blocks of white stone from Thunder Bay. Limestone is said to be abundant in the southern peninsula and the eastern counties. There are quarries at Queenston, Merritton, Beamsville, Wolfe Island, Guelph, Ottawa, Belleville, Huron county and other places. Marble, if one may judge by the number of exhibits, is even more abundant. There were twenty-eight exhibits of marble but most were by the Bureau of Mines. There were all colours—white, black, grey, green and shell pink. There was one piece of statuary marble sculptured ; but in most specimens there was some marking. The specimens were said to have been all taken trom the surface or near the surface and a more uniform and better quality is promised for deeper development. When will this development take place ? The principal beds of marble in Hastings, Leeds, Renfrew and Frontenac counties are not far away from the principal building centres on Lake Ontario ; and the Thunder Bay district, which supplied the remainder for this exhibition, is easily accessible by water. It seems safe to predict a market, if wealth continues to grow as it has recently. The use of good material in building will easily become a commercial necessity, and nothing will have a more important influence in developing good architecture.

THE SEWAGE DISPOSAL OF SUBURBAN HOUSES AND PUBLIC INSTITUTIONS.

By Dr. P. H. Bryce.

It gives me pleasure in complying with your invitation to prepare a paper on some sanitary problem connected with your work, to present a paper on the title indicated, as being of extreme importance, connected as it is, directly with the problem of "Pure Air in Houses," which I discussed before you last year.

As we are well aware, there is a more or less marked difference in the air of country places and of towns and cities, indicated by a small excess of carbonic acid (Co_2) in the latter and the absence of ozone, or oxygen in a nascent condition, due to the excessive presence in towns and cities of organic matters on the surface, in houses, lanes, manure heaps, drains and so on, constantly undergoing decay or reduction to simple compounds by the action of various living organisms, especially bacteria, which utilize oxygen in their biological processes. Sometimes they find this oxygen in the organic compound itself, especially in the azotic or nitrogenous compounds but also in the carbon compounds of a starchy character ; in other and under ordinary circumstances, they utilize the oxygen free in the air. As will be supposed, there are different species or classes of this minute form of largely vegetable life, some of which do not thrive in free oxygen and air and some forms what live within the bodies of animals and external to them in free air as well.

To the first class Pasteur long ago gave the name an-aerobes or microbes living apart from air, and the second he called aerobes or those which require free oxygen for their development.

The two classes have properties differing more or less from one other, one especially peculiar to an-aerobes being the liquefying of organic compounds by growing into these and really dissociating their solids, as, for instance, gelatine, forming, of course, by-products during the process both of gaseous and liquid character. The constitution of these chemical compounds varies; that of the gases being principally CO_2, H_2O, H_2S, and many highly organized volatile compounds, such as those given off by the breath of man and animals, those from the many foods and fruits, which develop during their mellowing and decay, and especially the extremely unpleasant emanations given off from putrifying meat, fish and the solid wastes, which pass off to the sewers as excreta, and kitchen and house wastes of every sort. It is a fortunate fact that the products of aerobic decomposition are less disagreeable and injurious than those from an-aerobic decay, since such are those which are most constantly exposed to air from surface decomposition of outside matter everywhere. With these preliminary remarks it will be easy to see something of the nature of the problem to be dealt with in disposing, safely and conveniently, the house wastes which go by the name of sewage, or those matters which are conveyed by water into underground pipes or sewers.

It is the experience of every local health officer, and a source of constant difficulty to the Provincial Board, that in those towns where a sewerage system does not exist and in many houses in the suburbs of towns, even where such systems are, in rural districts and in the large temporary summer resorts, hotels and cottages, the problem of what to do with excretal matters, both animal and vegetable, has been everywhere, if not difficult, yet the most constant one which the local boards have to deal with in the matter of nuisances, and which in many cases proves the most constant danger to the household immediately interested, and where streams or lakes are polluted, not unfrequently has become the occasion of some sudden and serious outbreak of typhoid fever or diarrhoeal disease. The fact that 253 examinations of water were made during the past year at the Provincial Laboratory, most of them due to outbreaks of typhoid, shows that the causal relationship between polluted water and typhoid and diarrhoea is well recognized, and general observation, as well as laboratory work is quite agreed as to the direct connection between such pollution and some accumulation of decomposits of animal or vegetable matter. Privy vaults, deep pits, or cess pools, constant contamination of the area around the house pump with kitchen washings and slops of every kind, hotel stables and barnyards, soakage from slaughter houses, the wastes from cheese factories and creameries and the heaps of refuse from canning factories, and indeed every kind of manufactory in which organic products are used, may become direct means of pollution to wells and sources of public water, and many are moreover the cause of serious injury to health from their creating effluvium nuisances.

Now, perhaps, gentlemen, as it may be only occasionally that as architects you are called upon to deal with more than one of these sources of ill-health, viz., this one of the disposal of house sewage, including excreta, kitchen and chamber wastes, in places where there are no public sewers, it is most essential that some general principles should be laid down and acted upon with a view to the safe, economical and aesthetic method of disposing of such organic wastes.

Probably every one here accepts the theory that in the economy of nature nothing can be lost, or that matter is indestructible, and perhaps all will, in a general way, agree that whatever is yielded by the soil, as, for instance, the potash, phosphates, ammonia and so on, which are contained in the grains and other fruits of the earth, should be given back to Mother Earth for her goodness to us. So in spite of man's foolish waste and ignorance, they ultimately are returned to her, but at an enormous cost of time and energy. Carried to the sea, sewage will form deposits ultimately forming new land, or in solution will become the food of microscopic vegetable forms of many species of the deeper ocean planton and of the larger plants of the ocean littoral, which in turn becomes the food of the microscopic infusoria and finally the food of fishes, molluscs and other sea animals, and so is brought back finally as food to man. Were we intelligent and careful we would see to it that not a single pound of organic waste matter is allowed to decompose out of its place, in other words, to so act as to return to the earth every ounce of C, H, O, andN, which taken from the humus or upper layer of soil is year by year being used up by cultivation and must be returned there, if fertility of the soil is to be maintained.

As however, it is found in practice in most parts of this country that there is a lack of appreciation of the manureal value of such materials, and that the adoption of what is known as the dry-earth system in houses and institutions has not proved free from objections, owing to neglect to supervise it carefully, owing to its cumbersomeness, and as moreover it does not do away with either the need for water pipes and a supply of water being laid on in the better houses, or of the need for disposing of the kitchen and chamber wastes, in any case it is evident that the growing appreciation of modern conveniences in houses is demanding some systematic method for dealing with all house wastes, whether for kitchen or closet by the water-carriage system.

I propose, therefore, to indicate how in practice such a system may be established, at once efficient and economical. In the annual report of the Provincial Board of Health for 1898 a chapter is devoted to "The Biological Principles Involved in the Purification of Sewage," which to those interested will be found to contain a very full discussion of the scientific principles of this whole matter. There will be found a table giving the average analysis of town sewage. While probably less concentrated than the sewage of a single house, since it would contain water from factories, from sub-soil drainage and so on, yet it will very well serve as an illustration of the contents of sewage. It is as follows :

1. Solid matters in suspension—
   - (a) Organic.....20 grains per gallon.
   - (b) Mineral.....10 " "
   - Total.....30 " "
2. Solid matter in solution—
   - (a) Organic.....20 grains per gallon.
   - (b) Mineral.....50 " "
   - Total.....70 " "

Or expressed in parts to 1,000,000 such a sewage would yield :

Total Solids.	Solids in Suspension.	Chloridne.	Free Ammonia.	Albumenoid Ammonia.
1428.0 parts	428.0 parts	120.0	50.0 parts	10.0 parts

Assuming what is in experience ample, 20 gallons per head per diem of sewage, it will appear that for an ordinary dwelling with 10 inmates, with a water supply laid on, there will have to be disposed of daily 200 gallons. By reference to the analysis it is clear that half the organic matter, or that in suspension, could easily be removed by any crude filtering method, as by a screen, a grit chamber, or even by passage over coke or some readily destroyed material, should it become clogged.

Assuming, however, that all the materials are carried to a common recepacle or tank at the end of the house sewer, there will be deposited daily 8,000 grains of organic matter, whether suspended or in solutions, and 12,000 grains of mineral matter or altogether some 3 lb., of which two-fifths is organic, or is, capable of undergoing decomposition, most of which will gradually be carried away when dissolved in the 200 gallons of water daily passing into the receptacle, the balance of carbon gradually being deposited in the tank. Of the mineral matter 50 parts are

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