

ASIATIC CHOLERA

*ITS HISTORY, PATHOLOGY, AND MODERN
,
TREATMENT.*

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TO HIS COLLEAGUES
IN
ITALY, SPAIN, GERMANY AND HUNGARY,
BY WHOSE KINDNESS AND COURTESY HE HAS BEEN ENABLED TO
PURSUE HIS INVESTIGATIONS IN MANY OUTBREAKS OF
CHOLERA, AND BY WHOSE SKILL AND DEVOTION
SO MUCH WAS DONE FOR THE RELIEF
AND ARREST OF THE DISEASE,

THIS WORK
IS GRATEFULLY AND RESPECTFULLY DEDICATED

BY THE AUTHOR

P R E F A C E.

I N the following account of Asiatic Cholera an endeavour has been made to depict the disease both as it exists in its home in the Delta of the Ganges and as it wanders about Europe, carrying desolation into its towns and villages. Whilst serving in India the author was brought constantly into contact with it, and in Europe he has taken every available opportunity of studying it under other conditions. He has endeavoured to present these different aspects to his readers.

In regard to the theories of cholera, he has approached the subject with the desire of knowing everything that could be demonstrated on the subject. A mere theory supported by names however eminent, unless strictly logical proof can be brought forward in its favour, should certainly not commend itself to any one. He has, therefore, placed before his readers the evidence that he has collected, in order that they may form their own opinion on the matters submitted to their consideration.

He has spent much time over the section on therapeutics, especially in consulting the records of past epidemics, so that, if possible, there should be no omission of any remedy of value. As he has had the advantage of seeing various methods of

treatment applied by many able physicians of different countries, he trusts it contains a summary of everything that has been used that has relieved the sufferings of the patients, or lessened the mortality of the disease.

As he has also seen the means adopted under different forms of government for the suppression of outbreaks of infectious disease, he has given an outline of those plans that have appeared to him most efficacious.

It is right, the author thinks, to say that the views on cholera here given have been held by him for many years, but it is only after seeing them confirmed by the evidence obtained in many epidemics that he now makes them public.

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ASIATIC CHOLERA.

CHAPTER I.

THE HISTORY OF ASIATIC CHOLERA.

IT would serve no useful purpose to discuss at full length the oft-debated question whether Asiatic Cholera was known before the year 1817. The evidence appears to us conclusive that it is one of the oldest diseases of which a description has been handed down to us. That it has often been absent from Europe for long periods, so that generations have passed away without having had experience of it, explains, we think, fully the fact that when it appeared in Europe early in this century, after a long absence, it was regarded very generally as a new disease. But the ancient authors were undoubtedly acquainted with it. Without attaching undue importance to the frequently quoted case given by Hippocrates, which cannot with certainty be said to have been an example of the Asiatic disease, yet in the description of the malady left by Aretæus there is evidence that he was thoroughly conversant with it. He probably met with it in the interior of Asia Minor, of which district he was a native, and where it is commoner to this day than in lands further west.

Dr. HIRSCH is not in favour of the belief that China was visited by cholera in very ancient times, and thinks that the picture given in a Chinese medical writing, translated by LIVINGSTONE, does not refer to the disease. The passage

is as follows:—"The *Ho-luan* (cholera) is a sudden attack of pain in the heart and abdomen, with vomiting and purging, a dread of cold and a desire of warmth. It is accompanied with pain in the head and giddiness. When the pain attacks the heart first, vomiting comes on first; when the pain commences in the abdomen the purging precedes. When the pain in the heart and abdomen synchronise, the vomiting and purging come on at the same time. When the disease is severe the patient has spasms; and when these enter the abdomen death ensues." There are several references to it in the earlier mediæval authors, as in Rhazes of Bagdad and Avicenna.† But when we come to the sixteenth and seventeenth centuries we find many accounts of it. In 1574 there was published at Antwerp a Latin translation of a work by the Portuguese physician, Garcia d'Orta,‡ residing at Goa, and the description given by him of cholera is very accurate.

Jacobus Bontius, a Dutch physician living at Batavia in the East Indies, wrote in 1629 an exceedingly good account of cholera. He says, "Cornelius van Royen, who being in perfect health at six in the evening, was suddenly seized with cholera, and expired in terrible agony and convulsions before twelve o'clock at night, the violence and rapidity of the disorder surmounting the force of every remedy. But if the patient should survive the period above mentioned, there is great hope of performing a cure. This disease is attended with a weak pulse, difficult respiration, and coldness of

* "Handbook of Geographical and Historical Pathology," by Dr. AUGUST HIRSCH. *London*, 1883.

† See "Annals of Cholera," by JOHN MACPHERSON, M.D. *London*, 1872.

‡ "Aromatum et Simplicium aliquot Medicamentorum apud Indos nascentium Historia." GARCIA AB HORTO, Auctore. *Antverpiæ*, MDLXXIII.

the extreme parts, to which are joined great internal heat, insatiable thirst, perpetual watching, and restless and incessant tossing of the body. If, together with these symptoms, a cold and foetid sweat should break forth, it is certain death is at hand. Those who die of the cholera generally expire in convulsions."

But before 1817 there are two epidemics of cholera reported by English authors. In 1781, a division of Bengal troops, consisting of about 5,000 men, under the command of Colonel Pearse, was marching to join Sir Eyre Coote's army on the coast. They reached that district skirting the Bay of Bengal to the north of the Bombay Presidency, between Ganjam and Chicacole. It would appear that a disease resembling cholera had been prevalent in that part of the country before their arrival, and the troops were infected with it on the 22nd March. "It assailed them with inconceivable fury. Men in perfect health dropped down by dozens, and those even less severely affected were generally dead or past recovery within less than an hour." "

In 1783 occurred the great epidemic at Hurdwar, the place of Hindu pilgrimago, where the Ganges issues from the mountains. In eight days 20,000 of the pilgrims died.

Mr. C. Macnamara | has shown that during the earlier periods in which the disease was known to the English in

* A most valuable account of the earlier epidemics in India of cholera, chiefly derived from reports of the medical officers of the Bengal Army, will be found in the following work:—"Report on the epidemic Cholera Morbus, as it visited the territories subject to the Presidency of Bengal in the years 1817-1818-1819. Drawn up by order of the Government, under the superintendence of the Medical Board, by JAMES JAMESON, Assistant-Surgeon and Secretary to the Board. *Calcutta*: Printed at the Government Gazette Press, by A. G. Balfour, No. 1, Mission Row."

| "A History of Asiatic Cholera," by C. MACNAMARA. *London*, 1876.

India it was not termed cholera, but frequently “the spasmodic affection,” from its chief symptom. This accounts for the fact that the earlier references to it were for a long time overlooked.

It would seem also that the word cholera has been applied at times to cholera nostras—a simple diarrhoea; and sometimes to other affections characterised by frequent evacuations.

But from the year 1817 the course of the disease can be clearly traced. On the 19th August, Dr. Robert Tytler, of Jessore, in Bengal, was called by an Indian physician to a patient who had been seized with vomiting and diarrhoea. He was moribund. Dr. Tytler was preparing a report of the case as one of poisoning, when he heard that seventeen other cases had occurred simultaneously. Dr. Tytler writes on August 23rd, 1817, “An epidemic has broken out in the bazaar, the disorder commencing with pain or uneasiness in different parts of the body, presently succeeded by giddiness of the head, sickness, vomiting, griping of the belly, and frequent stools. The countenance exhibits much anxiety, the body becomes emaciated, the pulse rapidly sinks, and the patient, if not speedily relieved with large doses of calomel, followed by one of opium, it carries him off within four and twenty hours.” In this epidemic 10,000 of the inhabitants of the neighbourhood perished.

In November of the same year the disease broke out in Lord Hastings’ army, then engaged in the Mahratta war. The troops were encamped on the banks of the river Sind, a tributary of the Jumna, in Bundelkund. Lord Hastings writes in his diary:—“13th November, 1817.—The dreadful epidemic which has been causing such ravages in Calcutta and the southern provinces has broken out in my camp. It

* MS. Report, quoted in “A Treatise on Asiatic Cholera,” by C. MACNAMARA. *London*, 1870

is a species of cholera morbus. It has gradually ascended the river Ganges to Patna, Gharsepore, Benares, and Cawnpore. There is an opinion that the water of the tanks, the only water which we have at this place, may be unwholesome, and add to the disease; therefore, I march to-morrow, so as to make the Pohooj river, though I must provide carriage for one thousand sick. Nov. 15th.—We crossed the Pohooj this morning. The march was terrible for the number of poor creatures falling under the sudden attack of this dreadful infection, and from the quantities of bodies of those who died in the wagons, and were necessarily put out to make room for such as might be saved by the conveyance. It is ascertained that five hundred have died since yesterday. 16th Nov.—This day has exhibited an abatement of the contagion. 17th.—Still more improvement. 19th.—We marched fifteen miles to the banks of the Bitwah, a clear broad stream with lofty banks. 21st.—There is an unquestionable diminution of the disease. 22nd. No one can comprehend my sensation on hearing laughter in our camp this morning, after witnessing the dismay and melancholy which have lately visited my soldiers.”

In 1818 the disease ravaged Bengal, and spread up the Ganges and Jumna to Patna, Benares, Agra, and Delhi.

In 1819 it was less severe, but the disease found its way to Ceylon and Arracan.

In 1820 Bengal suffered again severely; and the disease spread to the Philippine Islands and China.

In 1821 the disease commenced its march westward. It passed the Indus, and spread along the shores of the Persian Gulf. It raged with extreme violence at Bassorah, where nearly twenty-five per cent. of the inhabitants died. In Muscat it killed 10,000 persons. It also was very severe in the extreme east, killing in Java 100,000 of the inhabitants.

In 1822 it still travelled further westward. It attacked

Mesopotamia and Syria. Persia was visited, from Ispahan it reached Kazan in July, Tauris in September, and soon after it arrived at Erzerum.

In 1823, though still severe in the east, ravaging Burmah and China, its chief progress was westward. Astrakhan and the shores of the Caspian suffered severely, and at length it reached Orenberg, the extreme eastern province of Europe. During the next three years there was no great increase in the disease, either in the extent of territory affected or in its severity.

In 1827 it was very severe in Calcutta, but it did not make any progress westward.

In 1828 it reappeared in Orenberg, and in 1829 it was extremely severe in Herat.

It was, however, in 1830 that the disease made its greatest progress. It reached the shores of the Caspian Sea and also Orenberg, where it was very destructive to life. It was at Tiflis in July 1830. It ravaged Persia, Teheran suffering from it. It went north, and reached Saratow in July, Samara early in August, and Nijni Novgorod later in that month. It also appeared on the shores of the Black Sea, Sebastopol and Odessa suffering greatly. It ravaged Moscow from October 1830 to April 1831. Warsaw was attacked 14th April 1831. In 1831 it reappeared at Mecca and Medina, destroying large numbers of pilgrims, extending thence into Syria and Egypt. It also continued its march north in Russia; St. Petersburg suffered so severely as to cause a public tumult; Archangel was attacked in May; and it passed into Sweden.

In Central Europe Galicia suffered, especially the towns of Brody and Lemberg. It extended to the neighbouring territories of Silesia, Bohemia, and Moravia. It reached Berlin on the 30th August 1831. It was observed (Lebert says) in North Germany at that time that chickens and pigeons—and, in many rivers, fishes perished in great numbers. Magde-

burg and Hamburg were visited; and from Hamburg it was imported into Sunderland on the 26th October 1831, reaching London in January 1832.

Franco remained unaffected in 1831, but in 1832 the disease was imported—apparently from England to Calais—and broke out in Paris on the 24th March 1832, and the mortality from it soon reached 500 a day.

The disease spread all over the United Kingdom, appearing in Edinburgh in February 1832, and Dublin in March of the same year.

From Dublin it was carried to Quebec in Canada by the brig "Carricks," and it broke out there early in June 1832. On the 23rd June it appeared in New York, and from there it spread all over the continent.

From England, also, the disease was carried into Spain and Portugal in the beginning of 1833, and ravaged with great severity Madrid, Seville, and Barcelona. Quarantine was resorted to in order to stop its progress, the infringement of the laws being punished with death, but without effect.

In the New World the disease was especially severe in 1833, and killed 8,253 persons in Havana and 15,000 persons, during the month of August, in Mexico. It continued spreading south in Europe, and attacked Marseilles and Toulon in 1834, Italy, Nice, and Genoa being visited. It also attacked Turin, Livorno, Florence, and Trieste: thence it passed into North Africa.

In 1835 the chief activity of the disease was in Africa and on the Mediterranean Sea coast.

In 1836 and 1837 the disease still remained in Italy, and was especially felt in Naples and Rome.

In 1837 Malta was visited, and it caused about 4,000 deaths there.

In 1837 it again entered Berlin, Breslau, and Algiers, and the epidemic lingered on in Europe till 1839, when it finally ceased.

From 1839 for some years Europe was free from cholera. But in India the disease was not idle. In 1840 there were severe epidemics at Cuttack, Berhampur, Dinapur, and Ghazipur. In this year there was also an outbreak of the disease in China. In 1841 the disease was severe in Puri and Jessore, spreading to Bhagalpur, Monghyr, Allahabad, and Lucknow. In 1842 the disease was severe in its endemic area, but in 1843 there was a heavy outbreak at Agra. In 1844 the cholera was to the north of the Hindu Koosh range, Bokhara, Balkh, and Samarkhand suffering terribly. In 1845 the epidemic visited Meerut, Delhi, Scinde, and in Karachi in the following year there was a very fatal epidemic, and it was general all over Afghanistan. In 1846 it had reached as far on its western march as Bagdad. In November it was in Mecca, 15,000 pilgrims falling victims to it. In the month of May 1846, it was at Aden and in Arabia generally.

In 1847 it spread northward. Tiflis was attacked, and Astrakhan on the 4th July. It reached Saratow on the 11th August: and thus the second great European epidemic was inaugurated. In August 1847 it broke out at Taganrog. On September 16th it arrived at Nijni Novgorod and attacked Moscow. Constantinople was infected on the 24th October.

It burst out again the following year, 1848, at Mecca, and spread in Europe in the neighbourhood of the places that were visited the previous year. St. Petersburg was affected in June, and Berlin was attacked with extreme severity in July, Hamburg in September. From Hamburg—as before—it was carried to England; the first person attacked dying in London on the 22nd September, having arrived from Hamburg on the 19th September. Edinburgh was infected on the 4th October 1848.

Ireland was infected from Edinburgh, by a man who arrived at Belfast, on the 2nd December.

The ship “New York” sailed from Havre, 9th November

1848, for America; she had some German emigrants on board. One of the emigrants had some clothing with him that had belonged to an individual who had died of cholera in Germany. During the voyage, on account of the coldness of the weather, some of the articles were worn by some of the emigrants on board; these individuals were the first seized with the cholera.

At the same time another ship, the "Swanton," sailing from Havre, introduced the disease into New Orleans. Although she had cholera on board, thirteen deaths having occurred during the voyage, she was not subjected to quarantine. Cholera rapidly spread in New Orleans, and the whole of the United States was speedily infected.

During the winter of 1848-49 cholera was nearly inactive, but it began to show itself in 1849 in most of the places previously infected. It was introduced into Paris on 11th March 1848, and by the end of June of the same year 15,677 deaths had resulted from it. Of 5,000 inmates of the Salpêtrière, no less than 1,200 perished of cholera.

In 1849 cholera was widely diffused. In Hull (in England) it caused 241 deaths for every 10,000 living. The total loss of life in England from this epidemic was 53,293.

From this time the epidemic declined, and though many small outbreaks of the disease occurred it did not show any great energy.

The next epidemic was probably partly due to the lingering remains of the last one, and partly to an importation from the east. In 1851 cholera was very severe in the Bombay Presidency, and it extended that year as far as Bassorah. In 1852 it was extremely fatal in Persia. Tabriz lost 12,000 of its inhabitants. There was also an epidemic in Poland.

* "Report on the Mortality of Cholera in England, 1849." By Dr. W. FARR.

In 1853 it was also extremely severe in Western Asia, and 15,000 persons died of it in Teheran alone. Bassorah on the Persian Gulf was reached by it on the 29th June, 1853.

It also appeared again in Poland and Russia. It spread into the Netherlands, Denmark, and Germany. It appeared at Hamburg, causing three hundred deaths, and then passed to England, appearing at Newcastle, Gateshead, and London. It was introduced through Vigo into the Iberian Peninsula, where in 1854 it was severe in Barcelona and Catalonia generally, and in 1855 there was scarcely a province that was not affected.

New Orleans and New York were both infected, and the disease spread all over the continent, severely affecting the West Indian Islands also.

In the beginning of May, 1851, a ship arrived from Havannah at the island of the Grand Canary with a clean bill of health. A washerwoman, shortly after her arrival, who had washed some things from the ship, was seized with cholera and died. An epidemic followed in the island. All the neighbouring islands enforced a strict quarantine against the infected island, and they all escaped infection.

In 1853 and 1854 cholera was very severe in London. It appears to have reached London in August, 1853. It declined in the winter, but showed itself again with the spring of the next year. It reached its maximum in September, 1854, when there were 6,084 deaths from it.

It was in this epidemic that Dr. Snow traced several partial local outbreaks to the use of water from the public pump in Broad Street, Golden Square.

The north of Africa was also affected in 1853, but Greece was not attacked till the next year. France suffered in 1853 in Havre and Paris, the southern portion of the country being affected the next year. This epidemic in France alone caused the loss of 143,478 lives. It was severe in the Crimea in 1854-5. In 1855 cholera re appeared over nearly the whole

of Europe, and over North America and the West Indies. During 1856 and 1857 there was a general diminution of the disease, and by the year 1859 the epidemic may be said to have come to an end. But this year is remarkable for a sudden outbreak of the disease in a severe form at Hamburg, where it caused 2,586 deaths; but no other important outbreak succeeded it, and the epidemic may be considered to have ended with this manifestation.

Europe now had another respite from the attacks of cholera for some years, but in the East during this time cholera made many excursions from its home into the surrounding countries. But even in its endemic districts periods of considerable activity were noticed. In the island of Bombay, during ten years, the following were the number of deaths registered:—

In 1851	...	...	...	4,020
„ 1852	..	..	...	1,135
„ 1853	...	..	...	1,339
„ 1854	..	..	.	3,353
„ 1855	...	...	...	1,739
„ 1856	...	...	...	2,151
„ 1857	...	...	..	1,741
„ 1858	...	...	...	105
„ 1859	...	...	...	2,285
„ 1860	...	..	...	1,687
„ 1861	..	...	...	1,251
<hr/> 11 years				<hr/> 20,806

In 1858, and again in 1859, the disease appeared at Mecca, and Bengal was gravely affected with cholera in 1859; and the disease spread throughout the whole extent of India.

In 1860 there was an outbreak of cholera at Agra. But the year 1860 was otherwise remarkable in India for a famine consequent on the failure of the rains, and following it the

next year, after the rains had commenced, was a very severe epidemic of cholera.

In this year, 1861, Agra, Meerut, and Delhi were visited. Lahore was attacked in August, and the disease appeared at Cabul—whither it had probably been brought from Western India—in October. In this year the military cantonment at Mian Mir suffered very severely.

In 1862 there was an epidemic of cholera at Pekin causing 15,000 deaths. In 1863 it reappeared at Lucknow, causing, in all, 2,015 deaths.

In 1864 cholera was very general in Bengal, in the central provinces and also in the north-west. But it was most severe in the western portions of India, where, in the next year, it made 84,000 victims in the Bombay presidency alone. From this it commenced its march westward.

The European cholera epidemic of 1865 was, therefore, an extension of the cholera that affected Western India in 1864. It was carried by the pilgrims to Mecca, where it broke out with great fury on the 24th and 25th March, 1865. It reached Suez, carried by the returning pilgrims, on May 21st, and Alexandria on June 2nd. From Alexandria it was introduced by a frigate into Constantinople on June 28th. It was at Bassorah in August. On July 23rd it broke out in Odessa. From Odessa it was carried by a woman and her child into Saxony, where an epidemic was developed.

It entered Italy by Ancona from Alexandria. In Ancona the first person attacked was a washerwoman who had washed clothes from the lazaretto.

By Marseilles it entered France, and was carried on into Spain, causing in Valencia 5,100 deaths.

It appeared also in Southampton, but it has never been satisfactorily established whether it was brought from Alexandria or directly from India, though Professor Parkes

published an admirable report of his enquiry into the outbreak.

The steamship "Atlantic" left Havre on the 12th Oct., 1865, for New York. During the voyage there occurred sixty cases of cholera on board. On reaching New York she was strictly quarantined, and there was no extension of the disease from her.

On Oct. 22nd, 1865, a brig sailing from Marseilles had a boy on board who died of cholera. The captain kept some of the boy's clothes, and on reaching Pointe à Pitre at Guadeloupe, he sent them to be washed. The laundress was attacked with cholera, and an epidemic in Guadeloupe followed, causing 10,808 deaths. The neighbouring isle of Dominica placed a quarantine against all comers from Guadeloupe. Some persons landed and were surrounded by a strict guard, not allowing any communication with the rest of the inhabitants; two persons of this party died of cholera, but nobody else on the island was attacked.

During the winter cholera made, as usual, scarcely any progress; but in the next year, 1866, it re-appeared in most of the places that had been attacked by it the previous year. It was severe in Liverpool, and caused 1,792 deaths. It appeared in London in June, and caused a severe epidemic, but it is not known how it was introduced. Its connection with the water supply of the metropolis must be spoken of elsewhere.

The ship "England" sailed for Halifax from Liverpool on March 28th, 1866. Cholera broke out on board six days after leaving, and ninety-two persons died of it. Two pilots, who did not go on board, but met the ship, were the first persons in America attacked, and from this origin it spread all over the country.

In 1867 cholera still lingered in Europe, especially in the Central and Eastern parts; but by the end of that year the epidemic may be considered to have terminated.

In 1867 cholera broke out at Hurdwar on the 13th April, just as the pilgrims were dispersing. Thence it was carried to Roorkee and to Bajwanpur; to Shahjehanpur on the 24th April; to Allighur on the 20th April; Peshawur the 11th May. Thence it went into Cashmere and Afghanistan, 8,000 persons dying of it at Cabul. It reached Teheran, and spread over Persia.

In 1868 it was at Meshed and Astrabad, and there was a severe epidemic, which was as usual reproduced the next year all over Persia. It entered Russia, having reached the Caspian previously. It went up the Volga, and reached, as customary, Nijni Novgorod. It entered Constantinople and attacked Kiev.

It was severe in Asia Minor in 1871. Prussian Poland also suffered, it being introduced along the Vistula.

In 1872 there was an epidemic at Vienna; in Hungary, Prussia, and Belgium. In 1873 it again occurred in Russia and Central Europe: it manifested itself in the winter epidemic of Munchen, 1873-74.

In 1873 cholera appeared in New Orleans and spread up the Mississippi. It was apparently imported from Jamaica, where it was introduced by coolies who had arrived from Calcutta.

In 1883 there was a very severe epidemic in Egypt, of which Sir William Guyer Hunter has given an excellent report. It appears to have commenced about the middle of June 1883 and lasted till September. The following are the places most severely affected with the mortality that occurred:—*

Damietta	...	...	...	...	1,956
Alexandria	...	...	...	...	503
Chibin-el-Kon	...	...	...	...	1,120
Ghizeh	...	..	...	...	698
Cairo	...	...	...	...	5,661
Méhella Kibir	...	...	...	...	678

* "Further Reports by Surgeon-General HUNTER on the Cholera Epidemic in Egypt." London, 1888.

The total mortality was above 25,000. Sir W. G. Hunter believes that cases of cholera occur from time to time in Egypt, and gives examples from the statements of physicians residing in the country.

It is singular that, at the time of the outbreak, there does not seem to have been any activity of the disease in Arabia.

The epidemic that attacked Europe in 1884 had a very definite origin. It broke out on the 13th June 1884 at Toulon, directly after the arrival of the ship "Sarthe" with troops from Saigon, in the French possessions in the East. The condition of the ship during the voyage as regards health has never, as far as we can ascertain, been made public, but her commander committed suicide on cholera becoming epidemic in the town. From Toulon it spread to Marseilles, and thence over the south of France; and it was carried by some sailors, who landed, to Naples, where a terrible epidemic commenced in August. During the winter of 1884-5 but few cases were seen—as is usual with cholera, but by no means universal, as the winter epidemics at Moscow of 1830-1, and at München in 1873-4, show.

In 1885 it again showed itself in Marseilles, and spread also in Italy and Sicily, causing a most severe epidemic at Palermo, where it was introduced by the ship "Selunto." The first persons attacked were the washerwomen who washed some clothes brought from the ship.

A few cases had been seen in Spain in 1884, but in 1885 it literally ravaged the country. The districts that suffered chiefly were the provinces of Valencia—where there were 21,000 deaths—and Granada—where there were 10 000. In all, there were 119,620 deaths in the Iberian Peninsula.

In 1886 it attacked North Italy, Venice suffering especially. Thence it spread to Trieste and entered Austria and Hungary. Buda-Pesth was severely attacked. It was carried from Italy across the Atlantic to South America, causing a heavy

mortality. It even invaded Chili, on the Pacific coast, where it had never previously been, and in the first six months of 1887 caused 10,200 deaths there.

In this year (1887) it was again in Italy and Sicily, causing 2,000 deaths at Messina. This is above the official return, but our information is, we believe, authentic. It remained still in Italy and Spain, and caused several epidemics. It was this epidemic that manifested itself in Paris as late as 1892. Altogether, this epidemic cost 250,000 lives in Europe and at least 50,000 in America.

The epidemic that spread over Europe in 1892 is remarkable for the fact that, instead of approaching Europe by the southern or sea-borne route, as the late epidemics have done, it passed along its northern track by land, the same by which the great epidemics of 1831-32 and 1848-49 came to Europe. In describing it, therefore, we mention the names of places with which we are already so familiar.

In the early part of 1892 cholera was exceedingly active in Afghanistan; it entered Cashmere, and reached as far west as Merv in May. In the same month it was at Askabad, on the Transcaspian Railway—that recent product of Russian energy in its march eastward. On the 25th May it reached Uzun Ada, the western termination on the Caspian Sea of this Transcaspian Railway. Probably early in June it was carried across the Caspian by boat, and reached Baku on June 6th, where it caused 1,834 deaths.

In its march across Asiatic Russia towards Europe it caused the death of 115,184 persons.

It traversed the Caspian northwards, and reached Astrakhan at the mouth of the Volga on the 7th June. It caused a public tumult there. It was now on its high road to the

* See "The Cholera Epidemic in Russia," by FRANK CLEMOW, M.D. *Lancet*, March 11th, 18th, 25th, and April 8th, 1893.

centre of Europe. Saratow was reached on the 8th June, Samara on the 14th, and Nijni Novgorod on the 27th June. In Russia many outbreaks of popular feeling caused conflicts with the authorities. Besides Astrakhan, there were tumults at Saratow, at Khvalnisk, Tashkend, and Srednaia Akhtoubá. At Saratow, the populace, excited by some reports that some patients ill of the cholera had been buried alive, attacked the police and cholera attendants, killing two persons. The troops were called out and fired on the mob, killing three persons.* At Khvalnisk the resident physician at the hospital was killed.

The cholera arrived at St. Petersburg in due course, and probably from there it was carried to Hamburg, which it apparently reached early in August, though there is no certain information on the subject. From Hamburg it was carried in ships in various directions. In four ships the disease declared itself whilst crossing the Atlantic, but they were, fortunately, subjected to strict quarantine and the disease did not spread in America.

Cracow was visited early in September, and Buda-Pest probably on the 24th or 25th September. It remained there during the winter, causing about 500 deaths.

But during this time cholera was active in France, it was probably there due to the remains of the epidemic of 1884. It caused much loss of life in Paris and certain parts in the north near Boulogne, Havre, Rouen, and Dieppe.

The mortality from the epidemic we have just described was very severe. In the Astrakhan district there were 10,980 deaths, in Samara 18,000, and in Hamburg 8,200.

There have been, therefore, six great European epidemics of cholera since the disease was introduced into Europe early in this century. But, in several cases, the previous epidemic

* See *Times*, July 15th, 1892.

was still in existence when the new one commenced. So that it is not always clear how far the epidemic was a new one, or how much was due to its predecessor. Still, the six epidemics may be considered on the whole distinct, and their history is valuable, as many conclusions regarding cholera can be deduced from it.

CHAPTER II.

SOME CONCLUSIONS TO BE DRAWN FROM THE HISTORY OF CHOLERA.

IN the epidemics we have been considering, there are some striking features that cannot fail to have arrested the attention of our readers.

In nearly every case it can be proved to demonstration that the disease has been introduced from some other place that has been previously infected. Even in those cases where the exact origin is not known, there has always been a strong probability of its causation in this way.

But always the original starting-point of every epidemic has been the East. In most cases India has been its source ; but the origin of the epidemic of 1884 was the southern extremity of French China.

As it is clear that the East is the home of the disease, it will be best first to define its endemic area.

By universal consent, the great centre of the endemic activity of cholera is the Delta of the Ganges—that great alluvial plain broken up into innumerable islands by streams by which those great rivers, the Ganges and the Brahmaputra find their way to the sea. But cholera is undoubtedly endemic to the west of Bengal proper, Mr. Macnamara believes as far west as Saugor, and the endemic area also reaches into Oudh and beyond, perhaps, to Delhi, and some think still further in a north-westerly direction. In addition, the mouths of the great rivers of India are constantly affected with cholera, and some of the adjoining districts. Thus it is

endemic at the mouths of the Nerbudda and Tapti rivers ; also in the Bombay district ; the mouths of the Kavari and Krishna and the Godaveri ; also the district round Madras. In Farther India it is also endemic, as in the Delta of the Irawadi and Salwin rivers, in the Malay Peninsula, Cambodia, and Cochin China and Tonkin, the mouth of the Yang-Tsze-Kiang. Also in some of the islands of Farther India---Sumatra, Java, and probably the groups further east and north, even to the Spanish group of the Philippines.

It is observable that the home of cholera is generally fixed on damp, alluvial soils. Cholera for a time, as has often been proved, can flourish at great heights, as in the table-land of Mexico, the hill stations of the Himalayas, and the high plateau at Erzerum. But its favourite abiding place is the alluvial plain at the mouth of a great river.

When an epidemic of cholera passes westward it travels usually by certain well known routes, and some of these routes it appears to prefer to others. The northern route is an especially favourite one. It is an overland route. It enters Afghanistan, and passes through Cabul to Herat. It may then pass south into Persia, and so into Syria, but it usually prefers a more northern path, taking Meshed, Merv, and Astrabad, on its way. In future it will probably travel by the Russian Transcaspian Railway, and so reach Uzun Ada, its terminus on the Caspian. When the shores of the Caspian are reached it enters especially Baku, Asharada, and Astrakhan. Its high road is then up the Volga, from which it can easily reach the whole of Europe.

Should it pass by Persia it visits Teheran, Tabriz, Tiflis, and thus reaches the Black Sea at Batum ; or it passes more directly westward through Syria to the shores of the Mediterranean.

But a route very frequently followed is that taken by the pilgrims to Mecca. It leaves India by sea, very often touches



at Muscat, not unfrequently visiting the Persian Gulf, but it first shows its virulence at Mecca. It leaves with the pilgrims passing north, and spreads into Persia and Egypt, whence it is easily carried over Europe. This was the course taken by the epidemic of 1865.

One epidemic, that of 1884, there is good reason to believe, was imported by sea directly from Saigon, in Farther India, into Western Europe without any intermediate halting place.

Looking at these routes, it is clear that they are the great lines of communication, and it is along these lines, by preference, that cholera travels.

There are certain places on these routes where cholera halts for a time, and seems to gain additional virulence by its abode there. Mecca is a good example of this, and Muscat also in a less degree.

Bassorah is a great cholera centre; but cholera does not seem to have ascended the river Euphrates in the same regular way it ascends the Volga, for instance. At least, we have not been able to trace it in this way, but we think that, in all probability, the records of the districts that would be affected are too imperfect to allow any conclusion to be drawn.

Bagdad, on the Tigris, has been frequently the seat of a cholera epidemic. Further on its march westward Damascus and Aleppo are usually regular halting places of the disease.

Desert routes appear to be unfavourable to cholera. The great desert to the south-west of Herat is avoided, a route to the south or north of it being preferred. Caravans have often suffered most severely, but when they traverse a great desert, though many travellers may die during the journey, the disease does not appear to remain with them through the whole route.

It is, then, from its centres of endemic activity by these different lines of communication that cholera has been

imported over the greater portion of the habitable world, and in the great majority of cases the agent of its importation has been man himself. In 1848 the first person attacked in London was a man who had arrived three days previously from Hamburg, where the cholera was raging.

In 1865 the cholera was severe in Odessa. On the 16th August of that year the wife of a German artisan left Odessa for Altenburg in Saxony. She had with her a child suffering from diarrhoea. On the 24th August, nine days after leaving Odessa, she arrived in Altenburg. On the 27th August the mother was taken ill with cholera, and died on the 29th. On the evening of that day her sister, who had not been in Odessa, was seized with cholera and died on the 30th. From this beginning the disease spread through the town. From Altenburg it was carried by the family of a workman to Werdau, where it destroyed 20 per 1,000 of the inhabitants. But the surrounding portions of Germany remained free from the disease.

But next to man himself, the most common method of importation is the introduction of clothes or linen that have belonged and been used by a person who has been affected with the disease. There does not appear to be any room for doubt on this subject. We have seen how it broke out on board the ship "New York," on the Atlantic, amongst some passengers who were wearing the clothes of a person who had died of cholera. In 1851 it was introduced into the Grand Canary by some clothing brought on the island to be washed. In 1865 it entered Italy at Ancona by some clothes that had been sent into the town for the purpose of being cleansed. The terrible epidemic at Palermo in 1885 had its origin in a washerwoman, who had washed some clothes from the ship "Selunto."

In all these cases, articles of clothing belonging to cholera patients have introduced the disease into districts previously

uninfected, and we give a further well-known one, which we quote in the words of Mr. C. Macnamara :—

“The first case of cholera observed in the village of Moor Monkton, six miles from York, occurred on the 28th December, 1832. The disease did not exist at the time in the neighbourhood, or in any place within thirty miles. John Barnes, a labourer, had been suffering for two days from diarrhoea and cramp, when, on the 28th December, he was taken ill with all the symptoms of cholera, and died the next day. Barnes’ wife, and two other persons who visited the sick man, were seized with cholera, but recovered. The son of the sick man then arrived ; it appears that he had been apprenticed to his uncle, a shoemaker in Leeds, and that his aunt had died of cholera fifteen days before, her effects having been sent to Barnes without being washed. The trunk containing the things had been opened by Barnes in the evening, and the next day he was taken ill and died.”*

It is also established by the history of these epidemics that in Europe the period of the greatest activity of cholera is the warmest season of the year. July, August, and September are the months when it shows its greatest virulence.

The epidemic of London of 1854-5 affords an example of this. Cholera appears to have reached London in August, 1853. In the month of October of the same year there were 335 deaths from it, 228 in November, and only 43 in December. In the beginning of the year 1854 the disease scarcely showed signs of its presence. During the months of January, February, March, April, and May of that year there were altogether only 18 deaths from it, and there were three in June. But in July it showed increased activity, and 308 deaths were recorded from it. In August the number rose to

* “A History of Asiatic Cholera,” by C. MACNAMARA. *London*, 1876, p. 109.

3,513, and in September to 6,084. But in October there was a decline, and only 823 persons died of it, and in November only 52. It would be difficult to find a more striking instance of the influence of climatic conditions on the disease.

But though the warm months of the year can be proved to be those in which cholera shows its greatest activity in Europe, it must not be forgotten that several winter epidemics in Europe are on record. There is the winter epidemic of Moscow of 1830-31; the Munchen epidemic of 1873-74 recorded by Professor Max von Pettenkofer, and lately we have just witnessed the winter epidemic of Buda-Pest of 1892-93. A low temperature is, therefore, not incompatible with considerable activity of cholera.

As there are some differences in regard to the activity of cholera in Europe and in its endemic area, it will be of use to give an outline of its relations to physical circumstances as seen in its home. We give first, therefore, a table of the total deaths from cholera in Bengal in 1879, arranged according to months, with the rainfall in inches.†

Months		Deaths.		Rainfall in inches.
January	..	5,093	...	0.03
February	...	2,984	...	0.81
March	...	6,257	..	0.08
April	...	8,786	...	0.62
May	...	7,678	...	5.03
June	...	5,849	...	15.93
July	...	3,526	...	17.93
August	...	1,163	...	14.23
September	...	898	..	12.22
October	...	925	...	4.73
November	...	3,203	...	0.00
December	...	7,587	...	0.28

* Report on the last two cholera epidemics in London as affected by the consumption of impure water. By JOHN SIMON. *London*, 1856.

† From the Report for 1879 of the Sanitary Commissioner of Bengal. By J. M. COATES, M. D. *Calcutta*, 1880.

It will be seen, here, that April had the heaviest death rate and May the next heaviest, and that September had the least, and October the next lightest. The rainy season in Bengal begins about the 15th of June and lasts till October, and it will be noticed that, as it progresses, the cholera becomes less fatal, till it reaches its minimum in September. There was an exceptional mortality in December in this year.

In the following table will be found the mortality from cholera for ten years according to the months, together with the average temperature of the month, the rainfall, and the level of the subsoil water in feet, in the city of Calcutta.

		Mortality from Cholera for 10 years		Average Temperature. Fahrenheit.		Rainfall in inches.		Level of subsoil water in feet.
January	...	1,955	...	67°·7	...	0·44	...	13·8
February	.	3,226	...	73°·0	...	0·83	...	14·2
March ...	...	4,848	...	80°·5	...	1·28	...	14·4
April	...	4,658	...	84°·7	...	2·49	...	14·6
May ...	...	3,306	...	86°·2	...	5·46	...	14·7
June ...	...	2,231	...	84°·9	..	12·13	...	14·0
July ...	...	1,318	..	83°·5	...	12·64	...	12·2
August...	...	1,684	...	83°·1	...	13·71	...	9·6
September	...	1,543	...	83°·3	...	10·17	...	8·2
October	...	1,805	...	81°·5	...	5·61	...	9·7
November	...	2,789	..	74°·9	...	0·66	...	11·5
December	...	2,175	...	68°·1	...	0·24	...	12·9

Here, the heaviest mortality was in the months of March and April, and the lightest in September and August. The warmest months are May and April, the coolest January and December. The driest months are December and January, the rainiest July and August. The subsoil water is at its lowest level in May and its highest level in September. Thus, the greatest mortality from cholera in March does not corres-

pond with the hottest month, or the driest or the rainiest, nor with the highest or lowest level of the subsoil water.

Much has been written about the level of the subsoil water and its connection with cholera. But the mortality from cholera and the level of the subsoil water do not vary inversely, as some have thought. For though in September the subsoil water is highest; yet it begins to fall rapidly then, but the cholera mortality does not rise in anything like proportion; in fact, does not show usually any great increase till February, when it rapidly ascends: but the subsoil water, instead of descending rapidly then, as it should if it were inversely proportional to the mortality, scarcely descends at all, the fall being only 0·2 of an inch, while the mortality has risen from 3,226 to 4,848. Such a slight fall in the subsoil water cannot explain such a very great rise in the mortality.

It is observable that when cholera has been prevalent in a place in Europe in one year, it often breaks out again in the same place in the succeeding year. In many of the epidemics we have read how cholera re-appeared in the next year in the district that it had ravaged the preceding year, and that after this second visitation it generally dies out. But this is not so in India. When cholera appears in one year in a place outside its endemic area, it is unusual for it to occur again the succeeding year. There appears, therefore, to be a great difference in the behaviour of cholera epidemics in Europe and India in this respect.

Some towns in Europe are much more liable to epidemics of cholera than others. We constantly read of Saratow, Nijni Novgorod, Odessa, St. Petersburg, Marseilles, Paris, Rotterdam, Cracow, Lemberg, Antwerp, Havre, Buda-Pest, Hamburg, Valencia, and Granada, being affected.

Hamburg would appear to be especially liable to cholera epidemics.

The following is the cholera record of Hamburg since the first introduction of cholera into Europe in this century :—

Year.		No. of Cases.		No. of Deaths.
1831	...	937	...	439
1832	...	3,349	...	1,652
1848	...	3,687	...	1,765
1849	...	1,187	...	592
1850	...	794	...	440
1853	...	558	...	302
1854	...	471	...	311
1855	...	353	...	204
1856	...	121	...	78
1857	...	765	..	491
1859	...	2,586	...	1,285
1866	...	2,254	...	1,185
1871	...	171	...	101
1873	...	1,729	...	1,005
1892	...	18,000	...	8,200

This is indeed a terrible record. But it should be remarked that Hamburg is situated on an alluvial plain near the mouth of a great river—the Elbe—which is there strongly tidal. In position, therefore, it much resembles Calcutta.

On the other hand, there are some towns where cholera has never obtained any footing. A few cases may possibly have occurred, but there has been no regular epidemic. Among them are Versailles, near Paris, Cheltenham, Stuttgart, Lyons, Hanover, Frankfurt-am-Main, Olmütz. Lyons appears, perhaps, the most singular exception. In cholera epidemics at times 20,000 persons have taken refuge there from other districts affected with cholera. The greater portion of the city is on a low-lying piece of land, forming the triangle, at the apex of which the Soane and the Rhone unite. But in spite of what one would be inclined to think favourable

conditions for cholera, the disease has not succeeded in establishing itself there.

In addition to these, there are certain districts that cholera has never visited, as it has never been introduced. They therefore owe their immunity probably to that fact. They are, Iceland, the Orkney and Shetland Islands, the Azores and Bermudas, the Cape of Good Hope, Patagonia, and Terra del Fuego, and Australia and New Zealand. Chili enjoyed immunity till the year 1886, but cannot boast of this any longer.

The rivers of Europe are also not subject to cholera visitations in an equal degree. The Volga is one that has repeatedly formed the highway by which cholera has travelled to the centre of Europe. Saratow, Samara, Simbirsk, Kasan, and Nijni Novgorod are on its banks, and they have often been infected.

Many towns on the Danube have also suffered; Vienna, Buda Pesth, and Belgrade have had severe visitations.

The Seine has acquired an evil reputation from the frequency with which Paris has been affected.

The delta of the Rhine has often been devastated by cholera, but its upper portion has not suffered in an equal degree.

The inhabitants of the plains on the banks of the Elbe have suffered much and often also from cholera.

Repeatedly attention has been called to the dreadful outbursts of cholera that take place at Hurdwar, Puri, and Mecca. These are the great centres of pilgrimage of the Oriental world. It is here that vast assemblages of persons occur at intervals leading to a condition of overcrowding and its attendant filth that probably exceeds anything ever witnessed elsewhere, and it is precisely here—as might have been expected—that cholera produces its most fearful manifestations. It is by shutting our eyes to the conse-

quences produced on our race by overcrowding and filth that pestilences like cholera go through the land and destroy the inhabitants. It is almost too trite to insist here that any place that is visited by great numbers of persons at one time, whether it be for purposes of religion, of pleasure, or of business, should be made the object of the most careful regulations, which should be not only enacted but enforced, to prevent, as far as possible, the evils that overcrowding cannot fail to entail.

CHAPTER III.

THE SYMPTOMS OF ASIATIC CHOLERA.

THE symptoms of cholera are so various, and the disease has so many different phases, that it is almost impossible to describe it as a whole without making exceptions almost as numerous as the regular symptoms. At one time we have a disease killing with the rapidity of an apoplexy, and at another time allowing the patient, after cruel sufferings, to languish into life; at one time the victims are cold and icy to the touch, at another time burning with the fiercest fever known to medicine. It will, therefore, be more convenient to describe some typical cases showing the symptoms in the most characteristic forms.

The first case is one from Italy, and occurred during the epidemic of 1886.

CASE I.—M. S., aged 29 years, was admitted into hospital July 15th, at 11 a.m. She is a pale, blond, spare woman, looking somewhat older than her years.

She stated that on the previous day she had had some diarrhoea, which continued during the night, but as she did not feel ill she did not attach any importance to it.

She is lying in bed, with a pinched, drawn, anxious face, eyes deeply sunken in sockets, skin of hands and feet shrivelled, great difficulty in breathing, tossing herself constantly about, cramps in legs. Has passed no urine since the previous day. Temperature in axilla, $36^{\circ}6$ C. ($97^{\circ}8$ F.). Respirations, 36. Pulse at wrist so feeble that it can scarcely be counted; about 130.

2.20 p.m. She is lying barely conscious, passing under her

occasionally a "rice-water" motion. Sighs deeply, and throws her arms about, crying now and then for "more air." The skin has become of a deep leaden blue colour. Temperature, 37°C. ($98^{\circ} 6 \text{ F.}$). Pulse, 120, barely perceptible. Respirations, 32.

6 p.m. Is in profound collapse. No pulse in radial or brachial artery. Face very pinched, eyes deeply sunken, lips shrivelled, and cannot cover the teeth, which protrude, skin of a dark-blue colour, quite cold to the touch, covered with a slight sweat. Occasionally raises herself, to aid her respiration. Temperature, $36^{\circ} 2 \text{ C.}$ ($97^{\circ} 16 \text{ F.}$). Respirations, 24.

* She remained in this state for nearly two hours, and died a little before 8 p.m.

* CASE II.—A. M., aged 66, was admitted August 9th with Asiatic cholera. He states that he was quite well up to three o'clock this morning when he was seized with diarrhoea. He denies strenuously that he had any previous diarrhoea whatever. Shortly after this diarrhoea commenced he vomited, which he has since frequently done. He is a strong, healthy looking man; he has a marked choleraic appearance. Pulse 98, respirations 28; temperature in axilla, $36^{\circ} 4 \text{ C.}$ ($97^{\circ} 5 \text{ F.}$); diarrhoea constant; tongue, cold to touch; skin, blue and shrivelled, voice, hoarse and very feeble.

August 10th.—9 a.m. Has had much diarrhoea during the night and some vomiting. Is in profound collapse, has passed no urine, pulse imperceptible in radials, can be roused only with extreme difficulty. Respirations 24, heart-beats 80, temperature in axilla $35^{\circ} 4 \text{ C.}$ ($95^{\circ} 72 \text{ F.}$), temperature in rectum $37^{\circ} 2 \text{ C.}$ ($98^{\circ} 9 \text{ F.}$).

Evening. Has had much diarrhoea during the day, the stools being "rice-water" but distinctly tinged with blood. Has vomited also. Lying on his back scarcely conscious, eyes half closed, cheeks flushed, surface of body covered with an erythematous rash. Respirations 36, heart-beats 96 (no pulse

in brachial artery); temperature in axilla $37^{\circ}2$ C. ($98^{\circ}9$ F.), temperature in rectum $37^{\circ}5$ C. ($99^{\circ}5$ F.).

At 8 p.m. Temperature in axilla $37^{\circ}7$ C. ($99^{\circ}86$ F.), temperature in rectum $38^{\circ}3$ C. ($100^{\circ}9$ F.).

He died at about 11 p.m.

CASE III.—L.B., a youth about 19 years of age, was admitted into hospital on the 10th Aug. He states that he first suffered from diarrhoea on the 8th inst. His aspect is now somewhat choleraic. Respirations 18, pulse 104, temperature $37^{\circ}3$ ($99^{\circ}1$ F.). During the day he passed 50 cubic centimetres of urine (about two ounces), which contained much albumin, and gave an indoxyl reaction.

Aug. 11th.—Much diarrhoea in night. Is in a condition of stupor, from which he can be roused with difficulty, cheeks flushed, eyes half closed, diarrhoea has now stopped, has passed no more urine. Pulse 112, respirations 20, temperature $37^{\circ}3$ C. ($99^{\circ}1$ F.), temperature in rectum $38^{\circ}6$ C. ($101^{\circ}5$ F.).

In the evening the stupor was much deeper. He had no vomiting or diarrhoea during the day; also no urine has passed. When he is with difficulty roused he answers questions in a very husky voice.

Pulse 112, temperature in axilla $38^{\circ}1$ C. ($100^{\circ}4$ F.), temperature in rectum $38^{\circ}6$ C. ($101^{\circ}5$ F.). He passed no more urine. The stupor deepened into coma, in which he died at 5 a.m. the next morning.

In these cases which have been selected as being fair examples of the disease, may be seen nearly all the phenomena that occur in acute typical cases of Asiatic cholera that are fatal in the earlier stages, as they present themselves during an epidemic of the disease. It will be noticed that in all of them the symptoms of cholera were completely developed on their admission to hospital. The progress of the disease is usually so rapid that even the best

organisation fails, as a rule, to bring the patient to the hospital in the earlier stages, the disease is, therefore, nearly always far advanced before it presents itself for treatment.

It is for this reason that two of the earliest and most important conditions are scarcely mentioned in these cases. They are the period of incubation, or the time occupied between the reception of the infecting agent and the development of the disease; and, secondly, the exact nature of the earliest symptoms that occur and announce that the disease has commenced.

The question as to what is the length of the *period of incubation* in cholera is of the greatest practical importance; as much depends on the answer to be given as to the regulations that may be most advantageously employed for limiting the spread of the disease. But very little investigation is needed to show that it has no fixed term, like small-pox, for instance, but that it varies very considerably in different cases. The shortest period of which we have any knowledge is the one that occurred at Cardiff, where infection, development of the disease, and death, all took place in the course of a few hours. But such a case as this is exceedingly rare. In many cases that we have investigated, and where there was no reasonable doubt as to the exact time of infection, the disease was developed on the third day, in many others on the fourth. We have also come across a few in which the symptoms occurred on the first day. In Italy, whilst we were there, *many* cases occurred in persons after they had been released from quarantine, where they had been detained for *five* complete days, showing that the disease often takes six and seven days for development. Some cases that we have come across probably took eight and nine days, and there can be little doubt that it occasionally develops later than this.

There is valuable evidence in regard to the incubation of cholera to be derived from the well-known epidemic of cholera

that took place at Theydon Bois in Essex in the autumn of 1865.*

The epidemic was due to water contaminated with cholera matter from two patients, who had apparently contracted the disease in passing through Southampton, where the disease was raging. The water was drunk by several persons, of whom nine took the disease. The water was not used after the 6th day from its pollution, but still cholera continued to occur. While the water was being used, one case occurred on the second day after its pollution, two on the fourth, and one on the sixth. The water was then disused, but on the eleventh day after it had been polluted, and five days after it had ceased to be used, two more cases occurred; and on the twelfth day from pollution, and six days after disuse, there were three new cases. Of all these cases then the shortest incubation was two days, but the greatest number of cases occurred on the sixth day from disuse, giving an incubation of certainly six days, and possibly twelve.

There is another case of very great value in this connection. It is an account by Surgeon J. Tulloch, of an outbreak of cholera occurring at sea. Dr. Tulloch says, "I will now refer briefly to an outbreak of cholera on board ship at sea, twenty-four days after leaving port, which I conceive to be illustrative of the opinion that cholera poison may be conveyed otherwise than by personal communication. On the 21st May, 1859, I embarked at Calcutta on the ship 'Gertrude,' in medical charge of wounded and other invalid soldiers for England. Cholera was then universally prevalent in Calcutta, and in several troopships that had sailed earlier in the season, the disease broke out when they were in the river—a circumstance which caused serious apprehension for our safety at this

* Report on Cholera in London, and especially in the eastern districts, in 1866. By J. NETTEN RADCLIFFE. London, 1867.

advanced season, and, I may add, led to our using every available sanitary precaution. Having reached the equator without any signs of cholera, we congratulated ourselves on what we believed to be our escape. But it was not so, for on the 15th June, when in the fourth degree of south latitude, and twenty-four days from all communication with the shore, hundreds of miles from land, the weather hot and steamy, but not unusual for that latitude, a soldier invalided for ophthalmia (then convalescent from dysentery contracted on board) was seized in the morning and died next day. On the same morning, the chief officer of the ship, perhaps the strongest and healthiest man on board, was seized and died in three-and-a-half hours. In the afternoon a soldier's child, a boy six years of age, was attacked, and died on the following morning. On the 20th, a soldier recovering from dysentery was attacked, and died on the 21st, and on the 25th a strong healthy sailor was seized, and died next day.

"If we admit that the cholera poison is of a specific nature we must admit, reasoning from the above instance, that it was brought in the ship from Calcutta. It could neither have been generated in the ship nor wafted in the air from a mephitic shore. How and why it exerted its influence at this particular time, and not before or after, it is unnecessary here to enquire."

* It is greatly to be regretted that we have not more details given in this case. It may be assumed that Dr. Tulloch knew perfectly well that it was cholera, and not mere ptomaine poisoning. Had it been ptomaine poisoning also all the cases would have occurred together and not at intervals during ten days. But we are not informed whether there was any soiled linen or clothes on board, whether all the men on board drank from

* Dr. MURRAY'S Report on the Treatment of Epidemic Cholera. 1869. Page 18.

the same water supply, and whether the men who were seized with cholera had been resident in Calcutta before embarking. It is a case of great interest, and admits of a possible explanation by an exceptionally long period of incubation.

An Indian physician well acquainted with the disease told us that he believed the third and fourth days were those on which the disease most frequently developed, and if we add to them the fifth and sixth we shall probably have the period at which the disease shows itself in the great majority of cases. We have seen some instances in which the disease declared itself on the second day. In the epidemic at Messina in 1887, an outbreak at which we were present, there were some cases that showed themselves on the third day.

In the Hamburg epidemic of 1892 two cases occurred which show the uncertainty of the length of incubation in cholera. A physician arrived in Hamburg to give his assistance during the epidemic on August 28th. He was seized with cholera on the 29th. In this case there can be no doubt that the incubation was one day. A stoker who, there is every reason to believe, contracted the disease in the town of Hamburg itself, left that port on board a ship on the 16th August. He was seized with cholera on the night of the 18th and 19th August and died, giving a probable incubation of three days, and certainly over two.

Thus the incubation of cholera is not a definite period but varies considerably, and the conditions on which these variations depend must at present be declared as absolutely unknown. All that can be asserted is that a large proportion of cases develop in the second half of the first week, and that

* Die Cholera in Hamburg, von Dr. J. J. REINCKE, Deutsche Medicinische Wochenschrift. No. 3, 4, 5. 1893.

it is improbable that any are delayed much longer than the second week.

The next point is, what is the earliest symptom of cholera and what is the condition of the patient during the period of the invasion of the disease? In very many cases the stage of invasion is characterised by diarrhoea.

Very many patients will admit that they have suffered from diarrhoea sometimes for days. In most cases the diarrhoea is of a very painless character, although it may be profuse. Occasionally abdominal pains are complained of in this stage, and, still less frequently, a feeling of malaise. But, on the other hand, there are some patients, like the patient in Case II., who deny completely that they have had any diarrhoea. Many times we have closely investigated this point, and have seen not a few cases that were stated to have occurred without previous diarrhoea; some of the patients that we have asked have been obviously past all earthly hope, and we can see no reason whatever to doubt their word.

When the disease has developed the symptoms are more definite and characteristic, and must be examined in more detail.

The first stage of the developed disease is the *period of evacuation*. In this stage there is more or less diarrhoea, and generally it is profuse. The stools are at first yellow, and like those of ordinary diarrhoea, but they very soon become liquid, whitish, turbid, somewhat opaque, the so-called "rice-water" stool; a term which exactly describes them. They are sometimes tinged with blood. The earlier stools, after they have ceased to be yellow, are more watery, and contain less white, granular, and flaky matter than those that succeed. The dejections are always markedly alkaline. When this stage has fairly begun, it is exceedingly rare to find any trace of yellow colouration or biliary matter in the dejections. In the earlier watery condition of the alvine evacuations the amount

of albumin present is very small ; in the typical " rice-water " it may be considerable.

The vomiting accompanies this stage ; it may begin very early, but generally it follows and does not precede the diarrhoea. It may be entirely absent, but generally it is present ; sometimes it is easily performed, but at others it is so severe as to greatly distress the patient. The vomited matter after the stomach becomes empty of food is often a clear fluid, a little later it may be somewhat turbid. It is generally acid in reaction, sometimes neutral, and occasionally alkaline. It happens now and then that nothing is ejected, the patient retching continually without result. Sometimes the act of vomiting is so violent as to rupture the lining membrane of the air-passages, leading to an emphysematous condition in the region of the neck. Occasionally the vomited matters are tinged with blood. In this stage it is very rare for it to contain any biliary colouring-matter. On the whole, it may be affirmed that vomiting is not an unfavourable symptom, and even if it is continued late in the disease it is usually followed by recovery. The explanation is probably this, that when the cholera poisoning is very severe the nervous system is so affected that vomiting soon ceases to be excited, but in the lighter forms that does not occur.

During this period the patient generally complains of pain in the region of the stomach and abdomen. It is sometimes very severe, and this is of bad omen. The seat of it varies ; the stomach often, sometimes it is near the umbilicus, sometimes lower down. At times the pain is fixed, and at others it appears to move about very much as it does in dysentery ; but it appears to be rarely, if ever, accompanied by tenesmus.

It is at this period that the temperature of the body begins to fall, but the depression now is very seldom great. About half a degree centigrade ($\cdot 9$ of a degree Fahrenheit) is the usual amount of depression of the temperature of the body

in this stage, and it may be less than this. The skin begins to feel cold to the touch, the tongue especially so. To ascertain this point—as it is of some value in diagnosis—the dorsal surface of the middle phalangeal portion of the index finger should be used, as it is very greatly more sensitive than the tip of that finger, which is usually employed.

The exceedingly painful symptoms of muscular cramps now begin. They generally are strongest in the calves of the legs, the muscles often feeling hard and knotted. They may also be very severe in the arms. In extreme cases, nearly the whole of the muscular system is affected—the calves, the thighs, the arms, the forearms, the muscles of the abdomen and back, the intercostal muscles, and those of the neck. The patient writhes in agony, and can scarcely be confined to his bed, his shrieks from this cause being very distressing to those around him. The cramps are seen perhaps in their most pronounced form in the young, muscular, male adult European, stricken down with cholera soon after his arrival in India.

The appearance of the patient begins to assume the choleraic aspect. The eyes are sunken in the orbits, the nose sharp, the skin is cold and covered with a clammy sweat. The secretion of urine is arrested; the pulse loses much of its force; there is great thirst, and a general feeling of anxiety; the tongue is white, but is not thickly coated.

The next stage is that of the fully developed disease and is usually called the *stage of collapse*. In many cases it comes on quite suddenly. In a few minutes the pulse completely fails at the wrist, the patient's aspect changes, and it is at once seen that the condition has become much more serious.

In collapse the diarrhoea and vomiting lessen as a rule, though sometimes they persist, as in the following case.

CASE IV.—G. U., a man of 66 years of age, was admitted into hospital on July 17th. He states that he was taken ill yesterday with vomiting and some diarrhoea. He is now in

intense cholera collapse. Features excessively pinched, eyes deeply sunken; is scarcely conscious; no pulse, heart-beats 84, respirations 30, temperature $36^{\circ}2$ C. ($97^{\circ}16$ F.). The abdomen, judged by the signs elicited by physical examination, is full of fluid. He still vomits occasionally, but the diarrhoea is profuse, it pours from him literally in a continuous stream.

4 p.m. Is lying in a moribund condition, quite unconscious, breathing stertorous. No pulse in radial or brachial artery. Temperature $35^{\circ}6$ C. (96° F.). He lingered in this condition till 3 a.m. the next morning.

The patient in this stage assumes an aspect quite characteristic of the disease. The skin becomes of a dull blue colour, sometimes it is quite livid. The patient is cold to the touch, and he is often covered with a cold sweat that may be seen standing on the forehead. The eyes are deeply sunken in their sockets, and surrounded by dark coloured circles. The nose is sharp, the cheek sunken, the lips blue and shrivelled, and can no longer close the mouth, so that the teeth protrude, covered with sordes. The pupils of the eyes are contracted. The patient is tortured with thirst with an intensity unknown in any other disease.

Sometimes a peculiar odour is observed emanating from the body and breath; it is quite peculiar, it is of a sickly character, it might be styled "musty"; it is of very serious import, being generally shortly followed by death. It is interesting to note that Jacobus Bontius made exactly the same observation nearly three centuries ago. We have, however, known it to pass off, the patient, in one case, living for three weeks afterwards.

The cramps add greatly to the patient's sufferings; their most painful seat is usually the calves of the legs. The whole muscle may feel contracted, and, literally, as "hard as a board," or it may be knotted in places. The feet are often

strongly arched by muscular contraction, and the fingers flexed in the palms of the hands involuntarily. The thumb is sometimes drawn across the palm under the fingers. Occasionally a muscle may be torn through by them.

A very large number of patients complain severely of vertigo during the progress of the disease; it may supervene very early, or it may be a later manifestation, and it is a symptom that may remain for a considerable time.

The whole surface of the skin is blue, but the deepness of the tint varies very greatly in different cases, and this does not seem to depend on the natural tinge of the skin, for both dark and fair individuals often became excessively blue. The lips, the hands, the feet, and the circles round the eyes, are especially dark in colour. The tint varies from a dull leaden blue to complete lividity. The skin loses its vascular irritability, and the finger-nail drawn across it fails to leave any trace. The skin of the fingers is shrivelled, as if it had been soaked for a long time in water. If the skin is taken up between the thumb and forefinger it remains in the fold that it has been made to assume, as it has lost its elasticity. The patient usually complains of feeling cold—a great aggravation of his sufferings—though not always, and to crown all his tortures a distressing dyspnoea that threatens to suffocate him supervenes. He raises himself as well as he can to aid his respiration, and restlessly throws himself from side to side, crying out frequently on account of the cramp or for more air. The voice undergoes great change, as the expression *vox cholericæ* implies; it is husky, high-pitched, frequently reduced to a faint whisper, sometimes scarcely audible at all.

The pulse, in typical cholera, soon begins to lose its strength; it becomes feeble, compressible, and rises in frequency. Between 90 and 100 is the usual rate before it becomes imperceptible in the radial artery. After it is imperceptible there it may still be felt beating in the brachial

artery. Should it cease to be felt in the brachial, the case is of the gravest import. The heart's action now becomes faster, but it is often difficult, even by means of the stethoscope, to determine its rate. In the less severe cases, 120 to 140 may be noted. When the pulse begins to become again perceptible at the wrist, it is at first very feeble and quick; but its frequency soon diminishes again, but does not become normal for a very considerable time.

The temperature is, as a rule, much lowered. In Case I., the temperature descended to $36^{\circ}\cdot2$ C. ($97^{\circ}\cdot16$ F.). In Case II. it fell to $35^{\circ}\cdot4$ C. ($95^{\circ}\cdot72$ F.); but it may often fall much more than this, $32^{\circ}\cdot5$ C. ($90^{\circ}\cdot5$ F.), or $33^{\circ}\cdot2$ C. ($91^{\circ}\cdot4$ F.) being often noted. Dr. Goodeve gives $31^{\circ}\cdot1$ C. (88° F.) as a temperature recorded by him. In Case III. the temperature was never sub-normal. In typical cholera, the internal temperature, as taken in the rectum, may be above normal, or normal, or it may be sub-normal. In Case II. it was $37^{\circ}\cdot2$ C. ($98^{\circ}\cdot9$ F.), not very much changed, but we have known it as low as $34^{\circ}\cdot1$ C. ($93^{\circ}\cdot38$ F.). Immediately on the typhoid state occurring, the temperature rises above normal, generally from 38° to 39° C. ($100^{\circ}\cdot4$ to $102^{\circ}\cdot2$ F.), and afterwards falls again frequently to sub-normal. But the temperature in cholera shows many and great differences, for which it is difficult to account, and different epidemics give very different observations. In the Hamburg epidemic of 1892, for instance, the readings taken by the thermometer were unusually low, both externally and internally. In no case that we saw was there a highly febrile condition, and we made many enquiries, and we met with no physician who had seen a case of that nature. It is a subject to which we must return again.

The function of respiration is markedly affected in typical cholera. At the end of the period of evacuation a slight quickening of respiration will be usually observed. But it is in the period of collapse that it shows its greatest deviation

from normal. The rapidity becomes great, and this takes place usually comparatively suddenly. In a short time the respirations, which had only been 20 or 24 a minute, will rise to 30 or 35. The chest movements are also greatly exaggerated, and the nostrils dilate widely at each inspiration. But with all this extra movement there is an intense feeling of dyspnoea and impending suffocation; and it will be noticed that, as the dyspnoea increases, the colour of the skin becomes perceptibly darker. But there is not the slightest difficulty in the air entering the chest; the larynx and trachæa are quite free, and the air can be heard entering the lungs. Nor is there any condition like pneumonia, hyperæmia, or œdema in the lungs themselves to account for the dyspnoea, as can be easily verified in the autopsies of persons who have died in this condition. This subject must be further discussed when we come to the pathology of cholera. With the stage of reaction the dyspnoea lessens nearly as quickly as it supervened and the feeling of suffocation disappears.

It is in typical cholera with sub-normal temperature that the dyspnoea is most marked; in the other forms the respiratory function is less affected, sometimes not at all, and yet the cholera may be very destructive to life.

With the dyspnoea the breath feels cold, and it has been found to contain considerably less than its due proportion of carbonic acid.

There is a general diminution in the acuteness of perception of the special senses. The patients do not hear clearly, nor see, nor smell with the acuteness of ordinary health. In regard to intelligence, that is a subject that must be discussed further on.

It will be noticed that in all the cases given death occurred, and it is, undoubtedly, by far the commonest termination of severe cholera collapse. It very commonly takes place quite suddenly, and is especially apt to occur after a sudden change

of posture, the action of the heart and respiration ceasing abruptly, or more frequently the action of the heart becomes more and more laboured, and respiration is reduced to a slight upheaval of the chestwalls, which at last ceases completely. But death, though usual, is not the only termination of these cases.

CASE V.—A. M., aged 55, was admitted into hospital August 9th. He had suffered from diarrhoea since the 6th inst. He is a robust man. He has a characteristic cholera appearance. Skin cold and blue, voice husky, pulse feeble. Respirations 18, pulse 60, temperature $36^{\circ}\cdot2$ ($97^{\circ}\cdot16$ F.), pupils contracted.

August 10th.—Is still much collapsed; has passed no urine; has vomited much green fluid.

August 11th.—Is much better; vomiting ceased; has passed urine; temperature in axilla $36^{\circ}\cdot7$ (98° F.), temperature in rectum 37° ($98^{\circ}\cdot6$ F.), respirations 18, pulse 76.

He had no further symptom, and remained quite well.

Here the recovery was quite unusually quick. It is true that the symptoms were not very severe, but considering the age of the patient the recovery was very rapid. Still these cases do present themselves for notice from time to time. But usually the course of events is very different, as will be seen in the following case:—

CASE VI.—J. M., a strong, well-built man, 36 years of age, was admitted into hospital with cholera on December 16.

He had suffered from diarrhoea all the previous day. He is in severe collapse. Cyanosis of the skin; eyes sunken. No pulse. Has passed no urine since the previous day. Cramps in legs. Temperature, $35^{\circ}\cdot8$ C. ($96^{\circ}\cdot4$ F.).

December 17th.—Pulse scarcely perceptible. Temperature, 36° C. (96° 8 F.)

Evening. Better. Diarrhoea stopped; pulse stronger; temperature, 37° C. ($98^{\circ}\cdot6$ F.). Has passed no urine during the day.

December 18th.—Is better. Pulse of fair strength, 108; temperature, 37° C. ($98^{\circ}\cdot6$ F.). Suffers from stupor.

Evening. Temperature, $37^{\circ}\cdot8$ C. (100° F.) Has passed no urine.

December 19th.—Stupor very marked, can hardly answer questions. Moans frequently in the peculiar way cholera patients often do. Pupils much contracted. Pulse, 110; temperature, $38^{\circ}\cdot2$ C. ($100^{\circ}\cdot7$ F.).

Evening. Pulse, 120; temperature, $38^{\circ}\cdot8$ C. ($101^{\circ}\cdot8$ F.). Has passed no urine. Stupor very marked.

December 20th.—Much better. Has passed 200 grammes of urine (about seven ounces). It is highly albuminous and contains much indoxyl. Temperature, 37° C. ($98^{\circ}\cdot6$ F.). From this date his progress was uninterrupted and he was soon convalescent.

In this case, instead of the patient recovering at once or dying, after a somewhat long interval the pulse reappeared and the symptoms became ameliorated, and the *stage of réaction* was established. The pulse is at first very feeble, and scarcely perceptible, then it gains in strength, and with this the temperature of the body rises, the blue tint of the surface and extremities lessens. The dyspnoea disappears, the cramps also end, and the patient is in all respects much better. All this may take place in an hour or two, or it may take a whole day. In India we have often seen the change take place much more rapidly than it ever does in Europe. Sometimes with this great improvement in the general condition of the patient, the vomiting and diarrhoea, which generally cease in the period of collapse, recommence. This is most serious, as the improvement established is quickly lost, and the patient falls into a condition which is almost hopeless. Should this not happen, the patient next passes into the so-called *typhoid state*. The temperature rises to above normal; in the case given it rose to $38^{\circ}\cdot8$ C. ($101^{\circ}\cdot8$ F.). His face is flushed, his aspect that of a person suffering from fever. He answers questions with difficulty,

and is apt to moan at intervals in a peculiar way. The diarrhoea ceases completely, or is greatly lessened, and the stools begin to show, for the first time since the true choleraic process commenced, a green or yellow tinge, due to the presence of bile. This is a most favourable indication.

There are great differences in the degree to which the reaction is carried in different cases. We think it is decidedly more rapid in India than it is in Europe. In reading Professor Griesinger's account of the reaction written after the European epidemic of 1854, it strikes us as being nearer the form seen in the east than the present European one. It is likely, therefore, that epidemics vary much in this respect.

But the secretion of urine is not often re-established with the abatement of the other symptoms. It generally takes much longer for this function to be resumed. Its non-appearance gives rise to the gravest apprehensions. In by far the greater proportion of cases of severe cholera it is suppressed for several days. Occasionally cases may be met with in which the secretion is only much lessened, but they are exceptional. Every day that passes till the secretion of urine is re-established adds greatly to the danger of the patient. As the time of suppression lengthens the symptoms become graver. The patient either becomes first restless, then drowsy, unable to answer questions, or to notice what goes on about him, or else delirium supervenes. In the case given, the secretion did not make its appearance till the fifth day, but it is sometimes longer than this before it re-appears.

When the secretion of urine is re-established, a great improvement in the general condition is manifest in most cases. The stupor lessens, or the delirium ceases, and convalescence begins.

Should the urinary secretion remain suppressed coma

* Handbuch der Speciellen Pathologie und Theraphie. Infectionskrankheiten. von Prof. GRIESINGER. *Erlangen*, 1857.

generally supervenes, in which the patient dies. Not unfrequently cedema of the lungs occurs, rapidly proving fatal, sometimes in three or four hours from its commencement. Pneumonia is also not an uncommon termination, any complication occurring at this time is apt to cause death speedily, as the patient's exhausted condition does not permit of any combat with a fresh morbid condition.

Even when the urinary secretion re-appears it is not certain that it will be permanent. In certain cases, after amounting to as much as half a litre a day (about 17 ounces) it will diminish, ultimately ceasing altogether, the patient relapsing into the typhoid condition, in which he dies.

CASE VII.—J. P., a somewhat delicate man 48 years of age, was admitted into hospital with cholera on January 28th. He states that he has been ill a week with vomiting and diarrhoea at intervals. He has passed no urine since the 23rd inst. Skin is slightly blue in tint. Pupils contracted. Temperature, $35^{\circ}\cdot6$ C. (96° F.).

In the evening his temperature was $35^{\circ}\cdot8$ C. ($96^{\circ}\cdot4$ F.). He passed a small quantity of urine.

January 29th. Is in muttering delirium, very restless, cannot reply to questions. Pupils very contracted; temperature, 36° C. ($96^{\circ}\cdot8$ F.); pulse 90, very feeble; respirations, 30. He passed no more urine and died at 6 p.m.

Here the patient suffered five days from suppression of urine; a small quantity was then secreted, and then further secretion stopped. The muttering delirium is one of the commonest accompaniments of choleraic uræmia. In these cases it is almost universally found that any urine secreted is highly albuminous.

Occasionally an opposite condition occurs, and an enormous quantity of very pale urine of low specific gravity is passed. We have seen as much as eleven litres (considerably more than two gallons) passed in one day. It did not in the least

interfere with the convalescence of the patient, who completely recovered.

Contraction of certain muscles, or groups of muscles, are very frequent during the course of cholera. Reference has already been made to the flexion of the fingers and to the arching of the feet. We have seen one of the cremaster muscles powerfully contracted. Sometimes the muscles of the lower jaw close it, and, more frequently still, the muscles of deglutition are in a state of contraction, rendering swallowing impossible. This has always, as far as we have seen, portended a fatal termination. Once there was spasm of the laryngeal muscles, this was also rapidly fatal.

It has already been stated that during the acute choleraic process no biliary matter appears in the stools, or in the vomit, and the sooner the return of the natural colouring-matter is noticed in the dejections so much the more favourable is the prognosis for the patient. It is remarkable that after death in acute cholera, the gall-bladder is almost always found full of bile, which has not been able to enter the intestine. But, in spite of this condition, which one would think would be most favourable for the production of jaundice, it is a very rare complication of cholera. But all the cases that we have seen of it have terminated fatally.

This condition of suppression of the urine and retention of the bile, and the symptoms dependent thereon, Dr. Chevers* has termed Cholo-uræmia, a very convenient name for it.

When the urine has been suppressed for some time the intelligence becomes blunted, stupor is manifested, or delirium supervenes. But this, as a rule, does not occur at once. Several days may elapse without any change in this direction. But sometimes in cholera a peculiar deadening of the intellectual faculties comes on early. The patient appears dull and

* Diseases of India, by N. CHEVERS, M D. London, 1886.

heavy, unable to answer questions, or even a slight delirium may occur. We have seen this in cases which, judged by the general symptoms, could not be classed as severe cholera, and when the urine had not been suppressed, or, if so, for such a short time that it could not have given rise to such a severe cerebral condition. In cholera a man, otherwise fairly healthy, can suffer from suppression of urine for three or four days without its giving rise to any cerebral symptom, so that these cases cannot be attributed to this cause.

The following is a case illustrative of this :—

CASE VIII.—L. P., a muscular, well developed young man, was admitted into hospital with cholera Jan. 21st. He had suffered somewhat from diarrhoea for a day or two previously. His face is quite natural. Pulse of good strength, 72. Voice strong. When spoken to he answers vaguely, and does not appear to understand what he said. Pupils contracted. Temperature $35^{\circ}6$ C. (96° F.). A small quantity of urine drawn off by catheter was not albuminous.

January 22nd.—Is much more confused to-day, cannot reply intelligibly. Pupils much contracted. Temperature $34^{\circ}5$ C. ($94^{\circ}1$ F.). Pulse 100, of fair strength. Has had some diarrhoea, but not excessive. *

Evening.—Pulse 108, temperature $34^{\circ}8$ C. ($94^{\circ}64$ F.).

January 23rd.—He is no longer sensible, but in a muttering delirium. Pupils much contracted. Temperature $34^{\circ}5$ C. ($94^{\circ}1$ F.). Pulse good, 84. No change in the face, which is quite normal. No urine has been passed.

Evening.—Is suffering from symptoms of pulmonary cedema. Temperature $33^{\circ}8$ C. ($92^{\circ}84$ F.). He died of this condition early the next morning.

This case is of interest in several ways. The patient was a healthy looking young man, and when admitted had not suffered from suppression of the urinary secretion and the urine was not even albuminous. But in spite of this his intellectual

faculties were deeply affected. He did not know where he was, and could not reply to questions, and his aspect was that of a person greatly confused. When not addressed he was in a condition of stupor, with occasionally some delirium. It is clear, therefore, that this stupor was directly due to the action of the cholera poison and was not secondary to uræmia. From the time of his admission he secreted no more urine, and the symptoms were naturally aggravated by this condition. But the primary stupor was entirely independent of the state of the urinary secretion, and also of the enteritis. This condition is not uncommon in cholera, and it is often termed uræmia. But in the ordinary cholo-uræmia of cholera the cerebral symptoms do not come on till the suppression of the urinary secretion has existed for some time, but in these cases to which we are now referring they begin almost as soon as the cholera process itself. In some epidemics this is so common as to lend a special character to the disease, and cholera seems then somewhat allied to typhoid fever, where the same condition may often be seen totally unconnected with any suspicion of its being due to suppression of urine.

Another feature of interest in the case is that the patient never had the facial appearance of a person suffering from cholera. The eyes were not sunken, the cheeks were full, the lips natural, and the voice was quite normal. The pulse did not fail as it usually does, but was quite strong throughout the disease. The diarrhoea was moderate in degree, and was entirely absent for more than a day whilst he was in the hospital; but shortly before his death he again suffered from it. He had a markedly depressed temperature, but it is not always so in these cases. He had no choleraic dyspnoea. As the pulmonary oedema came on before death his respirations rose, but the true dyspnoea of cholera was not present. From his aspect, his voice, the absence of dyspnoea, and the amount of diarrhoea, anyone unacquainted with the disease might

have grave doubts whether it was cholera at all. There were no cramps also throughout the case. But these cases are not unusual, and in some epidemics they are quite common. In this particular case the autopsy disclosed the typical lesions of Asiatic cholera in a most severe form. This form of cholera, with severe cerebral symptoms occurring early in the disease, is very fatal.

As a complete contrast to this case, we give one of acute cholera, where there was total suppression of urine, and the intellectual faculties did not suffer at all.

CASE IX.—J. K., aged 30 years, a tall, spare man, was admitted into hospital on February 3rd. He states that he has been four days ill. Has had much diarrhoea, but was at work yesterday. Has passed no urine since yesterday; face markedly choleraic; voice feeble; pulse very weak; respirations, 36; some dyspnoea; pulse, 108; temperature, 35°·2 C. (95°·36 F.).

February 4th.—Has had much diarrhoea; stools coloured with blood; no vomiting; no urine; temperature, 36°·5 C. (97°·7 F.); pulse, 108, very feeble; respirations, 28; is quite intelligent; no stupor.

February 5th.—Temperature, 36° C. (96°·8 F.) Has had much diarrhoea and vomiting.

4 p.m.—Temperature, 36°·4 C. (97°·52 F.); pulse, 120; respirations, 36; no urine. Has wasted much during the time he has been in hospital. Pulmonary oedema commencing. He is perfectly conscious and intelligent, and not confused in any way.

February 5th.—Died at 2 a.m. this morning.

In the symptoms of these two cases there was the greatest difference. The patient who had the longest suppression of urine (Case IX.) was quite intelligent to the last. The other, (Case VIII.) had severe stupor from the first. In fact, it was almost the earliest symptom.

In these cases of cholera in which the stupor begins very early, we believe it to be a direct effect of the poison, and it is then to be distinguished from the secondary stupor, which is a consequence of the enteritis, as this last in its turn is to be distinguished from the later occurring stupor and coma due to the cholo-uræmia.

In Case IX. the enteritis was, if anything, more severe and extensive than in Case VIII., and yet the stupor was entirely absent. In the stupor due to the enteritis, the aspect is much more typhoid than in the primary stupor. The patient lies on his back, the skin over the cheeks is flushed, the eyes half closed and rotated upwards, no notice is taken of what is passing in the room; but should uræmia supervene, the patient is very apt to become restless at its commencement.

To put the matter, perhaps, in a clearer light, it may be said that the choleraic stupor depends on three factors: The direct effect of the poison, the enteritis, and on cholo-uræmia. Yet each of these alone is capable of producing stupor, and, in certain cases favourable for observation, their effects can be distinguished; but, in the majority of cases, as might have been expected, the typhoid condition results from a combination of the three.

But these cases are of value in other respects, as showing how completely the symptoms in cases of true cholera may differ. As has been said in Case VIII., the characteristic appearance of cholera was entirely absent; there was no dyspnoea, the pulse was strong, the voice normal, and there were no cramps. There was nothing to lead one to suppose that any undue quantity of fluid had escaped from the body. In Case IX. the appearance was choleraic, the pulse feeble, the eyes sunken, and there was dyspnoea. Yet the cause of death was the same in each case, and the autopsies of both disclosed the most severe lesions of Asiatic cholera. These cases supply a complete refutation, if one were needed, of the

assertion that cholera is merely an exaggerated form of diarrhoea, but show, on the contrary, that it is a disease of great complexity, having a wide range of varying phenomena.

Sometimes in the typhoid condition of cholera there is complaint made of insomnia: the patient will not be able to sleep for forty-eight hours, or even longer. It is chiefly noticeable for the trouble it causes the patient, who, however, usually does well in spite of it.

Hiccough is often a distressing complication at this period. It may be very severe. We have known it last for four days, but it is rare for it to continue so long as that; it does not appear to exercise any unfavourable influence on the course of the disease.

Sometimes the patient does not seem to recover from the stage of collapse completely, the temperature remains sub-normal and the aspect never becomes natural, or at any rate for a long time. These cases are often fatal. We shall allude to a marked example in speaking of the pathology of the disease. It is best described as cholera with imperfect reaction.

In the two cases we have just given the depression of temperature in both of them was very marked, being in one case $33^{\circ}\cdot8$ C. ($92^{\circ}\cdot84$ F.), and in the other $35^{\circ}\cdot2$ C. ($95^{\circ}\cdot36$ F.). Sometimes this condition is absent, though the other symptoms may be typical. If Case III. be examined, which was typical in most respects, at no period—while the patient was under observation—was the temperature sub-normal, in fact, the lowest temperature taken of the external surface of the body was $37^{\circ}\cdot3$ C. ($99^{\circ}\cdot1$ F.).

But in cholera we may sometimes find a condition of things quite different to that of depression of temperature. It will be best to give an example of this. We select an Indian one.

CASE X.—W. N., a healthy looking young seaman, $19\frac{1}{2}$ years of age, was admitted into hospital Sept. 15th with

cholera, at 5.15 p.m. He had profuse diarrhoea in the morning before admission, and passed urine last about 11 a.m. He says he suffered from diarrhoea slightly two days ago. Aspect slightly choleraic. Skin warm. Cramps in muscles of legs, and abdomen. Pulse weak, compressible, frequent. Vomits continually. Temperature in axilla $37^{\circ}3$ C. ($99^{\circ}14$ F.), temperature in rectum $39^{\circ}2$ C. ($102^{\circ}56$ F.).

6 25 p.m. Pulse 120, very weak, respiration 28, sighing.

7 45 p.m. Pulse 140, respirations 40, temperature in axilla $38^{\circ}6$ C. ($101^{\circ}48$ F.). Temperature in rectum $39^{\circ}8$ C. ($103^{\circ}64$ F.). He has had six choleraic stools since admission.

9 p.m. Temperature in axilla $39^{\circ}1$ C. ($102^{\circ}4$ F.), temperature in rectum $40^{\circ}7$ C. ($105^{\circ}26$ F.).

11 p.m. Respirations 30, temperature in axilla 40° C. (104° F.), temperature in rectum $41^{\circ}2$ C. ($106^{\circ}16$ F.).

September 16th.—1.30 a.m. Temperature in axilla $40^{\circ}9$ C. ($105^{\circ}6$ F.), temperature in rectum $41^{\circ}9$ C. ($107^{\circ}4$ F.).

3 a.m. Temperature in axilla 41° C. ($105^{\circ}8$ F.), temperature in rectum $42^{\circ}1$ C. ($107^{\circ}78$ F.).

4.55. Temperature in axilla $41^{\circ}8$ C. ($107^{\circ}24$ F.), temperature in rectum $43^{\circ}1$ C. ($109^{\circ}6$ F.).

5.15. Died.

After death there were muscular movements flexing the arms. Temperature in axilla, fifteen minutes after death, $40^{\circ}8$ C. ($105^{\circ}44$ F.), temperature in rectum $43^{\circ}8$ C. ($109^{\circ}9$ F.).

We have here chosen a marked example of this, the hyperthermic form of cholera. It is a form frequently seen in India, and we have seen many cases of it in Europe. It generally shows itself in a manner somewhat different to the one given. The stage of evacuation is usually well-marked, and followed by a definite period of collapse, which may, however, be short. Even during this period, if the internal temperature of the body be taken in the rectum, it will be found to be suspiciously high. This internal temperature soon begins to increase, and

the temperature of the surface of the body rises with it. If this occurs, the worst may be feared, as this form of cholera is most deadly. The temperature in the rectum rises to 40° or 41° C. (104° to 105°·8 F.). The external temperature following it, but, of course, not to such a height. Death is not long delayed usually in these cases, though it was perhaps somewhat early in the case given, and the temperature does not commonly rise so high as in the example. In cholera, if this form is apt to occur, the most constant watch should be kept on the internal temperature to obtain the earliest information of the development of this state. Sometimes in these cases a vivid erythematous eruption makes its appearance, and there may be a flushed appearance of the face. Sometimes the last manifestation of life is a general muscular tremor. In the earlier descriptions of cholera many cases given were clearly of this form. We once saw an epidemic in Italy where there was scarcely a house in which some one was not dead or dying with this particular form of cholera. On the other hand, of the very large number of cases we saw at Hamburg in 1892 not one of them had these symptoms, nor did we see one in the epidemic in Hungary in 1892-93. It cannot be attributed to personal peculiarity, for that would not explain how often this form does occur in an epidemic, it usually is very frequently seen, and claims for its victims persons of all ages, of both sexes, and of different racial characteristics. It is far more probable that the causative element of cholera is capable of modification.

Both in Europe and Asia during epidemics of cholera, a certain number of cases occur of diarrhoea, in many of these some trace of the choleraic process can be observed, however, in them it does not become acute or endanger life. It is probably the mildest form of cholera. Sometimes these cases are numerous, and we have never seen an epidemic without them.

In some cases of cholera, when the symptoms are very severe, there may be no alvine evacuations at all, but when the abdomen is examined it is found to be full of fluid. The fluid is poured out into the intestine, but is not expelled out of the body. In some of these cases it is no doubt due to paralysis of the intestinal wall through the severity of the choleraic process, but sometimes it depends upon a more obvious cause, which must be mentioned when we speak of the pathology of the disease. But it is referred to here to show the importance of a careful and often-repeated physical examination of the abdominal cavity in cholera to know exactly how the contents of the intestine are varying from time to time, and whether the process of exudation into the intestine is increasing or arrested—a most important piece of information.

A very common occurrence in Asiatic cholera is a relapse. It usually takes place shortly after reaction, but it may occur at any time.

CASE XI.—M. D., a vigorous young man, was admitted into hospital with cholera on February 3rd. He had had diarrhoea the previous day. In the evening he was cyanosed; radial pulse, feeble, 96; dyspnoea; respirations, 36; temperature, 35°·7 C. (96°·26 F.); passed no urine during the day; had eight dejections and much vomiting.

February 4th.—Diarrhoea continued; temperature, 36° C. (96°·8 F.); pulse, 96, very feeble; evening, temperature, 36°·4 C. (97°·5 F.).

February 5th.—Is still cyanosed; pulse, 96, very weak; respirations, 24; temperature, 36°·4 C. (97°·52 F.); eight dejections; is vomiting frequently a bile-tinged fluid; no urine; evening temperature, 36°·7 C. (98° F.).

February 6th.—Is much better; has only vomited twice and had two evacuations in the last twelve hours; respirations, 20; pulse, 96; temperature, 36° C. (96°·8 F.).

February 7th.—Is much improved; passed 150 cubic

centimetres of urine (about five ounces), highly albuminous, with strong indoxyl reaction; pulse, 84; respirations, 22; temperature, 36°C . ($96^{\circ}\cdot 8\text{ F.}$); has the characteristic appearance of the soporific state due to choleraic enteritis; only one alvine evacuation during the day.

February 8th.—Improving: passed 900 cubic centimetres of urine (about thirty-three ounces); pulse, 68, of fair strength; temperature, 36°C . ($96^{\circ}\cdot 8\text{ F.}$).

February 9th.—Is much worse; diarrhoea returned; five stools this morning; temperature, $35^{\circ}\cdot 8\text{ C}$. ($96^{\circ}\cdot 4\text{ F.}$); pulse, 80, feeble; urine only 500 cubic centimetres (about seventeen ounces); is in a very exhausted state.

February 10th.—Diarrhoea stopped; is better, 700 cubic centimetres of urine (about twenty-four ounces); temperature, $36^{\circ}\cdot 8\text{ C}$. ($98^{\circ}\cdot 2\text{ F.}$); pulse, 80, of fair strength; respirations, 12; has marked stupor.

February 11th.—Is improving. Urine, 1,900 cubic centimetres (about 67 ounces). Temperature $36^{\circ}\cdot 8\text{ C}$. ($98^{\circ}\cdot 2\text{ F.}$); pulse 84, stronger.

February 12th.—Better; the typhoid condition is much less severe.

He gradually recovered.

In this case, after the severe symptoms had passed off they returned with violence on the sixth day, placing the patient's life in great jeopardy. Sometimes, as in this instance, this occurs without obvious cause, but very often it is due to having taken some irritating substance as diet into the intestinal canal. Sometimes we have had reason to believe that a re-infection has occurred. This should be suspected when many cases of this kind occur in a hospital simultaneously. But though we think errors of diet and re-infection account for many of these cases, there will be found some that are quite independent of these causes, and the possibility of their occurrence should always be borne in mind in forming a prognosis of a case of cholera.

There are several points of interest besides in this case. The typhoid state was not fully developed till the secretion of urine was re-established, showing that it was not secondary to uræmia. In this case the typhoid condition was, we think, due to the enteritis. The slowness of the respiration—12 per minute—is worthy of note, as it is quite exceptional. The complete suppression of urine for nearly five days and its copious secretion afterwards, are quite characteristic of the disease. The early appearance of vomit stained with bile enabled one to say that the final result would probably be favourable.

It will be noticed from the cases that we have given that cholera shows a great diversity of forms, and those whose experience is Indian will probably be of opinion that it varies more in Europe than it does in the East; and we think that this opinion is well founded. But, even in India, every epidemic has a special character, though the earlier symptoms are fairly constant. In Europe this is not always so. An epidemic will begin with an outburst of typical cholera, and the appearance of the disease will be precisely similar to that seen in a European just arrived in Bengal. But the symptoms are apt to alter, especially if there have been considerable atmospheric changes. It may be noticed, for instance, that the cases are not quite so sudden in their onset. The stage of evacuation may be less acute and longer. The choleraic appearance becomes less marked, the cramps are modified, but the mortality does not lessen in the same degree as the symptoms. In spite of the earlier symptoms being less prominent the secondary ones may be very severe and fatal. Often some special feature may be produced in the later stages. We have seen cases where acute cerebral symptoms were developed with much delirium; sometimes the choleraic nephritis will be peculiarly severe and fatal. The cholera may become, in fact, so modified that it requires a consider-

able acquaintance with the disease to recognise it. It may become an apparently mild diarrhoea, with a severe typhoid state following it.

It is in these particulars that cholera Asiatica, differs completely from cholera nostras. With cholera nostras we have a severe diarrhoea, and the consequences of that diarrhoea, but in Asiatic cholera we have to do with the results of a very complex morbid state, manifesting itself in many different ways, which require much careful study for their recognition. An epidemic of cholera scarcely marked by diarrhoea and not at all by the obvious physical appearances due to extreme diarrhoea may cause a very severe mortality. Even after most mature consideration it is difficult to say which of its features is most to be dreaded. The nephritis is certainly as deadly as the enteritis, and the general poisoning of the system is not less fatal than either. And the effect of this poisoning lasts for a considerable time, as the occurrence of the sequelæ of cholera proves. It is also not possible to tell from the symptoms of the earlier stages of cholera how severe the nephritis may be, and the enteritis itself does not bear in its intensity any regular relation to the severity of the diarrhoea.

Another singular feature is that the complications and sequelæ of cholera change often with the character of cholera itself.

A cholera poison that has been causing in a large proportion of cases in an epidemic a severe erythema, will completely lose the power of producing it in a single case. And the same may be seen of other complications. To show how great this change may be, a physician of our acquaintance was present with us at an epidemic, and became perfectly familiar with its nature. He then went away and returned in a few weeks. During the whole of that time the epidemic had continued raging, but had altered in character. On his return

we asked him whether he noticed any difference in the nature of the epidemic, and he assured us that he could scarcely recognise it as the same disease. But the mortality had not greatly varied.

There are many different types that the disease may take, but they will be more advantageously discussed when the pathological changes due to cholera have been considered, as some of them depend on those conditions. No doubt in some cases the modifications of cholera depend upon personal peculiarities in the patients, but the changes in the nature of an epidemic can scarcely be attributed to this cause.

There are some other complications and sequelæ of cholera that must be mentioned.

Jaundice. It is remarkable that during the earlier stages of cholera no bile enters the intestine. At the autopsy the gall-bladder is generally found full of bile, which can be made to pass with ease through the duct, but it is nevertheless exceedingly rare for jaundice to accompany cholera. It is usual for bile first to be noticed in the stools in the typhoid stage, and generally early in that state, though it may be delayed beyond this. Jaundice does occasionally occur and is an exceedingly dangerous complication.

CASE XII.—E. H., a rather stout woman, 35 years of age, was admitted into hospital on Feb. 2nd. She stated that she first felt ill and had diarrhœa the previous day. On the morning of admission she had diarrhœa, vomiting and cramps. On admission her pulse was 104, weak, Temperature $37^{\circ}9$ ($100^{\circ}2$ F.) Her aspect was choleraic and there was much dyspnœa. Tenderness over abdomen. There was a slight tinge of jaundice. 4 p.m. Temperature $37^{\circ}7$ ($99^{\circ}86$ F.) Pulse 83. Cramps. Jaundice more marked. In the evening the pulse was not perceptible. Dyspnœa great. She passed no urine after admission.

She died at 9 p.m. the same evening.

It generally supervenes later in the disease, but the termination is generally equally unfavourable.

Polyarthrititis may occur after cholera. It consists of an inflammatory condition of the ligaments and fibrous structures round certain of the joints. It may lead to suppuration both within and around the joint. When one joint is affected it is usual for others to become implicated.

Anæmia is very common as a consequence of cholera. It is to be noticed nearly always when the disease has been severe, it is usually recovered from, but it may be fatal in the fifth or sixth week or later.

Cerebral meningitis is a somewhat rare sequela.

Occasionally paraplegia has been met with. It is mentioned in one of the earliest accounts of the disease published in Calcutta at the beginning of the century; but it has been seen in Europe also.

Dementia has been known in a few cases to follow cholera.

Dysentery is fairly common when the patient is recovering from the severe symptoms; as a rule, it does not cause much distress, and yields readily to the appropriate treatment.

Anasarca of the extremities is not rarely seen after cholera.

Occasionally a chronic diarrhoea follows cholera and it may lead to a fatal termination, in spite of treatment.

Conjunctivitis is very common in cholera. It supervenes in the typhoid stage; it frequently lasts some time, and often a discharge of pus takes place from the conjunctival surface. As the patient recovers it disappears.

Ulcer of the cornea appears as a crescentic ulcer at the lower portion of the cornea. It is only seen after severe cases.

Gangrene of the scrotum may take place when the cholera has been severe. It may also attack the penis. Sometimes the gangrene may affect the end of the nose, or sometimes one or more of the toes and fingers.

Parotitis is very common and leads not unfrequently to suppuration.

Pneumonia is a very usual complication, and also bronchitis. Œdema of the lungs is quite usual as a fatal termination. Very occasionally signs of it may commence and then fade away, but this is not common. Pleurisy generally occurs later than pneumonia. Pulmonary complications are certainly much commoner in Europe than they are in the tropics.

When cholera is combined with alcoholism it is generally fatal, and many of these individuals die of pulmonary œdema, which often sets in comparatively early in the disease and is fatal with extreme rapidity. We have known it destroy life in less than three hours from its commencement.

There are certain eruptions that occur in cholera to which allusion must be made.

Sometimes a light roseola will affect certain portions of the body.

More frequent than this is a vivid erythema widely diffused that occurs about the shoulders and loins. It generally shows itself about the third or fourth day. We believe it to be of bad import.

In the second week, a not unusual occurrence is the appearance of patches of erythema, over the limbs, the upper part of the body, the neck and face. They remain for about a week, then fade gradually, leaving a faint mottling, and are sometimes followed by a slight desquamation. They are not of bad omen, but occasionally a case will die in which they occur.

Sometimes the eruption will take the form of the weals of urticaria.

We have occasionally seen bullæ occur.

We once saw some cases in which a mottling of the skin occurred, which strongly resembled the eruption of typhus exanthematicus.

Pregnancy is a most serious complication of cholera. The child generally dies during collapse, we believe of asphyxia. We have several times been assured that the movements of the child have been much felt at this period, and we have ascertained the death of the child soon after. The child, should the mother live so long, is usually expelled a day or two afterwards. If the child is removed from the uterus after its death, it does not in the least tend to a favourable result in the mother. The only cases we have seen recover have been exceedingly vigorous young women, who have retained the child till the acutest symptoms had subsided.

CHAPTER IV.

THE PATHOLOGY OF ASIATIC CHOLERA.

THE pathological changes that are found in cholera are very extensive, and affect a wide range of organs. But the changes depend very largely upon the severity of the malady and the length of time it existed before death, and considerable differences arise from the course the disease has taken, and also from the methods of treatment that have been employed. It is, of course, in the alimentary tract that the greatest changes occur, but no class of organ entirely escapes the effects of the disease.

It will be best to begin with the thoracic organs.

The pleuræ are usually normal, and there is no fluid in the pleural cavities. After cholera, the pleuræ are not unfrequently found inflamed. This does not accompany cholera, but is a sequel.

The lungs, in a case which has been fatal, in the acute period of cholera are dry, anæmic, small, collapsed, of light weight, and on section, showing scarcely any signs at all of the presence of blood or fluid. In India, especially, these characteristics are very marked. Should operative interference with the course of the disease by the injection of fluid for the purpose of treatment have been undertaken, this typical condition of the lungs will not be found. They will then present signs more or less marked of venous congestion. In the later stages of cholera, especially in Europe, the condition of the lungs is very often the cause of death. They may then be found extremely œdematous, or in a state of great hyper-

æmia; sometimes there may be bronchitic, and sometimes in a condition of pneumonia, either lobular or of the true fibrinous form.

It will surprise our Indian readers to hear that in 152 consecutive autopsies from cholera in Hamburg in 1892, in sixty-two of them were found evidences of pneumonia; that is to say, in nearly 41 per cent.

The pericardium is usually normal and seldom contains more than a few drops of clear serum.

The structure of the heart presents no recognisable change in acute cholera. The cavities generally contain blood, but the condition and the amount of blood is dependent upon the stage of the disease in which the patient died. Hæmorrhagic spots are usually found upon the posterior surface of the heart.

The condition of the stomach varies a good deal in cholera. In many cases it appears nearly normal, in some cases it is the seat of catarrh. Not unfrequently the mucous membrane is hyperæmic, there may be hæmorrhages in the tissue and sometimes it is the site of a true acute inflammatory process. In one of the earliest descriptions of a fatal case of cholera on record, the fatal result was due to a hæmorrhage into the stomach from a vessel in its walls. The reaction of the stomach is generally acid, sometimes neutral and occasionally alkaline. So far from an alkaline condition of the stomach being necessary for the production of cholera, the stomach is not unfrequently highly acid and the earliest vomitings are often exceedingly so.

The duodenum is perhaps less frequently the seat of morbid changes than the rest of the alimentary tract. Griesinger †

*“Choleraleichenbefunde,” von Dr. SIMMONDS. *Deutsche Medizinische Wochenschrift*, No. 51 and 52, 1892.

† “*Traité des Maladies Infectieuses*,” par W. GRIESINGER, *Paris*, 1868.

states that Brunner's glands there, were in his experience, greatly enlarged. The duodenum itself may be somewhat hyperæmic. The jejunum also is very generally hyperæmic, and the hyperæmia is more acute at some points than others. We have remarked lately that in recent epidemics the middle portion of the jejunum was especially affected. But the hyperæmia may be very irregular in its distribution. The valvulæ conniventes are especially prominent, and the hyperæmia is apparent also in the peritoneal surface. From the mucous membrane can be removed a whitish opaque semifluid material very rich in granular matter and in cellular elements. The contents of the jejunum during the acute cholera process are not stained with biliary colouring matter.

The ileum is, however, the seat of the greatest changes in cholera; but it is rarely, if ever, found affected equally throughout its extent. The situation where, in most cases, the greatest pathological changes will have occurred is in its lower part, generally about 30 centimetres (about 12 inches) above the ileo coecal valve. In a few cases little can be seen but a localized hyperæmia, with swelling and softening of the mucous membrane, and in other cases the whole of the mucous membrane in this position may be found necrotic, and between these extreme conditions nearly every intermediate state may be found.

In a case of average severity for instance, the mucous membrane will be seen to be very hyperæmic, the arborescent distribution of the vessels being distinctly marked. The wall of the intestine feels thickened. If the disease is in an early stage the solitary glands will be often found exceedingly large, standing out above the level of the mucous membrane. But if the disease is in the later stages this will not be found. The Peyerian glands are generally also hyperplastic, and surrounded by a zone of intense hyperæmia. The mucous

membrane in some places is much more hyperæmic than in others, and if the disease is of some days standing hæmorrhage will often be found to have taken place in the substance of the membrane. We think this is not found before the fourth day, though some cases have been described as occurring earlier, but in these cases the process was probably of longer standing than the symptoms indicated.

The structural elements of the epithelial layer will be found swollen and cloudy, and often extremely granular. Later, many of them will have lost their contents, presenting an appearance like cup-cells, and there may be large tracts deprived of their epithelium altogether. But sometimes the process is more severe than this, and necrosis of the mucous membrane results, and irregular shaped ulcerations are found, often with a dark-red base formed by the site of a hæmorrhage. Sometimes this necrotic process is very extensive, even cases of perforation have been recorded.

There may be further changes still. In some cases a dense fibrinous membrane will be found lying on the mucous membrane. They may be quite separate from one another, with fluid between them, or they may be in contact, but separable, or the fibrinous membrane may be firmly attached and quite inseparable, having an almost diphtheritic character. We know of no case, however, where the Klebs-Löffler bacillus has been found.* We believe its occurrence in cholera to be much commoner than is usually supposed. In a very considerable number of cases, if the rice-water evacuations be carefully examined, there will be found to be present considerable pieces of this membrane. Surgeon-General Chevers was, we believe, the first to notice this condition. He states that in 1849, in Burmah, he observed

* "Ueber Choleraleichenbefunde," Von Dr. EUGEN FRAENKEL. *Deutsche Medicinische Wochenschrift*, No. 7, 1898.

an epidemic where "the congested mucous membrane was evenly coated by a strongly adherent croupous-like white exudation, nearly as thick as the intestine itself. From the inner surface of this, thin white processes floated convergently towards the axis of the canal into shreddy rice-water fluid. Clearly all passage through the inflamed gut had ceased sometime before death." We have seen several cases where the canal was so obstructed that no passage of fluid could have taken place.

In some cases when the disease is not soon fatal a more advanced condition than this may be found. The membrane remains attached to the mucous membrane and the intestinal wall becomes contracted and thickened.

CASE XIII.—M. R., a woman sixty years of age, was admitted into hospital with acute typical cholera. The dejections were coloured with blood. She had severe collapse, was treated with hypodermic saline injections, and the reaction was complete. The typhoid stage lasted eight days, the choleraic nephritis being severe. She then improved, but an intractable diarrhoea supervened. She became greatly emaciated and died exhausted at the end of the third week.

A portion of the lower part of the ileum was changed in the way described above. On examining it a firm fibrinous formation was on the surface of the intestinal wall, the epithelial and deeper layers of the mucous membrane had undergone necrosis, and no trace of them could be found. The intestinal wall was thickened and contracted, the ileum at this part being converted into a narrow, hard, rigid, scarcely compressible tube, and it was evident that it was quite incapable of performing its function sufficiently for the maintenance of life.

During the acute stages of cholera the ileum will generally

* "The Diseases of India," by NORMAN CHEEVERS, M.D. *London*, 1886.

be found filled with the white turbid alkaline fluid usually termed the rice water fluid. But sometimes very little liquid will be found, and then a creamy whitish material can be removed from the mucous surface. It is alkaline, rich in cells, occasionally red blood cells may be seen, and much granular protoplasmic matter, derived no doubt from the contents of the epithelial cells lining the intestine.

In the later stages of cholera, the contents of the ileum will be found generally stained of a greenish colour from the excessive secretion of bile. The mucous membrane will often be found pigmented in places, and the Peyerian glands also.

It has often been a subject of remark that so comparatively few intestinal epithelial cells are found in the discharges of cholera. But we do not think, on consideration, that it will be found strange. As we shall see in the kidney, when we come to speak about that organ, one of the great features of the cholera process is epithelial necrosis and the discharge of the protoplasmic contents of the cells. It is this granular protoplasmic matter that is present in the stools in cholera, but it would not be reasonable to expect that its exact origin should be indicated by its appearance.

One feature in the enteritis of cholera is its extreme irregularity. It cannot be said beforehand what its exact distribution will be. But many cases occurring in one epidemic will often have a striking resemblance to one another.

The cœcum is often the seat of changes similar in character to those in the ileum, but as a rule not so great in degree. The colon is also sometimes affected. Occasionally these parts may suffer very severely, even more severely than the ileum. Not unfrequently ulceration takes place in the cœcum, and this is usually the origin of the dysentery that follows cholera. The rectum may sometimes be affected also.

The peritoneum is greatly injected in cholera and varies

from a rosy tint to one of almost purple. It is usually covered with a glutinous sticky material even as late as the second week. The cells on the surface of the peritoneum are swollen, softened, easily removed, cloudy and granular in their contents. In very severe cases of cholera we have found some fluid in the peritoneal cavity with many crystals of chlorides and ammonio-magnesian phosphates, as if the cholera process could not be content with discharging these salts into the intestinal canal only.

The mesenteric glands are hyperplastic. During the first twenty-four hours not much change will be noticed. They then increase in size rapidly and reach their maximum about the seventh day, when they slowly begin to decrease again in size. On section a milky fluid can be expressed from them. The change in them is almost certainly secondary to that in the intestines.

The liver is usually in a state of considerable venous congestion. It is dark in colour, and a considerable quantity of thick blood escapes from it on section. The gall-bladder is usually full of bile, which does not during the acute cholera process usually enter the duodenum. If the cholera process is not very acute sometimes it may. But there does not seem ever to be any difficulty in the passage of the bile through the biliary duct. Not unfrequently in cholera the first evidence we get of the bile having re-entered the intestine is its appearance as a staining-matter in the vomit. It is undoubtedly a sign of good omen. On the other hand, the appearance of jaundice, which is rare, is one of the complications most to be dreaded. In the later stages, the gall-bladder will often be found full of extremely thin and watery bile. It is merely a free watery secretion of the liver, of the same nature that occurs in the urine at the same time.*

The kidneys in cholera are nearly always found to be the seat of extensive changes even when the disease has been

most rapidly fatal. They are always found extremely hyperæmic, in all parts from the cortical portion to the pyramidal. They are sometimes from this extreme congestion and from the epithelial changes nearly one third larger than normal. The vessels running between the tubes are seen to be greatly dilated and hæmorrhages are very usual. They may be seen in the mucous membrane of the pelves of the kidneys, in the pyramids, in the medullary portion of the kidneys and as stellate extravasations immediately beneath the capsule. The capsule is often rendered opaque. But the greatest changes are in the structure of the secreting tissue.

If the first urine passed after the return of the secretion in cholera, and a section of a kidney that has never regained its function be taken and examined microscopically the nature of the action of the cholera process on the kidney will be apparent. The urine will be found full of "cylinders" or casts of the renal tubes. In some cases where these casts are exceedingly numerous they will be found extremely hyaline so as to be detected only with difficulty, and a large number of them will be found to be so small in diameter that they must have been formed in tubes where the epithelium was swollen. Besides these cylinders there will be others larger and denser, and many of them will have in them the epithelium cells themselves though often much changed. So also in the section of a kidney affected by cholera, the lumen of the tubes will be found filled with protoplasmic material completely occluding it. In many of these cases the secreting substance of the kidney has been changed into an impermeable tissue, as thoroughly as if an injection of some obstructing material had been made by force through the ureter. The changes that are found in the kidney are very rapid in occurring. In the most rapidly fatal cases of cholera if the kidneys be examined the

epithelium in the tubes will be found swollen, cloudy, often without any defined outline and a protoplasmic formation beginning in the tube. Then the epithelium enlarges still more, sometimes to twice its normal size, it becomes granular, but the nucleus can generally be seen. Then fatty changes take place in the cells, and in the later stages of cholera, whole tubes will be found stripped of their epithelium. It is evident that the action of the cholera poison in the kidney is to cause epithelial necrosis. This explains a peculiarity of the cholera process that it would be hard to account for. One of the most characteristic features of the pathology of cholera is the great tendency that the saline matters of the blood have to pass out of the system. But they do not pass out at all by the kidneys. Dr. A. Crombie* was the first to point out that the first urine of cholera contains albumin with much indican but is almost entirely free from saline constituents. The explanation doubtless is that the special action of cholera poison on the kidneys is to produce the epithelial necrosis that we have described, and that though the most intense renal congestion occurs, the kidneys are quite incapable of action, and that when they do regain function there is scarcely any saline matter left for them to remove.

In the first urine passed in cholera there is then albumin, which we believe was first shown by Simon in 1832. There are renal cylinders, some very small and excessively hyaline, others large and dense, and quite waxy in aspect; others, again, containing renal epithelium, some in advanced degeneration. There may be white and red blood-cells.†

* "The Urine of Cholera," by A. CROMBIE, M.D. *Indian Annals of Medical Science*, vol. xvii.

† "Stoffwechseluntersuchungen bei Cholerakranken," von Dr. PAUL V. TERRAY, Dr. BERNARD VAS, and Dr. GEZA GABA, *Berliner Klinische Wochenschrift*, 20th March, 1893.

But there is a great diminution in sodium, calcium, and magnesium salts. There is indoxyl. Phenol and acetone are usually also to be found. Dr. Wyss* found indoxyl always present in the first urine of cholera, and the specific gravity varied from 1,013 to 1,020. In his researches he found the sodium chloride much diminished, and the urea sometimes, but not always so.

Pouchet† gives the following quantitative analysis of cholera urine:—Organic matter per litre, 34.062; urea, 26.216; sodium chloride, 1.60; total phosphoric acid, 1.638; sulphuric acid, 1.943.

Hoppe Seyler found the indoxyl reaction quite as strong in cases of cholera without the comma bacillus as in the cases of cholera in which they were present.

After the first urine has appeared, the secretion may again be suppressed, the illness thus terminating fatally as in Case VII. But more usually the flow of urine becomes considerably more copious than in health. Many litres may be passed in the twenty-four hours. This urine is of light colour, of low specific gravity. There is a fair amount of urea, of phosphoric acid and ammonia. The salts of sodium, calcium, and magnesium reappear.

Glycosuria has been occasionally a temporary sequela of cholera.

We do not know of any case where choleraic nephritis has given rise to chronic albuminuria, and we have never seen any case of cholera recover in which there was any reason to believe that chronic albuminuria previously existed.

* "Ueber die Beschaffenheit des Harns im Reactionstadium der Cholera Asiatica," von Dr. OSCAR WYSS. *Archiv der Heilkunde*, 9, 1868.

† "Sur les Modifications qui se produisent dans la composition chimique de certains humeurs sous l'influence du Choléra épidémique," par M. A. GABRIEL POUCHET. *Comptes Rendus*, 100, p. 362.

It is remarkable how rapidly and completely the urinary secretion is usually arrested in cholera. Supposing cholera to have commenced in the morning, which it frequently does, urine may be passed once shortly after the symptoms have commenced—which urine was probably secreted before the cholera process had begun, as it is sometimes free from albumin—but if the catheter be passed some hours after no urine will usually be found in the bladder. The bladder is usually found firmly contracted and empty in cholera, there may be hæmorrhages in its walls.

The uterus is congested, the mucous membrane swollen and hyperæmic, and the cavity often is full of blood. The vagina has often patches of inflammatory exudation on it.

The spleen is small and contracted during acute cholera, the trabeculæ prominent, and the capsule wrinkled. After the typhoid stage of cholera it may be hyperplastic.

The brain in cholera is often hyperæmic, and the puncta vasculosa fairly numerous. Sometimes the congestion is marked, the veins being full of blood. This is especially the case in the later stages of cholera, and particularly so in the uræmic form of cholera. But a very severe choleraic stupor may exist with no increase in the vascularity of the cerebrum or meninges. This we have often verified.

Sometimes a sub acute meningitis follows cholera as a late sequela.

The dejections of cholera have naturally attracted much attention, and much has been written about them. One of the best accounts is by Dr. Parkes,* who specially investigated the 1848-49 epidemic.

It may be remarked that the discharges are often not so copious as might have been expected. Fifteen to twenty

* "The Intestinal Discharges in Cholera," by E. A. PARKES, M.D. *London Journal of Medicine*, February, 1849.

stools in the twenty-four hours is, perhaps, above the average, but the later stools are not copious. We have paid much attention to this point, and are satisfied that 200 cubic centimetres would exceed the average of them. The stools are alkaline, generally strongly so; occasionally the alkalinity is not so marked. The specific gravity is about 1,010 in the characteristic cholera stool. In one of the dejections analysed by Dr. Parkes, the specific gravity was 1009.5, and in 1,000 grammes there were 989.13 of water and only 10.87 grammes of solids. Of these 10.87 grammes of solids, 1.18 was albumin, 0.55 of incoagulable organic matter and calcium phosphate. Soluble salts of sodium chloride and potassium chloride were 5.188 grammes, and phosphate of soda, 1.059. Other soluble salts, of which sodium sulphate and sodium carbonate formed part, were 2.893 grammes.

In another dejection, which was alkaline, with a specific gravity of 1008.3, the amount of water in 1,000 grammes was 989.17, with total solids 10.83 grammes. The coagulable organic matter was only 0.27 grammes. The incoagulable organic matter and insoluble salts were 2.23 grammes. The sodium chloride was 4.013 grammes, and the potassium chloride 0.791 grammes; sodium phosphate, 0.326; sodium sulphate, 0.487, and other soluble salts, 2.713 grammes.

It will, therefore, be seen that it is not the serum of the blood that passes off, but its water and its salts, especially its more soluble salts. It is the sodium chloride and potassium chloride that are removed most rapidly. In regard to the albumin, it is often* exceedingly small in quantity; but we have examined dejections in the later stages that contained much albumin.

Dr. Carl Schmidt has also directed special attention to the chemistry of the cholera process. He considers that the

* "Charakteristik der Epidemischen Cholera gegenüber verwandten Transsudations-anomalieen." Von CARL SCHMIDT. *Leipzig und Mitau*, 1850.

order in which the substances leave the blood is in the order in which they would naturally transude according to physical laws. The water naturally is separated in the greatest quantity at first, the inorganic solids afterwards, and then the organic solids. The chlorides pass away before the phosphates, and the salts of sodium before those of potassium.

There is generally in the cholera dejection a peculiar organic substance that gives a very characteristic red colouration, with nitric acid. The true cholera evacuation has also a most peculiar odour, though many authors deny this, but it is quite unmistakable in our opinion. It is not in the least faecal.

The later evacuations are copious, and generally of a dark green colour, from the biliary overflow that follows cholera.

The blood in cholera naturally gives evidence of the loss of fluid that it has sustained. It has been found in some cases to have as high a specific gravity as 1.081. It contains, therefore, a higher percentage of blood corpuscles; there is a great diminution of sodium and potassium chlorides; there is, a considerable excess of albumin. In the earlier stages of cholera the fibrin appears increased, but it is diminished later. The reason must be referred to hereafter. Schmidt found the oxygen in the blood corpuscles lessened by one-half. As the blood has lost such a large portion of its fluid it absorbs in its place from the tissues all the fluid it can appropriate, so that a general deprivation of tissues of their fluid occurs; a considerable addition to the albumin in the blood occurs from this cause. The tissues are therefore found in typical cases of cholera extraordinarily free from fluid.

It has been stated that hæmorrhages are apt to occur in the tissues in cholera. Sometimes they are very widely distributed. They are, as has been stated, seen usually in the intestines, in the heart, and the kidneys, but they may be found nearly everywhere. We have seen them in the muscles, and even in the courses of the great nerves, such as the

sciatic. We think they are not found early in the disease, and that they are almost exclusively confined to those cases in which there has been a well-marked collapse.

From the symptoms, combined* with the pathological appearances, it may be deduced that cholera is a specific disease, attended with a special enteritis, and complicated with certain other conditions, especially a particular form of nephritis. It was pointed out, in describing the symptoms of the disease, that the conditions together forming cholera do not always bear the same proportion to one another. A very severe and fatal nephritis may exist without the symptoms arising from the alimentary tract being unduly severe, and we have seen also that the cerebral symptoms may be out of all proportion to the others. It is, we think, exceedingly useful to distinguish between the different forms of cholera that present themselves.

That form of cholera in which all the stages are represented, that is, in which there is an evacuation stage followed by severe collapse with its attendant symptoms, and afterwards by reaction and a typhoid stage, is best known as *typical cholera*. When the symptoms of cholera rapidly and fatally end in a sudden and great elevation of temperature it is *hyperthermic cholera*. When the urinary affection is the chief morbid condition, and causes the most anxiety, it is *uræmic cholera*. When the symptoms of evacuation are severe, and the urinary secretion is affected, but through properly directed treatment or other causes the symptoms develop no further, it is, following Liebermeister's example in typhoid fever, *abortive cholera*. When the alvine evacuations are stained with blood early in the disease it is *dysenteric cholera*. This is, of course, totally different from the dysentery that occurs *after* cholera, and is only a sequela. Dysenteric cholera signifies that the enteritis is unusually

severe, and the after condition due to it is very dangerous to life. The form of cholera that is without the usual characteristics, in which the evacuation stage is absent or scarcely noticeable, and in which there is no collapse with its pulse failure and dyspnœa, but which may yet lead to the most serious consequences, a condition that is often combined with much stupor, is *typhoid cholera*, from its resemblance to that disease. In this condition the enteritis is quite as severe and of the same kind as in typical cholera, but the stupor is generally a very prominent symptom, but there is not the slightest appearance of the patient having lost any portion of the fluids of his tissues. It is, therefore, quite distinct from the typhoid stage of ordinary cholera. The symptoms described at Case VIII. give a fair idea of this form of Asiatic cholera. In addition, we have the form of *cholera with imperfect reaction* mentioned in speaking of the symptoms.

There is, it must be confessed, a great resemblance between cholera and typhoid fever: both have intestinal lesions, and in both the aspect of the patient is often strikingly similar, and both have their ultimate origin in the objectionable habit acquired by man of polluting his drinking water with his *dejecta*—a habit he has adopted partly through laziness and from difficulties arising from religious and caste prejudices—which cannot be entered upon fully here—as in the East, and partly from a desire to avoid expense, as in the West. It is so cheap, as its defenders always say, to mix these matters with water and trickle them over a field—the so-called sewage farm—and then let them run into a neighbouring river, where they only incommode the people living further down. Oxford and Reading, and several other towns, are not likely to protest against a system so cheap to themselves and only nasty to others; in fact, they and the water companies never have any difficulty in getting evidence to show how healthy the system is. Nor

does Hertford object to East London drinking sewage water, and is, in fact, indignant when it does protest against it; and the five thousand victims of the cholera of 1866, who lie in the neighbouring cemeteries, naturally make no sign.

But the resemblance between the two diseases does not end here. In both the diseases may terminate without going through the full process, as in the abortive forms; and in both there is the "ambulatory" form; and in both there may be a true relapse—the symptoms and process are gone through a second time by the same patient. As in cholera, it is certain that this may happen through a re-infection taking place; it is probable that the same is the cause of a relapse in typhoid fever, and as both have uncertain periods of incubation it is likely that the secondary infection may sometimes take place actually during the period of incubation. In cholera, moreover, the kidneys are affected; and in typhoid fever, there is a form with acute nephritis—the nephro-typhus of German authors.

Again, we shall have to point out more fully hereafter how much more resistant to cholera the natives of Bengal are than the inhabitants of the rest of India; and Dr. Crombie, whose opinion on this point is of the highest value, has stated that he doubts if the Bengali is susceptible to typhoid fever at all.*

So strikingly similar are the two diseases in many respects, that one might almost be tempted to think it probable that typhoid fever is the long isolated, much modified descendant of some pre-historic epidemic of cholera brought from the East by Phœnician ships in their voyages for the metals of the West to the distant Cassiterides.

Moreover, should cholera become endemic in Europe, it will almost certainly be in the typhoid form, so often does it assume that type already.

* See *Indian Medical Gazette*, May 1893.

But it cannot be too strongly insisted on that the diseases, though so similar, are perfectly distinct. The intestinal lesions of cholera are completely different from those of typhoid fever; moreover, typhoid fever is no protection whatever from cholera. We have repeatedly known sufferers from typhoid fever take cholera and die, and the lesions of typhoid fever were thus found to co-exist with those of cholera. It is because we believe that the diseases cannot be confounded that we think it safe to use the term typhoid cholera.

It is remarkable that though typical cholera can and does give rise to typhoid cholera, typhoid cholera does not appear capable of giving rise to typical cholera. We have often seen typical cholera of a most severe form, that was distressing to witness, with a great mortality from collapse, become so modified that nearly all the classical features were absent, but still causing a heavy mortality; but when it had reached that form it did not again give rise to the disease in its typical form. The change could, therefore, not have been due to mere personal peculiarities on the part of the patients, but must have had its origin in an alteration of the poison itself.

Hyperthermic cholera also, which is a very deadly form, is exceedingly common in some epidemics, and we have seen more than one epidemic without a single case. But on one occasion, in Europe, in a small town, nearly every case was of this type, and the mortality was very great. Its earliest sign is a high internal temperature. If the temperature at the beginning of reaction of cholera in the rectum is much above 39°C . (for instance $39^{\circ}\cdot 5\text{ C}$. $103^{\circ}\cdot 1\text{ F}$.) it may be suspected that it will rise higher, the case terminating fatally. In many of these cases the external temperature does not rise to 40°C . (104°F .) and yet they are very fatal. We think it never occurs when the internal temperature is low during the disease, and many cases of very low internal temperature have been recorded.

Usually, in an epidemic, there is a great tendency for the cases to assume one form—there is one type predominating. In the Hamburg epidemic of 1892 for instance, the most noticeable feature in the disease was the general lowness of temperature, and the rareness of high temperature even in the typhoid state. The temperature usually rose to above normal soon after reaction occurred, perhaps to $38^{\circ}9$ C. (102° F.) and then fell to a sub-normal level. In one case we saw the temperature remained under 36° C. ($96^{\circ}8$ F.) for three weeks. The patient ultimately died. On the morning of the day of the patient's death the surface temperature was $33^{\circ}5$ C. ($92^{\circ}3$ F.), and the internal temperature in the rectum $34^{\circ}1$ C. ($93^{\circ}38$ F.). This was, of course, an extreme case. It was a marked example of imperfect reaction.

It is in typical cholera that the symptoms are most conspicuously shown, and where the pathology of the disease is studied to the best advantage. Cholera in its most complete form is a specific enteritis accompanied by a special nephritis, and certain other conditions. From the facts that the enteritis generally requires a considerable period of incubation for its development, and that it is most irregular in its distribution, and also that the glandular structures suffer earlier and more severely than the rest of the intestine, it is probably not caused by the direct contact of the poison, but is secondary to its absorption into the system. The diarrhoea and vomiting are usually the first things that attract attention. It is not known whether the vomiting is due to direct irritation of the stomach, or whether it is of central origin. The stomach is sometimes inflamed, but is not always so, and sometimes the singultus after cholera is distressing, which cannot fail to be of secondary origin.

The stupor of cholera appears also often to be a direct effect of the poison. It comes on frequently exceedingly early in

the disease, when the face is not in the least choleraic. In discussing the symptoms of cholera a characteristic case of this was given.

But it is in collapse that the most striking features of cholera are seen. We have the rapid fall of temperature, the altered countenance, the sunken eyes, the loss of pulse in the radial artery, and very often in the brachial also, the difficulty in breathing, and the blue colouration of the skin. But there is one peculiarity about collapse which is often very striking, and that is the rapidity with which it comes on. A few minutes suffice to convert an apparently mild case of cholera into one of almost hopeless gravity. Sometimes, while one is standing by the bedside, the skin changes colour, the pulse fails, and the dyspnoea comes on. It can be seen at once that a serious change has occurred in the condition of the patient. What, then, is the nature of this change? If, during a severe case of cholera presenting all the characteristics of the disease in an acute form, careful attention be directed to the chest, especially the heart, some phenomena will be observed that will throw light on the nature of the process of collapse. Up to the time of its occurrence no change of great importance will be detected in the functions of the heart and lungs, but differences will usually be noted directly after. To investigate thoroughly these changes, the condition of the heart and lungs must be constantly kept under observation in a large number of cases from the beginning to the end of the disease; for it is only by contrasting what is seen in many cases that a just idea can be formed of what is taking place, for it is rare for one case only to present all the phenomena that may be observed in this state.

If the heart be examined during the approach of collapse, a change in the nature of the sounds will be heard; they no longer present the sharp, clear sounds of healthy action, but they become dull, prolonged, and faint. The first sound is

especially affected, sometimes becoming inaudible. But after collapse has occurred the changes are greater. In some cases a murmur, sometimes systolic, will suddenly develop almost while we are listening. This will be heard over the front of the heart, being often loudest over the right part of the sternum, on a level with the fourth rib, but it cannot be heard, or only very faintly, at the apex. Sometimes the murmur, or murmurs, will be loudest at the junction of the third left rib with the sternum. Sometimes a loud, unmistakable friction sound, sometimes a double one, will occur, occupying nearly the whole time of the action of the heart. Sometimes the friction sound may be very faint, and can only be heard immediately before the first sound; or it may be more difficult to detect than this, only occurring just before the first sound, and only then when it corresponds with the latter portion of *expiration*. In fact, the differences are very great between the various cases, and there is no regular sound characteristic of collapse. But the singular thing is that they change from hour to hour, and almost from minute to minute. A loud murmur will vanish, and its place be taken by a friction sound, or *vice versa*. In the most acute stage of collapse the heart-sounds, both normal and abnormal, will often completely disappear, with the exception of a very faint second sound, heard to the right of the sternum at the level of the interspace between the second and third ribs, and arising no doubt from the aortic valves. Then, as collapse gives place to reaction, often murmurs or friction sounds will reappear, again in their turn to vanish and be replaced by the normal sounds of the heart.

These sounds which we have been describing are heard best over the front of the heart. A very usual place is over the sternum, on a level with the fourth rib. Another site, as we have said, is the third rib just where it joins the sternum. But these murmurs and friction sounds can rarely be heard at the apex, or to the left of the heart. Their cause must, there-

fore, be in the right cavities of the heart. Yet, should a fatal result follow rapidly in one of these cases, the most careful examination will fail to detect any trace of either endocarditis or pericarditis.

The sounds must be due to some cause of a fugitive or temporary nature, and if the heart be examined in a case which has been rapidly fatal at the period when these phenomena have been well marked, there will remain not much doubt as to what the cause is. The right side of the heart will be found filled with a large thrombus.

CASE XIV.—P.M., a boy ten years of age, was quite well up to 10 a.m. on the morning of the 28th August, 1886; after this he vomited twice and had four scanty dejections.

August 28th.—1 p.m. He is lying in bed in a condition of stupor from which he can be roused to answer questions, he moans occasionally and tosses himself about from side to side restlessly, sometimes starting up in bed crying for air; eyes slightly sunken; skin, breath, and tongue feel cool; surface of body intensely blue—we never saw a human being so blue; no large quantity of fluid in the abdomen. Respirations 50, temperature $35^{\circ}\cdot6$ C. (96° F.). No pulse in wrist or brachial artery. On listening to the heart no recognisable normal sound can be distinguished, instead a confused churning sound is all that can be heard, and there is a harsh friction sound with it.

He gradually grew worse, was unable to swallow or to speak, and died at 7 o'clock in the evening of the same day.

At the autopsy no change was found either in the pericardium or endocardium, the valves of the heart were quite normal, but a large coagulum of a white colour—some parts of it, however, having the red corpuscles of the blood in it—filled the right cavities of the heart and passed into the pulmonary

artery. The intestines showed severe lesions of Asiatic cholera in a very early stage.

We must remark on this case, further, that it was a very acute form of cholera; in three hours from being in perfect health, the patient was reduced to a state without hope, but the diarrhoea in this case certainly was not extreme. Another point of interest is that the stupor came on as rapidly as the disease itself, and the condition of the intestines showed the cholera process had only just commenced, so that the stupor was in no degree secondary to the enteritis, and therefore must be attributed to the cholera-poison itself. The little boy was under the constant observation of his parents, who were very much attached to him, and who were very intelligent, and he was also under unintermitting medical care, so that the history is quite free from doubt.

In this case, then, the phenomena were very well seen. We have an acute case of cholera, producing the most severe symptoms in less than three hours. There is the most violent dyspnoea, and though the heart could be felt acting tumultuously, not the least pulse was to be felt in the brachial artery. On listening to the heart, no normal sound could be heard, but it was exactly as if some solid body was being churned up with fluid, and there was a loud friction sound. The patient died in this state, and yet there was not the slightest trace of pericarditis or endocarditis, but the right side of the heart was occupied by a thrombus, which must have given rise to the symptoms and physical signs. We believe, from many observations, that the thrombus begins to form in the right auricle, close to the entrance of the inferior vena cava; it then passes into the right ventricle, and especially clings to the tendinous structures of the tricuspid valve. As it increases, it fills the cavity of the ventricle and passes through the semilunar valves into the pulmonary artery, and, in one case where there was a systolic murmur of very

great loudness, a tangled skein of fibrin, that could only have been formed from blood in movement, went into the divisions of the pulmonary artery. It is the interference by the thrombosis with the action of the valves that gives origin to the murmurs, and the friction-sounds are due to the contact of the walls of the heart during its action with the contained thrombus. It is corroborative of this, that in some less severe cases the friction-sound may be only heard at the end of *expiration* and immediately before the first sound; and this is also evidence that the thrombosis usually begins in the auricle, for the walls of the ventricle are too thick to allow of the slight pressure of expiration to appreciably increase the pressure on the thrombus; but, on the other hand, the comparatively thin walls of the auricle would easily allow this to happen.

We have thus the explanation of how it is that the pulse fails suddenly; the patient becomes cyanosed and often dies of suffocation though the air enters the lungs freely. The cause is a physical one: the little fluid that remains in the vascular system has difficulty in reaching the lungs. Sudden death that so frequently occurs in collapse is due to the displacement of the clot by movement occluding completely the entrance of blood to the lungs at all. Sometimes the condition of thrombosis will be found to exist in the very branches of the pulmonary artery. It is not to be wondered at that the mortality during the stage of collapse in cholera is great.

The position of the thrombus in the auricle is also unfavourable to the patient, as it interferes with the return of the blood by the inferior vena cava. Thus, the little blood that there is in the body has a difficulty interposed in its way from the abdomen. This is a condition that is favourable to the continuance of the diarrhoea. Thus, in a body nearly deprived of blood we find, in cholera, often a venous congestion of the liver.

But though this thrombosis may be so complete as to interfere most seriously with the action of the cardiac valves, and so deranges the action of the heart as to prevent in some cases the heart sounds being heard at all, yet often in a few short hours the natural sounds of the heart will return and all the serious symptoms vanish. What has happened? The thrombus has completely liquefied. The clinical evidence of this is conclusive.

CASE XV.—E. S., a young man, eighteen years of age, was seized with cholera on the morning of August 25th. He had diarrhoea, vomiting, and cramps.

On the 26th August he was much worse. In the evening he was pulseless, cyanosed, and suffered much from dyspnoea. Respirations, 48; temperature, $37^{\circ}\cdot1$ C. ($98^{\circ}\cdot78$ F.). The first sound of the heart is preceded by a very soft murmur. The second sound is fairly clear.

August 27th.—Has had four dejections during the night, and is still in profound collapse. No pulse in radial or brachial artery. Much dyspnoea. Respirations, 36; temperature, 36° C. ($97^{\circ}\cdot8$ F.). In place of the soft murmur of last night is a loud, ringing systolic murmur, of astonishing loudness, heard over the front of heart, but comparatively faint at the apex.

In evening, 9 p.m.—Is better. Respirations, 28; temperature, $36^{\circ}\cdot2$ C. ($97^{\circ}\cdot16$ F.); pulse, 108, of fair strength in the radial artery. Dyspnoea ceased. The heart-sounds are normal. No murmur. The first sound of the heart is, however, weak.

August 28th.—Better. Pulse, 88; temperature, $36^{\circ}\cdot4$ C. ($97^{\circ}\cdot5$ F.); respirations, 36.

The heart-sounds never became abnormal again, but he ultimately died of pulmonary oedema in the typhoid stage of cholera on August 30th.

In this case during collapse the heart-sounds gave the

clearest evidence of a contained thrombus. At midday on the 27th August there was present a murmur of extreme loudness, accompanied by distressing dyspnoea, and all the signs of profound collapse. By the evening that murmur had entirely vanished, and with it all the symptoms of collapse. The dyspnoea disappeared, and a pulse of fair strength was perceptible at the wrist. Exactly as the thrombus liquefies so do the symptoms of collapse disappear. The clinical evidence is complete. The whole process may be watched repeatedly in the course of one day during a severe epidemic. Sometimes an almost complete silence will shroud the heart's action, then murmurs due to the softening thrombus will be heard, and, as it passes into a condition of solution, the normal sounds of the heart will again be audible; and exactly as this takes place, the cyanosis disappears, the dyspnoea is abolished, and the pulse is re-established, as in this case. It is naturally rare for a patient to die in the stage of reaction, for it is a condition extremely favourable to life; but sometimes it does happen, and in these cases may sometimes be seen infarcts in the lungs, caused clearly by fragments of the softened thrombus. These infarcts, having nothing septic in their origin, do not give rise to suppuration, the circulation is very soon resumed in the part affected, and should the patient live but a day or two after reaction, no trace of their occurrence will then be found.

The cause of the formation of the thrombus is probably not simple. The inspissation of the blood plays probably only a subordinate part in it, for sometimes it occurs with great rapidity, as in Case XIV., where the patient showed scarcely any sign of loss of the fluid of his tissues. That inspissation of the blood takes some part in producing certain of the phenomena of cholera there can be no doubt, but in the cases we are now considering the process is a true coagulation. In cholera the white corpuscles of the blood are increased in

numbers—an observation first made by Professor Virchow in 1848*; in addition, many "*Blutplättchen*," also granular protoplasmic bodies, probably derived from the leucocytes, are to be seen.

Now, whatever view may be taken of that most intricate subject, the coagulation of the blood, most observers agree that, under some conditions, a zymotic substance is necessary for the formation of fibrin, and the general view is that the leucocytes in some way furnish that ferment. What occurs in cholera undoubtedly strengthens that view, and it is probable that the cause of the thrombosis exists in some changes engendered in the leucocytes or their derivatives by the cholera poison. The observations made in regard to the intravascular coagulation of the blood by the injection of nucleo-albumin† add further evidence of the correctness of this view, and throw much light on what is probably the nature of the chemical changes produced on the blood by the cholera process.

So the liquefaction of the thrombus may be due to the pathological nature of the ferment that produced it. It is not stable. It is very remarkable the rapidity with which it takes place in some cases.

The evidence seems, therefore, to point to the changes being due chiefly to a chemical effect on the blood of the cholera poison, and it is of high interest in this connection to observe that in some cases of Asiatic cholera, as far as can be judged by the physical signs and clinical evidence, the process of formation of a thrombus is completely absent.

* "*Gesammelte Abhandlungen aus den Gebiete der öffentlichen Medicin und der Seuchenlehre*," von R. VIRCHOW. Band I. *Berlin*, 1879, p. 132.

† See the Gulstonian Lectures on the Chemical Physiology of the Animal Cell, by W. D. HALLIBURTON, M.D., F.R.S. *Lancet*, March 11th, 18th, and 25th, 1898.

Evidence also exists in the thrombus itself that it is due to the effect of the poison in the blood, for it varies extremely in appearance in different cases. Now we know that cholera poison differs very widely in its action, and it is to be expected it would also vary much in its effect on the blood. Some of the thrombi are so exceedingly firm that they almost resemble permanent tissue. In other cases they are loose and insubstantial, and contain a full proportion of red blood cells, as if the poison could not effect thoroughly the change necessary. In some cases an idea can be formed from the physical signs of the nature of the thrombus. In the natives of India that die during collapse the thrombus is particularly well marked.

In the cases of cholera that are described as of imperfect reaction, in some of them it can be demonstrated by the stethoscope that a thrombus still exists in the cardiac cavities, giving rise after many days to intra-cardiac friction sounds.

The heart, then, plays a very important part in the production of the symptoms of cholera, and it is easily understood how the great mortality during the collapse of cholera is caused. We have thrombosis actually occurring in the centre of the circulation, obstructing the blood, entering the lungs, and at the same time retarding the return of the blood from the abdomen, and so aiding the occurrence of diarrhoea. We next have the thrombus liquefying, and during this process it may be carried so as to completely occlude the entrance to the lungs, causing thus sudden death. As a rule the solution of the thrombus occurs quickly and completely, but it is not always so, we have heard distinct friction sounds four or five days after the collapse had passed off, and we have found occasionally hard bands of fibrin in persons who have died of some sequela. Dr. Bristowe* has published a case proving that the heart's

* Pathological Society's Transactions, Vol. XXXVII., 1886.

cavities may contain a large thrombus and yet give rise to no condition that can be discoverable during life. But in the majority of cases the liquefaction is quickly and completely effected.

The sounds of the heart are, therefore, a most valuable aid to the diagnosis of cholera. At the approach of collapse the sounds entirely change in character, though there may be no murmur, they completely lose the sharp clear characters of the normal sounds, and become dull, feeble, and prolonged, in fact, they have quite a special character, which can, after a little practice, be recognised with certainty. The auscultation of the heart should, therefore, never be neglected in cholera, as it affords most valuable information both of the character of the disease, and the progress it is making.

When once cardiac thrombosis has occurred in cholera to such an extent that it is evident by physical diagnosis, the recovery from cholera is never very rapid. The typhoid state appears often to be very much in proportion to it. When the thrombus has liquefied recently it is rare to find any distinct coagulum in the vascular system. The blood is not unusually thick and tarry, and that is usually the extent to which the blood can approach coagulation after the process of thrombosis and liquefaction has been gone through; but, generally, the blood is found quite liquid. But in a few days after the blood will often be found to have recovered its power of coagulation to a great extent.

In speaking of the symptoms of cholera we also gave the chief sequelæ, and it will have been noticed that these sequelæ generally consisted of sub-acute inflammations of fibrous and serous structures. Now, though the different symptoms of cholera are not always present in the same degree, it is unusual for sequelæ to occur after cholera unless the disease has been severe, and especially for the collapse to have been marked. It is, therefore, probable that there is a direct con-

nection between the consequences of collapse and the special nature of the diseases which occur as sequelæ.

In regard to the pathology of typhoid cholera we need not say very much. The enteritis is of precisely the same kind as in typical cholera. From the condition of the ileum it would not be possible to say from which form the patient suffered. But, usually, in this type of cholera the enteritis is exceedingly severe, and often very extensive. We have thought that the patients complain of pains lower down in the abdomen than in the other forms of cholera, for frequently in the other types the pain is not uncommonly referred to the pit of the stomach, though the patients may also complain of pains elsewhere. But patients will be found occasionally in both types who do not seem to have any noticeable degree of pain at all.

It is well to mention here that malarial fever of a severe type sometimes assumes a superficial resemblance to cholera. A very good example is that given by Dr. W. H. Rean, who was chief medical officer at the Andaman Islands. He states:—"The cases to which I refer happened in some patients who came under treatment at the end of the year, and had peculiar features which gave them a great resemblance to cholera. The patients were generally admitted from some very feverish locality, or had been employed in works of an unhealthy character. They were taken ill somewhat suddenly; the most urgent symptoms being frequent purging and vomiting, with great prostration. The alvine evacuations bear a resemblance to curds mixed with bloody serum, and the vomited matters were a light-coloured watery fluid; the countenance pinched, voice hoarse and husky, tongue pale and breath cold, the extremities of the fingers and toes puckered, pulse not perceptible, and the surface of the body cold and clammy. The patients suffered from cramps of the stomach and extremities, and had great thirst; respiration

was much restrained, causing extreme anxiety and a presentiment of approaching death; in most cases the urinary secretion was suspended. The only diagnostic sign to distinguish the disease from cholera was the character of the stools; and they sometimes approached the conjee-like character of choleraic evacuation. Until I had seen one of the patient's stools I could in no way distinguish the disease from cholera, and had a patient died without passing any evacuation, I should have unhesitatingly ascribed the death to spasmodic cholera. After a few cases had come under observation, the nature of the disease was clear; in fact, the rapid recovery of the patients (for only a few died) soon averted the attention and dispelled any misgiving I had about the character of the complaint. There are scarcely any marked stages in this type of fever as in the other varieties of the disease. It begins with the phenomena of collapse, and ends in reaction or death; it is marked by continued cold till reaction sets in and brings warmth to the skin and force to the pulse, which may determine severe head symptoms, or a critical sweat may restore the patient to convalescence. The reaction from this type of fever bears a complete analogy to the same condition in cholera. There appears to be no relapse—the patient gradually recovers from the great debility induced, and returns to his occupation. It is not contagious. The treatment should be prompt and active; first to restore the heat and combat the asthenic character of the disease by hot fomentation, rubefacients, and diffusible stimulants, control the vomiting by effervescing drinks or other means, and check the purging by opiate and emollient injections and astringents, and, as soon as possible, give quinine in moderate doses, to be frequently repeated.”*

* “Medical and Sanitary Report on the Settlements of Port Blair, Andamans, 1870,” by W. H. REAN, M.D., Senior Medical Officer, Port Blair.

The mimicry between the two diseases is very close, but it will be seen the premonitory symptoms that usually form such a marked feature in cholera were completely absent, and the sufferer from cholera does not obtain any relief from quinine.

Cholera seems to afford no protection from another attack. This appears to be the case from two circumstances. Not infrequently when the cholera process is nearly over a relapse will occur, and the patient will go back to his previous condition, and will have a recurrence of the earlier symptoms again. But sometimes it goes farther than this. A patient will have cholera, and completely recover, and resume his ordinary mode of life. In a short time, it may be for instance a fortnight or three weeks afterwards, a re-infection having occurred, he will go through the whole course of the disease again in the usual way. This has been known to occur three times. It would appear improbable, therefore, that any mode of inoculation would confer an immunity which cannot be conferred by the actual disease itself. Dr. Haffkine argues that it would, but it must rest with him to show how a condition produced by an artificial culture can possibly surpass in protective power an attack of the natural disease. Most persons will admit that the vaccine disease, though affording a protection of exceeding value, is inferior to a previous attack of variola, as a means of procuring immunity.

We have seen that cholera and typhoid fever can exist together, but there is another constitutional disease that seems to some extent to be a protection from cholera, and that is recent tuberculosis. It is true that in Hamburg in one series of cases seventeen per cent were said to be tubercular, but we believe that many of them were chronic. But in unhealthy towns, which Hamburg undoubtedly is, seventeen per cent. is not a large percentage for tuberculosis. In Buda-Pest some form of tuberculosis will be found in sixty per cent. of all

cases. But in 92 consecutive cases of cholera, tubercular lesions were only found in two, or a little over 2 per cent. We are much indebted to Dr. Nékám, of the University of Budapest, for examining for us the statistics of all the cases that brought out this interesting fact, to which we must return in speaking of the treatment of cholera.

From what has preceded we can gather how very complex a condition the cholera process is. First, in regard to the diarrhoea, it may be so severe as to completely change the aspect of the patient in a few hours, and to deprive his tissues so utterly of their fluid that life is in the utmost peril from this cause alone; or the diarrhoea may be so slight as scarcely to be recognised as such by the patient himself, and producing on him by itself no effect whatever. Then there is the enteritis, which may be so severe as to destroy life even without the secondary processes to which it gives rise, or it may be so slight as scarcely to attract the attention of anyone who happens casually to be present at the autopsy. Then the diarrhoea and the enteritis are independent of one another. A severe enteritis may exist with a slight diarrhoea, and a most severe diarrhoea with slight enteritis. This will naturally give rise to the idea that the diarrhoea is often the direct effect of the poison in the blood, and is not merely secondary to the enteritis; a position that is rendered probable by the extreme rapidity with which choleraic nephritis is set up by the same cause. In corroboration of this view, also, it may be remarked that it has been frequently noticed that, whereas sometimes the choleraic diarrhoea is extremely tractable, yielding readily to remedies, in other cases—treated in the same way and at the earliest possible period—it is quite intractable, the patient passing without delay into the later stages of the disease.

So it must be remarked in typical forms of cholera

when treated with intravenous injections, in some of them the recovery is rapid directly the condition which caused some of the more serious symptoms is relieved, being only followed by a very mild typhoid state. In other cases treated exactly in the same way, and where the symptoms are by no means more severe, a most serious constitutional disease follows.

Then we have the special changes in the blood causing the corresponding acute symptoms. The nephritis itself may be slight, causing little more than a passing albuminuria, or it may be of extreme severity, being not infrequently the cause of the fatal result. In the later stages of cholera the diversity is not less. We may have induced, by a rapid elevation of temperature, a sudden death. Or a special form of nerve poisoning may show itself, causing death in coma without any special elevation of temperature. But more frequently there are the complex phenomena of the typhoid state, sometimes with a febrile condition and sometimes without. Then there are the fatal conditions of cholo-uræmia and the severe secondary complications to which the cholera process gives rise.

Cases of Asiatic Cholera differ, then, very widely from one another, and the question, therefore, naturally arises:—Is not more than one disease included in the term Asiatic Cholera? It is extremely difficult to frame an answer to this. On the one hand we have the symptoms in various cases differing so greatly, and on the other the fact that the lesions of cholera are well marked, and characteristic, and by examining them it is not possible to say from which form of cholera the patient suffered. Thus a most severe choleraic enteritis may be found after typical cholera, and an equally severe one after only the typhoid form. It cannot, therefore, at present be said that a firm basis for a distinction exists. But we think, for clinical purposes the division of cholera into typical cholera, hyperthermic cholera, uræmic cholera, abortive cholera, dysenteric

cholera, typhoid cholera, and cholera with imperfect reaction, useful. But it will be advantageous to go beyond this, and provisionally to group the various forms of cholera into three classes :—

(1) That form in which the diarrhoea with its consequences is the most prominent feature, the constitutional effects not being severe, the nephritis being the chief.

(2) That in which the diarrhoea is severe, but the constitutional effects are also very serious, as in typical cholera.

(3) That form in which the diarrhoea is not marked, and its results not perceptible, but in which the choleraic lesions are severe, and the consequences of them *gravo*.

Though it is quite easy in different epidemics to find typical cases corresponding to each of these forms, the real difficulty arises from the many cases that present intermediate types. But it will be noticed that if one of these forms occurs there will be a tendency for the disease generally to assume, for a time at any rate, that form.

CHAPTER V.

THE TREATMENT OF ASIATIC CHOLERA.

THERE is, unfortunately, no specific for cholera. Its treatment must, therefore, depend not so much on the nature of the disease as on the condition of the patient; so that the most careful study of this is requisite, in order to adopt the mode of treatment that is most likely to be beneficial. It must be borne in mind that, as the progress of cholera is most rapid, even a few minutes may convert a case of no great severity into one that is almost hopeless—and sudden death is nowhere so frequently seen as in the cholera hospital—the physician must have in his mind most clearly laid down the principles of treatment, so as to be able to apply them at once. There is no time for deliberation or consultation, and still less for waiting to see what course the disease will take. What has to be done must be done at once. In the cholera hospital, more even than in any other hospital, must every contingency be prepared for; the delay of a few minutes in making ready a mode of treatment may cost a life.

In the premonitory stage, and in the stage of diarrhoea and vomiting, it is imperative to do the utmost to arrest these evacuations as soon as possible. No point in medicine can be better established than the urgency that exists for arresting the diarrhoea and vomiting at the earliest possible moment. In the earliest stages, if the evacuations can be stopped, the course of the disease is often stopped also. On this subject the evidence is overwhelming. We have met with no physician with a large practical acquaintance with cholera who has not thoroughly endorsed this view. The “elimination of the poison” by purgatives is a purely theoretical line of treatment,

that can be proved to be most deadly in practice. Castor-oil and calomel are highly injurious, but even more fatal are the saline purgatives, which, if administered during cholera epidemics, seem almost of themselves capable of producing the disease. In India, sulphate of magnesia has a peculiarly evil reputation; but all purgatives are highly dangerous. It is exceedingly to be regretted that in some instructions recently issued for the treatment of cholera, it has been suggested that aperients might be used in the earlier stages of the suspected disease. Nothing more dangerous could have been advised. Not only are aperients hurtful, but even substances causing but comparatively little irritation to the intestinal tract in ordinary times, will aggravate an apparently innocuous diarrhoea into a deadly form of cholera. This we have seen so often that it would be impossible to exaggerate the amount of danger incurred by acting in this way. Not only must purgatives be avoided in cholera, but the greatest care must be taken to prevent any substance entering the intestinal tract that could by any possibility produce irritation.

In the earliest stage of cholera, then, and whilst the diarrhoea exists, we must endeavour to allay the irritation of the alimentary canal, and to arrest the discharges from it. Sedatives and astringents are most valuable in this stage, especially tannic acid, kino, catechu, opium, ether, chloroform, and dilute sulphuric acid.

The following formula has proved itself very often to be of the greatest value in the early stage of Asiatic cholera —

Tinct. Opii. m. xii.

Tinct. Lavandulæ Co. m. xxx.

Sp. Æth. Co. m. xx.

Acidi Sulphurici dil. m. x.

Aquæ, ozj.

To be taken as soon after the symptoms occur as possible, and to be repeated, if necessary, in two hours.

In a considerable number of cases this will arrest the symptoms very speedily.

The astringent pills, composed of opium and aromatics, distributed by the Governments in India during cholera epidemics, are most valuable, and have saved many lives. They consist of opium, assafoetida, and black pepper, without, or better with, camphor. In districts far away from civilized centres, amongst a scattered and remote population, they are in the highest degree useful, as they are conveniently carried and easily administered; but the difficulty of absorption greatly diminishes their usefulness in cases that have gone beyond the very first stage. The remedies employed in cholera should, on account of the difficulty of absorption, be, as far as possible, always administered in a liquid form.

Unfortunately, in cholera vomiting is apt to occur very early, and is often very violent, and it then becomes evident that the administration of remedies by the mouth must be useless, for they will only be rejected, and if not rejected, will fail to be absorbed. The treatment must then be adopted to these altered circumstances.

When the disease has declared itself to be cholera, the greatest care must be taken to place the patient in as favourable circumstances as possible for recovery. If conveyed to a cholera hospital he must be taken *at once*. There must not be the delay of a minute beyond what is necessary, and during the transit he should be kept in a horizontal posture. He should be placed as soon as possible in bed, and kept absolutely quiet, and on no account should he be allowed to rise from his bed. He should be warmly covered also. Both movement and chills to the surface tend to increase the diarrhoea.

Vomiting, as we have said, soon occurs, and is often excessively severe, and adds considerable difficulty to the treatment. It is evident that remedies taken by the mouth must

be almost useless. The treatment must therefore be suited to this change in the state of the patient. We believe that, under these conditions, no remedy is so valuable as the hypodermic injection of opium. It must, of course, be an aqueous preparation that is used. Morphia is very inferior to opium for this purpose. It does not arrest the discharges nearly as well, and it has a far greater effect on the nervous system; an effect which is highly injurious in cholera. Morphia is distinctly more narcotic than opium, and is therefore less suited for administration. It must be remembered that in the typhoid stage of cholera we shall have probably to deal with a condition of stupor, itself caused by the cholera, and which will be probably complicated with uræmia, from suppression of the urinary secretion. We must, therefore, be as careful as possible not to give any remedy that may complicate this state. Morphia, given to any considerable extent, does—and so does opium, though to a less degree. But, in the condition we are now considering, the patient is in the stage of evacuation of cholera. The diarrhoea and vomiting have already begun. The appearance of cholera is beginning to show itself, and in a short time, unless the progress of the disease is arrested, collapse will come on, and the mortality in collapse is very great. Opium administered hypodermically before collapse has occurred will, in a large number of cases, save the patient from it. This we have seen over and over again. It is true that opium is injurious in the later stages of cholera, but here it is a choice of evils. If the patient is left without treatment the collapse will probably occur, and his chance of recovery is exceedingly diminished. If it is administered the collapse is often prevented, and a rapid recovery ensues. Should collapse have occurred—that is, should the pulse at the wrist have disappeared or be exceedingly feeble, and the temperature have fallen greatly, we may conclude that the patient has passed into that condition, and then no benefit can be ex-

pected from it, and it should not be given. It must be merely administered with the view to arrest as rapidly as possible the diarrhoea and vomiting, in order to prevent collapse. After the collapse has occurred, the mischief that opium can prevent has occurred also, and there is no object in administering it. But it can materially aggravate the typhoid condition that ensues on collapse, and therefore ought not to be administered if that collapse has occurred.

But when collapse has not taken place, but the vomiting and diarrhoea are alarming, the greatest benefit will be received from this treatment.

CASE XVI. R. V., a woman of good physique, aged thirty three years, was seized with cholera August 23rd, 1886. She had on that day constant diarrhoea and vomiting.

August 24th.—Aspect very choleraic. Voice very feeble. Eyes sunken. Vomiting frequently, and is purged. Temperature, $36^{\circ}6$ C. ($97^{\circ}8$ F.); pulse of fair strength.

2 p.m. —Twelve minims of the Extractum Opii. Liquidum, injected hypodermically.

8.30 p.m.—Vomiting and diarrhoea quite stopped. She had only one dejection after the administration of the remedy. Pulse, 96; respirations, 26; temperature, $38^{\circ}8$ C. ($101^{\circ}8$ F.).

August 25th.—She has not been purged, nor has vomited during the night. Aspect natural. Respirations, 22; pulse, 100; temperature, $37^{\circ}8$ C. (100° F.). In the evening she was quite well.

This was a severe case of commencing cholera. Several persons living in the same house had also suffered from it, and two of them had died. After the injection the diarrhoea and vomiting completely ceased, and she made a very rapid recovery. It will be noticed that the temperature rose above normal soon after the injection. This appears to be nearly always the case if cholera is arrested in this way. The reason

of this is most obscure. The elevation of temperature did not last very long, and did not interfere with convalescence, which was rapid and complete.

It is essential for the success of this treatment that collapse should not have occurred, and that the typhoid stage should not have been entered upon. If the pulse has failed, or is quickly failing, or if there is dyspnoea, or the temperature has fallen greatly, then collapse has commenced, cholera has entered on a new phase, serious pathological changes have occurred which this treatment cannot undo and would not ameliorate. It can also do nothing but complicate the typhoid stage. It is only of use to arrest at the earliest possible moment the evacuations. It should also not be given if the patient is the victim of chronic albuminuria, or has degeneration of his vascular system. These patients rarely, under any circumstances, recover from cholera, and they would not be capable of eliminating the constituents of the opium. We have placed this treatment in the hands of several physicians, and have received from them many proofs of its success.*

The best preparation to administer is the Extractum Opii. Liquidum of the British Pharmacopœia. Twelve minims of this, subcutaneously injected, is usually sufficient to obtain the result desired.

Opium is, of course, only of use in the diarrhoeal forms of cholera. It is only a method of treating a symptom. In those types of cholera in which the diarrhoea is slight no advantage is gained by using it, but it can in these cases very seriously complicate the typhoid state.

In typhoid cholera the diarrhoea never causes the physician anxiety, but the stupor is a very serious complication, and nothing should be given that can aggravate it.

* See "Cholera in Hamburg, 1892," by F. RUDOLPH, M.D. *Medical Annual*, 1893.

But very soon the situation assumes a much more serious aspect. The features become shrunk, the skin colder, the pulse fails rapidly and is soon imperceptible at the wrist, the skin is livid, and there is distressing dyspnoea. Collapse, in fact, has occurred. The patient's condition has become critical, and a fatal termination may be expected at any moment. The question then arises, should any operative interference be attempted, and is it justified by the results? It may be shortly answered by saying that though permanent amelioration and a cure cannot be assured by any procedure, yet great relief to the sufferings can be obtained, and, in many cases, a prolongation of life to patients, by appropriate treatment, that without it had obviously but a few minutes to live. A physician is certainly not justified in withholding treatment that will almost certainly lengthen life by several hours, especially when that prolongation may lead to a complete recovery in some cases, and in nearly all cases will alleviate the sufferings greatly.

The physician has open to him three modes of procedure. He can inject fluid directly into the veins; he can add fluid indirectly to the circulatory system by injecting it subcutaneously into the areolar tissue and leaving it to be absorbed by the vessels; or he can inject fluid into the rectum. Not one of these plans should always be selected to the exclusion of the others, but he should judge by the symptoms and select that plan that offers the best chance of a successful result.

Should the symptoms be of extreme urgency, the skin livid and cold, no pulse in the brachial artery, and the dyspnoea distressing, but little experience is required to know that the patient is in extreme danger. Death may occur at any moment. There is no time to consider; if the fluid is to be injected it must be done at once, and directly into the veins. Life will not last long enough to enable fluid injected into the

subcutaneous tissue to be absorbed. It will be found there unabsorbed after death, having given the patient pain without benefit. In a cholera hospital, every requisite for the treatment of cholera by injection should be ready at a second's notice—a minute's delay may be fatal.

The details of the operation are very simple. The fluid to be injected should consist of

Water, 1 litre (about 35 ounces).

Sodium chloride, 4 grammes (about 61 grains).

Sodium carbonate, 2 grammes (about 30 grains).

About five litres (a little more than a gallon) should be made ready for each operation. No advantage is gained by adding sodium phosphate to the solution, as is often recommended. We have seen many other substances tried, but we think without any corresponding benefit. Hydrogen peroxide added to the extent of ten per cent. was without result. The water should be distilled water, and free from impurity, and should be carefully sterilized by heating to boiling-point for some time previous to using. It is probable that the more favourable results recently obtained by this treatment are due to careful antiseptic precautions. Surgery, however, can well afford to share with Medicine the protection of the Listerian ægis. In a cholera epidemic, a large quantity of fluid should be carefully sterilized every day. The temperature at which the fluid should be injected should be 37° C. (98°·6 F.). During the injection it should be kept in a vessel with double walls, with hot water between them, to prevent the temperature sinking below this point. This is a detail of value.

This vessel should be placed above the bed of the patient about four feet above the level at which the patient lies, and the stand should be so arranged that it can be raised or lowered at will.

A vein at the bend of the elbow should be exposed—with strict antiseptic precautions, as suppuration is exceedingly

prone to occur after cholera—and opened, and the cannula connected by a flexible tube with the vessel containing the fluid introduced—care, of course, being taken to exclude any air from entering with the solution. The vein should be tied below the opening and round the cannula. The fluid should then be allowed to enter slowly. It is very essential that the injection should not be made too quickly; the rate can be easily regulated by raising or lowering the vessel containing the fluid. The most careful attention should be paid to the state of the patient during the operation. The rate of injection should not exceed a litre in twelve minutes. Should any difficulty arise in the fluid entering the vein it may be often overcome by temporarily raising the reservoir. Should this not answer, it may occasionally be necessary to open another vein on the opposite side.

The fluid now enters and after a variable quantity has been injected the condition of the patient changes. There is usually a great improvement and the amelioration is nearly in all the symptoms. After a little time a faint flicker will be felt in the pulse, and gradually the pulse will become re-established. At first the pulse is very weak; then as it becomes stronger the action of the heart becomes quicker, and then as the vessels become full the heart's frequency again sinks. The amount of fluid required to produce these results varies very much in different cases, and with it the amount of fluid that it is judicious to introduce. The best rule appears to be to inject very slowly and to stop when the pulse is of moderate strength in the radial artery. This will take very different quantities in different cases. In a severe case very often not the faintest trace can be felt of the pulse before two litres have been injected (about 70 ounces), in other cases it may be felt before a litre (35 ounces) has been introduced. In severe cases two and a half litres (87 ounces) may be injected before the pulse is perceptible, and then it

might require three litres (a little over five pints) for the whole process. In some cases not more than a litre in all need be introduced. It is entirely dependent upon the effect produced on the patient. If the operation is successful the improvement in the condition of the patient is very great. The pulse is re-established, the face loses its extremely drawn and anxious look, the eyes are less sunken, the livid tint lessens, the dyspnoea, the painful oppression of the chest, the sense of impending death all are removed or lessened, and even the cramps may cease. The effect is partly due to the introduction of an addition to the circulating fluid—of which so great a quantity has been lost during the cholera process—and partly to the solution of a portion of the cardiac thrombus, as the heart sounds are very greatly modified, even when the benefit derived is most transitory.

On withdrawing the cannula the vein should be tied just above the opening and divided below it, and the wound suitably dressed.

In a certain proportion of cases this treatment is not only alleviative, but curative. The improvement gained is never lost, and, after a certain period of the typhoid condition, convalescence ensues. Nothing can be more gratifying to the physician than the progress of these cases.

But, unfortunately, it is not always so. In a short time, it may be even in half-an-hour, but usually it is not so soon as that, the face will be noticed to change, the blue tint reappears, the dyspnoea recurs, and the pulse begins to fall, and the patient relapses into the same distressing condition in which he previously was. It is evident that he has lost the fluid that was injected into his vascular system. In some of these cases the physician has scarcely left the bed-side before the evacuations begin, and drain away the fluid just injected. Or it may not be quite so quick as this; for a few hours the improvement may be maintained, and then the pulse again

fails. There is nothing else now to be done but to repeat the injection. We cannot allow the patient to die, without an effort to see if the means that relieved him once will not do so again. Another vein should be opened, and sufficient of the sterilized sodium chloride solution injected to cause the pulse to become fairly perceptible again. As in the first instance, so sometimes in the second, the fluid will be retained, and the improvement in the condition will be permanent. The relief given is just as great as before. We have had a striking proof of this. A phlegmatic inhabitant of Northern Europe had been in severe cholera collapse and had received a very large intravenous injection, which had caused a great improvement, which, unfortunately, was not maintained. As the collapse again came on, and he tossed about in agony, a physician approached his bed; he put his hands together in that attitude of supplication so commonly seen in the East and the South, but we think scarcely ever to a fellow man amongst the northern races, and begged piteously that the operation might be repeated, which of course was done. It showed how deeply he appreciated the relief it afforded. It is, therefore, not only curative in some cases, but gives very great relief at the same time. It may, in suitable cases, be repeated again and again. We have seen cases that have relapsed six times, and each time the injection has been repeated, the last one being successfully retained. In these cases the amount of fluid injected was very large, probably, at least, two litres on each occasion. This would make twelve litres (or more than two gallons and a half). One case we have heard of where the injection was required to be repeated nine times, but we believe in the end unsuccessfully. There can be no doubt in the minds of those who have watched these cases, that the procedure will in many cases save life, and at the same time relieve the sufferings greatly. Should, therefore, death be imminent in collapse, it affords a prospect of relief and possibly

of cure, and time is gained, which, in a rapid disease like cholera, is a great advantage; it is therefore a means of treatment that cannot be neglected by any physician who wishes to do his utmost for his patient.

It must be pointed out that, as cholera is an extremely debilitating disease, a time comes in severe cases when the failure of the pulse is directly due to cardiac weakness. The patient's vital force is exhausted. No injection of fluid will remedy this condition. The appearance of the patient, the history of the case (especially in regard to the length and severity of the symptoms) will be a certain guide to anyone who is conversant with the disease. We mention this as we have seen injections made in conditions that rendered success impossible, and—though, probably, no injury was done to the patient—it is undesirable to perform an operation in so severe a disease as cholera unless there is some prospect of success.

The treatment of cholera by saline intravenous injections is a procedure by no means modern. In the first epidemic in England in 1831-32 it appears to have been first used. Dr. Latta, of Leith,* and Dr. Mackintosh, of Edinburgh† seem to have been the originators of it. We do not know the statistics of all Dr. Latta's operations, but Dr. Mackintosh appears to have operated 156 times with 25 successful cases. This gives a mortality very close on 84 per cent., and is evidence, we think, of the very severe character of the disease.

In the commencement of the practice the injections were made at a temperature far too high. They speak of 46°·1 C.

* See *Lancet*, June 2nd, 1832. "Letter from Dr. Latta to the Secretary of the Central Board of Health, London, affording a view of the Rationale and Results of his Practice in the treatment of Cholera by Aqueous and Saline Injections," dated May 23rd, 1832.

† "Handbuch der medicinischen Klinik," verfasst von Dr. C. CANSTATT. *Erlangen*, 1847. Band II.

(115° F.) being used, though exceptionally, but 44° 4 C. (112° F.) was quite commonly employed; this certainly would be too warm to be safely used. We think the best results are obtained at the temperature we have recommended.

We do not think a high temperature such as is apt to occur with a fatal termination in the reaction of cholera, takes place when a large intravenous saline injection has been resorted to, and this is a distinct recommendation to this method of treatment.

It cannot be too strenuously inculcated that intravenous injections cannot cure cholera, but they can in many cases prolong life that without them would very soon be terminated, and that some of these lives may afterwards be saved. Even a little time gained in such a rapid disease as cholera is beyond value. The circumstance most to be regretted in regard to intravenous injections is that their effect is often so transitory. In a series of 58 cases we witnessed of severe typical Asiatic cholera, in which intravenous injections were used, 41 died and 17 recovered, giving a mortality of a little over 70 per cent. In another series of cases of equal severity treated in the same way, of 135 cases 95 died and 40 recovered, a mortality also a little exceeding 70 per cent.

We think that, in several of the severe diarrhoeas known to medicine, such as that due to the ingestion of *Amanita phalloides* and the diarrhoea following the use of meat and also of preserved provisions containing ptomaines—a condition that deserves careful study in regard both to its etiology and pathology—where life is in danger from excessive loss of fluid, the urgent symptoms should be relieved, as in cholera, by the intravenous injection of saline solutions.

The difficulty in regard to the treatment of cholera by intravenous injections is the ease with which the fluid again escapes into the intestinal canal. If some substance could be added to the fluid to be injected that would have a great

affinity for water, and at the same time oppose great difficulty to dialysis, the fluid might then be retained. There are some substances that, to a certain extent, answer these conditions. Among them would be gelatine. It has a very strong affinity for water, and does not dialyse. We proposed this substance to a physician in a recent cholera epidemic. He naturally asked us if we had tried its effect on animals, to see if it could be safely introduced into the circulation, as an experiment like this could not be made in the intense pressure of a cholera epidemic. We were obliged to explain that attempts to improve the treatment of disease by experiment, however painless, as this would have been, were illegal in England. He expressed great astonishment. But we explained that it was fitting that a Parliament that allots a sum of money raised by taxation to keeping an establishment for torturing in suburban market-gardens a tame stag that had previously been subjected to the illegal operation of de-horning, lest by any chance it might injure its tormentors, should be the only legislative body in Europe that has thought right to stamp experimental research into the nature of disease and the methods of alleviating it with the brand of criminality.

In cases not so acute, where death is not immediately threatened, the fluid may be advantageously injected into the areolar tissue of the body. It is absorbed, and averts for the time the danger. It gives great relief, and greatly improves the general condition of the patient. But in extreme cases it is useless, for there is no time for its absorption. The fluid that should be injected should be the following:—

Water, 1 litre (35 ounces).

Sodium Chloride, 4 grammes (about 61 grains).

It should be most carefully sterilized, and on no account should any alkaline carbonate, or anything that can cause the

least irritation be added to it, and the most scrupulous antiseptic precautions in regard to instruments, and to making the necessary puncture, should be employed. After cholera there is a very great tendency to local suppuration, and we have seen some exceedingly large abscesses following this treatment, especially in some cases in which sodium carbonate was added to the solution employed. The fluid should be injected at 37° C. (98°·6 F.). It should be placed in a receptacle about four feet above the patient's bed, and the puncture should be made with a pointed cannula, connected by a flexible tube with the fluid in the receptacle. The site of the injection may be the front of the abdomen, or the chest, or the lateral aspect of the thighs, or the outer surface of the upper arm. Care should be taken that the cannula is introduced really into the subcutaneous tissue, and not into the tissues beneath. Directly the cannula enters, and the communication by a flexible tube with the reservoir is made, the fluid enters the issue with great ease and rapidity, a very large quantity may, in fact, be injected in this way. It is generally sufficient in these cases to inject a litre (35 ounces), and it may be done either in one place or two. It can, with two cannulae, be done simultaneously in two sites. If a litre is used, it is perhaps best to make the injection in two places. If half a litre is judged sufficient, as it may be in some cases, then one place will suffice. In a case that is suitable for this treatment, that is, when the collapse is not too severe, the fluid is rapidly absorbed, and its influence soon makes itself felt in strengthening the pulse. We think it is an exceedingly valuable means of treating cholera under the conditions we have stated. If there is a distinct pulse in the radial artery, but there is a tendency for it to become weaker, this is a case that would be particularly suited for the hypodermic injection of fluid.

It would also be of use in acute diarrhoea, where there was

danger from loss of fluid, but where the urgency was not extreme.

We do not know who first introduced this treatment. We employed it in India in 1878, but we were not indebted to any predecessor for the plan. It was too obvious to require that. It has been very largely used in Europe in recent epidemics.

The next method of treatment is adapted for a different condition of the patient altogether. At the end of collapse in cholera, and during reaction, and in the typhoid stage, it is not unusual for diarrhoea to return, and also the vomiting. Opium is not admissible in these cases if there is suppression of urine or albuminuria, and remedies given by the mouth are rarely retained. In these cases very copious enemata of warm water, in which tannic acid is dissolved, have often a most beneficial effect. The object is to introduce a large quantity of warm fluid into the intestine, charged with astringents, and to endeavour to make it ascend as high as possible. The patient's hips should be raised and the tube introduced, and the fluid allowed to flow from a reservoir placed at a considerable height above the bed; the patient may be gently moved from side to side to aid the ascent of the fluid. The injection should consist of

Water, 1 litre (35 ounces).

Tannic Acid, 20 grammes (308 grains).

Gum Arabic, 20 grammes (308 grains).

The temperature of the fluid should be 37° C. (98°·6 F.). Cantani used it warmer, but it is unnecessary, and, if possible, as much as three litres (about five pints) should be introduced and retained there as long as possible. It very frequently arrests the diarrhoea completely, and gives, in addition, relief to the patient. It is, we believe, to Cantani that the introduction of this method of treatment is due. He recommended that tincture of opium should be added to it. But we have seen that opium should never be given as routine treatment in

cholera. It should only be given for the purpose of arresting the diarrhoea in the earlier stages, and then only in a way to ensure its most rapid absorption and elimination. In the later stages of cholera it should rarely be given, and only with most carefully weighing the probabilities of its action being beneficial.

Professor H. von Ziemssen has used also a rectal injection of water, to which hydrochloric acid has been added. This we have not seen employed.*

All these methods of treatment aim at relieving the symptoms arising from the loss of fluid from the system, and in doing so they are very efficient. But in many cases of cholera that present themselves in Europe, where no loss of fluid is apparent, it would not be necessary to resort to them. But in urgent typical cholera no delay should be permitted till the most severe symptoms are relieved by these means.

But there is another mode of treatment of the collapse of cholera that is most valuable, which must be described. This is the warm bath. Judiciously used the warm bath is one of the most powerful means we possess of relieving the acutest symptoms of typical cholera.

The range of temperature of the bath which should be used is from 32° C. to 37° C. (from 89° F. to 98°·6 F.). The most useful bath for an acute case of cholera when the symptoms of collapse are urgent, is from 34° C. to 35° C. (from 93° F. to 95° F.). The bath should be wheeled to the bedside and the patient lifted by two attendants into it. On no account in collapse should the patient be allowed to exert himself in the least. He should be placed at full length in the bath, the shoulders being covered by the water, and his limbs and body thoroughly rubbed by an attendant. Mustard flour we have

* "Klinische Vorträge," von Professor H. von ZIEMSEN. IV. Vortrag *Ueber die Cholera and ihre Behandlung.*

often seen added to the water ; we cannot be certain that any special benefit has resulted from its use, but the baths have been most beneficial, so that no harm has resulted from adding it. The patient should be kept in the bath from ten minutes to a quarter of an hour. The friction should be continued the whole time. He should then be gently lifted from the bath and enveloped in a woollen or flannel wrapper and replaced in his bed. The benefit of this procedure is most striking. The body regains its warmth—which it often retains for some time,—the cramps lessen or cease entirely, the dyspnœa becomes less urgent, and we have even known the pulse return at the wrist. It has been advised to keep the patient for a long time in the bath, but we should fear to do so on account of the tendency to syncope in cholera. In about a quarter of an hour can be obtained all the advantage that can be gained by this method of treatment. The bath may be given again and again as long as benefit results from its use. We have seen it used every two hours, and should not hesitate to employ it oftener if needful. The points to be attended to are that the temperature should be exactly that given above, that friction should be used while the patient is in the bath, that he should not remain too long in it, and that the assistants should be able to lift him to and from it with ease. In the acute stage of cholera any excitement or rough treatment or struggling with the patient is most dangerous, and should never be permitted. We do not know who introduced the warm bath in the treatment of cholera or we would mention his name in a spirit of gratitude. It is spoken of favourably in reports by the medical officers of the Bengal Army as long ago as 1820.

The baths are useful also in the other stages of cholera. In the stage of evacuation, for instance, when the cramps are beginning they will often stop them. In the typhoid stage also they seem to relieve the patient greatly. They should be

used then at about 33°C . ($91^{\circ}\cdot 4\text{ F}$.). Often, also, when the patient is suffering from cholo-uræmia, and is restless, they tranquillize him. The relief afforded by these means is often very great indeed. In these cases also the best way of giving the bath is, we think, by employing one movable on wheels.

If there is any indication that the cholera is going to terminate by a sudden rise of temperature—that is, hyperthermic cholera—extreme caution must be used in regard to the bath. If the internal temperature is suspiciously high as taken in the rectum, namely, above $39^{\circ}\cdot 5\text{ C}$. ($103^{\circ}\cdot 1\text{ F}$.), we must always have the possibility of this before us, and then it would not be wise to employ any means of raising the temperature artificially. But with this exception, and using baths of different temperatures suitable to the case, a very great deal of relief can be afforded even in the severest cases of cholera.

In treating hyperthermic cholera the indication is to reduce the temperature as quickly as possible. The usual drugs employed for lowering temperature may be used. But no great expectation can be entertained of a favourable result. It is the *internal* temperature that must be watched, and by its progress the condition of the patient judged. The best means we have of rapidly reducing this temperature is the introduction into the rectum and colon of considerable quantities of fluid below the temperature of the body—a good temperature to employ is 26°C . (about 80°F .), but a temperature considerably below this may be used also. When this fluid has nearly acquired the temperature of the body, it should be allowed to escape and its place supplied by fresh. This is the most rapid method of reducing the temperature of the body with which we are acquainted, and should be resorted to if the temperature in cholera threatens to rise greatly.

In medical literature, both English and foreign, there are,

we believe, twenty-nine references to the use of chloroform in cholera; in some the administration was by the stomach and in some by inhalation, and many of the authors speak highly of it. But the explanation of its action does not seem to have occurred to any of them. Chloroform for a time destroys the coagulability of the blood, and it is to this effect that it owes the success that it has met with. We have used ether with some advantage. But in suitable cases we should try chloroform. Surgeon Colles, of the Indian Service, writes:—"No medicine that I have tried in the stage of collapse has more thoroughly removed the signs of obstructed circulation for the time than chloroform given by inhalation. Under its use cramps cease, and the pulso, warmth, and the colour of the face return. These effects are caused by its primary stimulant action; but as this use of chloroform does not promote the elimination of the poison, and as, by interfering with respiration, it causes the retention of effete matter in the system, it may be doubted whether, except as a palliative, its employment is justifiable in severe cases. My experience leads me to think that it does not prolong (if it does not shorten) life in severe cases, though it certainly relieves distress. Slight cases which only require stimulation are benefitted by it."

Another officer writes of these methods of treatment:—"I have never seen them do permanent good, and in some cases I think they shorten the duration of the disease by producing head symptoms, dyspnoea, and death."

We must recollect that in cholera we are dealing with the results of a poison of extraordinary virulence that causes many and widely differing lesions. So that we must not

* "Report on the Treatment of Epidemic Cholera," by JOHN MURRAY, M.D. *Calcutta*, 1869.

expect chloroform, or anything else, to cure all the conditions on which the disease depends. Still a method of treatment may be useful even if it only relieves one of the factors of the disease, if used with discrimination.

In consequence of Dr. Koch's theories of cholera, a large school of therapeutists has arisen, who believe the only method of treating cholera is by disinfecting the intestines. We have seen a large number of cases treated in this way, and a large variety of remedies of this nature employed—a variety so great that we could not recall them all; amongst them have been phenol, salol, thymol, creolin, cresol, hydrogen peroxide, chlorine. The results of this treatment generally have, in our opinion, been most disastrous. We have seen, perhaps, benefit result from the most harmless of them, but we have also seen the more active of them produce most injurious consequences. In being the cause of the origin of this school Dr. Koch's theory has already, we think, produced a large and irreparable amount of mischief. It may be perfectly true theoretically that the proper method of treating a disease due to poisoning is to disinfect and destroy that poison, but, unfortunately, that cannot be done without disinfecting the patient too, and a system that is scarcely able to struggle against a poison already present is not in a condition to resist a fresh toxic agent, however "disinfecting" that toxic agent may be.

There is a circumstance in cholera that prevents this school doing all the injury they are capable of; and that is in most cases on account of the condition of the alimentary canal, the substances often pass out unchanged without producing any effect whatever. So completely are the digestive functions in abeyance, that Professor Parkes, whose accuracy of observation was proverbial, states that he has known milk administered in cholera, pass away with the dejections so unchanged that it could be recognized as milk, and it even

formed a layer of cream afterwards on its surface. This also is the great safeguard of the castor oil therapists.

Should it be decided to try antiseptics, the milder ones should be used—permanganate of potash, or chlorine water, or, better still, hydrochloric acid, or, best of all, boric acid. But nothing should be given that can in any way increase the choleraic stupor. Those we have mentioned do no harm, and we think we have seen some of them administered with benefit.

There is also a method of treatment based on Dr. Koch's treatment of tuberculosis by tuberculin. A metabolic product of a pure cultivation of the comma bacillus has been administered hypodermically. It caused a slight elevation of temperature and apparently an increase in the fluidity of the blood, as any other injection that caused a slight sepsis would have done, but the disease pursued its course in other respects unchanged. It is probable that tuberculin would have been far more efficacious in producing these effects than the product of the comma bacillus; but it would leave the enteritis and the nephritis untouched.

But the fact to which allusion has already been made is of great interest in this connection. We have seen how recent tuberculosis is a great protection from cholera. It is probable that this protection is due to the previous effect of the tuberculin on the blood, protecting that fluid from the direct consequences of the cholera poison. But that occasionally fatal cases of cholera occur with recent tuberculosis shows that it is only this one effect of the poison against which it is a protection.

During the typhoid stage of cholera there are many conditions that may arise that require notice. In the stupor that

* "The Intestinal Discharges in Cholera," by E. A. PARKES, M.D. *London Journal of Medicine*, 1849 (Vol. I).

occurs often very early treatment does not seem to be of use. We have seen counter-irritation employed, but with very doubtful benefit. As the patient improves it passes off.

A condition that frequently gives rise to deep concern is the return of the diarrhoea. In these cases the vegetable astringents may be given by the mouth and the mineral acids also, and more useful still are the astringent enemata. They should be administered, as previously described, with great care, so that a large quantity may be retained for some time. Opium is a means that will often arrest this diarrhoea, but, on account of the choleraic nephritis, it is a *very* dangerous remedy. To say that it should never be employed in these cases is, perhaps, going too far, but if it is resorted to it should only be in cases where *great* danger is threatened by the diarrhoea and where there is good reason to believe that all the viscera are perfectly sound. It is at this period that great danger arises from taking improper articles of diet; nothing but liquid nourishment of the most unirritating kind should be given.

It has often been recommended to give calomel in cholera, and we have seen many cases in which it has been employed. We cannot recall one instance in which any perceptible benefit followed that was clearly due to the remedy. The intestinal tract is in a condition very unfavourable for absorption, and so in most cases the calomel passes out unabsorbed and unchanged; it has, therefore, done no harm, and thus it has acquired a reputation. But the two worst cases of intestinal necrosis we have seen were cases in which calomel was administered, and we do not believe the coincidence to have been accidental. We think, therefore, that calomel should never be given in cholera, though it is probably infinitely less injurious than castor oil. After the acute cholera process is over the bile again finds its way of itself into the intestine,

but should there be any delay in its return we do not know of any remedy that will hasten it.

For the abdominal pains we think nothing gives greater relief than flannels wrung out in hot water placed over the region complained of. They should be frequently renewed.

For the feelings of sinking and depression that the patients complain of we have seen benefit—and, we think, never harm—result from a remedy much used in Germany. It is a solution of camphor in olive oil, one part of camphor to nine parts of olive oil. Two thirds of a cubic centimetre (about twelve minims) may be injected subcutaneously with advantage.

For the cramps frictions with warm flannel and spirits of camphor are very useful. The warm baths already described afford the greatest possible relief to them.

We have before remarked with what extreme care opium should be used in cholera. It can often arrest the discharges, but that is all that it can do. But in the later stages it is a drug that should be regarded with suspicion, and only used in exceptional cases with the utmost consideration as to its capabilities of doing harm. It is, however, but right to say that some authors speak in less guarded terms about it. We have seen that Cantani employed it in his injections, and there are other authorities who use it more freely.* Still, our own opinion is unchanged, that opium should not be given in cholera except with the aim of checking the discharges, and then, as a rule, only early in the disease.

During the acute stage of cholera it is very difficult to administer any remedy by the mouth. The irritability of the stomach is so great that even the smallest quantity of fluid introduced will often excite vomiting. Little, therefore, can be done but to alleviate the intense thirst, which we believe to

* See "*Cura Specifica del Colera*," COL. TUNISI, M.D. *Vicenza*, 1884.

be greater in cholera than in any other disease, by giving small quantities of fluid. Very little should be given at a time, not more than a spoonful, but it may be repeated very frequently; the relief to the thirst is as great as if more were given, and it is much less likely to excite vomiting. Water, soda-water, or soda-water and milk, or soda-water with a little cognac, or lemonade made with dilute sulphuric acid, this is most valuable, as it aids in arresting the diarrhoea. What is given should be iced, if the patient prefers it; his wishes must be consulted. Sucking ice often greatly relieves the thirst. Alcohol in small quantities we think is useful in cholera; it should be given diluted, as, for instance, champagne with a little soda-water. Alcohol in large quantities we believe to be highly injurious. On one occasion we saw a patient who had a somewhat severe attack of cholera undertake to cure himself with brandy. He commenced his treatment, in spite of remonstrance, in the evening, and died early the next morning. He did not vomit. He certainly did not in the least lengthen his life by the treatment he adopted, and we do not think he derived any benefit from it.

Thirty-four medical officers serving in Bengal have recorded their opinion on the subject of the administration of alcohol during cholera. There is nothing definite in the opinion of four of them. Fourteen consider that if given with extreme moderation the action on the whole may be considered beneficial, but that given freely it is not to be recommended, but sixteen agree in considering the administration of alcohol invariably hurtful, even in small quantities. One of the officers remarks in regard to the efficacy of remedies, and the complete absence of the power of absorption and assimilation in cholera, that "You might give prussic acid without effect."*

* "Report on the Treatment of Epidemic Cholera," by JOHN MURRAY, M.D., Inspector General of Hospital. *Calcutta*, 1869.

We have simply stated what is our opinion on the subject, but we have no statistics to offer to our readers in support of it.

Beef tea, broths, soups, or jellies, and milk, iced or not, in small quantities, should be frequently administered, in fact, most forms of liquid nourishment that the patient prefers may be given; but the rule should be not to give much of anything at one time.

The most scrupulous care must be exercised not to introduce anything into the alimentary canal that could give rise to any irritation. Nothing containing any fibre, or hard substance, must be permitted. This entirely excludes vegetable structures, that might irritate the surface of the intestine. The number of deaths we have seen caused by patients neglecting to follow these instructions is really very great. In very many cases the offending substances have been found in the intestine that they have irritated. In no known disease is intestinal irritation so deadly as in cholera. But even more deadly than allowing the introduction of irritating forms of nutriment is permitting a new infection. A fatal relapse almost always follows should this occur. Should several patients in a cholera hospital at the same time undergo a relapse, there is good reason for suspecting re-infection has occurred. As this is nearly certainly fatal the most extreme care should be employed in preventing even the possibility of it. The wards should be kept most scrupulously clean, both as regards the floors, walls, and bedding, and every beverage that can possibly undergo the process should be heated for some time to boiling point, then cooled before being given to the patients. No care that can be exercised is too great to guard patients against any possibility of this.

The condition that gives rise to the most serious apprehensions in the later stages of cholera is the state of the urinary organs. As day after day passes by without any renal

secretion, the patient's condition becomes with each period worse. The stupor of cholera often gives place to a peculiar restlessness, and this in its turn is replaced by coma. It is often easy to recognise by their aspect alone patients suffering from this condition. But the treatment is much more difficult. Generally it may be stated that no diuretic must be given. No diuretics can clear the channel of the renal tubes of their pathological contents; but they can do harm by increasing the renal hypercemia. The patient should be encouraged to drink freely of mild, unirritating beverages, such as milk freely diluted with soda-water. Warm baths and hot air baths are most useful, and should never be neglected. Dry cupping over the loins should be resorted to, and it will often be advantageous to take blood from that region. But nothing in the nature of a diuretic must be given, nor should any alkaloid be administered. Opium, morphia, caffeine, digitalin, turpentine, and cantharides are all alike to be avoided. It is difficult, we freely admit, to do much good in this state, but it is easy to avoid doing harm. All we can do is to give mild diluents and to relieve the renal congestion by every means in our power.

The bladder should, of course, be carefully examined to see if it contains any urine, as it sometimes happens that the urine secreted is merely retained.

As convalescence begins, the chief points to be attended to are to prevent any return of the disease by being very careful as regards diet, and to help the patient to regain his strength, which, if the disease has been severe, has been greatly impaired. We do not think any substance containing hard vegetable fibre should be permitted for a fortnight at least. But easily digested meats, poultry, game, fish, with soups and the lighter wines, those of Bordeaux, Burgundy, and the Moselle districts will make a great change in the patient in a few days.

Should the subsequent anæmia be severe, and sometimes it is very severe, it would probably be wise to send the patient away completely from the scene of his disease. It is a condition that is sometimes fatal, in spite of everything that can be done.

The dysentery that not unfrequently follows cholera should be treated in the way the disease is ordinarily treated in India. In Europe we have seen excellent results from this method.

In regard to the remote effects of cholera and their treatment it is not necessary to say much. There is nothing special about them. Most of them are sub-acute inflammations, and they are best relieved by a treatment directed to restore the strength of the patient, so greatly impaired by a disease so acute.

It must be admitted that the treatment of cholera is not a satisfactory branch of the subject. But it would be going too far to expect that a specific for cholera should exist. A remedy to meet all the requirements of cholera would have to cure a severe diarrhoea, a serious blood change, an extremely dangerous enteritis, and a not less grave nephritis. We must therefore be content for the present to meet the indications as they arise. But we must always bear in mind that when we have relieved one of the dangerous conditions others equally perilous still remain. Thus, if we stop the diarrhoea we may have a fatal nephritis still left, and if we overcome the nephritis there may yet remain the enteritis. Still, when a symptom arises that causes suffering or threatens life, no time must be lost in relieving that condition with all the resources that we at present possess.

CHAPTER VI.

THE ETIOLOGY OF ASIATIC CHOLERA.

THE etiology of cholera is a subject that is complicated much more than the etiology of most other diseases, and, consequently, has been the subject of much more controversy. The literature of it is very extensive, and the most divergent views have been put forth. Some have traced its origin to the earth; others to air; others, again, to water. We have those who regard it as being diffused up rivers, and those who think it descends them. There have not been wanting those who think an electrical condition is the cause, others who believe it due to a kind of atmospheric storm; and its origin has been traced to the celebrated "blue mist" of London; while other observers have considered that it is only in diet that it has its source. It will, therefore, be necessary to examine at some length the chief points connected with it, and especially those that have been the subject of recent investigation.

At the commencement notice must be taken of a view that has been advanced by some that Asiatic cholera is not a specific definite disease introduced from the East, but a mere modification of the ordinary diarrhoeal affection that exists in European towns generally during the warmest months of the year; and that the filth that is present in these towns is the cause, and of itself begets the disease.

It must be conceded that many of the towns of Europe are filthy beyond description, and one would think capable of breeding any pestilence, and yet these towns go on year after

year without suffering extraordinary mortality. Diarrhoea breaks out in summer from time to time, but causes no great fatality. It will be found on enquiry that of these cases of diarrhoea not more than one or two per cent. are fatal, and even these are chiefly in the young and feeble. But let Asiatic cholera be once introduced from without, and the mortality at once becomes appalling, and no longer is it the children and the old, but the strong wage-earning men that are its chief victims, and not less than fifty per cent. of the cases are fatal. Toulon was as filthy in 1883 as it was in 1884, but no special increase in the mortality occurred there, but when in 1884 the "Sarthe" brought the disease from the east, the mortality was at once fearful. Palermo was as dirty as it well could be in 1884, but no cholera was introduced, and the mortality was not excessive, but in 1885 the steamship "Selunto" brought the disease, and a fearful outbreak of cholera followed. Messina, a city much filthier than Palermo, escaped in 1886, but when the cholera was introduced in 1887 the mortality was very great. Taking the almost innumerable cases that could be cited in which the filthiest condition can go on for years without cholera, and that when once it is introduced from without it spreads like fire amongst thorns, it would require a great deal more evidence than has ever yet been produced to support such an improbable position.

Besides these difficulties in the way of accepting this view, we have the fact that cholera nostras is a mere diarrhoea. The patient may be very ill, and present the appearance of having lost a considerable portion of the fluid of his body, but if he does not die in this state his recovery is rapid. But in Asiatic cholera the patient may scarcely have diarrhoea, his appearance may not give any indication that his body has been deprived of any quantity of fluid, and yet he may have the complicated morbid condition of Asiatic cholera in its

most fatal form. These facts must first be explained by the believers in the origin of Asiatic cholera *de novo* in Europe, and then they will be in a position to argue the question.

But the first and most important subject connected with the etiology of cholera is the exact nature of the causative agent; it is also a subject that must be approached with much care, for nothing concerning cholera has caused so much enquiry, and nowhere else in regard to cholera has so much wealth of assertion been employed.

It must be admitted in the beginning that in a large number of cases of cholera a bacillus answering in appearance to Dr. Koch's comma bacillus can be found in the evacuations. In many cases it occurs in large numbers, in others it can only be demonstrated with great difficulty, and in others the cultivations, even when repeatedly made, fail to give evidence of its presence, as in cases we shall refer to hereafter. We have seen many such cases. The severity of the disease, moreover, bears no relation to the number of bacilli present. In a peculiarly severe case which we witnessed, an observer, who had been one of Dr. Koch's assistants, had the greatest difficulty in finding even a few. It must be admitted also that in some cases of cholera the bacillus, even if found, may present anything but a typical appearance, and this is also true of the cultivations made from many cases. Still the fact remains that in a large number of cases of Asiatic cholera a bacillus of characteristic appearance can, after more or less investigation, be found. But when we go further than this, the question becomes surrounded with difficulty.

But these facts are not sufficient to establish Dr. Koch's position that the comma bacillus is the sole efficient cause of cholera, and that cholera cannot exist without the presence of the comma bacillus.

Dr. Klein has examined Dr. Koch's views in considerable

detail. He remarks that after careful examination he "cannot confirm the statement of Koch that the purer and more typical and acute a case of cholera the more does the lower part of the ileum contain an almost pure cultivation of the comma bacilli." Dr. Klein has paid great attention to the exact positions in which the comma bacillus may be found, and says that he "did not find anything that showed the presence of comma bacilli in the intestinal mucous membrane, not even in the superficial epithelium, when it had kept its position," and he goes on to show that only in those cases where the patient had been for a long time moribund, or the autopsy had taken place at a late period, so that the intestinal wall had been macerated, so to speak, in morbid discharges, were there any traces of the comma bacilli even in the exterior portion of the epithelium. He quotes an experiment of Van Ermengen's, where nine days after an animal had had administered to it comma bacilli, they were still in vigorous life in its intestine, but without producing the faintest pathological consequences. He points out that Finkler and Prior have demonstrated the presence of a comma bacillus in the intestine in other conditions than that of cholera.

There may be differences in the cultivations, but that does not alter the inaccuracy of Dr. Koch's earlier statement that comma bacilli are never found in the human intestine except in cholera: and he shows that in the one instance in which the comma bacillus was detected in a "tank" in Calcutta there was no epidemic of cholera amongst the people using that tank.

In the pathological laboratories of Germany and elsewhere may often be seen animals suffering from the effects of the administrations of cultivations of the comma bacillus made in

* "The Bacteria of Asiatic Cholera," by E. Klein, M.D., F.R.S. London, 1889.

different media, and in many cases the animals die. We have most carefully watched the symptoms in many of these animals and have examined the viscera with minuteness after death, but we have never seen anything that could possibly be mistaken for cholera by anyone conversant with the disease. It is quite true that cultivations of the comma bacillus can produce fatally toxic symptoms, but that is, of course, a totally different thing to producing cholera.

To determine this point, and to see how far the bacillus is in itself capable of producing a physiological effect, we made the following observations. A typical gelatine cultivation of the comma bacillus was taken and to it slightly warmed sterilized water was added. The solution thus obtained was then placed in a centrifugal separator. In this way the greater proportion of the bacilli were collected in the bottom of the vessel, while the upper portion contained fluid nearly free of them. This supernatant fluid, containing but few bacilli, was then injected into a guinea pig, which died in a few hours with symptoms of nervous prostration and muscular weakness, but without any feature in the least resembling cholera. The autopsy also disclosed no condition in the faintest degree connecting it with cholera.

The bacilli at the bottom of the vessel were then taken and injected in a similar manner into another guinea pig, which died with symptoms resembling those of the previous one, but the time before death was twice as long. The viscera in this case, also, gave not the slightest indication of the presence of cholera. These experiments clearly prove that the bacilli themselves are even less capable of producing toxic effects than the medium in which they are cultivated, but that the condition produced either by the bacilli or the medium is certainly not cholera.

It was next determined to see what effect the cultivation would have on the human subject. A portion, therefore, of

a typical cultivation of comma bacilli, exactly like the one that had been proved to have toxic properties, was taken internally, mixed with water, by an individual with whom we are intimately acquainted. But though this individual is very sensitive to cholera poison, never passing through an epidemic without having diarrhoea, which on one occasion caused severe symptoms, the cultivation produced nothing whatever of a choleraic nature on him.

Dr. Max v. Pettenkofer and Dr. Emmerich* appear in their experiments to have suffered slightly from diarrhoea, but from no malady in any way approaching cholera. They also seem, from the account given, to have been somewhat impressed by the risk to which they were exposed, and it is probable that the diarrhoea had its origin in this condition of mind; but in the symptoms, as related by them, there is nothing of a choleraic nature. But, though this was so, yet the comma bacilli were proved by bacteriological investigation to have multiplied themselves freely in the intestines, the dejections being crowded with them; but the result, as regards cholera was absolutely negative.

To be perfectly certain as to the effect on the human subject we repeated the experience, and with exactly the same result. Nothing in the remotest degree resembling any condition of cholera could be produced.

We have also had, through the kindness of Professor Stricker of the University of Vienna, the opportunity of seeing in his laboratory the effects produced by pure cultivations of the comma bacillus on the human subject. But no condition beyond a very mild gastro-intestinal catarrh could by any means be excited, and in a case in which this did occur, it could be as justly ascribed to an error of diet as to the effect

* "Ueber Cholera mit Berücksichtigung der jüngsten Cholera Epidemie in Hamburg," von MAX v. PETTENKOFER. *München*, 1892.

of the cultivation. Dr. Hasterlik's experiments are decisive, that the condition produced by the comma bacillus is not cholera.

It is within our knowledge that eleven individuals have taken pure cultivations of the comma bacillus, of these eleven, five are personally known to us, and they were perfectly competent to judge of its effects, and the cultivations were taken in every possible way to secure a result—on an empty stomach, on a full stomach, with previous alkalization of the stomach, and without it; and yet, in not one of these instances was anything like Asiatic cholera produced. In the cases with which we are most intimately acquainted, where one cubic centimetre of a pure cultivation was taken no effect whatever was produced, and on another occasion only slight abdominal uneasiness. It is not credible that eleven consecutive Europeans, living in Europe, should be insusceptible to the disease, if the cause of it were administered to them, when there are many epidemics on record in which more than ten per cent. of the population have died.

The important question to decide is:—Have the comma bacilli any power of themselves of producing a pathological effect of the nature of cholera? It has been already shown the cultivations can be proved to be toxic, though they are quite unable to produce cholera. Dr. Neil MacLeod and Dr. Mills* have experimented with rabbits, using alkaline injections, and then injections of opium, and afterwards giving a cultivation of the bacillus, and they state that the animals so treated died. But they are entirely silent on the nature of the symptoms. Had the symptoms been undoubtedly those of cholera, they would scarcely have refrained from mentioning

* "An Enquiry into the causation of Asiatic Cholera," by NEIL MACLEOD, M.D., and WALTER MILLS, *Lancet*, March 9th 1889.

Also, Reports Royal College of Physicians, Edinburgh (Vol. I., p. 161).

it and so weakening their case. Many bacteria give toxic cultivations which would be more hurtful in an intestine injured by a peritoneal injection, but no other bacterium was experimented with, they did not care to control their experience in this way. Nor do they seem to have taken the least care to distinguish the bacilli themselves from the medium in which they grow. This medium we have already shown to be poisonous, but not in the direction of cholera.

To decide this question of the activity of the comma bacillus in producing pathological results the following observations were made. In order to obtain the greatest possible indications it was determined to make the stomach alkaline. Dr. Koch believes that for the successful production of cholera by the comma bacillus an alkaline condition of the alimentary tract is necessary. Nature, it may be remarked, does not seem to endorse Dr. Koch's views, and usually produces cholera in an acid condition of the stomach. It does not require a large clinical experience of cholera to abundantly verify this fact. It is true that in the later stages of cholera the vomited matters may sometimes be alkaline; but, on chemical examination, the reason is evident: they contain the same alkaline salts that are found in the alvine evacuations, the separation of which from the blood seems one of the special faculties of the cholera process. But, in the majority of cases, the earlier vomitings are acid, and generally the stomach remains acid throughout the disease.* Some of the most acid stomachs we have ever tested have been in pronounced cholera cases. But Dr. Koch | expressly states that acidity of the stomach is rapidly fatal to the comma bacillus;

* See "Report on the Epidemic at Malta," by Surgeon LEITH ADAMS and Assistant-Surgeon F. H. WELCH. *Army Medical Department Report*, vol. vi.

† "Conferenz zur Erörterung der Cholerafrage." *Berliner Klinische Wochenschrift*, No. 37a, 1885.

so that, if Dr. Koch's view be correct, the comma bacillus produces cholera in a condition of the system which is absolutely fatal to it, without modifying that condition in the least. Still, it was thought better to make the arrangement in accordance with Dr. Koch's view. A young cat was taken, and 0·6 cubic centimetres (about 9 minims) of tincture of opium was administered by the mouth. This was to keep the digestive tract in a state of quiescence, a condition that Dr. Koch believes to be favourable to the development of the bacilli. We did not inject it into the peritoneum as the injury done to that structure would certainly add intensity to any toxic action produced by a bacillus, whether comma or of any other kind, and our object was to produce cholera, not mere poisoning. Three hours afterwards a solution containing half a gramme of sodium carbonate was given (about seven and a half grains). The cat was selected because, from previous observations, we believe it to be susceptible to cholera. Shortly after the administration of the alkali a pure cultivation of comma bacilli was given which had a portion of the gelatine separated by being allowed to stand with slightly warmed sterilised water. The bacilli sank to the bottom, and the clear supernatant fluid was drawn off and fresh water added; this was done three times. The whole of the cloudy portion at the bottom of the vessel, which contained enormous numbers of the comma bacilli in active growth, was then introduced by a syringe and flexible cannula into the stomach of the cat, which had thus previously been narcotized with opium, and whose intestinal tract had been rendered alkaline with sodium carbonate. But the animal, though carefully watched, suffered from not the slightest symptom of cholera—and, in fact, from no symptom at all—but remained in perfect health. It appears, therefore, that the bacilli by themselves are not capable of morbid action even in a narcotized and alkaline intestine.

As it has been suggested that a catarrhal condition of the mucous membrane is a powerful factor in the production of cholera, another observation was made to test the power of the comma bacillus in a catarrhal condition of the alimentary tract. A young cat had some warm water injected through a flexible cannula into its stomach. Shortly after a cold solution at 0° C. (32° F.) of sodium carbonate containing one gramme (about 15 grains) of the alkali was injected. After a short interval a very characteristic cultivation of comma bacilli in gelatine was administered, the whole of the gelatine as well as of the bacilli being given. In the course of the next day the cat vomited some mucus and had some slight diarrhoea, proving that intestinal catarrh had been excited. The dejections were only semi-liquid and well coloured with bile. The animal suffered no further inconvenience of any kind, and 24 hours from the administration of the cultivation was quite well again, eating its food with evident appetite. The treatment applied to the stomach evidently excited gastric catarrh, and to this the mucous vomiting must be attributed; it is not improbable that the cultivation added to the intestinal irritation, but though this was present to a certain extent yet not the faintest resemblance to cholera was produced. But cholera is a great deal more than intestinal irritation, as we showed in the chapter on the symptoms of the disease.

But Dr. Klein* has proved that the comma bacillus is not the only one that produces toxic effects, but that many others produce identical results with it. He experimented by injections in animals with six organisms, viz., the comma bacillus, and the Prior-Finkler, the bacillus coli communis, the proteus vulgaris, the bacillus prodigiosus, and the bacillus typhoideus.

* "The Anti-Cholera Vaccination: An Experimental Critique," by E. KLEIN, M.D., F.R.S. *British Medical Journal*, March 25th, 1893.

With all of these one can obtain depression of temperature, weakness, inability to move, and general malaise, but nothing resembling cholera. But in addition, the bacillus typhoideus, the bacillus coli communis, and the bacillus prodigiosus were far more active in this direction than the comma bacillus.

Dr. Klein further distinguishes the intracellular elements of a cultivation and the metabolic products.

Although, therefore, it is possible to produce toxic effects with the comma bacillus, it will be seen that all these attempts failed to produce anything of the nature of cholera. It will also be seen that eleven individuals most anxious to discover the real circumstances have taken the comma bacillus in large quantities without in one instance contracting anything like cholera.

The amount of the infecting material employed also was very great—in nearly every case a cubic centimetre was administered, and in some cases as much as ten grammes (154 grains) were given. But water has been known to communicate cholera when it had only eight milligrammes of organic matter of all kinds to the litre, and a litre is more than is usually employed in quenching thirst; and it must be remembered that over and over again the most careful examination has failed to detect the comma bacillus in water that undoubtedly caused cholera. It was not found in the deadly water of Hamburg. In the village of Szerb-Aradcz in Hungary in 1892, out of a population of 1,900 persons 194 persons suffered from cholera, of whom 112 died, yet the infecting water, though most carefully examined, failed to give evidence of the presence of a single bacillus. The same is true of Buda-Pesth, where the water from the water-conduits was examined with extreme care every day while the epidemic lasted without the bacillus being found on a single occasion.

To say the least, it is highly remarkable that a gramme

(15 grains) or more of the supposed infecting material may be taken without result while water in which it cannot even be proved to exist can communicate the disease.

All observers agree that the comma bacillus is speedily deprived of life by being dried. The observations are too numerous to leave any doubt on this subject. Two hours are more than sufficient to kill the bacillus if it is dried. Dr. Koch himself says, "even when the pulpy mass made by a cultivation on potatoes was dried, the comma bacillus did not retain its vitality for longer than twenty-four hours." But if there is anything certain in cholera, it is that epidemics have repeatedly had their origin in clothes and linen that have been worn by cholera patients being admitted into uninfected places. These clothes have been kept in the usual dry condition that clothes are preserved in often for a considerable time at high temperature, and yet an outbreak of cholera has followed their introduction.

In India a constant phenomenon of cholera is its increase directly after a fall of rain that has succeeded a period of drought. The recrudescence of cholera in Bengal that shows itself after the coldest months, is almost certainly connected with the showers that first occur after a season of dryness. The severe epidemic of cholera in India of 1861 followed upon the storms that succeeded the complete failure of the rains of 1860. This can scarcely have had any other cause than the bringing into activity material previously dried up by the sun, but which had by no means lost its power by thus being dried. And the power of the tropical sun in drying what is exposed to it is very complete, as anyone who has witnessed it will freely admit. It is remarkable, then, that Dr. Koch's theoretical cause of cholera and the real agent should differ in so essential a particular.

* "Conferenz zur Erörterung der Cholerafrage." *Berliner Klinische Wochenschrift*, No. 31, 1884.

But there is even a more striking case than this. Cholera is endemic at the mouth of the Yang-tsze-Kiang, but it only exists there during the months of July, August, and September, and part of October. It then dies away, only to reappear in July of the next year. We must suppose then, if Dr. Koch's view be correct, that a bacillus that, according to him, dies at once if it is dried, and in which Dr. Koch himself has never been able to demonstrate spores, is able to remain alive for nine months of the driest and coldest months of the year, and also during two of the hottest, without manifesting its existence, to regain full activity and vigour again at the end of that time.

But there is another aspect of the comma bacillus that must be treated of here, and that is Dr. Koch's assertion that it is invariably found in Asiatic cholera; and with this we must consider the question of the diagnosis of cholera by means of the comma bacillus. It is asserted by its partisans that the comma bacillus is of the highest value as a means of diagnosis. Fortunately we have the full details of the beginning of an outbreak, which will enable us to judge of its merits as a method of diagnosis, in which the history is told by its own advocates, so that it is above suspicion.

Cholera, as it is well known, broke out in Hamburg in August, 1892. Cases are said to have occurred as early as the 16th and 17th, but Hamburg was not declared by its authorities to be infected till the 23rd August. But the Hamburg officials do not now deny that before the 23rd August 128 persons had perished in the city of Asiatic cholera. It was a matter of common knowledge that cholera was in the city before August 23rd, so that some of the foreign Consuls residing in the town were on the point of holding a meeting to consider the urgent need of discontinuing, on their own responsibility, to issue clean bills of health to ships leaving

the port. Herr Professor Rumpf * has explained how it came to pass that it took a complete week to find out that cholera was in the town, and his explanation is worthy of careful study. He states that the first case resembling cholera that came under observation at the Neues Krankenhaus was admitted on the 16th August, and the patient, by name Kahler, died on the 17th August, but that the cultivations made from the patient gave, on the 19th and 20th August, a completely negative result, and that the case was therefore diagnosed as only cholera nostras.

The second suspicious case at the Neues Krankenhaus was admitted on the 21st August and died soon after. In the meantime five other suspicious cases were admitted into the Altes Krankenhaus on the 20th August, and ten more on the 21st August, and on the 22nd August the comma bacillus was found in them, and on the same day the bacillus was found in the second case at the Neues Krankenhaus. On the 22nd August also comma bacilli were found in cases treated at the Seamen's Hospital, and lastly on the same day (the 22nd August) the cultivations still carried on from the first case, the man Kähler, which occurred on the 16th August, and which had been diagnosed as cholera nostras, gave evidence of the presence of the comma bacillus. Then, and not till then, was Hamburg declared infected. Dr. Koch's method of diagnosis will, then, in highly competent hands enable cholera to be diagnosed almost within a week of its outbreak, and after one hundred and twenty-eight persons have fallen victims to it. Cholera penetrated to all quarters of the town, the mortality was appalling, and ships laden with this deadly freight were despatched to all parts of the world: these were

* "Die Diagnose der Ersten Cholerafälle in der Staatskrankenanstalten in Hamburg," von Professor Dr. RUMPF. *Deutsche Medicinische Wochenschrift*, 29th September, 1892.

the results of trusting to the comma bacillus as a means of diagnosis.

We have on the one side the statement of Dr. Koch and his disciples that the comma bacillus is invariably found in Asiatic cholera. But we have on the other hand equally positive evidence that it cannot always so be found. MM. Lesage and Macaigne, of the Institut Pasteur,* have most carefully investigated the patients suffering from Asiatic cholera in the Saint Antoine Hospital in Paris in 1892. There were 251 cases admitted, and there were 95 deaths. Of these 251 cases 201 were specially studied bacteriologically, and no comma bacilli could be found in 45 of them, or 22.4 per cent. Of 47 fatal cases specially studied as regards the contents of the intestine no comma bacillus was found in 13 cases, or 27.6 per cent. They remark "We would insist specially upon this, that the cases of cholera without the comma bacillus were observed at the same time, and during the whole of the epidemic, with the cases in which the comma bacillus was present. Clinically, it was impossible to distinguish the two classes of cases, only by bacteriological examination could any difference be established."

In the epidemic in Hungary in 1892-93 we saw several cases of typical Asiatic cholera in which repeated cultivations failed to give evidence of the presence of one comma bacillus, and these cases were quite as severe and as fatal as those in which they were found.

We have also the evidence on this subject given by Drs. Roy, Graham Brown, and Sherrington. These observers studied the epidemic in Spain in 1885, especially with regard to the etiology of cholera and its relations to Dr. Koch's

* "Étude Bactériologique du Cholera observé à l'Hôpital Saint Antoine en 1892," par MM. LESAGE and MACAIGNE. Annales de l'Institut Pasteur, 1893. Tome VII., pp. 18-27.

comma bacillus. They state absolutely that there were cases of Asiatic cholera in which it was impossible to detect the comma bacillus. They say, "In many cases of undoubted cholera Asiatica, where death occurred before the reaction stage had set in, we were unable to detect comma bacilli in any of the films or cultures prepared from the intestinal contents taken from different parts of the alimentary canal."*

In the *Annales de l'Institut Pasteur* of this year M. Metchnikoff says: "Mais pendant la dernière épidémie on a constaté que certains malades, qui présentaient tous les symptômes classiques du choléra Asiatique peuvent ne pas avoir dans leur intestin de bacilles virgules (Vibrions de Koch)."[†]

So, also, Dr. O. Lubarsch, of Rostock says that in 23 suspicious cases the comma bacilli were only present in 14. But of the nine cases in which they were not found three were real cases of cholera.

In India it is well known that whole series of cases have been seen without the comma bacillus.

At Hanover there were three cases of undoubted cholera in 1892, one of them a lady who had just arrived from Hamburg, where the cholera was raging. She died of the disease, but no comma bacilli were found.‡

* "Preliminary Report on the Pathology of Asiatic Cholera (as observed in Spain, 1885)," by C. S. ROY, F.R.S., J. GRAHAM BROWN, M.D., and C. S. SHERRINGTON, M.B. *Proceedings of the Royal Society*, Vol. XLI., Nov., Dec., 1886.

† "Recherches sur le Cholera et les Vibrions," par El. METCHNIKOFF. *Annales de l'Institut Pasteur*. VII. 7.

‡ "Zur Epidemie der Asiatischen Cholera," von Dr. O. LUBARSCH, *Deutsche Medicinische Wochenschrift*, No. 42. 1892.

§ See *Berliner Klinische Wochenschrift*. No. 48. 1892.

In a recent telegram in the newspapers from Berlin during the present (1893) cholera epidemic, it is stated that there are 16 persons in the cholera hospital there, of whom five have cholera. That is to say, in other words, that there are eleven persons who have every symptom of cholera, so that they are consigned to the hospital for that disease, and detained there, but that no comma bacilli could be found in them. Of course, if they choose to call cholera only those cases that have the comma bacillus in them, that is their affair, and one of mere nomenclature, but if they assert it is a different disease, they are bound to show in what it differs, and there has been no attempt to do that, whereas many observers have proved that true Asiatic cholera occurs without the comma bacillus. When Dr. Koch points out the clinical difference between Asiatic cholera without the comma bacillus and Asiatic cholera in which it can be found, we will spare no pains to investigate this difference. But though we have the greatest respect for Dr. Koch's scientific attainments, we can hardly be expected to recognise a distinction that has never been even indicated.

In Hamburg also, in 1892, in one of the hospitals the comma bacillus was not found microscopically, or was absent from cultivations in a proportion of over 17 per cent. of the cases.

Dr. Koch himself does not appear to be capable of resisting all this evidence, so he assures us that we should not despair of his theory even if no comma bacilli are present in cases of cholera, but we should attribute it solely to our incapacity to find them:—"Damit soll aber nicht gesagt sein das auch umgekehrt das Fehlen oder vielmehr das Nichtauffinden der Cholerabakterien in einem choleraverdächtigen Falle unter allen Umständen das Nichtvorhandensein der Cholera beweist."*

* "Ueber den augenblicklichen Stand der bakteriologischen Cholera-diagnose," von Professor R. KOCH. *Zeitschrift für Hygiene und Infectiouskrankheiten* (xiv. 2, 1893).

That cholera is caused by an organism that it is impossible to prove to be present, does not appear to us a very valuable contribution to practical pathology, and one about which we do not greatly care to argue.

Thus, in the well-known outbreak at the Nietleben Lunatic Asylum, near Halle, in January, 1893, by the third day there had been eighteen cases and seven deaths; but the disease was declared by authority to be only cholera nostras, as only the Prior-Finkler bacillus was present. But the mortality became alarming, and when twenty deaths had occurred they succeeded in discovering the comma bacillus, and the disease was declared to be Asiatic cholera.

It is quite remarkable the assistance that a heavy mortality appears to give to an observer in enabling him to recognise the comma bacillus in an epidemic where it has been previously indiscernable.

But Dr. Koch has a peculiar way of meeting these objectors. He states that those who differ from him are not to be regarded "seriously," and only those who agree with him have a sufficient acquaintance (*hinreichende Kenntnis*) with the subject.* Also in his article in the *Zeitschrift für Hygiene und Infektionskrankheiten* on the Cholera in Germany in the winter of 1892-93, he states that "all the learned" are in agreement with him. The able observers we have mentioned can well afford to be called incompetent by Dr. Koch, especially as Dr. Koch's definition of a competent observer appears to be one who can discover his bacillus in a cholera epidemic.

So, also, Dr. Koch always terms the comma bacillus *Kochii* the cholera bacterium. It must, therefore, be received as the cholera bacillus. Dr. Koch has apparently legislated on the

* See Dr. Koch in *Zeitschrift für Hygiene und Infektionskrankheiten* (xiv., 2, 1893).

subject, and we presume no appeal is to be permitted. It would, perhaps, have been better to have left to others the promulgation of the decree. *Sic volo, sic jubeo* is a formula that has not much weight in pathology; the demonstration of the bacillus in a larger proportion of cases occurring during a cholera epidemic would, we believe, be generally considered far more satisfactory.

In his "Conferenz zur Erörterung der Cholerafrage" also, Dr. Koch has given the most careful directions for distinguishing the Prior-Finkler bacillus from the comma bacillus Kochii. But as Dr. Koch has found that some observers have only been able to find the Prior-Finkler bacillus with its special features in undoubted cases of cholera (Dr. Koch characteristically calls them "beginners") we are told that the Prior-Finkler spirillum "ought, therefore, to be struck off the roll of micro-organisms" ("doch endlich von der Bildfläche verschwunden und aufhören")*. We confess we do not understand this. If it exists, and it may be presumed to do so, as it has been found over and over again, and has been accurately defined with its characteristics by Dr. Koch himself, it is a little hard to deprive it of existence because it will, with its peculiarities, get into a cholera intestine, to the exclusion of the bacillus that Dr. Koch believes is the only one that has any right to be there. And it is equally unjust to order it to lose its identity and be considered a real comma bacillus simply because the case in which it happens to be found is Asiatic cholera. Still, perhaps the principle is right that if it is Asiatic cholera it is best to consider it as a comma bacillus. If it aids in the recognition of Asiatic cholera in any manner and under any name, we shall be grateful to it, and

* "Ueber den augenblicklichen Stand der bakteriologischen Cholera-diagnose," von Professor R. Koch. *Zeitschrift für Hygiene und Infektionskrankheiten* (xiv., 2, 1893).

its assistance will be most valuable to Dr. Koch, and we think he is wise in enlisting it. Being kept under strict control by the mortality, it will be a valuable recruit.

Many species have perished from the world. The *Dinornis* and the *Didus giganteus* have both disappeared, and the "right" whale and the *Bison Americanus* are being rapidly exterminated by the greed of man. But this is the first occasion, we think, in which a whole species has been annihilated by a savant in the seclusion of his laboratory, and we feel sure that Dr. Koch is too ardent a lover of nature to have acted thus, unless he had been absolutely compelled by the exigencies of his position.

Amongst the most important methods of recognizing the true comma bacillus, has always been placed even by Dr. Koch himself, its action in liquefying gelatine and the special appearance it presents in doing so. But Dr. Koch now gives us a hint that we must not expect this any longer. He says that some true comma bacilli are found in cholera that show little tendency to liquefy gelatine (*eine sehr geringe Neigung zur Verflüssigung besitzen*). It would appear as if the comma bacillus was fast losing its special characteristics.

Dr. Koch tells us now that the comma bacillus can be recognised at present by the microscope alone, but previously we were assured that its other characteristics were necessary to secure a certain recognition. Dr. Koch himself said in his "Conferenz zur Erörterung der Cholerafrage" that "they bear the closest resemblance to the *Spirochaetæ* of relapsing fever, I could not distinguish one from the other if I had them side by side." We concur with Dr. Koch in thinking that, with the great extension that is rapidly taking place in the connotation of the term comma bacillus it may be quite possible in future to recognise it by the microscope alone, but it would, we think, be wise to continue to accept the assistance afforded by the mortality.

If our readers will turn to the second number for the year 1893 of the *Deutsche Medicinische Wochenschrift** they will find an account of an epidemic of so-called cholera nostras. The disease in this case attacked by preference male adults. It had all the symptoms of typical Asiatic cholera. It occurred at Wesel, on the direct line of railway between Hamburg and Belgium, whither much cholera was brought from Hamburg, and it took place while cholera was raging severely at the latter place, and it killed 83 per cent. of those attacked, and yet this epidemic is declared off-hand to be cholera nostras because the comma bacillus was not present, the author remarking with great simplicity that it certainly was unusually fatal for cholera nostras. One of the cases related was, if there be any truth in clinical evidence, without any doubt whatever Asiatic cholera. Can any proceeding be more dangerous? It was Hamburg again, without the tragedy.

There is, as we have said, no objection to defining cholera as a disease with a comma bacillus as long as it is clearly understood what is meant, nor is there any harm in calling the stomach alkaline in cholera as long as the facts are understood. Equally one may term the condition produced on man by administering the comma bacillus, cholera; though unless it interfered a little more with the general health it could scarcely be called an appropriate name.

But some of the cases of infection by cholera are of a rapidity that is simply startling. There is, for instance, the case of a seaman† residing at Cardiff in South Wales. He went on board an infected ship, the "Cadrau," in the after-

* "Eine Epidemie von Cholera Nostras," von Dr. KARP. *Deutsche Medicinische Wochenschrift*. No. 2. 1893.

† *British Medical Journal*, 12th September, 1885.

noon, and at five o'clock he drank some water from the ship's supply ; he was seized almost directly with the symptoms of cholera, of which he died at *nine o'clock the same evening*. This is far too rapid to be caused by the growth of a microbe, especially where that microbe can be proved not to enter the blood. In diseases undoubtedly caused by microbes, where these organisms do enter the blood, as anthrax, nothing approaching a rapidity like this has been seen. But cultivations of the comma bacillus take generally 24 hours to show anything like a characteristic increase ; it is scarcely credible, then, that they should be able to increase to such an extent as to destroy life in four hours.

In this connection it may be well to recall what we have said in regard to the great differences presented by different cholera epidemics. On one occasion we saw a singular illustration of this. In a town in Southern Europe there were two distinct types of cases ; on examination it was found they came from different quarters of the town, and there was good reason to believe that two separate sources of infection had been introduced into the town from without. For a week it was easy to distinguish from which source of infection the patients obtained the disease. After that the two epidemics blended, and it was no longer possible to make a distinction.

We have thus the facts that pure cultivations of the comma bacillus have been repeatedly taken by individuals without on one occasion producing cholera ; that many experiments are here recorded, both in men and animals, in which every effort was made to obtain a positive result, and in not one was anything like cholera produced ; that we have witnessed many experiments made by others to show that cholera could be caused by the comma bacillus, and yet in not one of them was cholera manifested. On it being pointed out to the experimenters that the condition was not in the least like

cholera, on more than one occasion the astonishing reply was given, "It must be cholera for it was caused by the comma bacillus." It is difficult to deal seriously with an argument like this. It is first assumed that the comma bacillus is the cause of cholera and then cholera is defined to be a condition produced by the bacillus. A position that only admits of an empty assertion of the point to be proved is of a character much more than dubious. We have, in addition to these, the fact that cholera can kill a strong man in a few hours with the most intense symptoms, but the most that has ever been effected by the comma bacillus is a mild diarrhoea. Again, water like that at Hamburg and Szerb Aradcz and Buda-Pesth can produce most virulent cholera, and yet contain no trace of the comma bacillus; but that, on the other hand, pure cultivations of the comma bacillus have been eaten in considerable quantities by numerous individuals without once causing the disease. It is not, we hope, being too exacting to expect that the cause of cholera should, sometimes, at any rate, produce its effect. But, even regarded as a mild aperient, the comma bacillus cannot be depended on.

Dr. Koch states that the comma bacillus is rapidly killed by an acid condition of the stomach, but as a rule in cholera the stomach is acid, and sometimes intensely so. Moreover, when an outbreak of Asiatic cholera occurred directly under the observation of Dr. Koch's followers, it took a week, and the death of 128 persons, and the threatened interference of the foreign consuls before they were able to diagnose the disease by means of the comma bacillus. We have beyond this the testimony of numerous independent observers that cases of pure Asiatic cholera occur during an epidemic without it being possible to discover the presence of the comma bacillus, and that these cases differed in no respect from the typical disease either in the nature of the symptoms or in the result.

We have, in addition, the extreme rapidity with which

infection occurs in certain cases of cholera—a rapidity too great to be accounted for by the mere development of microbes, and the fact that the comma bacillus is killed by being dried, but that the causative agent of cholera appears to resist the process of drying singularly well.

From these considerations it will probably be conceded that a great deal more evidence than has yet been given must be adduced before it can be considered even probable that the comma bacillus is the efficient cause of cholera, and that this evidence must take the form of a clinical demonstration before competent authorities that the condition produced is really Asiatic cholera. We think the subject is so important that no trouble should be spared in coming to a definite conclusion as to the causation of this disease.

But in regard to the diagnosis of Asiatic cholera we think there can be but one opinion. Asiatic cholera is a disease with very marked characteristics; it has a wide range of lesions; and it is a disease with a high rate of mortality—a rate so high that no modern European epidemic disease can compare with it. We have seen that independent observers have been unable to detect the comma bacillus in many cases of it, and we have also seen the terrible consequences that have ensued from waiting for the recognition of the comma bacillus before pronouncing the diagnosis of cholera. It is, therefore, clear that if a city or province should have a disease of the nature of Asiatic cholera, it is an imperative duty to declare the presence of cholera at once. But to have cholera, to conceal it, to send ships filled with this terrible scourge all over the world, as Hamburg did, simply because a bacillus which those fully in a position to judge do not consider an integral part of the disease has not been found, is an act that it would not be possible to censure in terms sufficiently strong.

But some of the subjects connected with the etiology of

cholera are not so obscure. For instance, that it is frequently in some way connected with water supply is now very generally recognised. As early as 1856 Simon published a most interesting paper on the relation between the water supply of London and the cholera in two epidemics. He shows that in 1855 there were two water companies supplying South London—the Lambeth Water Company and the Southwark and Vauxhall Water Company.* The Lambeth Company took its water from the Thames high up above London at Ditton, but the Southwark and Vauxhall Company took the Thames water from London itself at Battersea, where it was freely mixed with sewage. It may be remarked that Londoners have a taste apparently for drinking sewage. In those days they drank their own sewage; now they prefer to drink the sewage of other towns, such as Oxford and Reading, higher up in the Thames basin. The difference does not appear to us material. Simon shows that there was no distinction between the position of the houses supplied by the Lambeth Company and by the Southwark Company. Very often part of a street would be supplied by one Company and part by another. He states that in the 24,854 houses supplied by the Lambeth Company, having a population of 166,906 persons, there were 611 deaths, being at the rate of 37 to every 10,000 living.

But in the 39,726 houses supplied by the Southwark and Vauxhall Company, with a population of 268,171, there were 3,476 deaths, or 130 to every 10,000 living, or in other words $3\frac{1}{2}$ times more; so great is the effect of impure water in the production of cholera.

In the epidemic of cholera in London in 1866, which cost

* "Report on the last two Cholera Epidemics of London as affected by the Consumption of Impure Water," by JOHN SIMON. *London*, 1856.

5,548 lives, Radcliffe* pointed out that the mortality throughout the whole area of London from cholera was 18·4 for 10,000 population, but that in Stepney, which was supplied by the Old Ford works of the East London Waterworks, deriving its supply from the River Lea, the mortality was 107·6 for 10,000 population. Also, that in Whitechapel, which has two sources of supply, the New River Company and the East London Water Company, the death rate was 30 per 10,000 in the area supplied by the New River Company and 70 per 10,000 in the area supplied by the East London Waterworks; a great difference, but not so great as in the instance given by Simon.

The facts about Hamburg are also very interesting. Hamburg is a city of about 500,000 inhabitants, situated on the right bank of the River Elbe, which at this spot is strongly tidal. The sewers of Hamburg discharge into the Elbe, just below the town—the water supply is drawn from the Elbe immediately above the town,—and it is so arranged that, when the tide is flowing, the contents coming from the sewers are carried high up the river above the point whence the water supply is drawn. Practically, there is no attempt at purification of the water, which is pumped direct to supply the town. It is probable that, in some way which cannot now be traced, and we spent some time in endeavouring to ascertain the facts, the river became infected, the whole of the town suffered, and on August 30th there were 484 deaths from cholera alone. Dr. Reincke† has shown that though the cholera invaded all parts of the town, yet in the Altersdorf Institute (with 375 inmates), the Pestalozzi Institute at Barm-

* "On Cholera in London, and especially in the Eastern Districts," by JOHN NETTEN RADCLIFFE. London, 1866.

† "Die Cholera in Hamburg," von Dr. J. J. REINCKE, *Deutsche Medicinische Wochenschrift* No. 8, 4, 5. 1893.

beck (with 94 inmates), the Central Prison (with 1,100 inmates), and the House of Correction (with 600 inmates),—all these institutions being supplied with water from their own wells, and having a total population of 2,169 persons—not one case of cholera occurred. But in Hamburg generally the mortality from cholera during the epidemic was 130 for 10,000 population.

One of the best known cases of cholera being communicated by water is that recorded by Mr. C. Macnamara.* We give it in his own words:—"I may mention the circumstances of a case which occurred in another part of the country, but in which the most positive evidence exists, as to the fact of fresh cholera dejecta having found their way into a vessel of drinking-water, the mixture being exposed to the heat of the sun during the day. Early the following morning a small quantity of this water was swallowed by nineteen persons (when partaken of, the liquid attracted no attention, either by its appearance, taste, or smell). They all remained perfectly well during the day; ate, drank, went to bed, and slept as usual. One of them on waking the next morning was seized with cholera. The remainder of the party passed through the second day perfectly well, but two more were attacked with cholera the next morning; all the others continued in good health till sunrise of the third day, when two more cases of cholera occurred. This was the last of the disease; the other fourteen men escaped absolutely free from diarrhoea, cholera, or the slightest malaise."

The statement is very clear, and is of interest also in showing that the same infecting matter does not always produce cholera in the same time; the last cases taking three times as long as the first. The cause of the delay appears to have been in the individuals themselves therefore in this case.

* "Treatise on Asiatic Cholera," C. MACNAMARA. *London*, 1870, p, 196.

It is often stated that a river is poisoned with cholera, and there can be little doubt but that the statement is accurate. In 1892, for instance, the Danube was certainly poisoned. But the Danube is an immense river flowing along at the rate of at least three miles an hour—the water passing now, is three miles away in an hour's time, its place being supplied by fresh which comes from mountain and forest streams, but it is nevertheless all poisoned. It will be noticed also that certain regions in a poisoned river are more dangerous than others. Some rivers, too, such as the Ganges, are apt to become infected from below, the cholera taking its origin in Bengal ascends the river—a thing it could hardly do if it were water-borne. These considerations lead one to the conviction that it is not the water that is primarily poisoned but the bed of the river, and that the water receives its poison as it passes along. In the earlier accounts of cholera in India reference is often made to epidemics of cholera breaking out in boats sailing on the Ganges, and it is sometimes said on leaving a certain district the cholera ceased. Supposing they were traversing at the time a region where the bed was strongly poisoned, leaving that part would explain thoroughly the cholera ceasing. But if it were the water only that was poisoned, as the stream flowed on the poison would flow with it. It is probable, therefore, that it is the bed of the stream that is the important agent in poisoning a river.

This fact is very unfavourable to the view that the comma bacillus is the cause of cholera. The comma bacillus, it is true, can lead an independent existence in cultivations, but it does not propagate below 16° C. (60°·8 F.). But the Danube yielded much poison when the temperature was far below this. Also, when the comma bacillus has been placed in soil or water mixed with other microbes it, as a rule, quickly disappears. It seems not to be able to withstand the "*concurrency*" of true saprophytes; but from these facts the real

cause of cholera appears to be able to do so with great ease.

If there were any difference between the intracellular poison and the metabolic it would be reasonable to expect that the river water would contain more of the metabolic poison, and that some difference would exist in the disease when it had its origin from this source. But though we have seen a large number of cases of river infection, and have examined them with care, we have been unable to notice any difference in the nature of the disease.

Though we think the evidence connecting water supply and cholera to be conclusive, yet there are many cases that cannot be explained in this way. Professor Parkes, in his investigations into the outbreak of cholera in Southampton in 1865, gives some cases in which he states that there was no evidence of its origin from water. And in Mr. Radcliffe's Report, already quoted, he says that an explanation founded on water-supply would not account for the outbreak of cholera in the City of London Union Workhouse in 1866. In the Marienkrankenhaus, in Hamburg, in 1892, thirteen inmates were seized with cholera, though only boiled water was used in the establishment both for washing and drinking. Moreover, though one may believe in water being a most potent factor in the production of cholera, that does not at all imply a belief in its being caused by Dr. Koch's organism, which can be eaten with impunity in almost sufficient quantities to form an article of diet. Nor has Dr. Koch's theory added one particle of evidence to the subject of the causation of cholera by water; in fact, it has told quite the other way. If Dr. Koch's bacillus is the cause of cholera, why should it be so often absent from the water that has apparently caused the infection?

* "A Report by Professor PARKES, M.D., F.R.S., on the Outbreak of Cholera in and about Southampton in September and October, 1865," pages 395-397.

But Dr. Koch himself says that the medical officers he met in Bengal attributed the diminution of cholera to the better water supply; so that his theory has had nothing to do with that recognition, and Simon's paper, which is quite conclusive on the subject, was published when Dr. Koch was, we believe, about ten years old.

So, also, there is not much doubt now that cholera is carried chiefly by human intercourse. Toulon was quite free from cholera till it was introduced by the "Sarthe." The deaths at the quarantine station at New York lately are also good evidence in point. It may, however, be well to give authentic instances of cholera being carried by man. In the village of St. Paterno, Calabro, Italy, three young men returned at the end of July 1884 from Tunis. They had come *via* Marseilles; one was ill with diarrhoea during the journey, and the two others on their arrival. On the 4th August the father of these three young men died of cholera, and from this the disease spread in the neighbourhood. At Castel Nuovo, in Central Italy, after 14 artisans had returned from Marseilles and Toulon, where the disease was raging, the epidemic broke out in August 1884 and affected 126 persons, of whom 73 died out of a population of 5,094.* We have elsewhere given other instances.

It must also be admitted that linen and clothing coming from an infected source can most certainly convey the disease. At Palermo, on August 25th 1885, the first case occurred in a woman who had washed some dirty linen received from the Italian Navigation Company's ship "Selunto," and a fearful outbreak of cholera followed. It was clear that the *first* case occurred in a woman who had *handled* the linen. It appears to us that in many diseases infected clothing is a far more

* "Il Colera in Italia negli Anni 1884 and 1885" Roma, 1885.

efficient means of conveying disease than the persons bearing it. It is a question whether clothing of any kind should ever be admitted into a healthy town from one infected with any of the more serious communicable diseases without undergoing thorough disinfection.

But there are some epidemics the origin of which it is extremely difficult to trace. We will give as an illustration a case which we personally investigated at the time of its occurrence.

Lonigo is a small country town 28 kilometres (about 18 miles) south-west from the capital of its province, Vicenza. It is connected by railway with Vicenza, but the station of Lonigo is five kilometres (a little over three miles) distant from the town, and there is a steam tramway connecting it with its station. Cholera was raging in Venice early in 1886, but the first case that occurred in the province of Vicenza happened in the chief town itself on the 1st May, 1886. Lonigo, however, remained free from cholera during the month of May. But on the 26th June, 1886, a peasant living about half a kilometre (a little over a quarter of a mile) to the south of Lonigo was seized with cholera, and died suddenly. He had never left the town, and had received no guests in his house. The next day another person, living two kilometres (a little over a mile) to the west of the town, was attacked. He also had never left the town. The disease then appeared in the middle of the town, and a most severe epidemic followed. At the same time two towns, Tavernelle and Montebello, between Lonigo and Vicenza, both on the railway, escaped altogether.

None of the houses first infected had received guests, and no clothes had been obtained for washing. It is such a small place that everything that goes on is known to the inhabitants. Now, it happened that exactly eleven days before the cholera broke out—that is, on the 15th June, there had been a fair held at Lonigo, which is a great centre for the

bozzoli (silk-worm cocoon) industry, and it was attended by many strangers coming from all parts of the Delta of the Po. But no stranger passed the night there, and none of the visitors were ill. How, then, was cholera introduced? If, in a town in Europe severely affected by cholera, a house to house visitation be made, it will be found besides those lying sick there are very many who are distinctly choleraic, probably quite as many as those actually suffering. These individuals have one of the two choleraic aspects, either a slight appearance of having suffered some loss of fluid, or the dazed confused appearance of typhoid cholera. But they do not feel ill, and go about their business as usual. Some of them admit having had considerable diarrhoea, but not all; some of them have had abdominal uneasiness; and some will have a subnormal temperature. We have kept some of these cases under observation. Some of them develop the complete disease often suddenly and fatally, others never go beyond the state we describe. We have known some of these commit great improprieties in the matter of diet and yet without result. We believe there are many individuals that cannot develop the full disease. It is these individuals that are to be feared, and are chiefly concerned in spreading the malady. A person in whom the full cholera process takes place is comparatively harmless—he is, naturally, confined to his bed,—but one that has the poison in him and can go about his usual affairs is most dangerous. It was, no doubt, one of these individuals coming from an infected district that brought the disease to Lonigo, and this is the reason why Tavernelle and Montebello—nearer to Vicenza, but where there was no fair—escaped.

The great difficulty in investigating the etiology of cholera and of most other epidemic diseases arises from the great difference in personal susceptibility to the poison in individuals. It will be best to illustrate this further. One

person living in the midst of several thousand persons develops, we will say, cholera or typhoid fever. The population around is unaffected. The air, the water, the soil, and the food of the person affected differ in nothing from those shared by many thousands around him. But he alone evolves the disease. An attempt is made, and rightly made, to find out some condition to which he has been exposed, but to which the others have not. The attempt is not successful, and it is then believed that he alone has been subjected to the influence of some causative agent which has produced the disease which the others have not been subjected to, but that this agent has eluded research. We believe this line of reasoning to be often quite erroneous. The real view to be taken is that in all probability the others have equally been exposed to the causative condition, but, through their greater resistance, it has not caused the disease. We believe, from repeated observation, that a cause acting on thousands of persons shall only be able to produce its effect on one of them. The process, therefore, of finding a cause by the exclusion of causative elements that are common to those instances in which the effect is produced and to those in which it is not produced, though most valuable in most sciences, often fails completely in medicine, through the resistance of individuals to the causative element, or, to put it more accurately, to the extreme susceptibility of certain individuals who react to a cause that would be quite inoperative to thousands.

It is this comparative immunity from cholera that forms one of the most peculiar features of the disease. In Europe even, there are many individuals who seem quite incapable of taking cholera even if they are most reckless in every respect. But in India the greatest differences are to be noticed. Dr. Vincent Richards* pointed out that members of the Dhangar tribe

* "Cholera amongst Dhangar Coolies on board the Assam Steamers," by Dr. VINCENT RICHARDS. *Indian Medical Gazette*, Oct. 1877.

proceeding from Birbham to Assam could scarcely pass through the endemic choleraic district of Lower Bengal without contracting the disease. Probably the aboriginal of Lower Bengal has the greatest resistance to cholera of any person. We investigated an outbreak of cholera on board a ship in Calcutta in 1878. The disease was confined to the fore-castle of the ship. The officers and men had nearly everything in common. They drank the same water, they breathed the same air, and they lived within a few yards of one another. But only the men suffered. Now the men attacked had bought some milk from one of the milk-sellers that ply their trade on the Hughli. The officers had only used preserved milk. The next day after using this milk five of the men developed cholera in its most severe form. We were able to find the man who had sold them the milk. We accompanied him to his house where he kept his cows, which was on the bank of the little stream that runs to the south of Calcutta. This stream is so filthy that it would be impossible to give an idea of it were it not fortunately for the Thames. It will be enough to say it is nearly as foul as the Thames at London Bridge. This filthy water he mixed with his milk. But anybody who is acquainted with the habits of the natives of Lower Bengal will entertain no doubt but that both he and his family drank the water too. But though we carefully observed them, they remained in perfect health.

It is often said that cholera is not communicable by the person or by the contents of the wards where cholera patients are, and in support of this it is stated that the attendants on the sick and those who remove the discharges from the cholera hospitals in Bengal never take the disease. But there is a fallacy under this. Probably there is no one so absolutely insusceptible to cholera as the attendants in these cholera wards. They belong to the lowest caste of the aborigines of

Bengal, and they, and their forefathers before them, have been saturated with cholera poison for centuries. If they could have taken cholera they would not be surviving now. But it would not be safe to apply the same reasoning to the inhabitants of Western Europe, who are very sensitive to cholera poison. But the cases are too numerous where persons—extremely susceptible, no doubt, to cholera—have contracted the disease by handling clothing probably contaminated with cholera discharges to allow of any doubt but that the disease may be communicated in this way.

Dr. W. J. Simpson,* the Health Officer of Calcutta, however, says “the evidence as to the immunity of attendants is not so strong as could be desired,” and he quotes Dr. Davidson to show that in India in the year 1883 for every 1,000 European soldiers 1·5 was admitted for cholera. But of the 254 attendants 4 persons was attacked, making 15·75 per 1,000. So, among the 114,830 native troops there were 307 cases of cholera, giving 2·6 admissions per 1,000. But of the 677 attendants 15 persons contracted the disease, or 22·15 per 1,000. This is very strong evidence against the attendants having any immunity. It should, perhaps, be remarked that the attendants in the vast majority of cases were probably not Bengalis, who as a rule show a marked reluctance to have any connection whatever with military matters, but were natives of other parts of India, and therefore more susceptible to the disease.

Although there is a connection between cholera and a high temperature of the atmosphere in Europe, July and August being usually the months in which epidemics occur, yet a

* “A Resumé of some of the more important facts relating to Indian Cholera,” by W. J. SIMPSON, M.D., Health Officer, Calcutta. *Indian Medical Gazette*, May, 1893.

cholera epidemic can run its course in spite of great depression of temperature. Dr. Max v. Pettenkofer has made well known the winter epidemic in Munchen in 1873-4. In Russia cholera raged with great severity in the winter months of 1830-31. We saw cases of severe cholera in Hungary in the winter of 1892-93, with the thermometer at -9° C. (15° F.). This does not, of course, by any means exclude the possibility of cholera being caused by a microbe, but it is distinctly unfavourable to the comma bacillus. It will not grow in a low temperature, and Dr. Koch himself says it ceases to increase below 16° C. ($60^{\circ}\cdot 8$ F.).^{*} When the temperature was depressed it was with difficulty we could make cultivations of the comma bacillus in a room artificially warmed without resorting to the thermostat; but Nature herself seemed to have no difficulty whatever in preparing the efficient cause of cholera at a temperature much below this.

That lowness of situation is a condition very favourable to the production of cholera is well known. Cholera has its home in the low-lying tracts of the East, watered by the great rivers. The Deltas of the Ganges, the Godavari, and the Irawadi, are its permanent dwelling-places.

But we have seen that, when it is transplanted, it can flourish at very considerable heights, as in the Himalayan Hill stations and on the Mexican table-land.

But though in Europe it can establish itself for a time it does not appear to be capable of real acclimatization. In no case has it permanently remained there, though there are many conditions that one would think would be favourable to it. It is to continuous re-introductions, therefore, that it owes its existence amongst us.

When we were considering the cholera process in its

^{*} "Conferenz zur Erörterung der Cholerafrage." *Berliner Klinische Wochenschrift*, No 31, 1884.

entirety we saw how complex it was. We noticed that the diarrhoea bore no proportion to the enteritis, and that special toxic effects might be present not related to either. It would seem probable, then, that the material producing cholera is not simple in nature but complex, and that in some cases it may be proportionally stronger in some directions than in others.

That cholera poison is in relation with microbic organisation is highly probable from its intimate connection with alluvial soils, climatic conditions, with water and physical circumstances generally; but when it comes to the proof of its connection with any particular organism then the difficulties are very great. Dr. Franz, of the Austrian army, a careful observer, informs us that at least 61 species of bacteria are to be found in ordinary cholera cases. We have, we believe, seen true cholera produced in animals, but it could not be done at will. The presence of the comma bacillus did not appear to us to be the influential agent. Often, when present in overwhelming numbers, no effect whatever could be produced. But the efficient organism, from the circumstances here given, would appear to be one that can withstand considerable vicissitudes—it can multiply at low temperatures, it can survive being dried, it can remain dormant for many months without losing its vitality. But the evidence at present available will not allow of any predication more exact.

CHAPTER VII.

THE METHODS OF ARRESTING EPIDEMICS OF INFECTIOUS DISEASE.

EXPERIENCE has abundantly shown that, when infectious disease has once broken out, it is too late to organise with success the means of stamping it out. To enable an epidemic of any kind to be arrested at its commencement, the framework, at any rate, of the organization for dealing with it must be ready. To await for the appearance of an epidemic before preparing any of the means for coping with it, is like waiting for a conflagration before organizing a fire brigade. In these days of crowded populations, every centre should have always prepared the means of dealing with an outbreak of infectious disease, so that all that should be required on its occurrence should be mobilisation. As we have witnessed many epidemics under different forms of government we think it may be useful to give an account of those methods which we have seen in practice which have appeared to us most efficacious in suppressing outbreaks of communicable disease.

But one of the first and most important matters to consider in regard to the prevention of infectious disease is the efficacy or injuriousness of quarantine. The views expressed are usually diametrically opposed. We have those who hold that it is right both in theory and practice to adopt strict quarantine and to cut off all communication at once with an infected place whether by sea or land; and we have those

that believe that these measures, if undertaken, are not only vexatious, but in addition totally useless. It may be advisable to consider the question somewhat in detail.

Quarantine may be conveniently defined as the interference with free human intercourse for the sake of preventing the introduction of communicable disease, whether it is effected by hindering persons from leaving an infected place, or by preventing them entering a district not infected. Viewed in this light it is one of the oldest of human institutions. The Mosaic law recognised to the full the right of the community to isolate any persons suffering from communicable disease. Were it possible to isolate every one who had an infectious disease, according to the Mosaic idea, the number of contagious maladies in the world would indeed be very limited. But though conscientious efforts have often been made to arrest disease in this way, the failures have been numerous, and therefore there are many who believe every attempt in this direction to be completely useless.

The first thing that must strike anyone who considers the question of quarantine is that the condition of various places in regard to site, geographical position, and possibilities of quarantine, differ most widely. We have, for instance, a city like Calcutta, situated in the densely-populated plain of Bengal, with free communications in all directions by road, by rail, and by boat. We have, on the other hand, islands in mid-ocean, like Mauritius, or Teneriffe, separated from other lands by distances that would take days of sailing to pass over, and where the arrival of a vessel is an event. To draw a sanitary cordon round Calcutta to prevent anyone leaving it would be practically impossible. To surround it, and Howrah, its suburb on the other side of the Hughli, would require an army; even in war it would not be possible to accomplish it. It is a well-known fact that, in spite of the most strenuous efforts of the Germans, many persons escaped both from Paris and

Metz. We have heard from a person whose brother managed to leave Metz the way in which he accomplished his object. Shortly, it may be said that he ran a very great risk of being shot, but was not. But a sanitary cordon could never be enforced with the merciless severity of a blockade by Moltke; in our efforts to benefit mankind we can never hope to compete successfully in our methods with those whose object is only to injure. In efforts to accomplish good, mercy and humanity must be regarded; but those who have only to contrive harm are, fortunately, not hampered by any such considerations. Mankind will probably for long concede greater liberty of action to those whose object is to injure than to those whose aim is to benefit. The former must naturally therefore be much more successful.

But all places are not under the same conditions as an inland town. As we have said, there are islands in the ocean, and whole continents, completely isolated from the rest of the world. Is it, then, impossible to regulate the intercourse between them and an infected spot so as to reduce to a minimum the chance of introducing infectious disease? It is clear that it is quite possible. In the West Indies there are islands from which yellow fever is never absent. There are others where it is the rarest visitor. Are we then to make a hard and fast rule because we cannot isolate Calcutta completely from Benares, or Hamburg from Berlin, that such clean islands as Antigua and Barbadoes should receive without question all the diseases bred by the atrocious filth of Cuba and Hayti. It would not be possible to enforce such a rule, for the inhabitants of the properly and sanitarily administered islands would rise *en masse*. In the island of St. Christopher it is, we believe, twenty-three years since an epidemic of yellow fever occurred there, so carefully is supervision exercised over incoming ships, and so well attended to are sanitary rules.

In contrast to this we give a recent telegram from Cuba, published in the papers:—"Havana, January 9th, 1893. The situation is exceptionally serious. Typhoid fever has broken out with renewed force. The yellow fever continues its ravages. Diphtheria is extending with alarming rapidity, and malarial fever under all its forms is prevalent." And yet certain sanitarians tell us that, because we cannot isolate Delhi from Lahore, it is wrong to attempt to limit the consequences of the filth of Cuba to its own inhabitants. It is obvious that the well ordered islands of Jamaica, Santa Lucia, Nevis, and Barbadoes, are not only justified, but imperatively called upon, to protect themselves from the consequences of the disgusting condition of such places as Santos and Port-au-Prince.

But, though we think it is quite justifiable to exercise the strictest supervision in those cases where it can be shown by conclusive evidence that disease can be arrested in its progress by means of this nature, we think also that the greatest care should be employed not to interfere more than is absolutely necessary with free intercourse. A rule subjecting all ships under any conditions to a strict quarantine errs just as much as attempting to isolate Calcutta from Benares by a sanitary cordon.

Therefore, in framing rules for the supervision of intercourse, we should use all our intelligence to interfere as little as possible, and to see that that interference should be used to the greatest possible advantage for the object we have in view, and to take care that our regulations should be as little irksome as possible.

It will no doubt be remarked that localities can be placed in three classes according to their position in regard to the supervision of which their intercourse is capable. There are towns in a continent having free communication in all directions. There are islands situated near the mainland and

seaboard towns. Lastly, there are ocean-surrounded islands and continents completely isolated by oceans, as America and Australia.

In the first group of towns in a continent, quarantine and sanitary cordons are an impossibility. They have failed over and over again. But it must be remarked that they fail, not because they stop human intercourse, but precisely because they do not. Nobody has any real difficulty in passing a sanitary cordon, and we have had some experience. The most conspicuous failures have been in Russia and Spain, just exactly where you would expect them to fail. Take up a Spanish newspaper, and see what is openly said about the administration of justice. You can scarcely expect the officials of a cordon to be more scrupulous than those of the judicial department.

These measures, therefore, must fail under these conditions. Can, then, nothing be done to protect a population thus situated? We think that people in the present day are sufficiently intelligent to submit to some little inconvenience if they can see the utility of it. We believe it is quite reasonable and practicable to ask persons coming from a place infected with any serious disease, whether cholera, typhoid, small-pox, plague, cerebro-spinal meningitis, scarlet fever, yellow fever, diphtheria, or typhus, to notify to the sanitary authority of the district into which they are moving that they have come from an infected place, and that they should submit to having their clothes disinfected, and especially their soiled linen. In travelling abroad we have several times been served with notices when leaving a town infected that we should report our arrival to the authorities at the town to which we were going, and we have always carefully complied with the regulation; and though it has caused some inconvenience, we thought it quite right and reasonable to submit to it. The help that this method gives on the occurrence of a

disease with some obscure symptoms is very great, and often valuable time is saved which might otherwise be lost in uncertain conjectures. The more intelligent the population the better the system works. In France, whose population is undoubtedly the most intelligent in Europe, it has been used with great advantage. It is necessary for this system that every town infected with an epidemic disease should at once publicly declare the fact. But this is a rudimentary detail in sanitation. It necessitates, also, a central directing sanitary authority for the country, like the Gesundheitsamt in Berlin, of which we have no equivalent in England.

In islands near continents, and in seaport towns, the conditions are somewhat different. Ships arriving can be carefully inspected, with all the persons on board. In these cases great judgment should be used not to interfere unnecessarily. But we think that, if there is any reason to believe that a communicable disease exists on board a ship, it is quite legitimate to isolate any suspected person, to keep the remainder under observation for a reasonable time, to thoroughly disinfect everything that could act as a carrier of infection, and to purify the ship thoroughly, especially as regards its drinking water and its bilge water. It is perfectly justifiable to detain a suspected ship till all danger from her is over. We believe that carefully considered rules of supervision like these are capable of doing great service in preventing the introduction of communicable disease, and we do not hesitate to say that we think it permissible to retain under observation the whole of the persons on board a vessel if there is reason to believe that any of them may be infected, till the risk arising from that infection is over.

So, also, there is evidence that the careful supervision of routes that are well known to be the chosen tracks along which communicable disease travels, has been attended with success in checking its progress. There is no doubt that

Egypt owes its recent comparative immunity from cholera to the care that is exercised in restraining infected pilgrims from entering the country on their return from Mecca. The quarantine station of El Tor has abundantly justified its existence. We think, also, if a ship having cholera on board is allowed to proceed through the Suez Canal, it ought, in the first place, to be only to some small Mediterranean isle used as a quarantine station, till all danger of the disease is over. The few days' delay in the pleasant climate of the Mediterranean is a small matter compared with the risk of introducing cholera. Had this been done in the case of the "Sarthe," which brought the epidemic of 1884 to Europe, hundreds of thousands of victims would have been spared a cruel death. We do not think it justifiable to compel a ship to lie off Suez, in that intolerable climate, because she is suspected to be infected, for that would mean in many cases almost certain death to any invalids that might happen to be on board. Nor do we think it right that she should be permitted to at once follow the usual crowded paths of commerce, as is at present done.

In the third group, where a great extent of sea is interposed between the country to be protected and the source of infection, there is evidence, also, that carefully directed supervision, together with isolation if necessary, is perfectly capable of preventing a communicable disease from entering. Cholera, when introduced into America by ships in 1832, 1848, and 1854, spread with terrible fatality through the continent. But in 1865 the ship "Atlantic," that had cholera on board, was strictly isolated, and no epidemic followed. But the next year the "England," under similar circumstances, was allowed to enter, and an epidemic resulted. In 1892 the ships "Normannia," the "Moravia," and others, in spite of assertions that they had no Asiatic cholera on board, but only the cholera

nostras of Hamburg without the proper bacillus, were subjected to isolation, the American authorities, with sound judgment, deciding that cholera should be judged by its characteristics and effects, as is done in all other diseases. The result of this was that, though a large number of deaths occurred in the quarantine stations, the disease completely failed to obtain an entrance into the country. This year (1893) the restrictions were much lessened through the influence of persons financially interested in the Chicago Exposition, and many rumours of suspicious outbreaks have found their way into the press. But we do not think it likely that America will lightly abandon a barrier so effectual with which Nature herself seems to have provided her.

So we have seen how the Canary Islands were saved by quarantine by being infected from the Grand Canary in 1851, and how the West Indian Islands were protected by the same means from the infection of Guadeloupe in 1865. An efficient isolation is a complete protection, but an inefficient one is a great deal worse than useless.

It may be pointed out here that the real weakness of the defence of America against epidemic disease is the incompetency of the sanitary administration of the Central and South American states governed on Iberian and Negritic principles. It is only necessary to mention again the names of Santos and Port-au-Prince to carry conviction on this subject.

Cholera has also never been introduced into Australia and New Zealand through the care exercised, and what is of great interest also, hydrophobia is completely absent. Even animals, therefore, can be protected in this way. All animals capable of suffering from this disease are kept for a time under observation before they are permitted to be introduced. The result has been complete freedom from hydrophobia—a thorough proof of the efficacy of these measures.

Thus each country differs in the degree of protection that

supervision of intercourse can confer, and no rule of universal applicability can be formulated. Each state should, and no doubt will, enact those laws which are best suited to it; so that there is no difference in this respect between sanitary rules and any others. It is notorious that the two first communities to enforce quarantine on an outbreak of communicable disease occurring in the Mediterranean are the British dependencies of Gibraltar and Malta. Malta, for instance, enforced quarantine at the very beginning of this year. It is to be regretted that the Governor of Malta, Sir Henry Augustus Smyth, should have neglected to reply to two English ladies, who recently wrote to him complaining of the indelicacy of the accommodation provided for them, as reported in the public press. It may be a grievous necessity to enforce quarantine, but the public should insist that no gratuitous rudeness is added to it—the inconvenience and suffering inflicted are sufficiently great without it.

In organizing the sanitary department of a city to deal with infectious disease, the first essential is that there should be a head sanitary official, with a central Sanitary Bureau. The chief sanitary official should never be permitted to have any connection with private medical practice, which cannot fail to occupy too much of his energy, besides threatening seriously to interfere with his usefulness in administration through difficulties in connection with private interests. This of course is obvious, and all the best administered towns of which we have knowledge have a chief sanitary official without any other duties than his official ones. In connection with the Sanitary Bureau is the statistical office, where all the latest information in regard to the distribution of disease, and the condition of the hospital accommodation, is to be found. Attached to the Sanitary Bureau should be the ambulance department, for only in this way can the ambulances be

furnished to the different districts in proportion as they are required—as different districts do not usually suffer in the same degree or at the same time.

The city itself should be divided into districts for effective supervision, and these divisions will be naturally those that are employed for administrative purposes. In each of these should be a sanitary office, which should be in the closest communication with the central office, and during an epidemic each of these sanitary offices should have a medical officer always on duty for the purpose of seeing any sick that are reported to him. Added to each office should be a *depôt* for the supply of any medicaments that may be required, and for the gratuitous distribution of disinfectants. But to the Central Bureau should be attached a body of skilled disinfectors with all proper appliances for disinfection, so that, when a house is declared infected they should proceed to it, clean it, flush the water-closets and drains with disinfectants, and remove all dangerous clothing used by the sick to the disinfecting apparatus, and return it when properly disinfected. This service should be gratuitous. It is of the highest value ; and we could mention a city where the means of acquiring diphtheria are almost unlimited, but by very careful disinfection of all possible sources when a case occurs the mortality from the disease is kept within quite reasonable bounds. That London has no proper organisation of this kind is greatly to be deplored.

We have said that all services of disinfection should be gratuitous. We have seen both the paying systems and the gratuitous system in action, and we think that if ever there is a condition when assistance should be given from public funds it is in endeavouring to arrest or limit an epidemic. In Germany we have known as much as £1 5s. demanded by the authorities for disinfecting one small habitation. In another case a gentleman with whom we are acquainted was com-

pelled to pay five shillings for the disinfection of one garment—a profit on the transaction of at least 500 per cent. In contrast to this we have had to submit to thorough disinfection in France. No charge whatever was made; the officials explained that it was necessary, and with great courtesy expressed regret for the trouble they were compelled to give.

On a case of suspicious disease occurring it should be notified to the medical attendant and to the sanitary medical officer attached to the district office, and it should at once be visited by either one or other of them. If it is of an infectious character, on the medical attendant visiting it, he should report its nature to the district office, the report to be transmitted at once to the Central Bureau; and if the medical officer sees it he should also report it to the Central Bureau. But we do not think that the routine we have often seen followed necessary; that is, that after the case has been seen by the medical attendant and notified to be infectious, no further step should be taken till it has also been seen by the medical officer of health. In a severe epidemic this often causes most serious delay, which may result in the death of the patient. We think, therefore, that the medical sanitary official should use his judgment. If he thinks there is any ground for doubt he should at once visit the case, if not he should accept the report as sufficient evidence to act upon.

It should be decided as early as possible, if the patient is to be treated in his home, or removed to a hospital. If he is to be removed no delay must be allowed before the removal is carried out. In cholera the loss of even a short time will often place the patient beyond help. One of the best tests of administration of a town during an epidemic is the time that elapses between the notification of a case and the time the patient is placed in bed in the hospital. A cholera hospital for this reason should not be very far from the district which it is intended to serve. In acute cholera the mortality is very

great, and death is often rapid. A long journey in an ambulance is, therefore, very dangerous. In one epidemic we knew of seventy one deaths taking place in the ambulances attached to one hospital only. But in this case the journey was undoubtedly too long. The ambulances should be constructed so as to allow the patients to lie down, a journey in a sitting posture adds much to the risk. Sufficient attendance should always be provided to lift the patient to and from the ambulance without any effort on his own part.

We feel we cannot lay too much stress in urging that the transit from the patient's residence to the hospital should be as quick and as easy as possible. It should be felt that an error has been committed when the ambulance has to deliver its charge to the mortuary.

In regard to hospitals in cholera we have seen large numbers of cases treated both in private houses and in hospitals, and we think, regarding the nature of the treatment required, it is a disease which is very difficult to treat satisfactorily in the private dwelling-house. The means of treatment, as will have been seen, are of some complexity, and require considerable preparation and forethought. In a cholera hospital, of course, everything is arranged for, but great delay is almost inevitable in the private house. It would appear, therefore, that a hospital properly equipped, and not too far from the neighbourhood it is intended to serve, is absolutely essential in a cholera epidemic.

As to the hospital itself, some remarks should be made. The nursing of cholera patients is exceedingly laborious. The dejecta and the vomited matters have to be constantly removed if the ward is to be kept clean, which is an absolute essential. The patients require frequent baths; the limbs require warm frictions to relieve the cramps, and the mouth has to be kept moist to lessen the distressing thirst. There is

no disease that requires the incessant care that cholera does in the acute stage, and, it may be added, there are few diseases more painful to witness. From this it will be seen that the nurses should be provided in the most liberal proportion that can be allowed. But the acute stage of cholera is generally over in 48 hours, and then comes the typhoid stage, during which the patient scarcely requires more attention than a patient with enteric fever. It is, therefore, advantageous in a cholera hospital to have wards set apart for the reception and treatment of patients in the acute stage, and, when this is passed, to remove them to other wards for the treatment of the after conditions. In this way the nursing staff can be concentrated where their services are most needed, and those recovering are saved from witnessing the distressing scenes and constant deaths taking place in the acute stage. Should a patient develop uræmic delirium, it is better to leave him in the ward with the acute cases if he cannot be provided with isolated accommodation.

The advantage derived by the community at large by the treatment of infectious diseases of all kinds in hospitals is so great that it can hardly be over-estimated. Every case removed to hospital is one focus of infection the less, and it permits at once the thorough cleansing, and, if necessary, the evacuation of the house where it occurred. In arresting the spread of an epidemic there is no means that can compare with it in efficacy. It is probable that when these matters become better understood, the liberty at present possessed by every one to have an infectious disease in the midst of an uninfected population will be considerably curtailed.

There is another procedure which is exceedingly valuable in arresting epidemics, which we have seen employed. It is the temporary evacuation of a house where two or more cases have occurred. Often not only in cholera, but in scarlet fever

and diphtheria, and other diseases, in spite of the early removal of the cases from the house, other cases continue to occur, and sometimes no clue can be obtained as to the source of the disease. In these cases it is of great value to at once vacate the premises for a time. The law should confer power on the sanitary authority to empty premises infected in this manner at once; of course, without inflicting hardship on the inmates. It will be seen that this procedure is different from that employed against houses unfit for human habitation. The houses may often be apparently quite good, and the most careful examination will sometimes fail to detect the origin of the infection. The houses need only temporarily be vacated. But it is surprising to see how rapidly an epidemic will decrease when some of the houses most infected have been completely evacuated. The premises should be placed in charge of the Disinfection Department, and should be publicly marked as infected. We have seen this method used both in the North and South of Europe with equal advantage.

In a severe epidemic one of the greatest difficulties to contend with is the disposal of the dead. As long as the deaths are only two or three times the normal number, no trouble is experienced from this cause, but when they amount to ten times the normal rate it may be exceedingly difficult to deal with them. We remember one town becoming completely over-burdened with corpses, the means of burial being inadequate. This added greatly to the terror caused by the epidemic. In Hamburg the arrangements were exceptionally good. Large public mortuaries were provided, whither the bodies were at once removed after death to await burial, and the interment as a rule followed promptly. In Italy there is an arrangement that is well worthy of imitation. In the newer *Campi Santi* or cemeteries spacious mortuary chambers are provided where bodies can lie awaiting inter-

ment, and in some of them there is a room properly fitted up for autopsies. These are excellent arrangements, and deserve the widest imitation. They should be made compulsory in all cemeteries.

Interment of the dead is the method usually employed in Europe, even in times of epidemics. But there is evidence that the public are beginning to recognise the great practical advantages conferred on the living by the adoption of the practice of cremation—an advantage great at all times, but especially so in cases of infectious disease.

The practice of cremation is so valuable that it should be made easier and simplified. Most of the apparatus we have seen are very complicated. But in an Eastern city—Calcutta, for instance—large numbers of cremations take place daily in the midst of the population without causing the slightest annoyance, and without those in the immediate neighbourhood being aware of it. Yet the bodies are burnt entirely without apparatus in the open air. We have seen large numbers of bodies burning, and have never noticed anything objectionable or perceived any odour. The only essentials are that there should be plenty of fuel, and that the pyre should be sheltered from the wind so as to allow the fire to ascend. We think the cost of cremation in India is about two rupees, or under four shillings for each person, and nothing can be more satisfactory than the method. At one time the Calcutta municipality erected an expensive cremation apparatus, but it fell out of use, the natural system being much preferred.

The Disinfection Department is one of very great value, and amply repays its cost to the community. It should be well provided with all necessaries, especially a well constructed disinfecter. The best we have seen is that in use in Budapesth. It consists of a large iron chamber, in the shape of an

oval tube, about two metres long, and a metre and a half high. It is closed at each end by an iron door, which is steam tight. It is provided with a furnace which supplies it with hot air or steam at will. The building in which it is placed is completely divided into a front part for the reception of articles, and a back part for the delivery of them, the only communication between the two being through the disinfecter. The articles to be disinfected are placed in a movable framework of wood, to avoid injury to the fabrics, that fits into the disinfecter. The doors are then clamped on, and hot air admitted till the temperature stands at 100° C.; after ten minutes steam is admitted and the temperature raised to 110° C. In half-an-hour a valve is opened, which allows the steam to escape, and hot air at 100° is again admitted; in a quarter-of-an-hour the other door is opened and the things removed at the delivery end. They are then found to be nearly dry. It is very simple in mechanism, and, we think, very efficient.

The men who visit the houses infected should be thoroughly conversant with the defects to which drains are liable.

In cholera, and in many other diseases, it is of the greatest importance to disinfect the fluids and discharges that come from the patient. The usual means employed are mixing them with phenol, iron sulphate, or chlorinated lime, or the employment of heat, as was done in the Moabit Hospital in Berlin. This system is of Russian origin. It is a very efficacious method. The matters to be disinfected are placed in an iron vessel, and they can be heated by fire; or, if superheated steam can be obtained, it is best to use it. But simple heating to 100° C. for fifteen minutes we have good reason to believe is thoroughly to be relied on in cases of cholera. The thorough disinfection of discharges is an absolute duty. It is a very expensive item, and for this reason heat is likely to be employed more in future. But it cannot well be carried out

in a private house; so chemical disinfectants must then be resorted to.

There is one disinfectant of which we have a high opinion. It is creasote. It has the advantage of having a pungent flavour and powerful odour. If, then, it is mixed with the dejecta, and by any chance these find their way into a source of drinking water, it is at once detected by the taste and smell. This is a considerable advantage.

It is of practical value to have a laundry in connection with hospitals for infectious diseases. The soiled linen can at once be cleansed without removal, which necessitates disinfection—a very serious matter when such large quantities of linen have to be dealt with as are required in a hospital for acute cholera. The arrangements at the Neues Krankenhaus at Hamburg left nothing to be desired in this respect, the laundry being in the grounds of the hospital, but separate.

In protecting a town from an epidemic of infectious disease attention has always been called to the absolute necessity of a pure water supply. That and a perfect method of conservancy, and a careful system of inspecting all food supplies, are requisites of the first importance.

No care can be too great to employ to ensure a thoroughly pure supply of water. No filtered sewage, even though diluted, such as London is content with, and such as Hamburg persists in drinking, should be tolerated. But it is often said that water from sewage farms is a safe supply. It would not appear that recent epidemics have given much confirmation to this view. So also filtration is said by some to be a complete protection against the transmission of disease by water. Dr. Koch has gone so far recently as to affirm that water that has 100 germs to the cubic centimetre, that is, 100,000 to the litre, is quite satisfactory. Let us then see what are the facts. In London in 1865 the death-rate from cholera was

18·4 for every 10,000 inhabitants, but, as before mentioned, all districts did not suffer equally. In the Stepney district the death-rate rose to 107·6 per 10,000, and it was this high mortality that affected the general rate. But Mr. Netten Radcliffe pointed out that in that portion of the Whitechapel district which was supplied by the New River Company, which has an efficient filtration, there were no less than 30 deaths from cholera for every 10,000 inhabitants. This is a very unsatisfactory evidence of protection.

The results from Altona during the Hamburg epidemic do not differ widely from this. Altona adjoins Hamburg. It has, according to Dr. Koch, an efficient system of water filtration, but the mortality from cholera during the epidemic was 20 per 10,000, as Dr. Reincke states. This would appear so strikingly similar to the London evidence that they probably together give a true idea of the limit of protection afforded by filtration. But this limit would mean 15,000 deaths in London alone.

Berlin, according to Dr. Koch, is completely protected by filtration, and yet it has not been able to keep out cholera this year (1893). So, also, the new filtration works at Hamburg are supposed to be a perfect safeguard, but cholera has entered in spite of them.

It may be taken as an axiom that in any town in which typhoid fever can obtain an entrance cholera can enter also. It is not pleasant to contemplate what would be the result if the Thames were to become thoroughly poisoned with cholera. The average number of deaths annually in London from typhoid fever, taking the Registrar-General's returns for the last five years, has been 567, and taking the mortality of typhoid fever as about 22 per cent., this gives 2,551 stricken yearly with this terrible disease. The greater portion of these cases are probably due to water; if they were due to air-poisoning they would diminish under heavy rainfalls, which

would flush the sewers, and this is not the case; and on account of the notification of contagious diseases and the opening of hospitals for infectious maladies, cases of direct infection from the sick are reduced to a minimum.

The duty of securing a water supply perfectly free from the contamination of sewage for a great centre of population is one that cannot be evaded with impunity. In Hamburg the water supply had been so bad that for years it had been a standing jest on the stage in the theatres. But ultimately it produced its legitimate effects.

One of the most striking monuments of sanitation that the world possesses is one of the oldest—the system of aqueducts of ancient Rome. It must be remembered that some of these date from before the third century B.C. But Rome was a small town then. It was the capital of a territory less than 150 miles long and 100 miles broad. Rome, moreover, is built on a water-logged soil, and a river sufficient to supply all its needs runs through it—a river that in those days was much larger than at present. That the Romans at one time used water drawn from the ground is certain from the stone well-heads that have been found. What then induced a small town with an abundant water supply at its doors to bring water in costly aqueducts from long distances? It is often said that they did so to supply the public baths. But public baths were not known till the imperial era. The first one was established by M. Agrippa only a few years previously, but by that time there were already five aqueducts. The conclusion seems unavoidable that the Romans recognised the drinking of water from a polluted soil and from a river mixed with the discharge of the Cloaca Maxima as a fertile source of disease. An epidemic confined to the banks of the Tiber and the district round the Forum apparently taught the Romans thoroughly a lesson that centuries and many disasters have failed to teach the civilised populations of the

teeming cities of modern Europe. It was, also, not ignorance of the simplest principles of hydrostatics (as is often asserted) that compelled them to bring water on arches constructed at great cost, but the fact that they had not the means of casting metal tubes sufficiently large for the purpose. It is somewhat discouraging that a generation that has all the appliances of modern engineering at its disposal should have to go back for instruction in sanitation to a civilisation long since passed away. But the Romans, probably, had not to deal with the skilfully organised opposition of a water company.

So also the conservancy of a city should be faultless. The streets should be perfectly clean, and no filth allowed to collect. The drains should be constantly flushed. We think that the water-carriage of sewage is an error, although it is so cheap. If it is mixed with water, there is no alternative but to let it flow into the river, either directly or indirectly, from a field, and it must be drunk by those living lower down. The consequences we all know. In London very large sewers have been constructed in order to allow of the surface rain-water being taken away by them as well as the sewage; so that in dry weather the walls of the sewers previously covered by the sewage, are exposed to the air. This air then passes into the streets through the gratings, and is breathed by the inhabitants. The result is, that when there is a long drought there is a severe epidemic of scarlet fever. In 1886, with the rainfall a little below the average, the number of deaths from scarlet fever in London was 618. In 1887 the rainfall was 7.32 inches below the average, and the deaths from scarlet fever rose to 1,443, or more than double. In 1888 the epidemic caused by the previous drought was still in existence, causing 1,190 deaths. In 1889 the rainfall was only slightly below the average, and

the deaths from scarlet fever fell to 785. In 1890 the rainfall was 2·5 inches below the average, and the deaths from scarlet fever rose to 858. In 1891 the rainfall was nearly the average, and the deaths from scarlet fever fell to 591. In 1892 the rainfall was 2·81 inches less than the average, and the deaths from scarlet fever rose to 1,174. The dryness of the present year (1893), and the severe epidemic of scarlet fever that has occurred with it, is known to us all. Thus, as the result of the principle, *tout à l'égout*, we have supplied to London an apparently unfailing source of scarlet fever.

But the most important factor in the development of an epidemic of any kind is, without doubt, the existence of a population in a state of degradation, filth, overcrowding, and misery. This, and this alone, is the fuel on which the conflagration of an epidemic can feed. Without this element an epidemic of any great proportions is impossible. It is in the filthy alleys of the great cities of Europe that epidemic diseases of all kinds find their permanent abode. They are found in all parts of Europe, but after considerable experience of foreign ones we think the English ones are the worst.

It is, undoubtedly, this element that makes epidemic diseases the scourge they are.

Epidemic disease is a creation of civilized man himself. We have no reason to believe that feral man ever evolves a malady of this nature. It is true that when feral man comes into contact with civilized man he acquires these diseases, which then assume with him a virulence unknown to civilized man, as the Australians, Fijians, and Andamanese, have had good reason to testify, but this is itself evidence of their freedom from them previously. But though the old voyagers constantly gave these diseases to the aborigines whom they visited, there is no case in which they received any fresh ones from them in exchange.

But civilized man is still capable of evolving new diseases of this nature. Not to mention small-pox, which does not seem to have been known till the sixth century, there have been recent additions to the list. The evidence is complete that the wild tribes that wandered about the mouths of the Amazon and the Orinoco rivers, and who dwelt in the many islands of the Caribbean Sea, had no experience of yellow fever, and it was equally unknown in Europe. But Columbus crossed the Atlantic in 1492, and by 1647 the comparatively few white men who had followed in his track succeeded in producing the first epidemic of yellow fever. This is a remarkable result. Even the present century has seen the evolution of a new one, for there is no evidence that epidemic cerebro-spinal meningitis existed previously.

What, then, is it that makes this great difference between civilised and feral man? It must be explained by the existence of filth, misery, overcrowding, and degradation being apparently inseparable from civilisation. All who have seen epidemics must admit that it is in the midst of these alone that epidemics flourish. Dr. Koch* expressly states that, in the winter epidemic of cholera in Hamburg in 1892-93, only the very lowest were the victims.

It would not be difficult to trace the probable steps by which a new epidemic disease is evolved. But it would be of more value to consider the means for their diminution. For since man can create these diseases, it is at least probable that it is within his power to abolish them. But the sanitation that would annihilate them would have to be a sanitation that would have to go deeper than drainage, and be more searching

* "Die Cholera in Deutschland während des Winters 1892 bis 1893," von Prof. R. KOCH. *Zeitschrift für Hygiene und Infektionskrankheiten* (xv. 1. 1893).

than disinfection, for it would have to wage war against degeneration of the race. Nature, dealing with feral man, does this without mercy. Civilization, possessing no equivalent for these methods, fails in preventing degradation; but it would be possible to obtain the same result by acting in a spirit of true humanity. It will probably be admitted that no factor is so powerful in producing degradation as overcrowding. Over-crowding alone has been known to evolve typhus. And yet, though our criminals are allowed 600 cubic feet of space each, we permit human beings to herd together worse than the very animals do. It would not be difficult to find whole colonies of inhabitants where the cubic space does not average 150 feet. We have seen many habitations where the cubic space did not amount to this, and, in many of these rooms there was no direct communication with the outer air. Not long ago the papers contained an account of the arrest of a criminal in London in a small room where he was in bed with three other men and two women, with two children on the floor. It would not be possible to produce anything but a degraded race, fit subjects for physical and moral disease, under these circumstances. It was not in the least their fault, they had no knowledge of the evil; it was solely the fault of the State, that has that knowledge and does not act on it. It should be made an offence for persons to herd together with less than 600 cubic feet of space each, the householder being responsible. We know that 2,000 to 3,000 cubic feet are generally considered necessary for men; but we would not go so far as to ask that these beings should be allowed the requirements of men, we would only plead that they should be spared, in spite of themselves, from the degradation of beasts.

Every nation has the right of fixing the standard of existence below which its citizens shall not be allowed to fall. But it may be argued that, if a nation permits the influx of the

destitute of other countries this is impossible, they must bring the standard down to their own level. We think this is just. In England it was found out long ago that, if a parish could get rid of supporting its poor by turning them out, it did so, and this had to be prevented by legal enactment. But no attempt has been made to prevent the degraded inhabitants of Central and Eastern Europe from reducing our population to their own level. Yet the world has seen how civilization was completely destroyed in Europe for four hundred years by these hordes, when even the culture of Rome fell before them. It has been seriously advanced that emigration should not be stopped, because America gained greatly by receiving the Pilgrim Fathers, and England by admission of the French Huguenots. We gladly admit the truth of both statements. But the Pilgrim Fathers and the Huguenots left their country because their consciences would not allow them to conform to the state religion, and brought with them to their new homes that firmness of character and resolution that would have made them a valuable addition to any nation. But these emigrants, of whom we have seen crowds, leave their own countries only for poverty, and often to escape from a criminal condemnation, and bring nothing with them to their new homes but their vermin.

No one can have followed the course of the present cholera epidemic in Europe without being convinced that it is borne about almost exclusively by these migratory hordes of the lowest class. By them it was brought to the shores of the Baltic, by them it was carried to Hamburg, with them it crossed the Atlantic, and by them it was carried to our shores. It chiefly touched those districts through which they pass. But the routes by which people travel for health or pleasure, though thronged by crowds of human beings, were not affected at all.

The ease with which these hordes pass from country to

country under modern conditions is fraught with the greatest danger to our race. Fortunately for humanity, France, with her usual intelligence, has seen this, and now only admits foreigners to live in the country under the strictest supervision, but there is no doubt amongst those who have any acquaintance with public feeling in France that she will soon go beyond this, and either prevent the foreigner from earning his living there at all, or only doing so under a special tax that will prevent his *concurrence* being dangerous. It will not then be in the power of other civilised nations to prevent themselves from following her example. They cannot allow themselves to be eaten up by these human locusts while France remains verdant. It is often said that England sends abroad many of her sons, and to stop immigration would prevent other nations from receiving them. It is true that many leave the country, but they go chiefly to lands that are glad to receive them, as it is very advantageous to an under-populated country to do so. But the moment that advantage ceases immigration into them will be stopped; these countries do not receive immigrants out of benevolence. But, practically, the action of France will decide the question; it would not be possible to avoid following her example. It would take time, of course; even the decimal system, though inevitable, has not been introduced yet. Thirty-nine years after France had freed the slave throughout her dominions, the British Parliament was engaged in discussing the subject.

No one but those who have seen a great epidemic can realise the suffering inflicted by it. Commerce is paralysed; sometimes with difficulty can the necessaries of life be obtained. The roads are silent and deserted, often not a being in sight in streets that are usually crowded, the only traffic being the ambulances taking the stricken to the hospitals, and the passing of a vehicle with the dead. Then there is

the loss of life, hundreds of families being plunged into poverty by the death of the bread-winners, and there is the anguish of the survivors. The wail of a town weeping for its dead has been heard even in the distance. And yet man has the means of preventing these disasters.

The power of well-directed legislation to ameliorate the condition of the people and to limit disease is indeed very great. There is a disease known throughout the Medical Faculties of the Universities abroad as the English disease. A few years ago it was the commonest malady to be seen in our streets. It is rachitis. At the present time there is, we believe, more rachitis in a second-rate continental city than in the whole of London put together. The Act inflicting penalties for adulteration acting on the milk supply has wrought this change.

In sanitary legislation it is, of course, necessary to proceed with great judgment, but as far as experience has gone, nothing but good has resulted from it. In its wise extension lies a hope of elevating our race.

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