of the filtrate, of course partly destroying the filter's purifying power. Slaughter houses and wool and skin washers should always be compelled to clarify their sewage before discharging it into the public sewers. In England there is a firm contracts to extract the fat for the right of taking it away for sale. Hotels and restaurants should have a grease trap connected with kitchen and pantry sinks, for grease is the worst enemy to sewage works and drain.,

Those towns which have adopted the Jaggers carbonized refuse filters can dispose of greasy sewage without the use of precipitants, because coming on to the filters in a raw state, and having to pass down through a fine powdered charcoal, it leaves the grease on the surface, which in a short time covers the filter and stops the flow, when it can be scraped off, along with about two inches of the charcoal which has become contaminated.

Mr. Pasteur and Mr. Warrington both declared years ago that sewage contained the organisms necessary for its own destruction, and with the combined efforts of engineers, chemists and biologis's it will soon be accomplished. They have proved that there is a great variety of minute organisms in sewage and land, and that in the colonies of bacteria there is a marked difference in their tastes and habits. Some are very dangerous to the public health, and must be destroyed or they will destroy us. On the other hand, there are other colonies that, so far as the public health is concerned, are harmless, but they kill and destroy the dangerous ones. On this account we are now making the friendly ones useful by setting them to destroy the dangerous ones. And it is now helieved that ever since 1762, when filtering sewage was begun to be cleaned by passing it through land, that it has always been partly done by our allies the bacteria, and only very slightly by growing vegetation. We now are certain that the filtrate, whether composed of sand, rubble, spar, coke, coke breeze, carbon and iron-coal, charcoal, or charcoal made from refuse, that its value consisted only in its qualifications for becoming a comfortable lodging house to the bacteria.

Now the latest improvement is purification by bacteria filters, sometimes called purifying by microbes. In England there are about five small towns working on this principle of allowing the sewage to purify itself by natural processes. Each of the places do it by different ways, and patents are, I believe, placed on each method. Some use the settling tanks and precipitants; others' make a darkened tank answer in place of a precipitant and settling tank, and another by passing the raw sewage through a roughing filter to clarify, then through the bacteria filter to purify. The advantages of the bacteria filter are that it eats up all the injurious matter and dirt except grit,