vulsions of hydrophobia are always more or less co-ordinate in character. Such symptoms as I have described may probably succeed a true epileptic fit. They may also succeed attacks of *petit mal*. But the co-ordinated convulsion may also, as I have seen, commence in the first moment of the attack. The tonic rigidity, which often initiates these seizures, is different from the condition in a true epileptic fit, although apparently nearly the same as that which Charcot has described as the epileptic stage of these fits.

In women suffering from these attacks, I have occasionally found ovarian tenderness, and by ovarian pressure I have often made the patients feel ill, and caused choking sensations in the throat, but I have never succeeded in producing an attack. Nor, of many gentlemen who have practised ovarian compression at the Salpêtrière, and tried it on the hystero-epileptics at Queen Square, has anyone, as far as I am aware, been more successful. Now and then, I have arrested a fit by ovarian compression, but the arrest has appeared to be due merely to the pain caused, and not to any special influence; and, in such cases, the attacks could be cut short much more readily by faradisation of the skin. In one of the most severe cases of hystero-epilepsy which I have seen, Dr. Wilson of Surbiton found that at first ovarian compression had no effect; after many repetitions, in different attacks, it did arrest them, but even then less readily than compression at the epigastric region. Another point of difference from the disease as it occurs abroad is that, in the natives of this country, it is never, so far as I have seen, accompanied by any erotic manifestations. Such attacks occur in girls of any age over seven, in women under forty, in boys not at all rarely, and occasionally in adult men. Some of the severest attacks which I have seen have been in men between twenty and thirty-five. They frequently come on during sleep.

In the co-ordinated attacks just described, opisthotonos is frequent. A second variety presents, as its predominant characteristic, spasms of the opposite variety, emprostotonos. The trunk is flexed, so that the head and thighs are in contact. This form occurs chiefly in boys, and is usually very uniform in its occurrence, all the attacks being similar. One patient, a woman, whose attacks came on in the night, always woke up from sleep with a sensation of this spasm, although there was in reality merely general tonic rigidity. A third variety presents co-ordinated spasm in the legs of regular rhythm. During the attack, the legs are alternately drawn up and pushed down, the patient being commonly on her back. If on the floor, she may be gradually propelled, head foremost, from one side of the room to the other. Several cases which I have seen have presented singular uniformity in the character of the spasm. All were females. Identical convulsive movements in the legs have been observed in hydrophobia. A fourth variety of attack is characterised by extreme difficulty of breathing, not the rapid breathing sometimes observed in hysterical patients, but intense respiratory spasm. They are the "choking fits" of adults. It is no doubt an extreme degree of the disturbance, which in slighter measure causes the globus hystericus. Since this variety is rare, I may describe briefly an example of it. The patient was a quiet well-conducted girl. She was unconscious of any warning, but an observer could note a slightly frightened expression and restless movement of the eyes just before an attack; then she would suddenly fall, and instantly begin labouring for breath. If placed on a chair, she could sit up, but the agony of dyspnoea was extreme. Her head was thrown back, her mouth half open, her arms held out before her with fingers separated; the muscles of inspiration were thrown into violent action, and a choking noise in the throat accompanied each laboured breath. From time to time, there was an ineffectual attempt to swallow, and she would strike the upper part of the chest with violence, as if trying to shake something down. Her face became rapidly flushed, then dusky, and the dyspnoea increased, until she seemed on the point of suffocation. By closing the mouth and nose, and so producing actual apnoea, the spasm could generally be stopped, but her aspect was wild, and she spoke strangely, and in a few minutes passed into another similar paroxysm. Even if placed under the influence of chloroform, the dyspnoea returned as the effect of the anæsthetic passed away, and, if not stopped by means to be described in the next lecture, such attacks would go on for hours. It is instructive to compare the features of such an attack with the other well-known forms of respiratory spasm—the globus hystericus, the epigastric-throat aura of epilepsy, the paroxysms of laryngismus stridulus, and the respiratory spasm, which constitutes so prominent a feature in the symptoms of hydrophobia. The relation which attacks of the co-ordinated class bear to epilepsy and to hysteria is a subject on which various opinions may be and are held, and to which I hope to refer briefly in the next lecture, in considering the pathology of these diseases.

DR. MATHEW JOSEPH KEHOE has been elected Surgeon to St. Vincent's Hospital, Dublin, in the place of the late Mr. O'Leary, M.P.

THE CROONIAN LECTURES ON SOME POINTS IN THE PATHOLOGY AND TREATMENT OF TYPHOID FEVER.

Delivered before the Royal College of Physicians of London.

By WILLIAM CAYLEY, M.D., F.R.C.P.,

Physician to the Middlesex Hospital and to the London Fever Hospital; Lecturer on Medicine to the Middlesex Hospital Medical College.

LECTURE I.*

ADMITTING, then, that in all probability typhoid fever never arises *de novo* from decomposing sewage, and that, whenever it spreads from the sick to the healthy, it is by a process of indirect infection, it still remains to be considered whether this is the only way in which the disease may originate or become disseminated. To this question, I think we are compelled to give a negative answer. Several outbreaks have now been recorded which have been ascribed to eating diseased meat. And although in some of these considerable doubt has been expressed as to the real nature of the disease, in others I think the evidence is quite decisive.

The first of these outbreaks on record is the well-known one which occurred at Andelfingen, in the canton of Zürich, in 1839. On July 10th of this year, the Local Choral Society held a festival meeting, after which, 513 persons of all ages sat down to a cold collation, consisting chiefly of veal and ham. It was noticed at the time that neither the veal nor the ham was perfectly good. Some portions of the former had a greenish colour and a disagreeable smell; the ham, also, is said not to have tasted well. But most of the guests observed nothing amiss, and ate heartily. Of the 513 persons who partook of this collation, 421 were subsequently attacked by an acute febrile disease, which was regarded at the time as typhoid. Thirty-four inhabitants of Andelfingen were also attacked who had taken no part in the choral festival, but all of whom, it was ascertained, had been supplied by the same butcher who had furnished the veal and ham for the festival. The day after the festival, there was a wedding in the neighbourhood of Andelfingen, at which fifteen persons were present, only one of whom had attended the choral meeting. The meat—veal and beef—for the wedding breakfast was supplied by the same butcher. Of these fifteen persons, eleven were attacked. The period of incubation of this epidemic was very variable. A few were seized with nausea and vomiting on their way home, but this was ascribed to their having drunk too much wine. Out of 230 cases in which the incubation period was ascertained, 43 were taken ill during the first five days, 123 during the second five days, 48 during the third five days, and 16 during the fourth five days, 6 being attacked on the nineteenth day. The symptoms were those of severe gastrointestinal irritation, with high fever, delirium, stupor, congestion of the lungs, and great prostration. No rose rash was observed, but in some cases there were petechiæ. The duration of the milder cases was about eight days; of the severer ones, three to four weeks. Convalescence was slow, and often the hair fell out. The mortality was slight; and, on *post mortem* examination, in some cases there were infiltration and ulceration in the lower part of the ileum, with enlargement of the spleen; in others, these changes were not observed. There can be no doubt as to the meat having been the cause of the epidemic, as only those persons who had partaken of it were attacked, while a very large number of persons from all parts of the canton were present as singers or spectators who did not share in the collation, and they all escaped. But great doubts have been expressed as to whether it was really typhoid fever, or a form of poisoning resembling sausage-poisoning.

In 1845, a similar epidemic occurred at Thalweil, though on a much smaller scale. The particulars of this I have failed to obtain, as the journals containing it are out of print. But eight out of ten persons were attacked with what was believed to be typhoid fever after eating bad veal.

A third epidemic due to the same cause, and which was undoubtedly typhoid fever, occurred at Kloten, a place about seven miles north of Zürich, in 1878. On Ascension Day, June 30th, a festival was held of the united choral societies of the district, together with choirs from Zürich and Winterthur. The festival collation was furnished by the landlord of one of the inns, who himself was attacked by the epidemic. The food supplied consisted of ragout of veal, roast veal, and veal-sausages. The meat, which came from various sources, was hung up in the meat-room of the inn, and, the day before the festival, was partly

* Concluded from page 393 of last number.

roasted, partly minced-up for sausages, and the fragments used for the ragout were cooked on the following day. Nothing amiss was observed with the ragout, but the cold roast veal was in part decomposed, and the sausages were manifestly bad. In consequence of this, they were largely distributed amongst the spectators, the children, and persons who could not afford to pay. Out of 690 persons who sat down to the collation, 290 were attacked. In all, 668 persons were infected who had partaken of the meat provided for the festival, either at the collation or at the inn, or who had been supplied with it at home; besides which, 49 secondary cases occurred—i.e., persons who subsequently became affected by contagion without having eaten of the meat. All other sources of infection could be almost certainly excluded, and Kloten was quite free from typhoid at the time. A very large number of visitors to the festival ate no meat, but only drank wine; none of these were attacked. And it was clearly shown that the water was not the cause of the outbreak. Many persons who had drunk no water were attacked, and others who had drunk freely escaped. Several persons who drank wine to excess, and consequently vomited in the evening, afterwards escaped. The incubation period, as in the Andelfingen epidemic, was for the most part very short. Some persons were taken ill on the second day, with loss of appetite, nausea, headache, pain and swelling of the belly, and slight fever. These early cases were the mildest, and many patients recovered in a few days. The greater number fell ill between the fifth and the ninth days. The symptoms were chills, fever, diarrhoea, great prostration, in many cases early and violent delirium. Epistaxis frequently occurred, and also profuse intestinal hæmorrhage. The roseolous rash of typhoid was present in almost all the cases, and in many was remarkable for its extensive development, sometimes leading to little infiltrations forming distinct elevations, and leaving behind slight pigmentations. *Post mortem* examination showed the characteristic appearances of typhoid fever, infiltration, and sloughing of Peyer's patches and the solitary glands, with characteristic ulcers where the sloughs were detached; not unfrequently, also, infiltration and sloughing of the solitary glands of the large intestine, great enlargement of the mesenteric glands and spleen. With regard to the meat supplied, the following facts were ascertained. Forty-two pounds of veal were furnished by a butcher at Seebach, taken from a calf which appears to have been at the point of death from some disease, when it received the *coup-de-grâce* from the hands of the butcher. All the flesh of this animal was sent to supply the festival at Kloten, but the liver was eaten by an inhabitant of Seebach, and he was attacked by typhoid fever; and the brain was sent to the parsonage at Seebach, and all the household became affected by the same disease. It was also ascertained that another of the calves which supplied the veal was suffering from umbilical phlebitis and peritonitis, and was at the point of death when it was slaughtered. The veal from this calf had been kept fourteen days, and was in a decomposed condition. All the meat was placed together in the meat receptacle of the inn, which was in a horribly filthy state, and no doubt the putrefying flesh of this last calf, together with the state of the receptacle, would rapidly excite decomposition in the whole supply. According to Professor Huguénin, the meat had two injurious qualities—(1) it was putrid; (2) it was infected with the specific typhoid poison. And the resulting epidemic showed two corresponding groups of symptoms—(1) a putrid intoxication, which caused an acute catarrh of the gastro-intestinal mucous membrane, coming on early; and (2) typhoid fever, which sometimes followed on the former, and sometimes occurred independently. The mortality was extremely small, this being probably due to the fact that many of the affected persons only suffered from the former symptoms. The peculiarities of the Andelfingen epidemic are no doubt to be explained in the same manner. The question now arises, How did the meat acquire the specific typhoid infection? There can be little doubt that this was derived from the calf supplied by the butcher at Seebach, the liver and brain of which gave typhoid fever to persons residing there who had not visited Kloten. This calf was very ill; and Professor Huguénin thinks there can be no doubt but that the animal was itself suffering from typhoid fever. He has convinced himself that typhoid fever is not uncommon among cattle in Switzerland; and that the flesh of such animals is often eaten without any injurious results, some putrefactive changes being necessary to develop the infectious properties. A remarkable fact bearing on this question was observed in this epidemic. In the house of one of the persons attacked, while he was still laid up, two calves were taken ill and slaughtered, and a *post mortem* examination showed the characteristic intestinal lesions of typhoid fever, the presumption being that these animals became affected by the alvine discharges of their master before he took to his bed.

Shortly after this outbreak, another small one took place at Kronau. A butcher there refused to buy a calf because it was ill; the family, therefore, to whom it belonged, ate it themselves, and six members were

attacked by typhoid fever. A similar outbreak, affecting fifteen persons, occurred near Winterthur in 1869, the particulars of which I have been unable to obtain; and one has been recorded from Iceland.

I think, therefore, the evidence that typhoid fever may be caused or disseminated by diseased meat is sufficiently conclusive. But whether this is due to the animals being themselves affected with the disease, requires further investigation. The experiment of feeding pigs with typhoid stools in this country has always failed to produce the disease; whether the attempt has been made with calves, I do not know.

A point of great interest in the pathology of typhoid fever, and one which may perhaps be most conveniently considered in connection with the etiology, is the period of latency or incubation, the determination of which presents great difficulties. If we are to accept as trustworthy the statements which have been made by the authorities who have written on this subject, we should have to confess that typhoid fever may have an incubation varying from a few hours to six weeks; and though the evidence adduced in favour of these extremes is practically valueless, nevertheless it can hardly be doubted but that great variations do occur.

We may, I think, accept as well established that the usual period, especially when the disease is communicated by drinking-water, is about fourteen days. But considerable deviations, both real and apparent, are often met with. Often much difficulty is experienced in fixing the exact date of onset of the disease, and to this many of the apparent deviations from the usual period are due. Not only in many cases is the onset gradual, but frequently there are distinct premonitory symptoms, a *stadium prodromatum*, during which the patients complain of weariness, some pain and weight in the limbs, impairment of appetite, often diarrhoea. These symptoms may pass gradually into those of the developed disease; and, unless thermometrical observations have been made—which is rarely the case at this stage—it becomes impossible to fix the date of the true commencement of the attack, which should be reckoned from the time at which the temperature rises. In other cases, the period of invasion is distinctly indicated by the occurrence of rigors, which may or may not have been preceded by these premonitory symptoms. I have recently seen a very severe case of typhoid, in which the premonitory symptoms lasted for a fortnight before the occurrence of rigors and the definite onset. In this case, a very slight increase in the severity of these premonitory symptoms might easily have caused the incubation period to have been reckoned as one day instead of fourteen. In children, whose nervous systems react strongly to slight causes of disturbance, I have no doubt that the premonitory stage is often included in the fever; and many of the best authenticated cases of unusually short incubation periods have occurred among children. Another difficulty is that of excluding, in a disease like typhoid, of which the contagion is indirect, other sources of infection than that which is supposed to have caused the attack.

The following may be cited as instances of unusually short incubation. In the milk epidemic in Marylebone, a child was taken ill five days after drinking the contaminated milk, but it is possible that here the premonitory stage was included in the fever.

Griesinger relates three cases in which the period was less than twenty-four hours. He states that one day, while sitting by the bedside of a case of typhoid, he suddenly felt unwell and thought he had caught the fever, and the next day he was taken ill. I only mention this case, as it is not unfrequently quoted as an evidence of the occasional occurrence of very short periods. His other two cases are almost equally valueless.

Dr. Clifford Allbutt published a case in which the period of incubation was exactly four days; but further investigation showed that the disease was acquired, in all probability, in quite a different manner from that at first supposed, and that consequently no conclusion could be drawn from it as to the incubation period.

One of the most striking instances of a supposed very short incubation period is the well known outbreak at a school at Clapham in 1829. Here, within four days of exposure to the emanations from the contents of a choked drain, twenty boys out of twenty-two were attacked by vomiting, purging, fever, and extreme prostration, and two died comatose within twenty-five hours. In these two cases, the solitary glands and Peyer's patches were found swollen and infiltrated. Here, however, the nature of the disease is open to doubt. Some very high authorities, as Sir Thomas Watson, do not regard it as having been typhoid; and certainly the phenomena were very unlike those of ordinary typhoid. The contagion must have been of extreme virulence, as two cases died comatose in twenty-four hours, and yet the other eighteen recovered, giving a general mortality below the average. There can be no doubt that decomposing sewage may contain other poisons besides that of typhoid fever, and considerable swelling of the gland-

ular apparatus of the intestine may be caused by many kinds of irritation.

Professor Quincke of Bern cites the following example of unusually short periods. Three boys played on successive days, from March 13th to 16th, with some straw from a mattress soiled with the discharges of a fatal case of typhoid. All three were infected; the first was taken ill on March 22nd. Here the maximum limit was nine, the minimum three days. Another case was that of a woman who came from a distance to an infected house, where she stayed two or three days. She felt ill on her way home, and after a few days took to her bed, and died on the fourteenth day. Here the maximum limit was six days.

More common than very short are protracted periods, and an incubation of twenty-one days is by no means infrequent, especially when the cause has been contaminated water or milk. But periods of five or six weeks may, I think, in all cases be ascribed to errors of observation.

The causes of this variability of the incubation period of the contagious fevers are very obscure, and cannot be satisfactorily accounted for on any of the theories which have been put forward as to the nature of these diseases. In some the period is much more variable than in others. Thus in morbilli, rubeola, variola, varicella, and for the most part typhus, it is pretty constant, and is much the same in all; scarlatina with a short, and typhoid with a long period, are much more variable; and in some fevers in which poison is fixed, and can only be communicated by inoculation, as syphilis and hydrophobia, the period may be protracted to an extraordinary degree.

Among the causes which may influence the incubation period is, first, the mode in which infection takes place. It seems probable that, when the poison directly enters blood, as by inoculation, it is likely to take effect more rapidly than when it is absorbed through the mucous surfaces. Thus there is reason to believe that, when the poison of scarlatina is introduced through a wound or raw surface, as after a surgical operation or delivery, the incubation may be very much curtailed. So too we might expect that when the lymphatics are the medium of absorption, and the poison is first conveyed to the glands, the incubation period would be longer than when it is absorbed by the blood-vessels. Thus in syphilis, which has a very long incubation, the poison is absorbed by the lymphatics.

According to the views of Liebermeister, the poison of typhoid is always swallowed and absorbed by the intestinal glands, where it exercises its primary influence. There can, however, I think, be little doubt that it may also be absorbed by the respiratory and other mucous membranes, and so obtain a more direct entrance into the blood. Indeed, if, as is maintained by Friedreich, the spleen begin to enlarge during the incubation period, it is manifest that the poison does not lie dormant during this period in the intestinal and mesenteric glands, but has already passed into the blood. Now it appears, on the whole, that the incubation period is more frequently unusually short, where the disease has been acquired by exposure to emanations from decomposing sewage, than where drinking-water has been the medium of contagion, whereas the unusually long periods have occurred in the latter condition. But to this there are exceptions, as in the milk case I quoted above; and further evidence is required before any positive conclusions can be drawn.

Another cause which may influence the incubation period is temperature. It is well known that vaccinia will often run a somewhat shorter course in hot weather; and by increasing the temperature of the skin, as by a blister, the eruption of small-pox may be hastened: it is therefore probable, if anything occur to cause febrile disturbance, and so raise the temperature during the period of incubation, that this will be shortened. Lastly, certain constitutional conditions will influence the incubation period. Thus Obermeier has shown that the occurrence of menstruation shortens the latent period of small-pox.

That the variability of the incubation period is due in many cases to some peculiarity on the part of the patient, and not to any difference in the state of the poison or in the manner in which it is introduced, is manifest from the fact that it usually happens, when several persons are exposed at the same time and in the same manner, that they fall ill at very variable intervals. A very remarkable instance of this kind is narrated by Professor Quincke. On June 22nd, 1873, the Federal Gymnastic Festival was held at Münsingen, a village situated about seven miles from Bern, and there was a large gathering of visitors from all parts of Switzerland, most of whom left Münsingen the same day. It so happened that the wife and son of the landlord of one of the inns, which was close to the ground where the gymnastic meeting was held, were ill with typhoid fever, and only ten feet from the leaky soil-pit of the privy of the inn was a well from which water was supplied to the persons taking part in the festival, as well as to those who took refreshments at the inn itself. An epidemic of typhoid fever broke out among persons who had attended this festival, and the particulars of fourteen

cases occurring among visitors who came from places free from typhoid have been ascertained. In one case, the attack commenced eight days after the festival; in three cases on the twelfth day; in one case on the thirteenth day; in two cases on the fourteenth day; in two cases on the fifteenth day; in two cases on the sixteenth day; in two cases between the sixteenth and eighteenth days; and in one case some time between the fourteenth and twenty-second days, when he first came under medical observation. Here, then, we see incubation periods varying from eight to eighteen days, where there is strong reason for believing that the conditions of infection were the same.

Seeing, then, that the flesh of calves suffering from typhoid fever, when in a state of decomposition, appears to be capable of communicating the disease, it is an interesting inquiry as to whether the milk of cows similarly affected would also possess contagious properties. I believe that in this country, wherever epidemics have been caused by contaminated milk, the poison has been traced to the water which has been mixed with the milk; but, judging by analogy, there is great probability that the milk itself might be capable of communicating the disease. It has been demonstrated by repeated experiments that not only will the flesh of tuberculous animals, when eaten by other animals, cause tubercular ulceration of the intestines, followed by general tuberculosis, but that also the milk of tuberculous cows possesses the same properties; in both cases, the infection is prevented by thorough cooking or boiling. It is an uncomfortable reflection that cooking seems not to have destroyed the poison contained in this infected meat. Doubtless these questions, which are of the utmost importance to the public health, will soon be determined by the researches of foreign experimenters; for in this country I presume we must, in investigations of this kind, be satisfied now to play the part of hearers rather than of doers.

The usual modes in which typhoid fever becomes disseminated have been so thoroughly investigated, and are so universally recognised, that I do not propose again to repeat them. Wide-spread epidemics have always been traced to contamination of the water-supply, the water itself being the medium of the infection, or else the milk with which the contaminated water has been mixed. Local outbreaks confined to particular houses are sometimes due to the same cause; sometimes to inhaling emanations from cesspools, drains, and sewers, in consequence of some defective sanitary arrangement; and it must be confessed that great ingenuity has been shown by architects, builders, and plumbers to ensure that the air we breathe or the water we drink shall be so contaminated. Sometimes this is due to dishonesty; sometimes to carelessness; more often to ignorance. Several striking instances of each of these have come under my notice. Thus, in a new country house, where the drains had been properly planned and arranged, and it was supposed every precaution had been taken, the basement nevertheless became sodden with sewage. On taking up the drains, it was found that the pipes had merely been laid end-to-end, and not cemented together. This was an example of dishonesty. In another case, the drain-pipes had been made to slope the wrong way, insuring the perpetual accumulation of stagnating sewage. This was carelessness. A third case was that of a large public institution in which several cases of typhoid had originated, and I was asked to examine the water-supply and closets. The main cistern supplying the building was placed on the roof, and was, of course, covered by a lid. On lifting this, I found a distinct smell of sewer-gas; and I noticed a large pipe which opened a few inches above the surface of the water. On investigation, this was found to be a ventilating shaft constructed for the purpose of ventilating the main sewer of the building—no doubt put up with the best intentions many years ago, when the necessity of ventilating the drains first began to be insisted upon.

We may hope that such glaring examples are fast becoming things of the past, though I fear many of our architects are far behind the standard laid down 1800 years ago by Vitruvius, who demands of an architect not only that he shall be acquainted with the technicalities of his art, but shall have studied philosophy and acquired a knowledge of medicine.*

Probably one of the commonest causes of sporadic outbreaks of typhoid fever in large towns are water-closets, and the introduction into houses of this most necessary adjunct of civilisation has always been followed by an increase in its development. This has been notoriously the case in Edinburgh, where water-closets are of comparatively recent introduction; and I think we are justified in regarding Sir John Harrington, who in the reign of Queen Elizabeth invented water-closets, as being largely responsible for the spread of typhoid fever. The dangers of water-closets are twofold. 1. When the handle is pulled up, the contents of the pan necessarily displace the air in the soil-pipe and

* "Philosophos diligenter audiverit, medicinæ non sit ignarus"

drain; and, unless (which is the exception) a proper ventilating apparatus has been adapted, some of this rushes up into the closet, carrying of course with it the typhoid poison, if this should happen to be present, and so very likely infecting the occupant. 2. The risk of contaminating the drinking-water. Even at the present time, the great majority of water-closets are so constructed that the waste-pipe of the supplying cistern, from which the drinking-water is often taken, goes down directly into the soil-pipe, and so—as in the institution I have just described—though not intentionally, forms a ventilating shaft to the drain. I have no doubt that this arrangement holds in two-thirds of the London houses, and consequently the drinking-water is habitually contaminated with sewer-gases. Fortunately, the system of drainage is now so admirably constructed that stagnation of sewage, which seems to be the most important factor in the development of the typhoid poison, does not often occur.

It is manifest that a system of periodical inspection of the water-cisterns and water-closets is urgently required. The present water companies have the right, which they occasionally exercise, of inspecting the cisterns, but only for the purpose of seeing that the water is not allowed to run waste. But, if the water-supply were in the hands of a public body, nothing would be easier than to enlarge a little the scope of this inspection and to make it more regular; and I believe, if this were done, it would almost put a stop to the local and sporadic cases which occur in London. I except, of course, the annual outbreak among the upper and middle classes, who bring the disease back with them from the various health-resorts in this country and abroad, where they have spent their autumn holidays.

Another point of great practical importance in the etiology of the disease is the extraordinary dilution under which the poison may retain its potency. One remarkable instance of this I have described in the epidemic at Lausen. A still more remarkable example is furnished by the recent epidemic at Caterham and Redhill. This outbreak was clearly shown by Dr. Buchanan to have been caused by the contamination of the water of the Caterham Water Company by the alvine discharges of a single workman suffering from ambulant typhoid, who was engaged in the construction of a new adit. If any necessity arose for the workmen to relieve themselves during their spell of work below, which lasted from eight to twelve hours, and there should be any difficulty or delay in their being drawn up to the surface, it was arranged that they should use the buckets which were employed in raising the chalk. This man, it appears, had very copious diarrhoea, and had to relieve his bowels two or three times during each spell; but he positively denied ever having passed his motions in the adit without waiting for a bucket. Nevertheless, there were undoubted means by which his evacuations could have found their way into the water; for, as the buckets were drawn up, their oscillations caused them to strike against the sides of the shaft, and some of the contents would so be shaken out and fall over a stage into the water below. And he also stated that his motions were so liquid that the buckets, which were also used to lower materials used in the construction of the adit, must have been stained with them. Here, then, we have in all probability only some splashings of typhoid stools mixed with a very large body of water—a proportion of the most extreme minuteness—and yet the water so contaminated gave typhoid fever to 305 persons.

I think these two instances are sufficient of themselves to serve as a warning against trusting to irrigation and downward filtration as a means of purifying water, and also against the dictum that water containing less than a certain proportion of organic impurity is practically wholesome and fit for drinking, irrespective of its original source. It ought, I think, to be laid down as a rule of hygiene, that human excrements should under no circumstances be mixed with drinking-water, however completely they may be subsequently removed by filtration or rendered innocuous by oxidation. Of course, in the case of a city like London, this can only be looked upon as an ideal to be realised in some distant future; but with less than this we ought not to rest satisfied.

It is now an interesting question, What are the causes to which our immunity in London from the spread of typhoid fever by water is due? The Thames, from which we derive our drinking-water, is unquestionably contaminated not only with excrement, but also with the specific poison of typhoid fever. Until quite recently, many large towns, where typhoid fever is more or less endemic, discharged their sewage into it, and many places do so to this day; and yet I believe that, since the intake of the water companies has been removed above Teddington Lock, the water, as delivered from their mains, has never caused an outbreak. Where in London typhoid fever has been traced to the water, it has been due to its subsequent contamination in the cisterns of the consumers. With the evidence afforded by Lausen and Caterham before us, we can hardly ascribe this immunity to the mere dilution of the poison; neither can it be attributed to filtration; for we have seen that the very com-

plete natural filtration of the Lausen water was inoperative, and it is notorious that the filtration of the London water companies is very defective. It is not sufficient even to remove the coarser particles in suspension; thus in times of flood the water is often more or less turbid, and, moreover, frequently contains living organisms. It is, therefore, quite impossible that the extremely subtle poison of typhoid would be separated. What degree of natural or artificial filtration is required to effect this is not known. It is probable that filters which act chemically on the water may do so. Dr. Gustav Bischoff, in a paper communicated last year to the Royal Society, showed that the germs of putrefaction were completely separated or rendered inert by filtration through spongy iron; and the same thing has been claimed for charcoal; but hitherto these modes of filtration have only been applied on a small scale, and it must be remembered that, unless a filter is kept clean and in good order, it only increases the risk of contamination. I think, then, that we must assume that, when the typhoid poison enters a large running body of water, where it is freely exposed to the air and various oxidising agencies, it is soon rendered inert; while, in close confined situations, it retains its activity for an indefinite time. This is perhaps a reason for regarding a large open body of water as a safer source of supply in a thickly populated country than wells and springs, in consequence of the ever increasing difficulty of preventing their accidental contamination.

These cases are also interesting, as many of them were attended by well-marked premonitory symptoms, the causes of which in all the contagious fevers are very obscure. One of these patients was attacked two days afterwards by headache, vomiting, and diarrhoea, from which he recovered, though he did not again feel quite well, and then on the sixteenth day he was again attacked by rigors and headache, and the disease now became developed. In a second case, violent diarrhoea and vomiting came on a few days afterwards, and again quite subsided before the commencement of the fever. Similar cases are not uncommon. I have recently had under my care a case in which the patient was attacked by diarrhoea, which only lasted a few days, though he continued to feel somewhat unwell; but it was not till after the lapse of a fortnight that he shivered and was definitely taken ill with typhoid. These cases would seem to indicate that the poison exercises a primary irritating action on the intestinal mucous membrane before its absorption; or possibly, where contaminated water is the medium of infection, other irritating substances may be present which cause the primary diarrhoea. Most probably, however, the primary diarrhoea is due to the typhoid poison.

On the whole, we must, I think, come to the conclusion that the variability of the latent period of typhoid fever, though it may be influenced by the manner in which the infection takes place, depends in most cases upon some unknown peculiarities of the patient himself. It is not probable that the amount or intensity of the poison can have any influence, as we see both in this and in other fevers that the period of incubation of the mild and of the severe cases is the same.

BIRKENHEAD.—The newly constituted borough of Birkenhead now contains a population estimated at 84,000. During 1878, 2,932 births and 1,656 deaths were recorded, equal to rates of 35.12 and 19.83 respectively. Of the gross mortality, the deaths of infants accounted for 724, of children and young persons for 114, of adults for 534, and of old people for 284. The proportion of deaths under one year to registered births was 134, or 19 less than that of England and Wales. Two persons were returned as upwards of a hundred years at the time of death. One was entered as a joiner's wife, and as having died of bronchitis at the age of 102; the other as a weaver's widow, dying of senile gangrene at the age of 101 years and 11 months. Of the registered deaths, 383 were ascribed to zymotic diseases, 242 to constitutional diseases, 674 to local diseases, 264 to developmental diseases, and 68 to violence. The more fatal zymotic diseases were measles and whooping-cough. Measles appeared in March, and was more or less prevalent during the remainder of the year. During the last six weeks, the mortality greatly increased, 32 out of the 72 fatal cases being registered in these six weeks. Whooping-cough began to be fatal in December 1877, and it continued prevalent up to nearly the end of the third quarter of 1878. With these exceptions, the borough was singularly free from zymotic diseases. Scarletina and diphtheria were only fatal in a few isolated cases, and the deaths from diarrhoea were markedly below the average. The fever hospital, which, during the small-pox epidemic of 1877, rendered such invaluable service, continued to afford to the sanitary authority the means of isolation of infectious cases. "Every year brings new proof of the estimation in which it is held by the members of the medical profession, and of the good-will and confidence of those for whose benefit it was established." During the year, it received 45 patients, of whom 5 died. A word of praise is due to Mr. Vacher for his copious and valuable tables of statistics.