

tion of sugar) were present in nearly 76 per cent. of the cases. So that if one assumed that for the cholera vibrio to produce cholera in man the combined presence of torulæ and sarcinæ was necessary, of the above 17 persons only 3 ought to be susceptible to cholera.

M. Abelous has studied at Montpellier the flora of his own stomach, systematically and for a long period. He notes the presence of 16 forms of microbes, among them sarcinæ (favourable to the cholera vibrio) and the pyocyanic bacillus (unfavourable to it). He does not mention torulæ. On the contrary, MM. Capitan and Moran have not found in 30 persons examined for this purpose either sarcinæ or the pyocyanic bacillus. They have most frequently obtained torulæ, of which they have isolated two species. The third microbe found by them was a small bacillus, liquefying gelatine and producing yellow colonies.

In his memoir on the sarcinæ of the stomach, Oppler notes the interesting fact that the *sarcina ventriculi* is regularly found in the stomach of persons with simple dilatation of the stomach, while in a series of other diseases (acute and chronic gastritis, atony, ulcer of stomach, &c.), it is only found accidentally. In dilatation of the stomach, due to cancer, the *sarcina ventriculi* is extremely rare. Oppler has isolated five species of sarcina from the stomach, of which an orange yellow one, the rarest of all, is distinguished by the ease with which it multiplied in acid media. It is easy to understand what importance these facts may acquire in relation to the etiology of cholera.

In the material from ten stomachs which I have studied, I have only found sarcinæ once in abundance. This was a white and viscous sarcina, which has been employed in my experiments on the intestinal cholera of rodents. Torulæ were more frequent, and I have isolated several varieties.

Besides these facts demonstrating the localisation of the human microbial flora, others might be adduced. The local character of epidemics of remittent fever is well-known. The spirillum of Obermeier is a parasite very common in certain countries, and absolutely unknown in others, e.g., France.

There are also a certain number of facts as to the localisation of the pneumococcus. While the mouths of certain persons may contain it in considerable numbers sometimes for years, in others the pneumococcus is entirely absent. In his researches on blue pus Mühsam (cited in the *Centralb. f. Bakter*, 1894 p. 316) has shown that the pyocyanic bacillus is found as a saprophyte on the skin of a certain proportion of persons. Other analogous cases might be quoted.

The fermentations furnish confirmatory evidence of a certain localisation of the microbic flora. M. Duclaux has communicated the fact that certain cheeses, as for instance those of Brie, prepared in the same way but in other localities than Brie, do

not thrive so well even when they are furnished with seed in the form of straw coming from Brie and containing the microbes of that district. These microbes, coming into contact with the flora of the new district, were invaded by representatives of this new flora. On the other hand, in certain localities, as in Champagne, according to M. Duclaux, the juice of the grape is invaded in the great majority of cases by the same species of yeast. An application of this fact is attempted in the use of the yeast of a certain local production for the amelioration of wines.

The general conclusion arrived at is that in cholera, a disease due to the specific action of Koch's vibrio, the favouring and impeding microbes of the digestive organs play a most important rôle; and that we can thus explain certain epidemiological facts which appear to be out of accord with the theory of the specific action of the comma-bacillus, and above all the influence of time and place, which play an incontestable part in the development of epidemics.

PURIFICATION BY FIRE.

By G. V. POORE, M.D., F.R.C.P., Physician to University College Hospital, London.

[The following is an extension of a speech delivered in Section XIV. of the Eighth International Congress of Hygiene and Demography, held at Buda-Pesth, September 1-9, 1894.]

WE have heard several papers this morning which have all tended in the same direction. The authors of some of these have advocated the burning of the organic refuse of our houses and streets, and have described furnaces constructed to this end, and rightly called "destructors"; while others have been insisting that the *only* safe way of disposing of another form of organic refuse, viz., the bodies of those who have "joined the majority," is by cremation.

The advocates of "destructors" wished the Section to pass a resolution to the effect that their method was, under all circumstances, the *best* way of dealing with organic refuse, and I feel some satisfaction that it was on my initiative that the words "in crowded centres of population" were interpolated.

To burn organic refuse is a dissipation of energy, and to burn it unnecessarily is wanton wastefulness. To burn it is easy, to do the right thing with it is difficult. The stable manure of our big towns gives us, considering its huge quantity, very little trouble, because the mass of the population knows that it is indispensable for the production of food. Another reason is the fact that stable manure is not as a rule mixed with other materials which hinder tillage. The farmer places it on the surface of his field, and then ploughs it in, and nothing but good results. It is noteworthy that those engaged in manipulating dung in the field (farm-labourers and gardeners), are amongst the healthiest of the

labouring classes, notwithstanding that a considerable amount of the dung used must contain pathologic microbes, such as those of tubercle and anthrax. A broad fact of this kind, a fact which has been recognised for centuries, must surely be taken into consideration before we begin to burn the dung of animals affected with tubercle and anthrax. "Practice with science" must be our motto, as it is that of the Royal Agricultural Society. It is too much the fashion at present to divorce science from practice, and to be in a hurry to push every half-understood fact which is established by bacteriologists to its logical conclusion. These facts are very precious, and I yield to no man in my appreciation of the labours of pure scientists; but we must remember that logic becomes a dangerous pastime if our premises be ever so little wrong. Many recent utterances from the laboratories seem to point to the fact that fresh air and sunlight are fatal to many forms of microbial life, and it is doubtful if any safer course can be followed in dealing with organic refuse than to spread it over the fields, as is the daily practice of the farmer. To burn such matter is a dissipation of energy and a waste of manurial matter, and it is very doubtful if there be any countervailing advantage. The fouling of the air by the products of combustion is a recognised disadvantage, and it must be regarded as a very serious one in a country where the air is far too foul already. The Indian ryot uses his dung for fuel, and is in consequence perennially very near starvation.

Now, with regard to the disposal of the dead body, I must be allowed in the first instance to state my belief that many of the utterances put forward by cremationists go very much ahead of the facts. One may look in vain through the records of our Local Government Board for any mention of an epidemic of disease which has been definitely traced to a burial ground as a cause. There is nothing in these records bearing upon burial-grounds at all analogous to the countless epidemics of enteric and cholera which have been definitely traced to water fouled by fœcal matter. Our population has increased by leaps and bounds, and when we remember that the dead beneath the earth vastly outnumber the living that are upon it, it is hard to believe that dead bodies are so full of danger as cremationists would have us believe. We are told by Herr Kronfeld that living pathogenic microbes have been found in the bodies of guinea pigs exhumed after an interment of two months; but this is no proof that such microbes could by any possibility become a danger to the living. Some of these animals were buried at a depth of 3 metres, a measure well calculated to preserve the animals and their contained microbes. This was no instance of "scientific burial," concerning which I shall speak later. A distinguished English surgeon and gynecologist, in a recent article on cremation, speaks of an instance of

diphtheria being caused by drinking water which had filtered through a graveyard; but neither place, time, nor reference is given, and considering that diphtheria is not usually regarded as a water-borne disease, this statement may probably be disregarded. It is most important that a congress of this kind should be careful not to tender advice to the public unless it be based on well-established facts. The eyes of all civilised nations are before us, and their ears are open to catch our utterances. If we give wrong advice, we shall lose any influence for good which we may have, and we shall run a risk of incurring a popular revolt against our teaching. M. Pasteur thought that earth worms brought anthrax spores to the surface (into the fatal sunlight?), but Professor Koch doubted the possibility of this, and it is noteworthy that Professor Brown, and Professor Macfadyean, of the Royal Veterinary College, in a recent paper on anthrax in the *Journal of the Royal Agricultural Society*, state that the bacillus anthracis perishes very soon after the death of the animal, and they give a very decided opinion that the best thing to do with the body of an animal dead of anthrax is to bury it.

Further, it must be remembered that at the London Congress, a report on the air of cemeteries was presented by MM. Brouardel and de Mesnil, the gist of which was that these gentlemen had found nothing noxious in such air.

It will at least be conceded that little or nothing has been definitely proved as to the danger of earth burial. The proper disposal of the dead body is a purely scientific question, and it seems certain that, according to the rules of the Congress, we should have no right to pass resolutions which embody any opinion on the scientific aspects of the question.

The scientific method of disposing of the dead body is that which is the quickest, safest, and most profitable, viz., burial in the earth. This was pointed out many years since by my distinguished friend and fellow-countryman, Sir Francis Seymour Haden. The body should be placed as near the surface as is practicable, in order that it may be brought under the influence of what in my "Essays on Rural Hygiene," I have ventured to speak of as "the living earth," because it is full of insects which consume, and microbes which subsequently bring about the nitrification of the body. It goes without saying that all coverings and coffins merely tend to hinder the process of dissolution, a process which, under these prescribed conditions, has no analogy to putrefaction, and is without offence of any kind. The earth beneath the body should be trenched, and in filling in the grave the mould from the surface should be mixed with that which is beneath. In order to prevent the exhumation of the body by dogs or other carnivora, it might be necessary to cover the grave for a time with a piece of wire netting, fastened to

the ground by stakes. The final act should be to plant upon the grave some tree suitable to the soil and situation, and it is clear that impermeable coverings, such as by flat tombstones, are not permissible. Last year in Hampshire, in England, I exhumed the bodies of three animals: (1) a cow which had been buried just beneath the surface for eighteen months, with the result that nothing but clean white bones were found; (2) a horse, buried some eighteen inches deeper than the cow, for two and a-half years, with the result that the bones were not quite clean nor completely disarticulated, but the skeleton was quite odourless; (3) a favourite pony, which had been buried for five years quite deeply in the chalk—about five feet deep. Above the grave leaves, to be used for horticultural purposes, had been collected in a mound. When this animal's body was reached, it was found to have been consumed only to a small extent, and, as it smelt offensively, we covered it up again. Sir F. Seymour Haden has recently written to me to say that a calf buried one foot beneath the surface on January 1, 1893, was found to consist of nothing but perfectly clean bones when exhumed on January 1, 1894. It seems indeed to be a fact that bodies are consumed with a rapidity which bears an inverse ratio to the depth of burial, and here we find that practice is in perfect accord with the teachings of bacteriology and chemistry. The cremationists in their pamphlets assert that sand is the only suitable soil for burial, but here again they go characteristically ahead of their facts. It is true that one may bury deeper in sand than in any other soil, but there can be no doubt that any soil which is capable of being used for agricultural purposes is also capable of consuming the dead body of an animal or a man, provided such burial be tolerably superficial. To place a body deep in the clay is to place it in an impermeable sarcophagus. It will be preserved for years; but being surrounded by an absolute filter, it can do no harm to the living.

When one ponders on the "machinery of dissolution" and the countless insects and saprophytes to which a dead body falls a prey on its road to nitrates and phosphates, it is evident that even the spores of pathogenic microbes can hardly be expected to escape; and when one further considers that the earth is an efficient filter, we shall cease to wonder that earth burial, notwithstanding the attempts of superstition to counteract its value, has been productive of very little harm to the living.

Now we owe to cremationists a debt of gratitude, because they have been instructing the public to regard the question of burial without superstition; and one may feel that those who are sufficiently philosophic to accept cremation would also accept "scientific earth burial," if convinced of its advantages.

The question, baldly put, resolves itself into

this: Is it better to bury or burn a dead body, and shall it be put into a hole in the ground or into a furnace-hole?

Now, it is evident that if a body be buried in such a manner as to further in every way its complete dissolution, the land will be ready after an interval to receive a second body, and, if the cemetery be systematically planted, the earth will be purified and the air above it freshened by the green leaves of a flourishing vegetation. The power which scientific burial gives of using the same ground repeatedly, after due intervals (say 10 years), abolishes the fear which has been expressed that the amount of land devoted to burial will become unduly great, and it enables one to calculate with tolerable accuracy the amount of land which must be set aside for burial purposes. My calculation is that, with 10 years interval between successive interments in the same spot, an acre of land would prove to be an ample area for a burial ground in perpetuity for a population of 10,000 persons.

It will probably be conceded that a burial ground, such as I have imagined, could hardly prove a danger or annoyance to the living.

On the contrary, it would certainly be a decided benefit. In the first place, it ensures an open space in or close to a city in perpetuity, an open space which tends to mitigate the terrible physical and moral evils which result from overcrowding. If burial be conducted scientifically, so as to benefit the living, there would be no object in having the cemetery removed from the town, and it is obvious that the transporting of dead bodies for long distances is in itself undesirable. For burial, the nearest available spot is the best and the cheapest.

If burial be considered scientifically, it is not in our power to prevent the soil becoming exceedingly prolific. It is a *sine quâ non* that a cemetery or any other spot where organic matter has been buried must be planted. The greater the growth, the quicker and more complete is the purification of the ground. I have lately seen a proposal that the burial ground at Hong Kong, where the Chinese victims of the plague have been buried, should be concreted on the surface. Such a plan is calculated to ensure the foulness of the land for a maximum period. *Concrete is no cure for a foul soil.* The only cure for a foul soil is production.

The herbage of a cemetery freshens the air, for every green leaf that it produces gives off oxygen. In a cemetery the organic matter is consumed, and oxygen is given off. In a cremation furnace the products of the consumption of the body are irrespirable gases, which are noxious, if not offensive, to the living.

Finally, the products of a cemetery must have a money value. At least, it must produce a large amount of fire-wood, and it would probably accord with popular sentiment if such products were put

to some pious use, such as the warming of the sick and needy in the winter months.

A cemetery produces fuel, while a cremation furnace merely consumes it.

Finally, as to the cost of the two processes. There can be few places, even in crowded England, where the cost of erecting a cremation furnace would not be more than sufficient to purchase several acres of land. The cremationists are fond of saying (quite characteristically) that land is no longer to be got. This argument was used at Birmingham last year, notwithstanding that freehold land in Essex had actually changed hands for 37/6 per acre; while the price of coals, in consequence of the strike, had reached the record figure of two pounds a ton.

The cremationists claim that their process is quicker than burial; but here again they are practically wrong. A cubic yard of earth can be removed and replaced in a time very much short of the one and a half or two hours during which the cremation stoker must be in attendance. When a body is once laid in the grave, no further appeal to the clock is rational.

I have always, although I do not agree with them, felt grateful to the cremationists, because they seemed to be going to free us from the trammels of "*Pompes funebres*." A glance at their exhibition, and an inspection of vulgar urns and silver dust pans for gathering up the sacred phosphates of lime, has convinced me that the spirit of the old-fashioned "undertaker" is not yet dead, and that "even in their ashes lurks their wonted fires." A regard and veneration for the memory of the good and just is a sentiment which ought most strenuously to be encouraged; but the sooner we recognise that all attempts to preserve the bodies of deceased persons is puerile and futile, the better will it be for humanity.

It seems to me to be quite characteristic of the greatest of all legislators and sanitarians, that "No man knoweth of his sepulchre unto this day."

I freely admit that the problem of successfully dealing with the organic refuse becomes more and more difficult as the area and density of a city increases, but my firm belief is that the decadence of a city must commence so soon as its size and density prevent the authorities from dealing rationally and scientifically with the daily accumulations of organic refuse, inclusive of the bodies of the dead.

Ancient Rome seems to me to be an historic example which should serve as a warning to us. Historians tell us that the Roman Campagna was not always the desolate and pestilential waste which it now is, but that in the early days of the city it was highly cultivated and thickly studded with farms. It is inconceivable that it should have been otherwise, for how could the population of a city be supported in the middle of an unproductive desert in the days when locomotion and transport

were slow and difficult? In the days when the Campagna was tilled, the City of Rome had an abundant food supply at its doors, and it is probable that the local wells supplied a sufficiency of good water, and that the pumping from local wells and the upward drainage of a luxuriant vegetation prevented the soil of the Campagna from becoming water-logged and malarious. With the growth of their city the Romans were confronted with those same sanitary problems which are troubling and puzzling the authorities of modern cities. The ruins of the Roman aqueducts stretching across the plain from the mountains to the city confront the wondering tourist at every turn, and modern sanitarians are accustomed to hold up Rome as an example of a city with an unstinted supply of pure water, an example which we are told we should do well to follow. With this abundant water supply the city became superficially cleaner, for it was easy to wash all the filth and offal into the *Cloaca Maxima* and send it seaward by the Tiber. This superabundant water supply necessarily led to the neglect of local wells, and, combined with the *Cloaca Maxima*, must have tended to lessen the draining and induce the starving of the soil in the neighbourhood of the city. The custom of burning the dead must also have had the effect of depriving the soil of what legitimately should have been returned to it. With the extension of the Empire it became easier to import food than to produce it locally, and thus the Campagna lapsed into a malarious waste. The abundant water and food supply produced an enormous increase in the area and density of the population, and these conditions, combined with malarious surroundings, produced a large amount of disease which may have been one of the causes to tempt Nero to try "Purification by Fire," and to feel justified in fiddling while it was in progress. Finally, the city became uninhabitable, the seat of Empire was moved to Byzantium, and Imperial Rome became little more than a heap of ruins surrounded by a swamp.

History has to a large extent repeated itself in these modern days. Will the repetitions be complete? This is a question well worth pondering.

In contrast with ancient Rome stands out the still existing Empire of China, in comparison with which the duration of the Roman Empire may almost be spoken of as ephemeral. The main characteristics of the Chinese are absolute thriftiness and religious rendering of all organic refuse to the mother of all things, the soil of their native land. I would call attention to the fact that even the bodies of Chinese who die abroad are sent home for burial, and this is no solitary instance of national economy being enforced in the name of religion, as those who have studied the laws of that greatest of law-givers and sanitarians—Moses—must very well know. The astounding productiveness of the "Flowery Land" is a cause of perennial

astonishment to the rest of the world, and it is noteworthy that in spite of a total neglect of personal and domestic hygiene by the Chinese masses, they continue to increase, and their "quiver" being full to overflowing, they are certain to suffer no serious harm from the enemy which is now at their gates.

REPORT ON THE EPIDEMIC OF ENTERIC FEVER IN 1893, IN THE BOROUGH OF WORTHING, IN BROADWATER, AND IN WEST TARRING.*

By CHAS. KELLY, M.D., F.R.C.P., Professor of Hygiene, King's College, London, M.O.H. for the Combined District of West Sussex.

(Continued from page 399.)

THE milk supply showed no bearing on the incidence of the epidemic.

SEWERAGE AND DRAINAGE.

Worthing and part of West Tarring are linked together as regards sewerage arrangements, while the other two areas of West Worthing and Broadwater are quite distinct, and the whole of the Worthing sewers discharge by a 30-inch iron pipe into the sea, about one and a-half miles east of Worthing Pier.

West Worthing has a system of sewerage to itself, and the outfall sewer discharges by an iron pipe about a mile to the west of the Worthing Pier.

Broadwater has no public system of sewerage, in-door water closets are rare, and the drainage is chiefly into cesspits, while house water is often utilised on the cottage garden.

The appearance of the fever at the same time in Worthing and Broadwater does not harmonise with the view which some held that the sewers or sewer emanations were the cause of the outbreak, for in that case West Tarring and not Broadwater would have been attacked. The further outbreak in August, which occurred at the same time in West Worthing and West Tarring also, negatives the idea that faulty sewers played any part in causing the disorder, for these places also are on quite different systems.

In 1878 a new main sewer was laid along the course of the Teville Stream, and extends from a point near the Worthing Railway Station, in an easterly direction to a point in the brooks east of Meadow Road, when it takes a more southerly direction, and ends at the outfall.

This brick barrel sewer is from 3 ft. 6 in. to 4 ft. in diameter, and it was made of this size so as to be able to hold a large quantity of sewage whenever the outfall was tidelocked, a circumstance which occurred twice in every 24 hours. From this year the pumping at the old

works ceased, and all the Worthing town sewerage flowed by gravitation to the sea.

The old works were disused in 1878, and the High Street sewer was diverted, so as to pass in a north-easterly direction to join the new main sewer.

After these new works were completed, the old abandoned sewer was bricked across at two points, one between High Street and the Waterworks enclosure, and one between the enclosure wall and the sewage well; later on, it was partially filled up.

The sewage well and the chain pump well were filled up with earth, after the brick walls had been pulled down. In September, 1892, the carrier pipes from the old sewage well were removed as far as the south-east corner of the enclosure wall, and more recently fresh portions have been removed between this wall and Lyndhurst Road. In 1885, some of the 15-inch pipes were removed in the north-east corner of the enclosure for a space of about 10 feet; this space was then filled in with earth, and a brick wall set in cement was built across each exposed end. The removed portions are shown on the chart by blank spaces in the course of the dotted lines.

In connection with the sewerage arrangements there still remains for careful consideration the old system of sewers in and about the Waterworks enclosure. For this purpose the chart should be carefully examined. The plan of the Worthing Waterworks shows an enclosure of about two acres in extent, in which the three wells, A, B, and C, are shown with the headings connecting each; these are all coloured blue. In 1857, a main system of sewerage and water supply was carried out by the old Local Board of Worthing.

The sewage from the town was received by a main sewer which came down High Street, and terminated in a sumpt, 6 ft. 2 in. by 2 ft. 10 in., and a sewerage well, 30 ft. deep, and 10 ft. in diameter at the top, reduced to 6 ft. at the bottom.

In this well there was placed a sewerage pump, consisting of three 15-inch barrels, worked by steam-power, and connected with the engine in the water tower by an iron shafting and driving gear, by which the sewage was pumped through an outfall sewer emptying itself into the sea, at a place two miles westward of the town, called Sea Mill Bridge. The works were carried out by Mr. (now Sir) Robert Rawlinson, and at the time they were considered very perfect of their kind.

Probably some alterations were afterwards carried out, for when the old works were abandoned, two chambers were filled up; they are said to have been 36 ft. deep, one of which was called the sewage well, or sumpt, and the other was called the chain pump well; the first received the raw sewage, which passed into a second well by a 15-inch pipe which connected the two at the bottom. Thence the sewage was pumped from the sewage well by two pipes to the sewage farm, which lay to the east of the town towards the

* Condensed from a Special Report to the Worthing Town Council.