

CHOLERA

HYGIENE & DISEASES

OF

WARM CLIMATES.

EDITED BY

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CHAPTER X.

CHOLERA.

BY C. N. MACNAMARA, F.R.C.S.

HISTORY OF ASIATIC CHOLERA.

WE learn, from the description given by Sanskrit authors writing some 400 B.C., that Asiatic cholera existed in India in their day. They have described the symptoms of the disease, which are precisely similar to those met with at the present time. In spite, however, of repeated inroads of warlike races from the north-west into India, cholera does not appear to have spread with them beyond the confines of that country. Probably few of these conquering races overran Lower Bengal, which we may therefore suppose was, as it now is, the home of cholera. As we pass from the study of these ancient records to comparatively recent history, we learn that, in the year 1438, Ahmed Shah was compelled to raise the siege of Mando, in Mehwah, in consequence of an outbreak of a disease which is said to have destroyed some thousands of his troops in the course of a few days; the disease is described as "*waba*," a word still employed to designate Asiatic cholera. In 1490 Vasco de Gama visited the Malabar coast, and has left us a full account of the symptoms of cholera as it affected the natives and his own sailors. For centuries past, in the Gangetic Delta, the "*Oolee Beebe*," or Goddess of Cholera, has been worshipped; and temples still exist in that part of India containing emblems of this goddess.

In 1781–82 cholera was very deadly in Calcutta, and the Government reported to the home authorities that it had "pursued its course northwards." During this year epidemic cholera visited Ganjam; it attacked a division of our troops passing through that district, and in the course of a few days no less than 1143 sepoy, out of a force of 5000 men, were down with cholera. Colonel

Pearce remarks that "death raged in the camp with horrors not to be described, and all expected to be devoured by this pestilence."

In 1782-83 the whole of Madras and Ceylon were under the influence of Asiatic cholera; at the same time the disease broke out in Burma; and we hear of it in the north of India at Hurdwar, where it was reported to have destroyed 20,000 pilgrims. It seems, therefore, certain that within twenty years of the Battle of Plassey, imperfect as our knowledge then was of many parts of India, that a vast area of the country was under the influence of a virulent form of Asiatic cholera. In fact, from the year 1438 to 1817 we have references, by sixty-six independent observers, to the occurrence of Asiatic cholera in India; and of these authorities ten refer to epidemic outbursts of the disease.¹

ASIATIC CHOLERA OF 1817-23.

This outburst of the disease seems to have commenced in August 1817 in Jessore. The Medical Board of Calcutta, however, asserted "that it was the usual epidemic of this period of the year," and was always present in Calcutta. Before the end of October cholera appeared throughout the whole of Lower Bengal. The Marquis of Hastings was then in Bundelkund with his army, and he notes in his diary the following facts:—"13th November 1817.—The dreadful epidemic, which has been causing such ravages in Calcutta and the southern provinces, has broken out in camp. It is a species of cholera morbus. It has gradually ascended the River Ganges to Patna, Ghazeepore, 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 1000 sick. November 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 infliction, and from the quantities of bodies of those who died in the waggons, and were necessarily put out to make room for such as might be saved by the conveyance. It is ascertained that 500 have died since yesterday. 16th November.—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

¹ *History of Asiatic Cholera*, by C. N. Macnamara, p. 22.

witnessing the dismay and melancholy which have lately visited my soldiers.”¹

During the cold season of 1817–18 cholera subsided throughout the greater part of the tract of country it had visited in the hot season and rains; but in April and May 1818 it burst out with renewed violence, and advanced to Delhi and all the intervening country. Westward, it extended along the valley of the Nerbudda and Tapti rivers, and appeared at Poonah in July, and at Bombay in August 1818. Eighteen months later we hear of it in the Punjab.

Cholera was very prevalent along the whole of the western coast of India. In 1819–20 Captain Thomson was despatched from Bombay to the assistance of the ruler of Oman, and in the following year another force landed from Bombay at Sur, in Arabia. Shortly after the landing of this expedition, cholera broke out in Oman. The Arabian historian states that “this year (A.D. 1820–21) a plague first broke out in Oman; it attacks a man’s abdomen, and matter is ejected from the mouth and anus till he dies; great numbers fell victims to it in Oman; it prevailed also in India, in Sind, and in Mekrain.” In these few words we have the record of the introduction by our troops of Asiatic cholera into a country situated beyond the confines of India. Cholera spread during 1821 to Muscat, and in that and the following year over the whole of Persia and into Asiatic Turkey. In 1823 it appeared at Tiflis, and extended to Astrakhan (Sept. 22nd). The Russian Government put forth all their strength to check the diffusion of the disease into the neighbouring provinces from Astrakhan. It is impossible to determine how far the severe quarantine imposed by Russia against the importation of the disease into her territories saved its inhabitants at this time; but it is certain that, as cholera appeared and spread through Arabia on the landing of our troops from cholera-stricken Bombay, so certain is it that the disease did not penetrate into Russia, guarded by severe quarantine regulations.

Turning to the opposite coast of India, we have a repetition of the same story. Cholera, in a virulent form, existed along the coast from Calcutta to Madras and Ceylon. During the latter part of 1819 the disease spread in Burma, and in 1820 in Siam, which was absolutely devastated by cholera; it broke out at the same time in Malacca, into which place it was “said to have been brought by a vessel from the coast; the fact is undeniable that the disease occurred shortly after some persons, ill of the complaint, had been landed from such a vessel.”² Penang and Singapore were affected,

¹ *A Treatise on Epidemic Cholera*, by F. Corbyn. Calcutta, 1832.

² *Transactions of the Medical and Physical Society of Calcutta*, 1842.



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but cholera broke out in neither of these islands until it had previously become planted in the neighbouring mainland, with which there was constant intercourse.

M. Huc, who was in China at this time, states that this malady, "formerly unknown," made its appearance in 1820, when it committed frightful devastations in the Celestial Empire. This statement corroborates the testimony of the Arabian historian, and points to the fact that the countries to the east, as well as those to the west, of India, first suffered from Asiatic cholera during the epidemic which originated in Hindustan in 1817-18, and was carried by English vessels to Arabia, China, and other countries. Before leaving the history of this outburst of cholera, it is well to refer to the appearance of this disease in the island of Mauritius in 1819. From the journal of the surgeon in charge of H.M. ship *Topaze*, we learn that she sailed from Trincomali, where cholera prevailed, on the 9th of October, and immediately after sailing cholera broke out on board, and four men out of seventeen attacked by the disease died. The ship arrived in Mauritius on the 29th of October, thirty-six men were taken on shore and placed in the military hospital at Port Louis; four of them died from cholera. On the 17th of November cholera, which had never before visited the island, burst out among its inhabitants, and spread in all directions. A Government Commission was appointed to report on the circumstances of the disease, and its members arrived at the unanimous opinion "that the disease was contagious, and was imported into Mauritius."

The Governor of Bourbon (now Réunion) was convinced that the disease was contagious, and he therefore took active measures to prevent its being carried from Mauritius into that island. In spite of his efforts, a boat from Bourbon communicated with a vessel from Port Louis, and within a few days cholera broke out in Bourbon, but did not spread, the French Governor adopting stringent measures to isolate the sick from the people surrounding them. The disease, therefore, appears to have been stayed in its progress into Russia and also in Bourbon, during this epidemic, by means of quarantine.

THE INDO-EUROPEAN CHOLERA OF 1826-34.

Asiatic cholera gradually died out in the countries over which it had extended in 1817-22, and in Bengal little was heard of it throughout the years 1823-24-25, except in its endemic area. But during the year 1826 cholera was again on the increase in Lower Bengal, especially in the Presidency Circle; it extended to Dinapur and throughout the Benares and Cawnpore Divisions. The

stations on the right bank of the Jumna, viz. Delhi, Meerut, and Agra, were slightly affected; during the cold season the disease was comparatively quiescent. In May 1827 cholera, in an epidemic form, occurred with violence throughout the region affected in the previous twelve months; it was especially severe in the North-Western Provinces, and spread to Ajmere and Jeypur. The Punjab and some of the Himalayan hill stations were likewise affected. From the returns of our European and native troops we learn that a recurrence of cholera took place throughout India in 1828. And in 1829 Lieutenant Conolly, who was at Herat, reported that the disease during that year was extremely violent throughout the kingdom of Cabul, and extended through Khorasan to the Persian capital. In Teheran it destroyed a vast number of the inhabitants. Lieutenant Conolly also stated that cholera had spread to Bokhara and to Khiva, with terrible consequences to the inhabitants of those countries. So that Asiatic cholera, during 1829, occupied the whole extent of country, west and north-west, from Cabul, through which the trade routes from India pass to reach the great Russian marts of Orenburg and Nijni-Novgorod.

On the 26th August 1829 the disease broke out at the Russian frontier trading town of Orenburg; it was then stated to have been carried to that place by caravans arriving from Bokhara; it rapidly extended to various places in the province of Orenburg, but almost disappeared in the winter of 1829-30.

In the meantime Europe was threatened by an invasion of cholera *via* Persia. It broke out with great virulence throughout that country in the spring of 1830, and appeared at Tabriz and Resht on the Caspian. In July it spread to Tiflis, and soon afterwards throughout Astrakhan; and here the stream of cholera which entered Russia in 1829 from Bokhara and Khiva seemed to have united with that passing to the north-west through Persia.

In August 1830 cholera appeared in the great annual gathering of Nijni-Novgorod; it reached Moscow in September, and speedily passed on to the western provinces of Russia, where, in consequence of the war going on between Poland and Russia, it was disseminated quickly through both armies and communicated to the inhabitants of the former country.

The cholera epidemic of 1830 was in full force again in the spring of 1831, when it spread throughout Russia and passed thence to Sweden; on the 3rd of August it reached Vienna and Berlin, France remaining free of the disease until the following year. About the end of October cholera appeared at Sunderland, and was supposed to have been imported from Hamburg; the persons

first affected resided on the quay, and had constant intercourse with the shipping. The epidemic broke out soon afterwards at Newcastle and Gateshead; it appeared at Edinburgh about the 22nd January 1832, and in London in the month of February. The disease was most deadly throughout almost the whole of Europe during the year 1832-33.

On the 8th of June 1832 cholera appeared in the cities of Quebec and Montreal in the following circumstances:—The *Carrick*, in April, sailed from Dublin, then affected by cholera, with 173 emigrants on board. The disease appeared among these people soon after leaving Cork, and forty-two of the emigrants on board died before the 3rd of June, when the vessel arrived at Quebec. The emigrants were landed at Grosse Island, a few miles from Quebec but no effective measures were taken to prevent intercourse between them and the city. The first cases of Asiatic cholera ever seen in Canada appeared in Quebec on the 6th, 7th, and 8th of June. The disease passed from Quebec into the United States, reaching New York and Philadelphia in July; it spread over the greater part of America before the end of the year.

With regard to this epidemic, never were greater efforts made by the combined Governments of Europe to exclude an invading disease from their territories by means of quarantine regulations. In Spain infringement of these rules was punishable by death. But land quarantine utterly failed in its object.

In France it was stated that of 55,000 persons affected with cholera, only 164 had been employed on duties which obliged them to be near the sick. On the other hand, there were numerous instances of the following kind, given by persons who had no possible motive for stating what was untrue on the subject. At Moor-Monkton, six miles from York, John Barnes, a labourer, died from cholera on the 28th of December; the disease did not exist within thirty miles of his residence. Barnes' wife and two other persons who visited the sick man were seized with cholera. The son of the deceased then arrived; it appears that he had been apprenticed to his uncle, a shoemaker at Leeds, and that his aunt died of cholera fifteen days before; her effects were sent to the Barnes' to be washed. The trunk containing the contaminated things had been opened by Barnes in the evening, and the next day he was taken ill with cholera and died.

The history of cholera in India, from 1830 to 1845, though presenting features of much interest, need not detain us, so that we may proceed to refer to the second epidemic visitation of cholera, which extended from the East, through Europe, to America.

ASIATIC CHOLERA OF 1841-46.

On referring to the returns of the Medical Board in Calcutta, we find that, with regard to Singapore, Penang, and Malacca, from 1827 to 1840, not a single death from cholera had occurred, either among the troops or convicts, at any one of these places. The Madras records confirm the fact that epidemic cholera was unknown in the Straits throughout the thirteen years above referred to. Cholera was very deadly in Bengal and Madras during the year 1840; and it was at this time the Government of India had collected a considerable body of troops in Calcutta and Madras to embark for service in China. The vessels constituting this expedition, starting from Calcutta and Madras, met at Singapore in April 1840, and the superintending surgeon of the Straits, residing in Malacca, reported to the Calcutta Medical Board "the remarkable circumstance that epidemic cholera broke out, early in the year, along the seashore towns bordering the Straits, and slowly advanced to Malacca." On the 4th of July our troops arrived in the harbour of Chusan. Dr. Francis states that our soldiers had hardly landed before twenty cases of cholera occurred among them, and it spread to the inhabitants of the island. He states in his report, written in July 1840, "that, from inquiries made from the missionaries and inhabitants, he assured himself the disease did not exist in the island before the arrival of our troops."¹

From July till the end of the year, constant supplies of men and materials of war arrived in China from cholera-stricken Bengal and Madras; "the disease was most malignant" among our sepoys at Ningpo in August. Dr. Bryson reported that cholera broke out on our vessels in the Wongoo and Nanking expeditions, and that "this was quite a new feature in the medical history of our fleet in China seas." During the following years, 1841 to 1843, epidemic cholera spread from the coast over the greater part of China, committing devastation and terror among the inhabitants, which, an eye-witness observes, the "pen of a Defoe would fail to describe."

The late Professor E. Parkes was at this time in Burma with his regiment, and reported that "early in 1842 cholera appeared in the *north* of Burma, and, passing in a southerly direction, committed great ravages at Ava; it passed down towards Rangoon, pursuing the course of the Irawada." This invasion of cholera into Burma evidently extended from China along the trade routes into the valley of the Irawada.

The first envoy from Kashgar who had visited India came to

¹ *A Treatise on Asiatic Cholera*, by C. N. Macnamara, p. 141.

meet the Viceroy in Calcutta about the year 1869; he was under charge of Dr. Cayley (now of Netley), then the British representative at Leh. On questioning the envoy as to the existence of cholera in Chinese Tartary, he informed us "that the disease was almost unknown in Yarkand, but that in the year 1844 cholera came from the side of China; that during the summer it attacked all the places on or near the main line of traffic from China; that in Kashgar, Yarkand, Khokan, and Bokhara it killed thousands of people; it lasted for a few weeks in each place, and the people died by hundreds every day; and that such a disease, so far as he knew, had only once before visited Khokan and Yarkand, some fifteen years previously (p. 356), when it lasted for a year, and came from the East. At the time of the epidemic of 1844 there was free traffic between China and Turkestan; every year several thousand horse-loads of tea passed from China through Kashgar to Bokhara." It is evident, therefore, that Asiatic cholera was imported into China by our troops, arriving from Calcutta and Madras in 1840-41; it extended throughout that empire and spread through Burma, and also to the north of the Himalayas to Yarkand, and so to Bokhara by the trade route. Our agent on the frontier of Cabul reported that "cholera travelled south from the countries north of the Hindoo Koosh in 1844, and that in Balkh alone 25,000 people were said to have been destroyed by it; it extended throughout Afghanistan and passed to Peshawar and the Punjab." In Lahore it carried off 22,000 people. So that the Indo-China cholera of 1840 spread not only south into Burma, but also into Afghanistan, and from thence to the Punjab and the North-Western Provinces, along the Indus to Sind and Karachi.

General Ferrier endeavoured to travel from Teheran into the Punjab to join the army under Runjeet Sing, and when to the north of Herat, in June 1845, he first met with cholera; he states that, although he had for some years resided at Bagdad, and passed through Teheran to Meshed and Herat, he had heard or seen nothing of the disease, which, as he observes, was passing from the east, that is, from Balkh and other parts of Afghanistan, westwards. Cholera quickly spread to Teheran and Tabriz, and reached as far north as the town of Derbend, on the Caspian.

At the time this disease was advancing from Bokhara and Persia towards Europe, it had, as in 1821, been imported into Arabia from Bombay; it was extremely severe in Western India in 1845-46, and broke out in May 1846 at Aden, Mocha, and Jeddah; "it even penetrated as far as Oman, and spread up the Tigris and Euphrates, so that Europe, as in the epidemic of 1826-32,

was penetrated by two streams of an invading cholera, one passing from China, the other from Bombay, both of which had originated in Bengal in 1840-42.

At its appointed season, April (1847), cholera broke out again at Orenburg, and soon afterwards at Nijni-Novgorod and Moscow. By October it had covered the greater part of Russia and Turkey, and in the following year almost the whole of Europe. In Edinburgh it first appeared on the 4th of October 1848. Three pilots from Newhaven went to the Isle of May to look out for a vessel; one of them went on board a ship from Cronstadt, where cholera existed; they both remained on the ship at Leith; one of them died of cholera the following Sunday. During the next eight days several cases occurred among relations and immediate neighbours of the pilot who died, and these were the first cases in Scotland; it spread throughout the country. In like manner cholera broke out at Hull and Sunderland immediately after the arrival of vessels, cases of the disease having occurred on board during the passage from Hamburg. The first case reported in Ireland was that of a man who arrived at Belfast from Edinburgh on the 2nd of December; he was sent to the workhouse, and cholera spread to its inmates, and from thence to the town.

America had been free from cholera for thirteen years, but on the 9th of November 1848 a vessel, carrying emigrants from parts of Europe affected with cholera, sailed from Havre. On the 24th of the month, being very cold, there was a general overhauling of baggage to obtain warm clothing. The next day cholera broke out on board. One of the men employed to remove the sick from the ship to a quarantine hospital at New York died of cholera on the following day. In a dirty German lodging-house three persons who escaped from quarantine were attacked with cholera; but the disease did not spread, the weather having suddenly become exceedingly cold, with sharp frost.

At New Orleans, cholera was imported at the same time by German emigrants, who sailed in a vessel from Havre on the 3rd of November. Cases of cholera were brought into the hospital in New Orleans from this vessel; the disease rapidly spread through the city. "The weather was very warm and damp, the streets were as muddy as possible, and heavy fog overhung the city." The disease extended from town to town along the Mississippi, and covered the United States and Canada during the following year.

This, probably the most fatal epidemic of cholera that has ever spread from India throughout Europe, Asia, and America, had almost completely died out by the end of 1851. In England alone it

killed no less than 53,293 men, women, and children. In a report drawn up by the Royal College of Physicians, London, regarding this epidemic, they observe: "It is not probable that in the case of cholera the influence of water will ever be shown to consist in its serving as a vehicle for the poison generated in the bodies of those who had suffered from the disease."¹

THE INDO-EUROPEAN EPIDEMIC OF 1848-53.

India was, unless in its endemic area, free of cholera in 1847, the epidemic of the previous years having died out; but in 1848 the accounts of cholera at Dinapore, Cawnpore, and Agra were bad. Throughout 1849 we have a repetition of the old story—cholera of a virulent type in the Mirzapore district, "the devastation of the disease was terribly fearful; the inhabitants fled for refuge to other districts, forsaking their habitations, cattle, and property." Central India was subjected to a most awful visitation of cholera, and Dr. Leith reported that "cholera made its approach to Bombay from the east towards the end of the rains of 1849, in spite of the south-west monsoon which blew during the same week with a force varying from $1\frac{1}{2}$ to 5 lbs., or on an average of $3\frac{1}{2}$ lbs. on the square foot, which is equivalent to a velocity of more than 15 miles an hour, in a direction contrary to that in which the cholera advanced."²

Throughout 1850 the disease was reproduced over the Bengal, Madras, and the Bombay Presidencies; in the town of Bombay, for instance, the number of deaths from this disease in 1848 had amounted to 69, in 1850 to 4729, and in 1851 to 4020. In 1851 cholera broke out in the port of Bassorah, having direct communication with Bombay, and from thence extended by two routes, the one towards the west to Hillah, the other east to Mohammera. That pilgrims spread the disease seems more than probable, for it was reported that from the 1st of December 1849 to 1st December 1850 there passed through the station of Khaneguin 52,053 pilgrims, with 64,138 beasts of burden, 4504 muleteers, and 2837 *loads of human corpses*, which, giving three dead bodies to a load, would amount to 8000 *corpses*, to be buried at Kerbela." In 1852 cholera spread from Persia into Russia, along the borders of the Caspian Sea, when, as in previous years, it met with a stream of the disease extending from the Punjab through Cabul and Meshed to Teheran. In 1853 the disease broke out over the whole of Persia and Asiatic Turkey, Russia, and the north of Europe. It appeared

¹ Dr. Baly and Sir W. Gull's *Report*, p. 213.

² *Bombay Cholera Report*, 1891, p. 9.

in England first at Gateshead, afterwards in London, during the months of August and September. New York and New Orleans were both visited by cholera in 1853; Mexico and the whole of the West India Islands were during the year under the influence of the disease. In 1854 Asia, Europe, and America were covered by the epidemic which had originated in Bengal during the year 1848-49, and travelled thence to Bombay and to Cabul, and so to Persia and westward, as in previous years, in its progress causing untold misery and death. The disease died out of Europe and America in 1856-57.

In 1854 the death-rate from cholera in the district of St. Ann's, Golden Square, was at the rate of 128 for every 10,000 persons, the general death-rate of the metropolis being only 60 to the same number. It seems that at 40 Broad Street (St. Ann's), a child, having been ill for three or four days, died from cholera on the 2nd September, her fæces having during her illness been emptied into a cesspool only 3 feet from the well supplying the pump used by the people in Broad Street. The contents of this cesspool drained into the well, as was subsequently discovered. On the night of the 31st August, cholera broke out among the inhabitants of Broad Street, the greater number of cases occurring on the 1st of September. "Nearly all the persons who had the malady during the first outbreak drank of the water from the Broad Street pump, and very few who drank of this water during these days escaped having cholera."¹

In the weekly return of deaths for 9th September the following was recorded as occurring in the Hampstead district: "At West End, on the 2nd September, the widow of a percussion-cap maker, aged 59 years; diarrhœa two hours, cholera epidemic sixteen hours." Dr. Snow was informed by this person's son that she had formerly resided in Broad Street, but had not been in the neighbourhood for many months. A cart went from Broad Street to West End every day, taking out among other things a large bottle of water filled from the pump in Broad Street, the lady in question preferring this to any other water. The bottle of water was carried out to Hampstead as usual on Thursday the 31st of August, and she drank some of it that evening, and more on the following day. She was seized with cholera on the evening of the latter day, and died on Saturday. A niece, who was on a visit to this lady, also drank this water; she returned to her residence, in a high and healthy part of Islington, was attacked with cholera, and died. There was no cholera at the time either at the West End or in the neighbourhood. Besides these two persons, only one servant partook of the water at Hampstead, West End, and she did not suffer, or only to a slight extent.

With regard to this remarkable case, the committee appointed by the Board of Health to conduct a scientific inquiry into the circumstances of the epidemic of 1854, remark: "It seems probable that the water of this well did really act as a vehicle of choleraic infection; but (assuming the absence of fallacy in the case) this probability might easily be admitted, without its therefrom resulting

¹ *Report of Committee for Scientific Inquiries into the Cholera Epidemic of 1854*, p. 50.

that infection depended on the specific material alleged (by Dr. Snow). The water was undeniably impure with organic contamination; and we have already argued that if, at the time of epidemic invasion, there be operating in the air some influence which converts putrefiable impurities into a specific poison, the water of the locality, in proportion as it contains such impurities, would probably be liable to similar poisonous conversion."¹ The committee argue: If, therefore, the specific action caused by the Broad Street pump water be admitted as a fact, it did not arise from its containing the dejecta of those who had died of cholera, but because it had participated in the atmospheric infection of the district.

The committee had by no means neglected to investigate the state of the water consumed by the inhabitants of London during the epidemic of 1854. It was shown that in two large sections of the population of London, "breathing the same atmosphere, comprising the same classes, and averaging the same habits of life," in the one class the death-rate from cholera was 130, and in the other only 37 per 10,000. The former, however, were supplied with water "impregnated with the sewage of the metropolis," and the latter with pure water. From a comparison of the mortality in the epidemic of 1849 with that of 1854, it appears that the population to which the Lambeth Company's water was distributed in the latter epidemic suffered a mortality less than one-third of that sustained by the drinkers of the water purveyed by the Southwark and Vauxhall Company, and that the tenantry using the purer water supplied by the Lambeth Company in 1853-54 suffered not a third as much as the same tenantry had done in 1848-49, when the water was impure. On the other hand, the Southwark and Vauxhall Company, which pumped an impure water in 1848-49, pumped even worse water in 1853-54, and the mortality in the houses supplied was 10 per cent. higher.² It was a consideration of facts such as these that led to the passing of "The Metropolitan Water Supply Act" in 1852, and which came into operation from the 31st of August 1855. Previous to this time the several water companies took water for domestic use from tidal and impure portions of the Thames, simply straining it through wire screens on its way to open settling tanks, from which it was pumped for use. By the Act of 1852 no company could draw water from the Thames below Teddington Lock; all reservoirs in which water was stored were to be roofed in, and on its way from any such reservoir to the mains or pipes for delivery, the water was to be filtered. The only

¹ *Report of Committee for Scientific Inquiries into the Cholera Epidemic of 1854*, p. 52.

² E. H. Greenhow, "On Cholera," *Medico-Chirurgical Review*, 1857, p. 71.

exception to this rule was in the case of water which was pumped from wells into a covered reservoir or aqueduct, without exposure to the atmosphere.

The practical effect of this Act was to induce sand-filtration, and the supply of water from covered water tanks to the entire metropolis.

In 1854 cholera was not unknown in the county of Bedford, where it broke out in the village of Ridgmount, and eleven cases occurred, all of which were fatal. It was ascertained that the first case occurred in a man whose son had died of cholera in London a week or two before, and whose clothes were sent down to the country. The poor man unwrapped the bundle of clothes himself; he was seized with the disease and died. His case was the nucleus of the others.¹ An instance of a similar nature was reported from Munich; the first case of cholera was generated in the house of a labourer, one of whose daughters was in service in Munich. The latter sent her parents clothes belonging to a family, some members of which had just died of cholera; these old clothes were at once appropriated and worn; three days afterwards (21st September 1854) the father and mother were seized with cholera and died; on the 22nd and 25th other members of the family took the disease.

Dr. Lebert reports the case of a man who was attacked with cholera, having worn the clothes of a person who had died of the disease two months previously. Other instances are cited of persons having been seized after sleeping in beds previously occupied by cholera patients, but which in the meantime had been kept locked up.²

In the neighbourhood of Tavatola the wearing apparel, the bed-clothes, and the mattress of a cholera patient were washed at one of the fountains of the city; the waste pipe of the fountain being broken, this foul water became mixed with the drinking water. On the following day sixty persons in this small and up to that time healthy district were stricken with the malady.³

CHOLERA IN INDIA FROM 1858. PUNJAB EPIDEMIC OF 1861.

Our information regarding cholera in Bengal in 1857-58 is necessarily defective on account of the disturbed state of the country; we know, however, that the disease appeared among our troops engaged against the mutinous native army before Delhi, from June to September 1857; and some sixteen cases and eleven deaths

¹ *On Malaria and Miasmata*, p. 140, by J. Barker. London, 1863.

² *Constantinople Cholera Conference*, p. 95. Calcutta, 1868.

³ B. W. Richardson, "On Cholera," *Transactions of Epidemiological Society*, vol. ii. p. 427.

took place among the prisoners in the Delhi jail in 1858.¹ The Lucknow garrison also suffered to a slight extent from cholera in 1857.²

I would only refer, however, in detail to the history of one outbreak of the disease which occurred during this year in connection with its appearance at Kalka.

Kalka is a small village at the foot of the Himalayas, on the road leading to the Simla, Sabhathu, Dugshai, and Kassowli sanitarium. This village was infected with cholera when our troops marched through it, suffering greatly from thirst induced by the sudden change from the cool climate of the hills to the scorching plains. H.M.'s 75th passed through Kalka on the evening of the 12th May; soldiers were attacked with cholera of the most virulent type at Umballa on the 15th May, probably within sixty hours after they had left Kalka. The 1st Bengal Fusiliers passed through Kalka about midnight on the 13th May; two men were attacked with cholera at 10 p.m. of the 14th, or twenty-two hours after leaving Kalka. The 2nd Fusiliers passed through the place on the morning of the 15th May, and suffered greatly from heat and thirst; the soldiers drank copiously of every stagnant pool they passed; on their arrival at Umballa severe cholera broke out. These regiments were perfectly healthy before leaving their stations in the hills.

The water of Kalka is obtained from a spring, which discharges into a square open masonry reservoir. The reservoir is enclosed on three sides by a wall, the fourth side of the enclosure is formed by the hill at the back. At one side of the reservoir, and enclosed with the surrounding wall, there is a piece of ground about 6 by 5 feet, on which the people stand when drawing water. I found this piece of ground polluted with fæcal matter and other impurities, which were being slowly washed by the dripping water into the reservoir. The spring itself was situated in a watercourse below the level of the village, and its produce was liable to admixture with the drainage and sewage of the village. This is the only spring in the neighbourhood, and people come to it to draw water from a distance of a mile or more. The circumstances stated show that every facility existed for the infection of the troops through the drinking water.³

During the year 1859 cholera was widely disseminated throughout Bengal and to the north-west as far as Cawnpore; but it did not extend further in this direction, although it spread directly west and south, attacking the whole peninsula, as Mr. Cornish remarks, from Karachi to Cape Comorin; it was very severe in Bombay during the month of May; at the same time its progress through the Deccan was as steady as in 1818-19, and also along the eastern and western ghats; but it covered this vast space of territory in a very much shorter time than it had done thirty years previously.⁴

¹ *Punjab Selections*, vol. v. No. 8, p. 39.

² Greenhow, "Notes during the Siege of Lucknow," *Indian Annals*, vol. x. p. 336.

³ De Renzy's *Report for 1869*, p. 23.

⁴ Cornish, *On Cholera in Southern India*, p. 16. Madras, 1871.

Throughout the year 1860 cholera prevailed in Bengal proper, and, in fact, from Assam to Oude, and from the seashore of the Bay of Bengal away into Central India and Bombay, as well as over a very large portion of Madras; it also spread far up the Himalayas to Darjiling. The number of deaths from cholera among the prisoners confined in the jails eastward of Cawnpore was nearly four times as numerous as in 1859. Among the small European force at Morar there were 89 deaths from cholera; at Jhansi, 13; at Saugor, 4; Nagode, 15; and Jubalpur, 5. The prisoners in those stations, together with the civil population, suffered in an equal degree. So that we have evidence of cholera of a virulent type, and extensive power of diffusion, having been raging over the enormous tract of country above indicated during the early part of the year 1860. And, as we might have expected, it spread at the same time to Agra.

Dr. Walker informs us that cholera appeared in the city in July, and extended slowly among the natives: "Rain had fallen sufficient to soak the ground, and even to be lying in pools in many places."¹ On the 10th of August cholera broke out among the prisoners at Agra; at the same time there were twenty-four casualties from this disease among the European troops at Muttra.

Dr. Walker was of opinion that the epidemic influence appeared to have been on this occasion more widely spread, and more generally fatal than in former years,—a statement which is borne out by his figures; and from the history of the disease in 1859, together with its terrible virulence over the whole of Bengal proper, the Central Provinces, and as far to the north-west as Muttra, we should naturally have expected to have heard of its immediate dissemination throughout the North-Western Provinces and the Punjab with the setting in of the rains of 1860.

I would call the reader's attention, however, to the exceptional state of these provinces. Throughout this year they were subjected to unprecedented drought, which converted an enormous tract of otherwise fertile country into a desert; this arid waste was bounded to the east by the Agra district, to the west by Sirhind, to the north by Dehra, and to the south by Goorgaon; and although cholera spread from Bengal and Central India up to the very borders of these districts, it extended in no single instance that we know of into this barren area, which constituted what Colonel Baird Smith describes as the famine tract of 1860–61, and which is very clearly defined in Chart No. II. of his report on the subject; section 28 refers to the mortality attributable to the famine; but among the

¹ *Prison Returns for the North-Western Provinces for 1860*, pp. 123, 124.

diseases which affected the starving people, he makes no allusion to cholera. Throughout the whole of the jails in the famine districts not one instance of cholera occurred; and there were only one or two cases among the troops, and some of these are described as "cholera biliosa." Dr. B. Smith, who at this time was in medical charge of the civil station at Delhi, and therefore in the midst of all the suffering, expressly states that the first instance of cholera he heard of among the famine-stricken people was in May 1861. Smallpox and fever raged among the starving people; but in all the reports and returns I have read on the subject, the existence of cholera is never once alluded to during the year 1860 in the famine-stricken districts.

I am justified, therefore, in asserting that in 1859 a very considerable portion of the peninsula of India was under the influence of epidemic cholera; throughout the following year it was reproduced over the whole of this area, with the exception of that part of the country which had been affected by a grievous drought, and thereby converted into a sandy desert.

It is almost impossible for those who have not experienced the influence of the annual rains in the north-west of India to realise the condition of the country after such a year as 1860. Colonel Baird Smith says: "It would be difficult to exaggerate its forlorn dreariness: it seemed denuded of its inhabitants; that monotonous brown tint of the untilled soil suppressed everything else. It was only by some inquiry it could be learnt that, even in this great waste, there was cultivation in plots round the villages, and round the wells remote from villages." This is truly a faithful picture of a desert; and in this country cholera never gained a footing during the continuance of the drought, although the disease raged around it.

It is not my province now to discuss the bearing of this fact on the etiology of cholera; but when taken in conjunction with the circumstances I have related as occurring in the north-west in 1831, it is very significant, and well worthy of our serious consideration.

This remark is strengthened by what follows, for no sooner had the rains of 1861 set in over the famine-stricken districts, than cholera burst out among its inhabitants with terrible virulence. I shall now proceed to demonstrate this fact from documentary evidence bearing on the subject.¹

In 1861 cholera was reproduced over the whole of Bengal proper; out of fifty-two jails in this province only eleven escaped the disease. In May the convicts and European troops at Cawnpore and Allahabad were attacked with

¹ *A Treatise on Asiatic Cholera*, by C. N. Macnamara.

cholera, and in July those at Gwalior and Jubalpur suffered very severely. It is evident, therefore, that cholera was reproduced over the area in which it was principally prevalent during the previous years; and this remark is applicable to the circumstances of the inhabitants of the Agra and Muttra districts, where, as I previously stated, cholera had been very severe in 1860.

Dr. Smith informs us that "the first heavy fall of rain at Delhi in 1861 occurred on the 31st of May," at which time cholera appeared amongst the inhabitants of the southern portion of the Goorgaon district, extending from the direction of the Bhurtpore territories. The disease rapidly spread among the famine-stricken people of the district, and reached Delhi on the 11th of June.¹ "It is important to note that at this time there was not a single case of diarrhœa in the jail, and the amount of sickness in the station generally seemed to be below the usual average; it is well known that many cholera epidemics are preceded, introduced as it were, by the occurrence of a great amount of generally prevailing diarrhœa; it was not so in this instance as regards the city of Delhi."

It appears that among the prisoners one patient only sank from the effects of the disease within four hours of the time he was attacked by it; of the others, none died under an illness of less than nine hours.

In H.M.'s 82nd Regiment, eighty men were seized with cholera, and fifty-seven of these were in a state of collapse on admission into hospital. "One man had no vomiting or purging throughout; but after death the intestines were found filled with rice-water fluid."

The men of H.M.'s 107th Regiment, and the prisoners, were attacked by cholera on the same day at Agra (7th July); the disease spread with alarming rapidity both among the Europeans and natives; indeed, it had existed among the latter from the middle of June.² Dr. Banister writes from Muttra that the disease appeared among the Europeans on the 14th July: "The weather being very close, the rain was unusually heavy, the wind continuing to blow from the east."

On the 26th of July the station of Meerut was visited by a heavy fall of rain, which flooded part of the prison enclosure. On the 27th the first case of cholera occurred among the prisoners, and the malady did not cease until the 24th of August; during this time there had been 664 admissions, and 344 deaths from the disease. Cholera had, however, appeared among the Europeans in this station since the 30th of June.

On the 6th of August and five following days, fifteen cases of cholera, all of which were fatal, occurred among the European troops at Mian-Mir; by the 14th of the month all the regiments in cantonments were more or less affected; and Dr. W. A. Green (Inspector-General of Indian Medical Service) strenuously urged their removal into camp. Unfortunately, it was found impracticable to march the whole of the troops out of cantonments at once—the country for miles round being under water; besides, the commissariat was unprovided with carriage and other appurtenances for a camp of the kind at a moment's call. The military authorities, however, did all in their power to forward Dr. Green's views, and on the 15th of August three companies of H.M.'s 51st Regiment left the station; at the same time the artillery marched to Shahdera, on the banks of the Ravi, 10 miles to the north of Mian-Mir. Subsequently, one single case of cholera occurred among the men of this party; but among the troops who

¹ *Punjab Selections*, vol. v. No. 8, p. 44, "Cholera in the Delhi Division."

² Murray's *Report on the Epidemic Cholera at Agra*, 1861, p. 3.

remained in the station there were no less than 457 cases, and 261 deaths from the disease within the following ten days. In fact, after the 15th of August, cholera increased with such fearful rapidity, that the soldiers in a few days were panic-stricken and hopeless.¹

In one regiment, out of a total strength of 1002 men, 863 were employed as hospital orderlies; and of these no less than 428 were seized with cholera. In the other European regiment at Mian-Mir, of 203 cases of cholera, 137 occurred among hospital orderlies. It was not found possible, however, to determine if these hospital orderlies were more liable to be attacked than men who had not been exposed to cholera in the hospital, because all the men in the station had been on duty of this kind at one time or another. On the other hand, we cannot overlook the fact that the medical officers and the whole of the medical establishment, together with the native servants, almost entirely escaped the influence of the disease, although prostrated by the fearfully harassing nature of their duties. And what is more remarkable, when it was discovered that the European orderlies were unable to work any longer, some thirty Sikhs of the 31st Regiment were daily sent to take their place in the European hospitals, but not a single instance of cholera occurred among these natives.

The Commission, a member of the Indian Civil Service being their president, was appointed by the Government of India to report on this terrible outbreak of cholera, and they stated: "That the mere contamination of drinking water may cause disease, but will not cause cholera,"—an idea which, under the leading of the gentleman appointed as head of this Commission, the Government of India adhered to for a long time.

THE EPIDEMIC CHOLERA OF 1863-64.

The reports from the various jails throughout Lower Bengal for the year 1863, demonstrate the fact that this province was subjected to a most severe visitation of epidemic cholera during the early months of the year. These returns show cholera swarming up the Ganges valley in the east, and covering the Behar provinces; in which province, we are told, not a village of any note escaped. The disease spread to the Central Provinces and into Oude; it broke out in an epidemic form among the pilgrims assembled at Punderpur in November 1863, and was by them communicated to the natives of Poonah. Cholera was reproduced over the whole of India during the year 1864; the western coast was specially affected; in the town of Bombay the deaths amounted to 4588. Early in the following season the disease appeared at Karachi, Sind, and along the shores of the Persian Gulf, also in Yeman, Mocha, and Aden. Cholera was carried to Mecca by pilgrims; after a fall of rain it burst out among the assembled multitude, and some 30,000 of them are said to have fallen victims to the disease.

¹ *Report on Cholera of 1861.* Published by the Government of India. Appendix, p. xvii.

At this time there was not a trace of epidemic cholera in Egypt, Europe, or America.

On the 19th of May a ship, bringing 1500 pilgrims from Jeddah (Mecca), arrived at Suez. Many of the passengers had died of cholera during the voyage; the captain of the vessel and his wife were attacked by the disease on the 21st of May at Suez. The pilgrims were at once forwarded from Suez to Alexandria by rail, and on the 22nd of May the first case of cholera was noticed in a body of these people on their way to the port. Numerous pilgrims from Mecca followed by this route, and many of them embarked at Alexandria in vessels provided to carry them to their homes.

Cases of cholera occurred in Alexandria early in June, and the disease spread rapidly over Egypt, destroying 60,000 of its inhabitants during the following three months. The panic was great, and people fled from Egypt to Constantinople, and to various places along the Mediterranean coast. At the same time, the disease was extending through Persia to the north and north-west, and so along the shores of the Black Sea, and up the Danube into Europe. In July, Turkey, Russia, Italy, France, Spain, and Portugal were under the influence of cholera. The disease reached England in September *via* Southampton, the port at which the Peninsular and Oriental vessels from Alexandria landed goods and passengers. Cholera was imported into America by the steamer *Atlantic*, from Havre; she carried 540 steerage passengers, who had come from Paris and other infected places. So that the Indian cholera of 1863-64 was, in the course of twelve months, disseminated from that country over the greater part of the civilised world by means of persons from infected areas passing in steamers and railroads to localities previously free of the disease; as in the case of the pilgrims from Mecca already referred to, or as in the following instance:¹—

The wife of a German workman left Odessa on the 16th of August for Altenburg, in Saxony, with her child suffering from diarrhoea. On the 24th, after a journey of nine days, she arrived at her father's house. On the 27th, the child's diarrhoea having become considerably aggravated, the mother called in Dr. Genitz. The mother was in perfect health on that day. At nine o'clock on the evening of that same day she fell ill of cholera, and sank under the attack on the morning of the 29th. At eight o'clock on the evening of the same day her sister-in-law, who lived in the house, was attacked in her turn, and died on the 30th. The house in which these two women died became the primary focus of infection,

¹ *History of Asiatic Cholera*, by C. N. Macnamara.

whence the disease spread throughout the town. The family of a workman who had died at Altenburg on the 18th of September imported the disease into Werdau. The dwelling occupied by this family became the starting-point of an epidemic which carried off 2 per cent. of the population of the town.¹

The following details are from a despatch to the Foreign Office from H.M.'s Minister at Florence, dated October 26, 1866. He reports: "The outbreak of cholera at Palermo has taken place under circumstances which merit some remark. Last year cholera prevailed at Naples, Malta, Marseilles, and other places where the intercourse with Sicily is most frequent; but a quarantine of the most stringent, not to say exaggerated, form was enforced throughout the island, and the disease never appeared there. The same thing occurred again this summer; and notwithstanding the prevalence of cholera at Marseilles, Genoa, and Naples, it did not make its appearance in Sicily, where quarantine was as before rigidly enforced. Then came the disturbance at Palermo, and the necessity of bringing troops at once from Naples, and of landing them without delay. In a few days it began to be whispered that cases of cholera had occurred among them, and shortly afterwards some of the townspeople were attacked, till, by last returns, above a hundred deaths had taken place within the twenty-four hours."

The first case of cholera reported in London in 1866 was traced by Mr. N. Radcliffe to a family at Bromley; the discharges passed by this patient were emptied into the River Lea, 600 yards below the open reservoirs at Old Ford.

This took place on the 27th June; the water from this reservoir was distributed to certain parts of London; early in July, out of every 10,000 of the persons who consumed this water, 27 were attacked with cholera; whereas in other parts of London only 5 in 10,000 persons were attacked by the disease.

THE CHOLERA EPIDEMIC OF 1867 IN (HURDWAR) INDIA, AND IN PERSIA AND EUROPE IN 1868-70.

From the jail returns of Bengal for 1867, we find that no less than 368 per 1000 of the prisoners in Chyabapa, 132 per 1000 in Cuttack, and 100 per 1000 in Raipore, died from cholera; fearful as is this death-rate, it was probably trifling as compared with that of the surrounding population. The disease was very severe in the Central Provinces, and appeared among the people assembled at the Viceroy's Durbar at Agra. Hurdwar is a town situated on the

¹ *History of Asiatic Cholera*, by C. N. Macnamara.

banks of the Ganges in a gorge of the Sewalick hills, about 13 miles from where the river escapes from the Himalayas. Here pilgrims collect from all parts of India at a certain day of the year, to the number of about three millions; they camp on a space about 22 square miles in extent. The year 1867 was the year of the *Kumble mala*, which occurs every twelfth season, when the blessings derived from bathing in the Ganges are supposed to be unusually great, and Hindoos flock to Hurdwar in vast numbers from all parts of India.

The pilgrims began to pour into the camp from the 1st of April in vast numbers from the plains, and to settle themselves down in the blocks laid out for them. On the 3rd of April the fair may be said to have commenced, though dense living streams stretched backwards for a very long distance into the plains, and with a volume steadily increasing up to the auspicious bathing hour of noon on the 12th of April, continued to concentrate themselves in Hurdwar, and to pour out their multitudes on the encamping ground. It is important to notice here that, on the night of the 11th of April, a very heavy thunderstorm burst over this vast unsheltered multitude; the rain lasted the whole of the night and throughout the following day.

Those only who have been exposed to these hill storms in the tropics can realise what a night of misery these three million pilgrims must have passed on the open plain of Hurdwar, cold and drenched to the skin, the water running in streams off their half-naked bodies over the rocky ground into the river; and however perfect the conservancy may have been, this downfall of rain must inevitably have washed excrementitious matter from the latrines and surface soil into the Ganges during the night of the 11th of April.

With the exception of a case of cholera on the 9th, under the care of Dr. Kendall, the entire mass of pilgrims appears to have remained in good health up to the 12th of April, and I cannot do better than describe what then occurred in Mr. Cutcliffe's own words. He says, the bathing place of the pilgrims was a space 650 feet long by 30 feet wide, shut off from the rest of the Ganges by rails, which prevented the people from getting out into the river further than the limits of the space thus enclosed. Into this long, narrow enclosure, the pilgrims from all parts of the encampment crowded as closely as possible, from early morn (the rain still beating down over them) till sunset. The water within this space during the whole time was thick and dirty, partly from the ashes of the dead, brought by surviving relations to be deposited in the water of their river god, and partly from the washing of the clothes and

bodies of the bathers. Pilgrims at the bathing ghaut, after entering the stream, dip themselves under the water three times or more, and then drink of the holy water whilst saying their prayers. The drinking of the water is never omitted; and when two or more members of a family bathe together, each from his own hand gives to the other water to drink.

Observe what follows;—On the evening of the next day, 13th April, eight cases of cholera were received into one of the hospitals at Hurdwar. By the 15th the whole of this vast concourse of pilgrims had dispersed, and the encamping ground was again left a barren waste. Dr. J. Murray has given a detailed report of the events that occurred after the pilgrims left Hurdwar. He states that the immense crowd at Hurdwar having entirely dispersed on the 15th, the pilgrims passed chiefly on foot at about the rate of 15 miles a day. “The moving mass crowded the roads at Meerut in a continuous stream for nearly a week. This pilgrim stream carried cholera, which lined the road with victims, whose funeral pyres studded the surrounding fields, or whose corpses were thrown into the canal or collected by the police and buried. The disease was communicated to the neighbouring towns and villages, and the pilgrims carried it to their homes over the whole of Hindostan.” Dr. Murray, in his able report, traces the appearance of cholera over districts, otherwise free of the disease, to the advent of bands of pilgrims; the date and particulars of each outbreak is given in detail.¹

Cholera spread to Peshawar and to Cabul, from which country many pilgrims travelled from Hurdwar; it broke out with fearful violence in Cashmere, and at Teheran in the summer of 1867. It appeared in Meshed in July 1868; the place was then crowded with pilgrims, and with them it was dispersed over the whole of Persia and Asiatic Turkey. In the same circumstances Kiev, the “Jerusalem of Russia,” when full of pilgrims was attacked with cholera (August 1869), and in the three succeeding years in Russia alone it destroyed no less than 241,808 people, and throughout Europe probably not less than one million human beings.

It was after this terrible visitation of cholera that the second International Sanitary Congress was opened at Vienna (*vide* Appendix), the first Congress having met at Constantinople in 1866. The Vienna delegates affirmed their belief that epidemic cholera invariably spread to Europe from India; that it is not likely to become localised in Europe or America; that it travels with man, and only to a limited extent by the atmosphere; and that it may be spread by means of drinking water, soiled linen, or merchandise

¹ Report on the Hurdwar Cholera of 1867.

coming from an infected locality; that the period of incubation of the disease did not last beyond a few days.

I may mention an instance of the disease, the first occurring in Calcutta, on the 25th December 1871, regarding which I published the following details in the *Indian Medical Gazette* for March 1872:—

Nos. 3, 4, and 5 Russell Street form as fine a block of three-storied houses as any in Calcutta; they stand well apart from one another, and are, in fact, nearer to a parallel row of houses overlooking the Chowringhee maidan than they are to one another. The locality is admirably drained, and supplied with water from the Calcutta municipal works. The three houses above referred to form a boarding establishment, presided over by a lady living in No. 5 Russell Street, and all the European lodgers on the premises are provided, not only with food and milk, but also with water, from a kitchen in No. 5; for it is remarkable that although the pipes from the municipal waterworks run along the side of the street, the water is not laid on to any of the three houses in which the cholera occurred, but the supply of drinking water is brought in bheesties, dirty leathern bags, and emptied in an open filter kept in No. 5 Russell Street, from which filter the drinking water for all the persons in this boarding establishment is drawn.

There has not been a single case of Asiatic cholera among the Europeans residing in the immediate neighbourhood of Russell Street within the past four years.

On the night of the 26th December, a gentleman who had lately been living at Bhowanipore among a community free of cholera, although the disease existed in the neighbourhood, was seized with cholera in No. 4 Russell Street; he passed rapidly into collapse, and died the following morning. The wife of this gentleman, and a Christian servant in their employ, who partook of the food and water¹ consumed by his master, were attacked with cholera on the 27th; they both recovered. At the same time a lady in No. 5 Russell Street was seized with cholera, and during the night of the 27th another lady residing in No. 3 Russell Street was attacked by the disease. Archdeacon Pratt was living in rooms in No. 5 Russell Street; he left the house on the night of the 25th, and travelled away some 300 miles by rail to Ghazepore. He was there seized with cholera on the 27th, and died from the effects of the disease on the following day.

It appears, therefore, that of inmates of Nos. 3, 4, and 5 Russell Street, who were all in good health on the 25th of December, six were attacked by cholera within the next forty-eight hours. Since that time there has not been a single case of the disease in the neighbourhood. We cannot overlook the fact, that of the multitude of native servants on the premises, only one ate and drank the food and water consumed by Europeans, and he was attacked with symptoms of cholera. Further, the three houses in which the cholera occurred were respectively nearer to the houses overlooking the Chowringhee maidan (where no cholera occurred) than they were to one another.

We must bear in mind the fact that the one thing which the European inhabitants of Nos. 3, 4, and 5 Chowringhee had in common was the kitchen, from which they all received their food and water; and it is very

¹ It was proved by subsequent analysis that this was hydrant water, but containing just double the amount of organic matter existing in water drawn from stand pipes close by.

important to observe that the bheestie who carried the water (it may have been from a municipal stand pipe) in his *mussuck* to the common filter in No. 5 Russell Street, resided in a suburb of Calcutta called Bhowanipore; further, the milkman who supplied milk to the establishment (Nos. 3, 4, and 5 Russell Street) also lived in Bhowanipore, and we have since ascertained that within a stone's throw of the tank from which the milkman gets his water there is a large house in which no less than eight persons were attacked with cholera between the 18th and 23rd of December, and of these four died. Cholera was, in fact, very deadly in parts of Bhowanipore during the weeks previous to the 25th of December; and it is quite possible the infecting matter was introduced through the medium of milk, and distributed to the people residing in Nos. 3, 4, and 5 Russell Street on the 24th and 25th of December. It affected those susceptible to its influence within three days from the time it was swallowed.¹

THE INDO-EUROPEAN CHOLERA OF 1879-83.

During the years 1876, 1877, and 1878 there were respectively 196,590, 155,305, 95,193 deaths from cholera in the Bengal Presidency; in 1879 the mortality rose to 136,363, so that in these four years in one of the three Presidencies of India no less than 583,451 of its inhabitants were carried off by this terrible malady. In the Bombay Presidency, from 1875 to 1878, about 183,667 people died from cholera; while in 1883 no fewer than 37,954 deaths occurred in Bombay from this disease.

The epidemic of 1879 was remarkable for its terrible virulence in the North-West Provinces and in the Punjab, and appears to have been disseminated by pilgrims returning from Hurdwar in the same way as the cholera of 1867 had been spread by them over that part of India. As I before remarked, every twelfth year is supposed to be exceptionally sacred at Hurdwar, and as in 1867 pilgrims collected to the number of about three million to bathe on a certain day in the Ganges, so in 1879 another *Kumble mala* was held in this place. Cholera broke out among this vast assemblage of pilgrims about the 12th of April, and from that time it spread over the north-west of India. On the 15th of April, after the return of pilgrims from Hurdwar by rail, the first cases of cholera were observed at Lahore; the disease broke out among our troops in the Peshawar valley; 284 died from it in the month of June; it spread throughout Afghanistan during the year 1879, and also into Cashmere.

Cholera was very destructive over the greater part of Oude and the North-West Provinces in 1880.

In 1881 the disease killed 16,694 persons in the Bombay Presidency, and in 1883 no less than 37,954 people, as we have said, died in this province from cholera.

¹ *History of Asiatic Cholera*, by C. N. Macnamara, p. 383.

I have not attempted to describe the course of this epidemic over India, for year by year a vast area of that country had gradually been opened up by railways, facilitating the rapid transit of people through extensive tracts of country; and so complicating the circumstances of the distribution of cholera, as to render the outlines of its progress from one part of the country to another almost impossible to follow. We must, however, refer to the spread of the disease beyond India during the year 1881-82. In the month of November 1881 the feast of Kurban Bairam was held at Mecca; some 60,000 pilgrims assembled in and around the holy city on this occasion. Many of these people arrived at the port of Jeddah early in September to be ready for the festival. In July the *Columbia* left Bombay with 650 pilgrims on board bound for Jeddah. This vessel made no less than five trips with pilgrims between April and November, carrying in all 3566 pilgrims from India to Arabia. In September the *Columbia* touched at Aden to unload a quantity of rice she had taken on board in Bombay (then under the influence of epidemic cholera); three of the natives employed to unload this rice were within a few hours after commencing their work attacked with cholera, and from their homes the disease spread to natives living in surrounding villages, and so throughout the Hedjaz. The *Columbia*, having discharged her cargo of rice, proceeded on her voyage to Jeddah, and landed her 650 pilgrims; they passed on to Mecca about the middle of August. Soon after these people arrived in Mecca, that is, on the 29th of August, cholera commenced among the pilgrims in the holy city, and it is believed killed some 6000 or 7000 of them. On the 27th of November a shipload of these cholera-stricken people arrived in Egypt, the vessel being at once subjected, together with the pilgrims, to strict quarantine regulations at El Wedj. Although the disease existed more or less constantly in this station, being frequently imported by fresh arrivals from Mecca, cholera did not spread to Egypt in 1881, some batches of pilgrims being detained four months in quarantine.

On the 25th of July 1882 the *Hesperia* entered the port of Aden, after leaving Bombay about the 12th, with 501 pilgrims and a cargo for England. At Aden the stoker of this vessel died of cholera. Three-fourths of the pilgrims on board came from Bokhara and Afghanistan, where cholera existed at the time of their departure. Several of them died of cholera on their journey, and the disease again broke out at Mecca in October. During this year a brigade of Indian troops landed in Egypt from Bombay, and took part in the occupation of that country by our forces, and the Egyptian quarantine regulations had to be relaxed in consequence of

the exigencies of our military operations. At the end of June 1883 cholera appeared at Damietta, and afterwards at Rosetta, Port Said, and Mansourah. During July it spread from these localities; at Cairo it was very fatal, and also in Alexandria. It is estimated that from the 22nd of June to the 1st of September 1883, cholera destroyed 50,000 people in Egypt. There can be little doubt that the Egyptian cholera of 1883 originated in the 1882 epidemic of India and Arabia. "The French delegates to the Sanitary Council had urged that pilgrims who reached Suez without previous quarantine should be isolated and kept under surveillance for three days; but, owing to the opposition of the English delegates, these measures were not enforced. The Council did not meet again, and so no protective system was adopted."

Dr. W. T. Simpson, the Officer of Health in Calcutta, has given an admirable account of this outbreak of cholera in Damietta and Egypt, and, after the most careful consideration, arrived at the conclusion that there was room to suspect the introduction of cholera into Damietta by pilgrims; but, as in India so in Egypt and Europe, in consequence of the vastly increased facilities given of late years to the transit of human beings and merchandise from the East, it is now extremely difficult to follow the course of the disease from one country to another.

About the end of June 1884 cholera broke out in Toulon, and soon afterwards at Marseilles. I cannot pretend to settle the question as to the exact route by which cholera reached these places. It is quite certain Egypt was under a widespread epidemic in 1883-84, and that France, which had before that year been free from Asiatic cholera, became affected by the disease, it may be directly from Africa, or, as some authorities hold, by vessels arriving at Toulon and Marseilles from Saigon; but it seems almost certain that during the summer of 1883 cholera was carried from Egypt to Marseilles. The disease spread over Southern France in 1884, and appeared in Genoa, Naples, Palermo, and various other places in Italy, where it remained until 1886-87.

As early as 1884, Spain was slightly affected with cholera, and in 1885 it broke out with considerable virulence over a portion of that country. The disease commenced in Spanish ports having direct communication with infected places in France, and from the seaboard extended inland; according to the best authorities it was disseminated principally by means of polluted drinking water.

On the 17th of February 1883 I addressed a letter to Earl Kimberley, then Secretary of State for India, asking him to grant me the services of an officer of the Indian Medical Department to

assist me in working out the bacteriology of cholera. Lord Kimberley on the 9th of April declined to grant my request. Fortunately, however, in the summer of 1883, Germany, France, and subsequently America sent men possessing the highest scientific knowledge to investigate the cause of cholera in Europe and Egypt. Among these, Dr. Robert Koch, the Director of the Pathological Laboratory of the Imperial Board of Health, Berlin, was commissioned by his Government to proceed to Alexandria, and subsequently to Calcutta, to investigate the nature and cause of Asiatic cholera. The French Government deputed experienced pathologists and bacteriologists to proceed to Egypt on the same errand. America sent Dr. E. O. Shakespeare, of Philadelphia, on a like mission to Spain, Italy, and to India. The report of this physician to his Government is one that does honour, not only to the gentleman who compiled it, but also to the United States, who have published his exhaustive and admirable work on cholera in Europe and India. The labours of Dr. Koch have justly received recognition by his own Government; and by men of science throughout the world their value are now fully acknowledged. But no sooner had his views become known in Europe, and been confirmed by many of the best authorities on the subject, than the Home Government sent a Commission, with Dr. Klein at its head, to Bengal, "for the purpose," as Dr. Shakespeare remarks, "of investigating the grounds of the opinions announced by the German Commission." Dr. Shakespeare adds: "After having spent some time in Calcutta and Bombay, the English Commission returned in due time to London, and published a report, in which they related observations and conclusions directly opposed to those of the German Commission. At the same time, they incidentally advanced statements concerning the dejecta of cholera patients which would seem to warrant the inference that they were imbued with a notion, entertained by some medical officers high in authority in India, and connected closely with the Government of India, that there is nothing specific or contagious about these dejecta, and that it is extremely doubtful if this disease is at all infectious or contagious in the ordinary acceptation of these terms."

The Indian Government, since the unfortunate Commission on the Mian-Mir cholera of 1861,¹ had adopted views regarding the preventive treatment of cholera which differed from those held on this subject by the medical and sanitary authorities of Europe and America. In this way it came to pass that when Asiatic cholera extended beyond India westward, England was accused of neglecting the proper precautions to prevent the disease spreading from its

¹ *Treatise on Asiatic Cholera*, by C. N. Macnamara, p. 194.

home. This idea was unfortunately fortified by some expressions of opinion used by Government on the subject. For instance, in 1883 the Sanitary Commissioner of Madras, in his annual report, recorded facts bearing on the spread of the disease in Southern India by pilgrims and by passengers travelling over our railroads. With reference to this communication, which was in accord with all that we learn from science and the history of cholera, the Government of India, on the 6th March 1883 (No. 83, Home Department), observes: "We are not called upon to enter into theoretical discussions as to the causation of disease, but there can be no doubt that the publication of such theories as are contained in this report is likely to prove most embarrassing, especially at the present time, when the International Sanitary Board (p. 57) at Constantinople and Alexandria not only accept these theories, but immediately proceed to put them in practice, to the great disadvantage of India." Expressions of this kind necessarily gave rise to the ideas I have mentioned regarding England's proceedings in this matter. So strong had this feeling grown in 1883, that the Foreign Office felt it necessary to publish a note to the French Government repudiating the idea that England was in 1881-84 "responsible for the outbreak of Asiatic cholera in Egypt and Europe." But so long as views such as those I have quoted find their way into Government despatches, we must remain under suspicion as to our motives and action in the preventive treatment of epidemic cholera.

Since the year 1869, Drs. T. R. Lewis and D. D. Cunningham have to a large extent led the Government of India in matters connected with the origin and spread of Asiatic cholera; these gentlemen in 1882 had expressed views on the subject precisely similar to those enunciated in the Government despatch of 1883, above quoted. Dr. T. R. Lewis, writing on the cholera which broke out in Aden in 1882, observes that "the influence of the promulgation of current theoretical views (see p. 373) has many disadvantages. What the essential cause of cholera may be is wholly unknown; but surely," he adds, "it is wiser frankly to avow our ignorance than to promulgate purely theoretical doctrines which tend to direct the attention of Government and individuals from the necessity of getting rid of known local causes of ill-health, and which, if carried to their logical conclusions, would seriously interfere with personal liberty, and prove very embarrassing to the commercial intercourse of nations."¹

In this country, Sir Joseph Fayrer, Physician to the Secretary of State for India in Council, maintained similar ideas to those above

¹ *A Reprint of the principal Scientific Writings of the late T. R. Lewis, M.B.*, p. 327.

referred to regarding Asiatic cholera. In an address delivered in February 1886, Sir Joseph Fayrer "rejected the theory of contagion of cholera by personal intercourse, and therefore condemned in strong terms the inability of all coercive measures of quarantine and cordons." He observed "that the British and Indian Governments, who based their action in the matter on well ascertained facts, had wisely discarded all quarantine measures on both sea and land, and relied solely upon sanitary laws."¹

In the *Lancet* for May 19, 1888, Sir Joseph Fayrer observes:—

The cause of cholera is still unknown; but so much, however, has been learnt of its habits, that in Europe and India we have come to know that action based on any theory of contagion is as useless as it is unprofitable—that the rate and direction of an epidemic are not influenced by facilities of communication, or by the greatest streams of human traffic. Many circumstances attending the outbreak of the disease and the pathological conditions these develop seem opposed to a specific poison as being a cause of the disease.

Sir Joseph Fayrer remarks that "cordons and quarantine have utterly failed to prevent the spread of cholera, but, on the contrary, have done harm"; that unripe fruit, saline purgatives, fear, and anxiety are powerful predisposing causes; the former, he states, may "bring on the disease." Sir Joseph "demurs to a microbe being accepted as the solution of a problem as the cause of cholera." On the other hand, he remarks "that Dr. Bryden maintained that cholera was due to a miasm, and has a perennial abode in certain areas of India, and in other districts is renewed by invasion from these areas; that it is earth born and aerially conveyed."

EPIDEMIC CHOLERA OF 1891-92.

During the early part of 1891 cholera was very prevalent in parts of Lower Bengal. Surgeon-Captain D. G. Crawford (the *Indian Medical Gazette* for February and April 1892) has published an account of an epidemic that occurred in 1891 in the Purnia district, which is situated within the endemic area of cholera, between Nipal and the Ganges: it contains a population of about two million people. There was comparative freedom from cholera in this district during the year 1890. On the 8th of February 1891, a great bathing festival took place on the banks of the Ganges at Karagola. Surgeon Crawford writes that this festival (Suan) is said to occur only once in thirty years, and it took everybody by surprise. The railway authorities appear to have been unprepared for the enormous quantity of passenger traffic suddenly thrown on

¹ *Brit. Med. Journ.* p. 457, March 6, 1886.

their hands, and were unable to concentrate sufficient rolling-stock to carry pilgrims applying for transport, especially as this unexpected demand was made in more directions than one at the same time; crowds of pilgrims poured down the N.B.R. line to Sara, as well as along the Assam-Bihar Railway to Manihair. Nor were any preparations made in this district, at least for dealing with the sickness that might be expected to occur among the assembled masses at Karagola. On the 8th of February 1891, cholera broke out among these pilgrims, and by the 12th about 60,000 of them had been despatched by train, some of them, it is reported, dying of cholera in the railway carriages. A great number of the pilgrims came from the hills, that is, from the lower ranges of the Himalayas. In March the disease had become general over almost the whole of Purnia, 2187 deaths being registered from this cause. In April the deaths from cholera reached 10,730; in May, 6668. Dr. Dawson Williams, in the *British Medical Journal* for September 17, 1892, states that towards the end of 1891 cholera was imported into the Peshawar district from Swat, and spread through the Khyber Pass to Cabul before the close of the year.

In 1892 our attention is fixed on another outbreak of cholera among pilgrims assembled at Hurdwar, which, as I have before stated, is situated near the exit of the Ganges from the Himalayas. From the *Indian Medical Gazette* for April 1892 we learn that in the year 1891, when the great fair was held at Hurdwar, at which an extraordinary number of pilgrims assembled, the Government had the satisfaction of recording the fact that no cholera had broken out either at Hurdwar or among the returning pilgrims. This fortunate result was attributed to the excellent, but costly, sanitary and other arrangements organised and carried out by the Government. "This year (1892), however, we are informed that with a smaller number of pilgrims cholera has broken out in a severe form at Hurdwar, necessitating the breaking up of the fair. It is reported that this year the sanitary and food arrangements were defective. The Punjab Government has taken steps to establish dispensaries at every large station on the N.W. Railway for the purpose of inspecting all special trains conveying pilgrims from Hurdwar back to their homes. Already, however, we hear that cholera has reached Saharanpur; and, if we may judge of the past history of the disease caused by returning pilgrims from Hurdwar, this is only the first stage of its journey, the first *act in the drama*." I have quoted this passage because it might seem that I was harping unnecessarily on the dissemination of cholera over the north-west of India by affected pilgrims.

The outbreak of cholera occurred among the pilgrims assembled at Hurdwar about the 22nd of March 1892; on the 25th of the month the Government issued orders preventing the railroads from taking any more pilgrims to Hurdwar, and those who had assembled there were dispersed as speedily as possible. This action of the Government was the subject of much comment in the native papers, but, as the *Pioneer* at the time observes, it is impossible to sympathise with "the complaints which reach us from Delhi and elsewhere regarding the action of the authorities in dispersing the pilgrims at Hurdwar when cholera appeared among them. It is argued that whereas the course taken was meant to stamp out the epidemic, it has had the opposite effect, returning pilgrims carrying the disease with them wherever they appear in large numbers. This is unfortunately the case, but it was inevitable. What the authorities really did was to minimise the local outbreak, to stop hundreds of thousands of persons congregating instead of only the tens of thousands who had already gathered when cholera of a most virulent type broke out. If one imagines the terrible results that would have followed had not the 70,000 pilgrims been hurried from the bathing-place, the action of the authorities will be justified a hundred times over. It has been proved again and again that pilgrims, imbued with the spirit of fanaticism and filled with that fatalistic belief so common among Eastern races, will incur every risk from pestilence sooner than abandon the religious object they have in view. Thus at Hurdwar several Hindus in the last stage of cholera were actually lifted from the sacred waters, only to die a few minutes later. Their companions resented all interference with their 'right' to bathe, and it was with the greatest difficulty that their dispersal was eventually effected. Had not the strongest measures been taken, there would have been an epidemic probably unequalled in the century. Less than 100,000 persons had assembled when the order was given to break up the fair, and we know what has followed. What would have been the return of mortality if 500,000 had made their way to Hurdwar? The latter figure is well within the mark, for in all probability the attendance this year would have been exceptionally large. Not all the appliances of sanitary science, and no amount of medical skill, can check an epidemic of true cholera when hundreds of thousands of people are camped together in a small space. There is nothing for it but to disperse the gathering as quickly as possible. It is the less of two evils, and the only question is when the order for the breaking up of the pilgrims' camp should be given."

From the 1st of April to the 7th there were twenty-four cases of cholera between Simla and Kalka. By the 20th of the month it had broken out at Mian-Mir; it prevailed to an alarming extent at Peshawar and in the surrounding country. Seven thousand deaths from cholera were reported in the Punjab since the second week of April. During the month of May cholera spread to Kashmir, and in Srinagar alone 5736 out of a population of 124,000 died from the disease.¹ Dr. R. Harvey, who was deputed by the Government of India to investigate the circumstances of this epidemic in Kashmir, reported "there can be no doubt the disease was imported" into the country. By the 11th of May cholera was "raging at Cabul"; the disease spread rapidly over Northern Afghanistan, and, in spite of the strict quarantine of forty days imposed on their frontiers by the Russian and Persian authorities, cholera reached Meshed by the 27th of May, 700 deaths occurring in that city every day. The Persian Government proceeded to establish *cordons sanitaires* round Meshed, to prevent pilgrims from moving from place to place. The town of Turbaty-Shan is described as presenting "a terrible picture. The streets of the place strewn with unburied corpses. The inhabitants flying in terror to the hills;" although the Russian authorities had sent an armed force to the Persian frontier to keep the disease out of their territory. Places westward of Meshed were speedily affected; the disease reached Astrabad, Yezd, and Resht, and by the 26th of June we hear of it at Baku and in various other towns on the shores of the Caspian. At the same time, the disease had broken out with great severity throughout Northern Khorassan and at both termini of the Transcaspian Railway—from Samarcand along the road to Taskend on the east, and from Urun-ada on the Caspian, and so by steamer to Baku, on the west. The Russian Government made strenuous efforts to prevent cholera spreading along the banks of the Volga; but it broke out in Astrachan, and by the 1st of July appeared at Isaritzin, far up the river, and by the 4th of the month at Saratov, some 500 versts up the Volga, and so it reached the famine-stricken districts of Russia. Cholera passed on to the University town of Kasan, and into the province of Orel. It appeared at Nijni-Novgorod on the 11th July. On the 13th of July, persons travelling from Moscow to St. Petersburg were stopped *en route* and sent back, as they were believed to be suffering from cholera. In Moscow it was officially notified on the 24th July, and in St. Petersburg on the 1st of August.

The disease extended over a great part of Russia during the months of August and September, destroying not less than 300,000

¹ Surgeon-Colonel Harvey, M.D., *Brit. Med. Journ.* August 13, 1892.

of her inhabitants during this period. Professor Virchow, who visited Russia at the time, on his return to Berlin reported "that the preventive measures taken by Russia against the dissemination of cholera over the country were simply magnificent. The best possible means of checking the disease were everywhere at the disposal of the local authorities." Virchow adds: "In some respects it is evident the Russians are ahead of us in Germany and Berlin. It is true the disease is raging in some districts of the Volga (September 8), and the arrangements are not so perfect there as they might be; but the disease there finds a favourable soil among the famine-stricken population, and Germany could do no more than the Russians have done." I can endorse the views here expressed by Virchow, for I visited Russia and the Volga not many years since, with the object of observing the condition of the people, and the preparations made by Russia with reference to the passage of cholera from India into Europe. There can be no doubt her sanitary authorities were aware of the danger, and, as far as practicable, were prepared for an invasion of cholera from the east, such as has this year overtaken their country.

There is a larger emigration of Russians, especially Jews, as well as Germans, from Hamburg than from any other port in the north of Europe. The sanitary condition of the city is most defective, and the water of the Elbe, into which the drains of Hamburg empty themselves, was delivered unfiltered for the use of the population. In these circumstances, Asiatic cholera broke out in the city about the 18th of August 1892, and continued until the end of October, during which time 17,972 persons were attacked by cholera, and 7610 of them died from the effects of the disease. Asiatic cholera appeared in a number of places in Holland, Belgium, and the north of Europe; it also broke out in Poland, Cracow, Buda-Pesth, Vienna, and other towns in the east of Europe; but, with the exception of Hamburg, no place beyond the confines of Russia was seriously visited by the disease. In all doubtful cases the nature of the affection was determined by the presence, or absence, of Koch's cholera bacillus in the discharges passed by the patient.

The news of the outbreak of cholera in Hamburg served to increase the vigilance of our Local Government Board. Dr. Thorne had for months carefully watched the progress of the cholera from Asia through Europe. Hamburg had always been a suspected place, owing to the large number of emigrants from Russia and Eastern Europe generally who annually arrived there *en route* to England and America. In anticipation of an outbreak of cholera in the great German port, medical men, by order of the Department, had, in the spring of 1892, been closely watching the ports on the eastern coast of England, with which Hamburg is in almost daily communication. As soon

as the Local Government Board received official notice that Asiatic cholera had actually broken out in Hamburg, the Board telegraphed the news to every medical officer of health at every port from the Tyne to the Solent. Three medical inspectors were also despatched without delay to the chief ports at which ships from Hamburg might be expected to arrive. The Board received telegrams from those gentlemen showing that they were actively at work in co-operation with the various port sanitary authorities, which bodies, in many cases, are constituted by the town councils. Orders were issued to all port sanitary authorities, all urban and rural sanitary authorities, officers of Customs, masters of ships, and other persons concerned, reminding them of the powers they possess, and the responsibilities attaching to them. Suspected persons could be detained, and, if released, they were obliged to give their names, addresses, and other particulars, so that their subsequent movements could be followed. As a matter of fact, every new arrival suspected of having been in any way in contact with cholera was followed to his destination and closely watched, with a view to prompt medical attention and isolation in the event of the disease developing itself. Dr. Thorne added that, short of absolute quarantine, which would practically mean the suspension of all commerce, every precaution had been taken to prevent the importation of the dreaded disease.

On the 25th of August the Hamburg steamer *Gemma* arrived off Gravesend with three suspicious cases of Asiatic cholera on board. The patients were at once removed to the floating hospital; two of them died the same evening of cholera. The next case occurred at Middlesborough on the 27th of August.

The steamship *Geona* arrived at Middlesborough from Hamburg, and reported a clean bill of health. She went into dock, and most of her hands were paid off and went to their respective homes. Later in the day a seaman named Goodlad, of Leith, who had steered the vessel into dock, became ill, and Dr. Malcolmson, of the port sanitary authority, was sent for. He found Goodlad suffering from the symptoms of cholera, and ordered the vessel into quarantine. Goodlad died on Saturday night. Dr. Thompson, local Government inspector, confirms the opinion that the case was one of cholera.

At Hull on the same day, August 27th,

“Two German firemen on board the steamer *Hamburg*, of and from Hamburg, which was lying in the Queen’s Dock, Hull, at which port the vessel had arrived the previous day, were found to be unwell, and were examined by the medical officer of health (Dr. Mason), who pronounced them to be suffering from diarrhoea. Under the circumstances the authorities deemed it prudent to remove them to the Garrison Side Hospital, which is set apart for cases of infection, whither they were at once taken and isolated. The vessel having received free pratique, and there being no reason for her detention, she sailed the same night for Southampton. All vessels arriving at Hull were rigidly inspected, and closely watched both by the Customs officials and those of the port sanitary authority, no person being allowed to land until they had satisfied the authorities they were in good health.”¹

Since the 25th of August until the end of October 1892, twenty-

¹ *The Standard*, August 27th, 1892.

nine cases of Asiatic cholera have been brought to our shores in vessels arriving from infected places on the Continent. Not one single case of cholera had arisen out of these twenty-nine importations of the disease; nor had a single case of Asiatic cholera besides those imported occurred in England.

On the news arriving in America of the outbreak of cholera in Europe, President Harrison prohibited any further emigration into that country from infected places on the Continent; in the same way old rags and clothes were excluded from the United States. A considerable number of vessels, however, arrived at various American ports, principally at New York, from Hamburg, with cholera cases on board. The passengers and crew of some of these vessels had suffered severely from cholera during the passage across the Atlantic. All such vessels were placed in strict quarantine on their arrival in American waters. No cases of cholera occurred throughout the United States during the year 1892, except in the instances of persons who, as in England, had embarked from cholera infected places on the continent of Europe.

In short, Asiatic cholera of a virulent type broke out within its endemic area in March 1891, and was widely disseminated over districts to the north of the Ganges, and into the Himalayas. During March 1892 the disease appeared among the pilgrims assembled at Hurdwar, and, on their being dispersed, was rapidly carried over the Punjab into Kashmir and Cabul. During the month of May, cholera spread into Persia and Samarcand, and in June it had reached various towns bordering the Caspian Sea. The disease was officially notified on June 18th in Astrakhan, and somewhat later the cities along the banks of the Volga were under the influence of the epidemic; the disease had spread before the 6th of July into the provinces of Saratov and Kostroma, some 700 miles up the Volga, in the centre of Russia in Europe; and in the south to Shusha, near the Turkish frontier, and so to Tiflis. In August cholera had broken out in the north of Europe, and had been carried westward as far as New York by the 3rd of September. This rapid dissemination of the disease may be accounted for by the fact that pilgrims leaving Hurdwar about the 23rd of March would have reached our Afghan frontier by rail in the course of a few days; and the communication between Samarcand and the Caspian was equally expeditious, and from Europe to America; so that in this, as in former epidemic outbursts of the disease, cholera has not outstripped human intercourse in the rapidity of its progress over the countries in which it appeared.

We cannot conclude the history of cholera during the year

1892 without reference to the outbreak of the disease in Paris, which has been in existence since the 10th of May; it was reported on that day that a man had died in the Necker Hospital of cholera nostras. Since then a number of cholera and cholera cases have taken place at Puteaux and other suburbs of Paris. In July the disease was spreading at St. Denis and Aubervilliers, about seven deaths per diem having taken place from cholera in these localities. The season had been a peculiarly hot and dry one in Paris, and the river water was drunk by no small portion of the suburban population. The disease, however, was considered sufficiently serious by our Local Government Board to call for a General Order on the subject, dated July 12, 1892. In this Order it is stated, that "Whereas cases of an infectious disease, alleged to be cholera, now exist in certain parts of France, and it is expedient that regulations should be made, as hereinafter mentioned, with reference to ships having on board bales of rags from that country,"—and then follow regulations preventing the import of rags from France into this country. It seems that the cholera of Paris in the early part of 1892 was not an invading cholera, such as that which, during the spring, spread from India to Europe, destroying thousands of people within a few months in its progress. I am disposed to believe that the Paris disease is a revival of the South of Europe epidemic of 1884-87, unless cholera had been imported in the meantime directly from Tonquin into Paris. There seems to be no doubt in the minds of a Commission of Spanish bacteriologists and physicians sent to examine into the matter, that the epidemic disease existing since May in Paris is Asiatic cholera. But it has comparatively feeble infective properties, and in this respect is not at all like the epidemic which in the course of six months has spread from India to Europe and America, and which is likely to overlap the disease which during the summer has been prevalent in France.

Cholera appeared at Havre on the 5th July, and deaths from it were known from the 15th of that month. Energetic preventive measures of treatment were at once enforced to combat the disease. All bedding, clothing, and the effects of the sick were destroyed; disinfectants were freely used. Although the disease hung about the town until October, it never attained large proportions. So far as it is possible to judge, the Havre cholera was an offshoot of that of Paris, and hardly a branch of the Indo-European cholera of 1892.

While cholera was thus widely disseminated over India and Europe in 1892, the disease had during the summer shown a tendency to extend towards the east. Later in the year we have information

from Chung-kung, *viâ* Shanghai, that Asiatic cholera of a virulent type was raging at Cheng Ten and the neighbouring districts of China.

BACTERIOLOGY.

Morphology and Cultivations of the Comma Bacillus.

—The question we have to consider is,—if in persons suffering from Asiatic cholera there is a specific micro-organism in the evacuations, or in their bodies after death; and if so, what are the distinctive characters of the parasite?

In order that we may arrive at a satisfactory conclusion on this subject, it is necessary to define the meaning which we attach to the term specific organism. Dr. R. Koch has supplied us with precise information on this point. He states that a micro-organism must fulfil the following conditions before it can be admitted to be the specific agent which effects definite pathological alterations in the body. The parasite must be present in all cases of the disease. It must exist in this and in no other form of disease. This micro-organism must occur in such quantities, and be so distributed within the tissues, that the symptoms of the disease can reasonably be attributed to its action.

As far back as 1866, in a work published on Asiatic Cholera, I insisted on the fact that the disease was caused by the introduction of specific organic matter into the small intestines of human beings, and that this "vibrio" was destroyed by the acid of the healthy gastric juice; that it was necessary for its development that it should rest in an alkaline medium, having a certain temperature and moisture. I stated my conviction that this organic matter might, if swallowed, be digested in a healthy stomach; on the other hand, supposing this organ to be in an unhealthy condition, or that the germs of cholera largely diluted in water gained speedy access to the small intestines, that it would then develop and cause the symptoms of cholera. These opinions were based on experience and a careful study of the disease, extending over nineteen years' continuous residence in Lower Bengal.¹ It was almost impossible in those early days of bacteriology to advance the subject further than this; in fact, it made but little progress until 1883, when, through the labours of Dr. Koch in Egypt and in India, a most important step forward was taken regarding our knowledge of the nature of cholera. After the most careful study of the micro-organisms contained in the evacuations of persons suffering from this disease, Dr. Koch arrived at the conclusion that in all cases of

¹ *A Treatise on Asiatic Cholera*, by C. N. Macnamara, pp. 418-433.

cholera there was present in the evacuations during life, and in the contents of the intestines after death, a bacillus which in his opinion presented clearly defined characters of its own. He further asserted that this micro-organism was never present in the evacuations or contents of the intestinal canal unless in persons suffering from Asiatic cholera. Dr. Koch believes, and I concur in his opinion, that the presence of this bacillus in the intestines of human beings is sufficient to produce the symptoms of cholera; these symptoms being the result of a poison formed by the cholera bacillus in the intestines.

The appearances presented by the cholera bacillus under the microscope are not characteristic, and they vary with the medium in which the micro-organism has lived. This bacillus, vibrio, or spirillum is about half as long, but thicker than a tubercle bacillus; it has rounded extremities, and a more or less pronounced curve along its longitudinal axis (Fig. 37). The bacillus is supplied at one



FIG. 37.—Cholera bacilli from a pure culture, twenty-four hours old, stained with fuchsine. Magnified 1000 diameters. (From Gaffky and Koch's Report.)

end with a flagellum, by means of which it exercises rapid movements across the field of the microscope. It may be isolated, but, as a rule, remains closely aggregated, often assuming an S or screw-shaped form; in old cultivations these are found with bulgings along their axis. On the whole, the cholera bacilli increase with extraordinary rapidity. Their vegetation reaches its highest point very soon; it remains stationary only for a short time, and then quickly diminishes. The growth of the bacilli is perhaps most rapid if placed in moist earth or on linen kept moist. In these conditions

even in twenty-four hours it grows extensively, and a pure cultivation of the bacillus may thus be quickly obtained; but they die after two or three days, being replaced by other organisms.

The cholera bacillus is killed if exposed to a temperature above 50° C., or to one below 15° C. It is, as a rule, destroyed after being kept free of moisture for a few days; but there is reason to believe that if the fluid in which it was contained gradually dries on moistened wool or cotton material, the bacillus may retain its vitality for some weeks, and if then removed to favourable conditions of moisture, heat, and oxygen, it may develop. The cholera bacillus multiplies by fission; it does not seem to be capable of producing spores by which its vitality can be preserved against surrounding deleterious influences. In any circumstances it thrives best when supplied with moisture and oxygen and a proper temperature. Koch has proved that the bacillus of cholera is destroyed by healthy gastric juice, and by most acids, and many chemical substances, but it will live in some weak vegetable acids. It thrives well in sterilised milk without perceptibly changing this fluid. In non-sterilised milk it can only live for a short time. The bacillus develops also in sterilised water, reaching its most luxuriant growth under favourable conditions of temperature, light, and free access of air in about seven days. In non-sterilised water it is destroyed more speedily. Koch found when he planted the bacillus in ordinary well water that it continued to live for upwards of a month; planted in dirty canal water, it lived for a shorter time; in bilge water of a ship and in salt water, Dr. Nicati found the bacillus lived for thirty days; in the drainage of cesspools it quickly disappears.

The cholera bacillus is stained by various anilines and in a watery solution of fuchsine. It may best be isolated for microscopic purposes by mixing one part of a fresh cholera evacuation with five of alkaline beef broth, and allowing the mixture to stand for ten or twelve hours at a temperature of 40° C. The bacillus rises to the surface of the liquid and forms a film, a drop or two of which shows almost a pure cultivation of the comma bacillus.

It is by means of cultivations of the cholera bacillus that we can best distinguish it from other micro-organisms. The reader is referred to works on bacteriology for directions regarding the necessary steps to be taken in cultivating the bacillus; these differ in no way from the methods employed for other micro-organisms. But I may observe that for cultivation purposes we may mix a little water in which cholera bacilli have been planted (or plant the bacilli directly) in some properly prepared and slightly alkaline

gelatine which has been rendered liquid by heat. The mixture, having been shaken up, is to be poured over a glass plate and allowed to set. In the course of from twenty-four to thirty-six hours a microscopic examination under a low power, say, fifty diameters, of the gelatine plate, shows colonies of the cholera bacillus. These present a rough granular centre of a grey or brownish-yellow aspect, having the appearance of a collection of highly refracting finely broken glass, surrounded by a clear zone, in which are scattered some dark refracting granules (Fig. 38). The bacilli as they develop liquefy the gelatine, and then sink to the bottom of the small

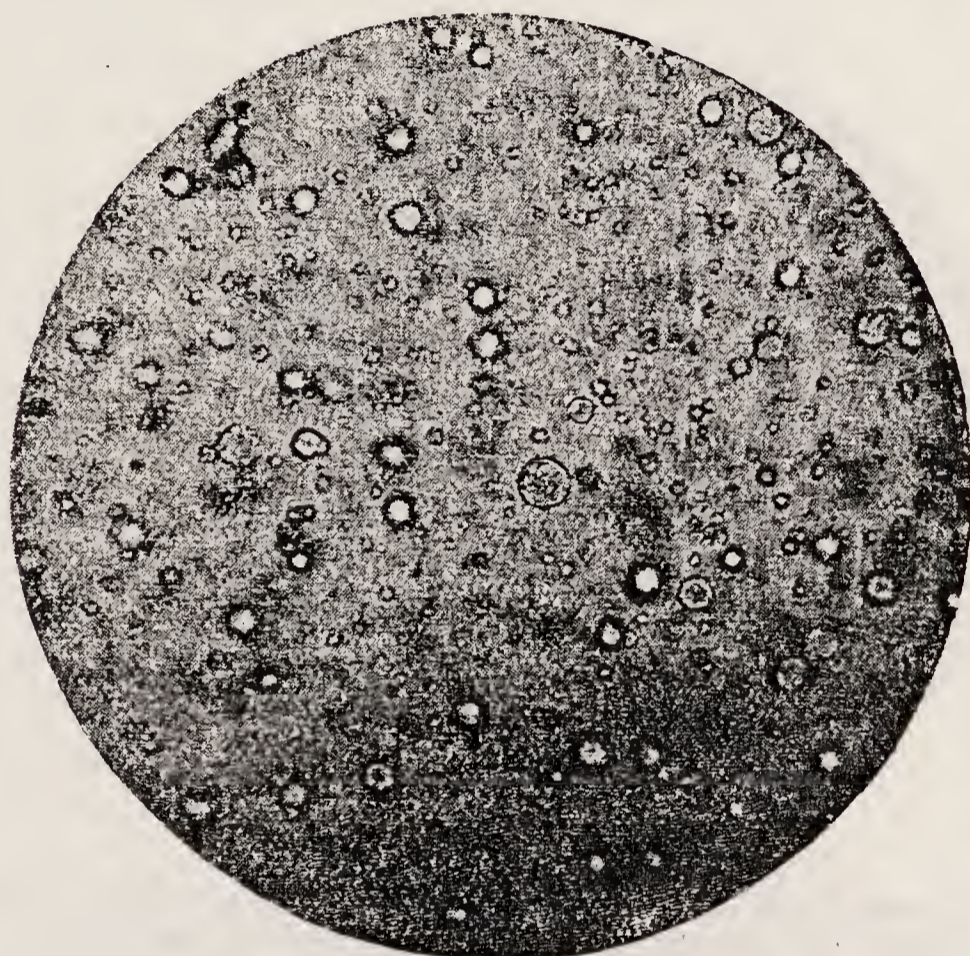


FIG. 38.—Gelatine plate cultivation of cholera bacilli, showing growth of colonies of the bacilli, forty-eight hours old. Magnified 50 diameters.

depression thus made. This change is best seen in about seventy-two hours after the bacilli have been planted; the surface of the gelatine then looks as if it had been perforated by a number of minute holes or air-bubbles; funnel-shaped depressions they really are, found in the position of the original colonies of bacilli; these pits, due to the liquefaction of the gelatine, increase in depth, and at the bottom of each a small whitish-yellow clump of bacilli may be seen, each one about the size of a pin's head (Fig. 39). From the fourth to the fifth day a halo appears round the cluster of bacilli, and, at the same time, the group assumes a reddish tinge; liquefaction extends, and soon the gelatine is completely liquefied.

Test tube cultivations of the cholera bacillus are best carried on in slightly alkaline gelatine. In the course of twenty-four hours after inoculation the track of the needle is indicated by a slight opaline line, due to a number of scattered points at which the bacillus is growing. At the end of forty-eight hours the surface of the gelatine is seen to dip. The upper portion of the culture is more or less funnel-shaped, with the appearance of an air bubble at the top. The fluid contained in the funnel-shaped cavity beneath the apparent air bubble is clear, or only slightly opalescent. At the bottom of the funnel and along the narrow neck below, greyish finely granular masses of the micro-organism may be seen, which have

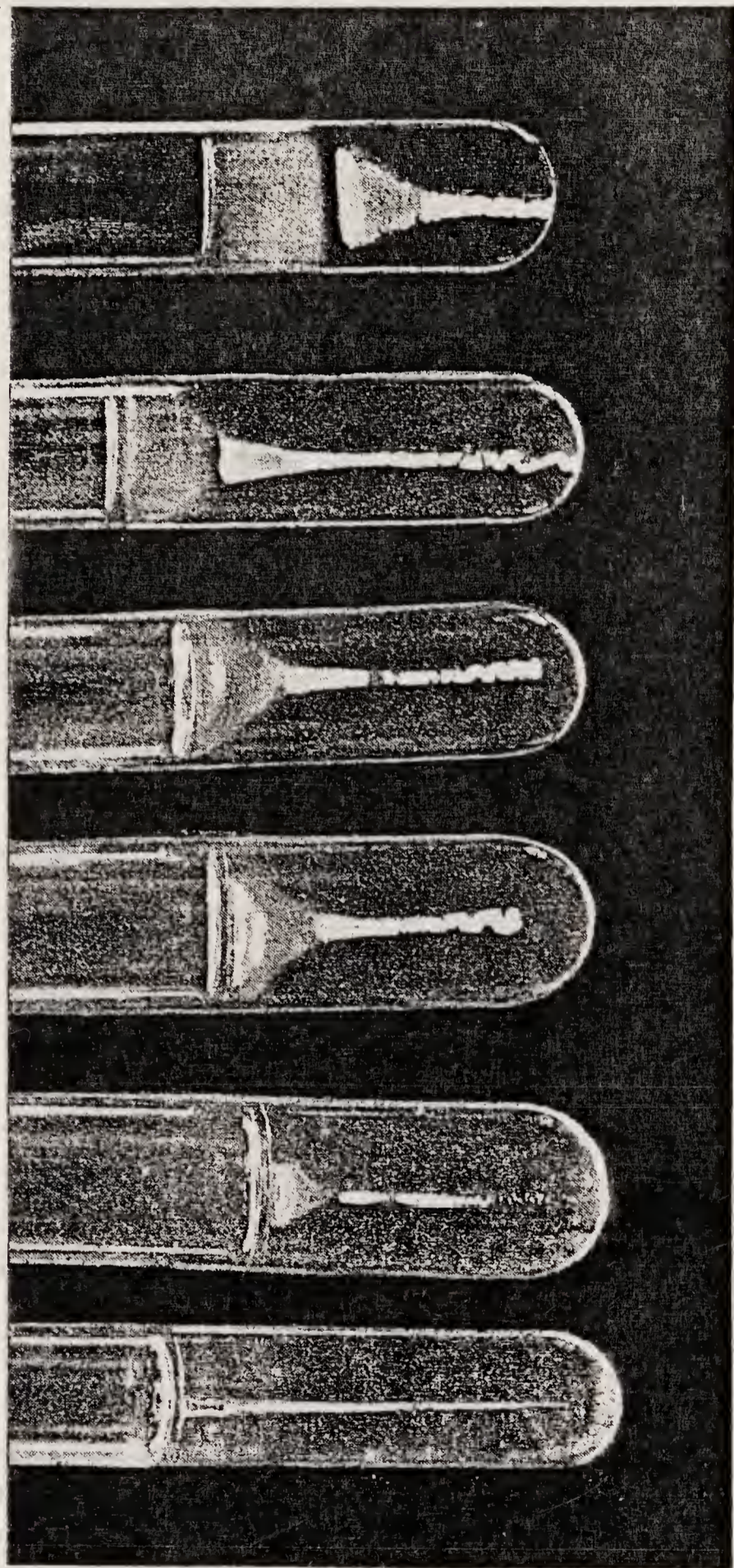


FIG. 39.—Gelatine plate cultivation of cholera bacilli, showing growth of colonies of the bacilli, seventy-two hours old. Magnified 50 diameters. (From Gaffky and Koch's Report.)

subsided from the growth of bacilli above and fallen down to the bottom of the liquefied gelatine. Under the microscope these greyish masses may be seen to consist of comma-shaped bacilli. At a later stage most of the bacilli pass into the lower extremity of the needle puncture, where they settle as yellowish-white clusters. At the end of a few weeks the upper half of the gelatine contained in the tube is converted into a turbid yellowish alkaline liquid, having a faintly ethereal odour. In about two months the whole of the gelatine in the tube is liquefied (Fig. 40).

Hueppe recommends the following method of obtaining the bacilli as the shortest. He inoculates bouillon and places it in the incubator (37° C.) for eight to ten hours, after which time there is often a development to be seen, and the cholera bacilli

may be recognised. In doubtful cases he then prepares, from the bouillon plate cultivations on agar-agar, and obtains growths after keeping them twelve hours in the incubator. Sometimes, however,



6th day.

5th day.

4th day.

3rd day.

2nd day.

1st day.

FIG. 40.—Gelatine culture of the cholera bacillus.
 (From Report on the work of the German Cholera Commission in Egypt and India in 1883, by Dr. G. Gaffky,
 assisted by Dr. R. Koch.)

the bacilli on the agar are not of characteristic form, and he therefore also inoculates from the bouillon gelatine plates, which he keeps twenty-four hours at 20° to 24° C. Then the bacilli are

examined. The nutrient media must be of distinct though feeble alkaline reaction. Hueppe says that, as the diagnosis depends upon the appearance of the growth and the microscopical shape of the individual microbes, it is important to know that the comma bacilli vary very much in shape, and do not always grow in the typical way described by Koch. This variation partly depends upon the nutrient medium, and may be explained by the difference of the nutrient medium in the intestines of different individuals.¹

If the surface of a slice of potato is inoculated with cholera bacilli, and placed for twenty-four hours in the culture oven, a growth of curved bacilli will be found to have developed in this faintly acid medium. To prevent the admixture of bacilli from the surrounding air, it is well to cultivate the cholera bacillus on chips of potato, which after inoculation can be placed in a test tube, its mouth being protected by a plug of cotton wool. S-shaped bodies may often be seen in these cultivations, caused by the attachment, end to end, of two bacilli curved in opposite directions.

The cholera bacillus may live on agar-agar for months, developing as a moist film of white lustre along the line of inoculation.

Blood serum is gradually liquefied by the cholera bacillus. It thrives luxuriantly in nutrient bouillon, and on the surface of such a mixture a wrinkled film forms; a growth of this kind flourishes best if the bouillon is kept at blood heat. The bulk of the mixture is rendered only slightly turbid when shaken, a few heaps of bacilli arise from the bottom, and are distributed throughout the fluid.

By treating cholera bacilli cultures grown in bouillon containing peptone (or in common nourishing gelatine) with a small quantity of pure sulphuric acid, there will shortly appear in the solution a reddish-violet, frequently purplish-red, discoloration. Bouillon cultures exhibit this reaction after remaining ten or twelve hours in the incubator, while the gelatine cultures furnish it only after a few days, liquefaction having taken place in the greater part of the culture medium.²

Dr. R. Koch and the greater number of bacteriologists hold that we have in the above tests definite and easily recognised features, which are characteristic, when taken as a whole, of the cholera bacillus, and that these characteristic tests differentiate this micro-organism from any other bacillus as yet described. Further, these observers hold with Dr. Koch that the cholera bacillus is invariably present, and is intimately associated with definite changes in the

¹ *Brit. Med. Journ.* vol. ii. 1892, p. 540.

² *Text-Book of Bacteriology*, by Carl Fraenkel, M.D. Translated by J. H. Linsley, p. 266.

intestine to be found in all cases of Asiatic cholera. Lastly, this bacillus is seldom if ever met with in the evacuations or in the intestines, either in health or in any form of disease except Asiatic cholera. During the epidemic of 1892, throughout Russia, Germany, France, and, in fact, in every part of Europe, the presence of the cholera bacillus in the discharges of patients suffering from the disease, has been received as evidence of the malady being Asiatic cholera.

Some of our most eminent English bacteriologists, however, decline to accept the conclusions of Dr. Koch as to the specific nature of the cholera bacillus.¹ Among them I may mention the names of Professors Klein and Lankester. With reference to these opinions, Professor Koch writes as follows:—

Klein was sent to India by the English Government to carry out investigations into the etiology of cholera. From the reports by Klein which have as yet been published, we must conclude that he has exclusively busied himself in upsetting my statements. At least, I have as yet found nothing in Klein's publications but what stands in direct contradiction to my results. Any other result could scarcely be expected; for before he went to India, his judgment of my statements was decided. He attempted, at that time, to show that I had contradicted myself; that I had, in Egypt, compared the bacteria found in the wall of the small intestine with the bacilli of glanders, but that the latter were not curved, but straight bacilli; then all at once, in India, the straight bacilli had become curved ones. This objection has later, also, been brought forward by others; but—in order at once to settle this point—he who asserts this has evidently never seen side by side sections containing cholera bacilli and glanders bacilli—I have taken the liberty of placing here such preparations, and you will be able to convince yourselves that it is very difficult to distinguish these two kinds of bacteria from one another in these sections. The glanders bacilli are, no doubt, generally straight, but they are by no means rigid bodies, but, on the contrary, are soft and yielding, and very often assume more or less curved forms in the tissue when lying between cells closely packed together, to which they must accommodate themselves. On the other hand, the curved form of the cholera bacilli is not so well marked in sections. I would not hesitate a moment, if I wished to convey quickly a general idea of these bacteria to any one who had not yet seen the cholera bacilli, but who knew the bacilli of glanders, to select, as a comparative object, sections containing glanders bacilli; and it was only of the appearance in sections which I spoke when I made my returns from Egypt. With what astounding ignorance of bacteriology this matter has been treated will be seen from this drawing, which was published by Lankester, in *Nature* of December 25, 1884. In this question Lankester takes up the same standpoint as Klein, and says that it is a horrible error on my part to compare glanders bacilli with comma bacilli. In order to illustrate this, he figures here a glanders bacillus, and side by side a hay bacillus and a tubercle bacillus. As you see, these different kinds of bacilli are shown as

¹ "Further Researches on Cholera," by Dr. R. Koch, *Brit. Med. Journ.* January 1886, p. 6.

of about the same size. In fact, the glanders bacillus seems to be longer and thicker than the hay bacillus. The differences in size are, however, in reality very considerable, the glanders bacilli and the bacilli of tubercle being both very much smaller than the hay bacillus.

A further objection of Klein's, which, however, is of very small consequence, but which characterises the style of his controversy, is that the cholera bacteria are not bacilli but spirilla. It is all the same to me whether the cholera bacteria are called bacilli or spirilla, so long as one pays attention to and lays stress on their other characteristics; the name is, in this case, of the least importance. I can, however, here show you that a capable botanist, namely, De Bary, still calls curved rod-shaped bacteria bacilli.

Further, Klein states that he has found the cholera bacteria, not only in the deposits on the teeth of healthy men, but also in other diseases, more especially in persons who had suffered from diarrhœa; for example, in phthisical and dysenteric cases. He further asserts that they are present in cholera in only quite small numbers, and that the earlier the post-mortem examination is made, in so much the smaller quantity are they found, large numbers being only present in bodies where the necropsy has been delayed. In this point Klein stands in opposition, not only to me, but to all other investigators who have found the comma bacilli in numbers a very short time after death.

He further ascribes to me the assertion that the comma bacilli are killed by weak acids—a statement which is quite erroneous. I have not, in my former communications, spoken of the death of the comma bacilli, but, as you will remember, only of the hindrance to their development caused by different substances, and among others, of the absence of growth in gelatine of an acid reaction.

In India, Klein states that he found comma bacilli in the same tank in which we found them, but at a time when those who lived in the neighbourhood of the tank were free from cholera. No one knows what Klein found; his report has in England been subjected to a very thorough and able criticism by Dr. Watson Cheyne. Klein was compelled in consequence to withdraw most of his assertions, or almost all which are of importance; more especially, he had to admit that the cholera bacilli differed from those occurring in phthisis, in dysentery, and in the mouth; and he has further admitted that he has found true cholera bacilli in all cases of cholera. Thus he finally comes, under compulsion however, exactly to the same result as I did—namely, that the cholera bacteria are a specific variety, and seen exclusively in cholera. Klein will not be able to escape from all the conclusions which follow from these facts, unless he again involve himself in contradictions.

In May 1888, Sir Joseph Fayrer, writing on this subject, observes that—

In 1883 Professor Koch, after investigating cholera in Egypt, and later in India, discovered a bacillus in the alvine discharges of cholera patients, which was announced to be the germ which caused the disease. The doctrine of contagion received thereby an impulse by which the dread of it became enhanced, and Southern Europe for a time was almost demoralised by fear, whilst the old measures of coercion and quarantine threatened to be reimposed with greater severity than ever. In May 1884

the Secretary of State for India at my instance despatched a Commission (Drs. Klein and Gibbs) to investigate the subject in India. In March 1885 they submitted their report, and a committee of physicians and pathologists was convened to consider it. The following conclusion was arrived at: that comma-shaped bacilli are usually found in the dejecta of persons suffering from cholera, but that there is no ground for assuming that they are the cause of the disease, that they are, in fact, but epiphenomena; thus confirming the conclusions of Lewis and Cunningham, arrived at years before, after a long and careful microscopic study of the disease in India.

There can be no question that the vibrio of Metchnikoff is nearly related to that of the cholera bacillus of Koch; there is this difference, however, that whereas the cholera bacillus can only be transmitted to animals by artificial means, that of Metchnikoff has the most pernicious influence on almost all animals; vast quantities of the bacteria being found after death in the blood and tissues. Other forms of vibrio, such as Emmerich's, Deneke's, and Finkler-Prior's, have one after the other been described as identical with Koch's bacillus of cholera; but they have each and all of them, when examined by proper tests, been found to differ from it in various ways, their study having clearly demonstrated the fact that the cholera bacillus is a specific micro-organism.

It is evident that in its growth the cholera bacillus changes the media in which it grows, liquefying gelatine and producing a definite chemical substance of basic character, which, in all probability, when absorbed into the blood causes the symptoms characteristic of cholera. Substances thus produced from the action of the cholera bacillus are poisonous if inoculated in full doses into various animals, and in pure cultures in very minute quantities it causes peculiar symptoms in man, which I shall subsequently describe; it is asserted that a person so inoculated is, for the time, immune to cholera.

Inoculation Experiments.—Dr. Koch has introduced pure cultures of the cholera bacillus directly into the intestinal canal of animals through the stomach, that is, without opening the walls of the abdomen. He first neutralised the acid contents of the stomach by injecting into it a 5 per cent. solution of carbonate of soda. After the contents of the stomach have thus been rendered faintly alkaline, Koch introduced into it, through a tube, a solution of a pure cultivation of cholera bacilli; he then injected a small quantity of opium subcutaneously, so as to lessen the peristaltic action of the intestines, his object being to retain the cholera bacillus as long as possible within the intestinal canal. Thirty-five guinea-pigs were experimented on in this way, and “thirty of them died from

cholera." The symptoms and post-mortem appearances of the animals were the same as those in which the injection had been made directly into the duodenum. The animals treated as above described, on the day after the bacillus had been injected into their stomachs, appeared to be ill, looking shaggy; they did not eat. On the following day they suffered from paralytic weakness of the posterior extremities; the animal no longer supported itself on its hind legs, but lay quite flat, with its limbs stretched out. The respiration was weak and slow. The head and extremities were cold, the pulsation of the heart hardly perceptible, and the animal died after it had lain for a few hours in this condition. Immediately after death an examination was made of the contents of the intestines, and they were found to contain a pure culture of the cholera bacillus. The walls of the abdomen were flaccid, the internal surface of the small intestines markedly infected. The stomach and cæcum contained a quantity of fluid. The epithelial pulp found in the intestinal canal was in many instances crowded with comma bacilli. The urinary bladder was empty, the gall bladder full of bile.

Dr. Shakespeare, from numerous observations, confirms Dr. Koch's facts as above stated; he remarks that "guinea-pigs are susceptible to the influence of the cholera bacillus introduced through the stomach—after a period of three days' incubation, accompanied or not by cyanosis, prostration, algidity, spasmodic muscular contraction, and death." The post-mortem changes above referred to may always be found.

Other observers have confirmed these observations; and it seems almost impossible to doubt the truth of the statement that pure cultures of the cholera bacillus are capable of causing in animals symptoms similar to those produced by this micro-organism in the human subject, and that animals dying under these conditions present the same pathological changes as are found in the bodies of human beings after death from Asiatic cholera.

With reference to human beings: during the course of instruction on the bacteriology of cholera carried on in the laboratory of the Imperial Board of Health, Berlin, one of the gentlemen attending the course became infected with the bacteria; he had been five days in Berlin, when he was attacked by slight digestive disturbance, accompanied with diarrhœa. The evacuations were loose, and occurred several times a day; so that his condition excited no alarm. But, on the last day of his attendance here, more frequent, quite thin, watery evacuations occurred. He thought, however, that he was able to travel; he did so, and reached home, but was then

seized with a true attack of cholera. For two days he had very frequent watery and colourless stools; there were great weakness and unquenchable thirst; the urinary secretion was reduced to a minimum. True cramp of the calves of the legs did not occur; but there was marked contraction of the sole of the foot, and cramp in the toes. As he felt too weak to examine his evacuations himself, he put a small quantity in a well-cleaned flask, and sent it to Berlin. The vessel was sent off in the evening, arrived on the following morning, and was at once investigated. As the transit only occupied a night, and that in the cold season of the year, the contents could not have been materially altered by the transport. The investigation of the dejecta, which was made by means of cover-glass preparations, and also by plate-cultivations and cultivation in cupped slides, showed by each method the presence of very numerous true cholera bacilli. One of the pure cultivations of cholera bacilli shown in the laboratory came from the dejecta of this case.

A case of a somewhat similar kind came under my own observation, in which cholera dejecta became mixed with water. This water remained for a whole day exposed to the heat of the sun, and was then drunk by nineteen persons, five of whom were taken ill with cholera within thirty-six hours.¹

As I shall subsequently have to refer to Dr. Ferran's inoculations of human beings with the products of the pure culture of the cholera bacillus, it is unnecessary in this section to describe the remarkable results which he appears to have obtained by this system of treatment.

The Comma Bacillus Pathogenic.—From the evidence at our command, therefore, it seems impossible to question the truth of Koch's views regarding the existence of a specific bacillus in cases of Asiatic cholera. This bacillus is present in every case of cholera, and in such quantities in the dejecta and contents of the intestinal canal as to account for the symptoms of this disease. The history of the disease is perfectly in accord with this statement, for we find that no instance has ever yet been recorded in which Asiatic cholera has manifested itself among people, until they have been brought into relation with those suffering from the disease, or to articles of consumption, or fabrics tainted with the discharges from persons affected with cholera.

It is perfectly true, as Virchow remarks, with respect to the silkworm disease (*mus-cardine*), an undoubted mykotic affection, studied now for many years, that "we cannot, even to-day, state with certainty what are the reasons for its appearance alternately in greater or less extent, nor can one say what one must do to suppress

¹ *A Treatise on Asiatic Cholera*, by C. N. Macnamara, p. 196.

it." Virchow adds: "During my studies of natural science, I have always been inclined, whenever an observation has been made in a single concrete case under every guarantee of certainty, not to make the acknowledgment of the correctness of such an observation depend on its ability to account for everything." With regard to cholera, Virchow remarks: "Its cause is a specific bacterium. This passes from man to man by means of moist agencies, especially drinking water; is received with the food, and, being developed in the intestines, gives rise to cholera. Its entrance and increase are probably facilitated by certain favourable conditions of the intestinal canal, an individual predisposition, to be accounted for, perhaps, by a diminished acidity of the stomach, and inertia of peristalsis."

In answer to the question whether Asiatic cholera can be ascertained in cases in which no bacilli are found, Virchow said: "The bacteriological investigation is of such a nature that parts of the liquids evacuated by patients are placed on a soil favourable to the development of bacilli, after which the investigator waits to see whether they develop. In this procedure, as in that of the sower, it may happen that hope is disappointed, owing to the unfavourableness of the soil. As science, however, can hold nothing fast but facts, the investigator can only state that he has found "no comma bacilli; the case, therefore, is not one of Asiatic cholera."

ETIOLOGY.

Relation to Ground Water.—From the history of Asiatic cholera we learn that the endemic area, or home of the disease, is located in Lower Bengal, from a line drawn through the district of Pooree north to the Himalaya, and from the delta of the Brahmaputra River through Tipperah to the east. The mortality from cholera in this region is, as a rule, highest during the dry season, that is, from October to May. Throughout the rains the death-rate from cholera decreases. At first sight it might seem as if there were some connection between the rise and fall of the underground water, and the increase or decrease of cholera in Bengal. But on examining into details it appears that the connection is incomplete. For example, the underground water in Lower Bengal reaches its lowest point in May, whereas the maximum cholera mortality by no means takes place in that month. During December and January the level of the underground water subsides, and yet the mortality does not rise; on the contrary, it falls. The connection between the changing state of the underground water and the rise and fall of cholera in other parts of India is not found in

any way to coincide, and is unimportant with reference to the spread of the disease in India.

Relation to Rainfall and Winds.—In the same way numerous statements have been advanced as to the supposed effect of the rainfall in India upon the death-rate from cholera. There is no reason, however, to believe that the rainfall in itself has any direct influence on the spread of the disease; excessive rain seems at times to hinder its extension, and so does the absence of rain (p. 366).

It has often been assumed that the south-east wind, blowing over Lower Bengal for several months of the year, is a means by which cholera is carried from its endemic area over Northern India. There can be no question as to the fact that before the days of railroads cholera spread from Lower Bengal northward at that season of the year when the prevailing wind blows from the south-east. It was by means of this wind, however, that large country boats laden with goods and passengers passed along the Ganges from Bengal to the north-west of India; and consequently, as the Marquis of Hastings observed in 1817, "the disease gradually ascends the river from the lower provinces." Beyond this the monsoon seems to have no special influence in disseminating cholera over the hill country immediately to the north-west of the endemic area of the disease; the aborigines inhabiting these hills are, in fact, singularly free of cholera until they leave their homes for the plains of Bengal. Again, Dr. Leith (p. 36) informs us that cholera advanced from the east into Bombay in 1849, in the teeth of the south-west monsoon. Quarantine has frequently, by isolating an infected locality, or by separating a healthy place from an infected one, demonstrated that Asiatic cholera does not spread by means of the atmosphere beyond, we may affirm, a distance of about 100 yards. We can readily understand this, because we know that the cholera bacillus is a delicate plant, incapable of producing resisting spores, and is destroyed if kept for any length of time without moisture. On the other hand, the disease may be conveyed from one place to another by an infected individual, breaking out where he stops, and passing over intermediate places through which he has passed without stopping; although the two places may present identical conditions of air, temperature, moisture, and so on.

Altitude and Temperature.—From the history of the disease we learn that although cholera manifests itself with virulence among the inhabitants of over-populated, badly ventilated, and dirty, low-lying towns, nevertheless from time to time it breaks out with deadly effect in places situated 7000 feet above the level of the sea. It stands to reason, however, that an enormous majority of the popula-

tion of the globe are located in and about large commercial towns generally built on rivers. Temperature has, doubtless, much to do in arresting or in aiding the growth of the cholera bacillus. We know that this micro-organism is killed if exposed to a temperature of 15° C., or to one of over 50° C., and from the history of Asiatic cholera we have noticed that year after year it dies away in the cold weather of the North-Western Provinces of India and the Punjab. The effect of cold in arresting the progress of epidemic cholera is still more marked during the continuance of a European winter; when spring returns the disease reappears, becoming most vigorous in summer. As an example, we may refer to the disappearance of cholera after being introduced into New York during the winter of 1848; and of its spread at the same time of the year from New Orleans during hot damp weather. Cholera has, however, sometimes extended its ravages in the winter, as was the case among the troops of the Russian army in Poland in 1830–31; but we must take into account the high temperature at which many of the houses in Russia are maintained during their long winter.

We are, therefore, in a position to affirm that Asiatic cholera is endemic among the inhabitants of Lower Bengal, but that it does not extend from its endemic area by means of the wind—in other words, it is not carried by the wind from Lower Bengal over India. When introduced by human beings suffering from the disease into a locality, no kind or condition of soil can prevent it from spreading among the inhabitants of the place. No race of men are exempt from attacks of cholera; those living at 7000 feet above the level of the sea may suffer equally from the disease as persons dwelling at or below the sea level. But people existing under bad sanitary conditions are more liable to suffer from cholera than those who live in healthy localities.

Influence of Sanitary Conditions.—The influence which imperfect sanitary conditions have on the dissemination of cholera is twofold; in the first place, people dwelling in these conditions are less capable than their more favourably placed brethren of resisting the development of a micro-organism like that of the cholera bacillus, when it enters their stomachs mixed with water or food. Beyond this, there is every reason to believe that the cholera bacillus is dangerous, not only according to the dose received into the stomach, but also in proportion to the favourable or unfavourable conditions under which it has been developed. The cholera bacillus, I repeat, is a delicate organism; its vigour depends on the medium in which it is sown, and upon the temperature in which this medium is placed, upon the free access of oxygen, and, I believe, of light. Moisture is

essential to its development, and probably certain salts of lime as well as organic matter. If the bacillus is sown, as Watson Cheyne has observed, in a particular locality, what happens? It is deposited in the soil, in the water, etc., and, according to the conditions in which the bacillus finds itself, it grows or it does not grow. If it is deposited in a place where the sanitary conditions are good (in other words, where the conditions are adverse to its growth), it either dies out or it grows with difficulty. If it grows at all, it may be that small numbers or a weak dose finds its way into the intestines of some of the inhabitants through water or food. But these quantities, being small and of low vitality would be insufficient to cause virulent disease, and would either produce no effect at all or only a mild diarrhœa. Hence we find that in places where the sanitary conditions are good, cholera does not spread to the same extent as it does among people living under the reverse conditions. Impure water supply and other results of defective sanitation may also favour the dissemination of the germ.

MODE OF DISSEMINATION OF ASIATIC CHOLERA.

Human Intercourse.—From the history of the disease we learn that before the English entered India, epidemic cholera extended over that country from time to time; and we have every reason to believe that it then had its endemic area in Lower Bengal (p. 351). But we may be equally sure that Asiatic cholera had, until 1830, never spread from India east and west. The reason of this seems to be that India was practically cut off from the rest of the world by its position. It is true, goods reached Europe from India, but only after something like a year's passage up the Red Sea and across the desert to Koptos, a distance of 280 miles; they were then carried 500 miles down the Nile to Alexandria.

The first steamer that navigated the Red Sea was the *Hugh Lindsay*, which left India in the same year that cholera spread from that country to Europe, 1830. The vessel took thirty-two days to reach Suez. In 1834 a Committee of the House of Commons reported that it was practicable to carry on steam communication between Suez and Bombay during the north-east monsoon; but they were doubtful as to its practicability at other seasons of the year. The route from India to Europe *viâ* the Persian Gulf, or through Cabul, was no less protracted, and for long periods was strictly prohibited. Consequently, it was almost impossible for cholera to have been communicated to Europe in these early times, supposing it spreads from infected persons to healthy

communities. No sooner, however, had England taken possession of India, and opened up relations with Persia, Arabia, Europe, and China, than Asiatic cholera manifested itself in localities along the routes followed by our men and merchandise. First breaking out among the inhabitants of seaport towns into which vessels from infected localities discharged their passengers and cargoes, and from these seaport towns the disease spread inland.

In like manner, from the first epidemic outburst of cholera of which we have any authentic record in 1782, up to the present time, the assemblage of a large concourse of pilgrims at places like Hurdwar or at Mecca has afforded a favourable breeding ground for cholera; and when the disease has broken out among such an assemblage of human beings, it has spread far and wide with them to localities previously healthy.

From these, and, in fact, from the whole history of the disease, we arrive at the conclusion that Asiatic cholera extends from one place to another through means of human intercourse. We may go a step further, and assert that no amount of overcrowding, of famine, poverty, filth, or any other condition, have ever originated an epidemic outburst of Asiatic cholera beyond its endemic area. Before the disease can occur among people outside the home of the disease, its seeds must have been carried to them by persons suffering from cholera, or by articles of clothing which have been soiled by the excreta which patients have passed during their illness. In other words, living cholera germs must be planted among the inhabitants of an uninfected place before Asiatic cholera can develop among them.

Drinking Water.—The influence which drinking water has in disseminating cholera among an otherwise healthy population, is a fact which no unprejudiced person can deny at the present time. The first authentic account we have of a widespread epidemic of this disease was given by the Marquis of Hastings in 1817; and it is remarkable that he should have attributed the spread of cholera in his camp to the consumption by his soldiers of impure water. Acting under this impression, he removed his camp from this source of drinking water to the banks of a running stream, and, in the course of a few days, again to the vicinity of a rapidly flowing river, with the result that cholera disappeared from among his men as if by magic. Striking as are the details of this incident, no one seems to have profited by its teaching, or to have applied the principle to the relief of bodies of men similarly affected, until within the last few years, when our military authorities in India have followed the example set them by the Marquis of Hastings in 1817; and, on the occurrence of an outbreak of cholera among troops in a

station, they are marched out into a cholera camp, that is, a spot previously selected and kept in readiness for the occasion. One of the chief objects held in view when preparing such a camp for the use of our soldiers is, that the water supply should be unexceptionable, and be strictly guarded from all chance of contamination. The establishment of these cholera camps in India, has been attended by a marked improvement in the death-rate from this disease among our European army located in that country.

In the year 1857 Dr. Snow published the particulars of the Broad Street case (p. 362), and I have referred to other instances of the same kind. In these cases, water contaminated with the excreta passed by persons suffering from cholera caused the disease. We may, however, turn to the other side of the picture, and refer to the remarkable results following the supply to a body of men living in the endemic area of cholera of pure drinking water. From the year 1826 until 1864 our European soldiers in Fort William, Calcutta, were, year after year, subject to cholera; in some seasons, as in 1857, out of a strength of 700 men, no less than 73 died from Asiatic cholera. The average mortality, however, for the above period from this disease was 20 per 1000. From the year 1863 up to the present time, the death-rate per 1000 of our troops in Fort William from cholera has fallen from 20 per 1000 to 1 per 1000. In the year 1863 the fort was, for the first time since it was built, supplied with pure drinking water, with the result referred to. In the same way the death-rate from cholera among the inhabitants of Calcutta has decreased in a marked manner since the year 1870, when a pure supply of water was provided for the town. The decrease in the death-rate from this disease among the inhabitants of Calcutta has not been so marked as that which has taken place in Fort William, because, in many parts of the city, the municipal water supply is imperfect, and people still consume contaminated tank and well water.

Dr. Guttman, chief physician of the Moabit Hospital in Berlin, delivered an interesting lecture, on the 23rd September 1892, on "Cholera," at a meeting of the Society for Internal Medicine. He pointed out with satisfaction that the epidemic has not assumed any great dimensions in Berlin. The cases that have occurred prove beyond doubt that the water for drinking purposes is one of the chief sources of infection. The fact that Professor Carl Fraenkel, of Marburg, has found the comma bacillus in the docks at Duisburg, on the Rhine and Ruhr Canal, shows how far the cholera infection has travelled along the rivers. Thus the disease has broken out on board vessels which had had no intercourse either with the

inhabitants of infected districts or with other vessels. Dr. Guttman further urged the great importance of sending persons who are only suspected of cholera to the hospital. Many such patients, though not suffering from cholera, when received, afterwards fell ill of that disease. The sending of them to the hospital enables them to be isolated at once. Without this they would have become centres of infection. He emphasised the diagnostic importance of the comma bacillus. There are, he said, real cases of cholera so mild that nobody would take them for such, and again there are other cases having nothing to do with cholera which sometimes take a very malignant course. He mentioned a case of antipyrin poisoning, for instance, which showed all the external symptoms of Asiatic cholera. But the presence of the comma bacillus in any case at once cleared up the nature of the disease from which the patient was suffering.

Milk.—However pure the drinking water consumed by the inhabitants of a cholera infected place may be, it is certain that milk, which forms so large an element of the diet, is liable to be contaminated with cholera excreta by being mixed with impure water. I gave the particulars of a case of this kind which occurred under my own observation (p. 374); and Dr. Simpson, the present able Officer of Health in Calcutta, has supplied the details of similar localised outbreaks of the disease, caused by persons drinking milk which, there was good reason to believe, had been adulterated with contaminated water.

Other Modes of Dissemination.—It is possible that the germs of cholera may pass into the circulation by other paths than the stomach, but we have no reliable evidence on this subject. From the details of numerous cases, to some of which I have referred (pp. 360 and 364), it is more than probable that the disease may be communicated through articles of clothing which have been contaminated by the evacuations of persons suffering from it. In like manner the bodies of individuals who have died of cholera may become a source of infection.

The attendants upon cholera patients are, as a rule, safe from fear of contracting the disease during their care of the sick. It is under peculiar conditions, such as those to which I have referred as existing at Mian-Mir in 1861 (p. 368), that attendants on persons suffering from cholera generally contract the disease. In this case the air of the hospital was foul in the extreme, and doubtless charged with the germs of cholera, which, I suppose, were absorbed by the drinking water, contained, as it was, in large open, porous vessels standing in the cholera wards. This water was largely consumed by the European orderlies in attendance on their sick comrades, and many of

these poor fellows were soon down with cholera. On the other hand, when the European orderlies were relieved by native troops none of these latter took cholera; for the obvious reason that, although inhaling the same atmosphere, and performing duties exactly similar to that of the European orderlies, the native was prevented by his caste from drinking the water, or allowing anything to pass his lips in the shape of food, so long as he remained in the hospital.

That the immunity enjoyed by hospital attendants is not so complete as is generally supposed, has been shown by Dr. Davidson, who has taken the trouble of analysing the figures bearing upon this point, as furnished by the reports of the Indian Government.¹

Cholera, like typhoid fever, is not communicable by contact. A person may rub, wash, and administer to the necessities of a patient suffering from the disease without risk of contracting it, provided the room in which the sick person lies is properly ventilated. The disease is communicable from the sick to the healthy in the manner above described, but, in the proper meaning of the term, it is not a contagious disease.

PREVENTIVE MEASURES.

Quarantine.—Before entering on the more immediate consideration of this subject, it is necessary to make a few observations on maritime and land quarantine. I take it that the meaning now attached to the word “quarantine” is that given in Webster’s *English Dictionary*; it is “*A period of time, variable in length, during which a ship or vessel supposed to be infected with certain diseases is not allowed to communicate freely with the shore.*” This is the sense in which the term was employed by the delegates of the International Sanitary Congress of 1874 and of 1892. In the report drawn up and signed by the delegates of all the European Powers, including England (of the Congress of 1874), the second section is devoted to rules and regulations appertaining to “*questions relating to quarantine.*” The first rule under this heading refers to the examination of all vessels arriving from infected parts by duly constituted sanitary officers. These officers are allowed either to grant a vessel free pratique, or to order her and everybody, and everything she contains, to be isolated from communication with the shore. If cases of cholera have recently occurred on board, the “crew and passengers, after the removal of the sick and dead, are to undergo a careful process of disinfection.” Any one on board having cholera, or who may be attacked by the disease after the vessel has been placed in quarantine, is to be removed to a hospital

¹ *Geographical Pathology*, vol. i. p. 434.

specially provided for the care of such patients. At the expiration of five days, if no fresh cases of cholera have occurred on board the vessel, provided her passengers and crew can give satisfactory references as to the places in which they propose to reside on shore, they may by permission of the medical officer leave the vessel, but they remain under inspection for a week or so longer.

The Sanitary Congress of 1874 further appointed a committee to consider and draw up rules as to the management of "*the quarantine establishments* in those States which intended to erect such." It is obvious that the sanitary authorities of Europe draw a marked distinction between quarantine regulations, and quarantine establishments—they are treated under different sections. Regarding the former, the delegates were almost unanimous; as to the latter, there was a considerable difference of opinion. A system of quarantine establishments has kept cholera out of isolated localities, but it means lazarettos, the crowding together of people indiscriminately who have arrived from infected countries, and the complete cessation of free intercourse between a country where cholera exists and unaffected places. It seems to me therefore that the Right Hon. H. H. Fowler, President of the Local Government Board, is inaccurate when he states that quarantine "has never been resorted to in this country since 1848," its regulations are in force at the present time; but England does not approve of quarantine establishments, and I believe she is quite right in the theory and practice she follows.

As far back as 1869, in a work I then published on Asiatic cholera, I urged in the most forcible language at my command the following ideas regarding the preventive treatment of cholera; I stated that "the fundamental principle upon which all such treatment must be based is, that Asiatic cholera can only spread through means of food or water contaminated with the infecting matter passed by persons suffering from this disease;" that "cholera is not a contagious disease in the ordinary sense of the term, but it is nevertheless eminently a communicable disease, through means of the infecting matter passed in the evacuations of persons suffering from cholera, which organic matter must gain access to the intestinal canal of another person before it can produce the symptoms of cholera. In this lies the secret of preventive treatment; for if this specific matter is destroyed immediately it is passed by patients suffering from cholera, the disease cannot spread. In the same way articles of clothing, or, in fact, any and everything soiled by the evacuations of a person suffering from cholera, as well as his body, if he dies, must be destroyed, in order that we may effectually stamp out the disease. . . . It is evident the more perfect quarantine is enforced round India, the better as regards pilgrims and native traffic, which we cannot otherwise control; but," I added, "this rule does not apply to well-conditioned vessels under the order of European officers and crew. The reason for this is obvious, for we can insure the destruction of the organic infecting matter in the latter instance, whereas in the former it would be impossible to make

certain of any such result. Supposing a first-class steamer starts from Bombay or Calcutta, and cholera occurs among the crew within four days of her leaving India, if proper precautions are taken to destroy the infecting matter, and no cases occur within six days of the arrival of the vessel at Suez, there could be no reason for detaining the passengers, provided the quarantine officer could satisfy himself that the reasonable precautions above indicated had been faithfully carried out, and all the apparel of the patients, and everything likely to have been contaminated by the infecting principle, destroyed. Supposing a case of cholera to have occurred within six days of the ship's arrival at Suez, it would be the duty of the quarantine officer to examine into the circumstances of the case, and to use his judgment as to the course to be pursued; for instance, the fact of one of the crew being affected, if the passengers were healthy, would hardly be a valid ground for detaining them. It might be a different matter if the vessels were going into a crowded port, or still more, into dock, in which case I would certainly allow no communication with the shore until six days had passed without any fresh instances of cholera occurring on board. I have before stated my firm belief that cholera is a mild form, but the same disease as cholera. The dejecta, therefore, of patients suffering from cholera must be destroyed in the same way as those of cholera."¹

I did my best, so long as I remained in Bengal, to get these ideas recognised and acted upon by the Governor of India; but the Government and their sanitary advisers had other views on these matters (p. 379). It is, however, satisfactory to find that the Dresden International Sanitary Conference of 1893 have expressed opinions on this subject precisely similar in principle to those above quoted. And what is of still more importance, all the great Continental Powers are now determined that these principles shall be carried into practice as regards the preventive treatment of cholera.

The quarantine regulations which England now enforces are based upon the knowledge we possess regarding the cause which produces Asiatic cholera, and the means by which it spreads over the world; so long as we can keep the bacillus of cholera from our shores, England is quite safe from this disease. We may go a step further and assert that if the germs of cholera obtain a resting-place among us, that if medical men will take the proper steps to kill the bacillus as it passes from patients under their care, by means of chemical agents, that epidemic cholera cannot spread among the people of this country.

The precautionary measures to be adopted against Asiatic cholera may be considered under three heads: first, those intended to prevent the transport of cholera from India to surrounding countries and to Europe; second, the measures to be adopted to prevent the spread of the disease after it has been imported into places beyond the confines of British India; and, lastly, we have to consider whether by inoculation it is possible to render individuals immune, or insusceptible to the disease when it has broken out among the surrounding population.

¹ *A Treatise on Asiatic Cholera*, by C. N. Macnamara, pp. 464-474.

With reference to preventive measures in general, the International Sanitary Congress of 1874 laid down the following principles:—*General sanitation and isolation, real and complete, of everything which might introduce the disease, are the best means for preventing the importation and subsequent propagation of cholera.* The object being by complete supervision of the intercourse between persons, or soiled things from an affected locality, to prevent the passage of cholera germs into unaffected places.

Cholera having become epidemic beyond its home in Bengal under peculiar conditions of soil, temperature, and other circumstances which we do not understand, extends by human agency over India, and so to Cabul and Persia, or to Bokhara; it may be carried directly from Bombay by trading vessels up the Persian Gulf, or to Arabia. The way through Cabul, or up the Euphrates, has been the most frequent route by which an invading cholera has travelled to Europe. It would be difficult by land quarantine to stop the progress of epidemic cholera westward, when it has reached Bokhara, Persia, Arabia, or Turkey in Asia. The countries also bordering on the west of India, through which the disease extends towards Persia and Russia, are inhabited by half-civilised fanatics, and beyond the control of the British or any other civilised Government. Nevertheless, I feel sure that an effort should be made, not only to mitigate the ravages of cholera in India, but to prevent it passing from that country into Cabul and Kashmir.

The evidence of Asiatic cholera having been carried directly from India *via* the Suez Canal to Europe is incomplete; and if we exclude the outbreak in Southampton in 1885, I know of no evidence which demonstrates the fact of cholera having been introduced into England by vessels passing through the Canal from India. The cholera of Southern Europe of 1885 is said to have originated in Tonquin, and to have been imported by French vessels to the South of Europe; if this were the case it may account for its exceptional character, in that it appeared to have possessed but feeble power of spreading far from the Mediterranean coast; it was hardly therefore an invading cholera. Doubtless, as time goes on, other countries beyond British India may become endemic foci of the disease; and as railways and steamers give facilities for the transmission of men and goods from these areas, cholera may be more frequently imported into Europe.

The history of this disease hardly sanctions this idea, so far as the trade carried through the Suez Canal is concerned; for the Canal was opened in 1869, and the last widespread epidemic of cholera in Europe, excluding the present outbreak of the disease, occurred in 1865–66. Pilgrims returning from Mecca to Egypt and Turkey may,

and should, be prevented from disseminating cholera in places along their homeward journey by quarantine regulations and establishments enforced at the entrance of the Suez Canal. Quarantine at Suez is a necessary safeguard to Egypt and to Europe from infection by this class of people. But it is equally certain that vexatious measures of quarantine, applied to steamers carrying European passengers from the East to Europe will defeat their own ends. Harsh measures of this kind lead to the concealment of the truth regarding doubtful cases of cholera, in order that the suspected vessel may escape detention at Suez. I believe that if sounder knowledge as to the nature and the history of cholera were diffused among the officers and men of our Mercantile Marine, it would be a more effectual means of guarding Europe from cholera than quarantine regulations of a harassing character enforced at Suez. When once the officers in charge of such steamers as those which pass through the Egyptian Canal understand the terrible consequences likely to arise from landing passengers suffering from cholera, either in Egypt or in Europe, or articles of clothing used by the sick, we shall have gained the best protection against the spread of cholera by such vessels from India or other places.

It is beyond my purpose to enter into minute details regarding quarantine regulations: these have been settled by the International Conferences of 1874, 1890, and 1893; the principles upon which they are based have been referred to at the commencement of this section. They include isolation on board ship of persons suffering from cholera, and on arrival in harbour of the removal of the sick on shore under the supervision of constituted sanitary authorities. A vessel in which cases of cholera have occurred must be thoroughly disinfected, and retained in quarantine for five days, after which, if no fresh cases have occurred on board the ship, she may be permitted to proceed on her voyage. The management of the excreta passed by patients suffering from cholera on board ship, and of articles of clothing they have used during their illness, is to be effected in the same manner as when the case occurs on land.

Measures for Preventing the spread of Cholera in a Community.—To prevent the spread of cholera in a community into which the disease has been carried, the first cases of cholera must be isolated. The premises in which the patient resides are to be thoroughly disinfected. Especial care is necessary to watch and isolate cases of this disease travelling over a line of railway, or by river steamers. Rigorous cleanliness should be observed upon trains and at railroad stations. Disinfectants must be employed, both to patients after recovery from cholera and also to their clothes and

bedding. The bodies of persons dying from cholera should be cremated, or enclosed immediately after death in sheets soaked in disinfectant fluids, after which the corpse must be covered with chloride of lime, and buried as soon as possible.

The following is a summary of the chief provisions of the Convention of 1893:—

“The Governments engage to notify to the contracting States every appearance of a focus of cholera on their territory. They shall specify the locality and the extent of the invasion, and also what measures have been adopted for its limitation.

“The Conference has specially stipulated that foreign countries shall only put in force restrictions against the productions of the infected area, and not against those of the whole country of which that area forms a part.

“Prohibitions against imports shall only be applicable to objects capable of transmitting the disease, and a list is given, enumerating by name the things considered dangerous. We have reason for believing that this list contains only a comparatively small number of articles, and that it in no way interferes with the transport of manufactured goods, textile or woollen fabrics, food supplies, or even with the exportation of fruit.

“The measures prescribed by which a Government may protect its frontiers, or which it may take against an infected area within its boundaries, are founded on medical inspection, disinfection of soiled linen, sanitary passports, and surveillance of passengers in the country to which they go during the time which corresponds to the incubation of cholera. The Conference decided that this period should be taken as five days, which, although not perhaps scientifically accurate, is practically sufficiently near the mark to cover the great majority of cases.

“As regards ships, the passengers will not be isolated or disembarked unless there either is cholera on board, or there has been a case within seven days. But we may assume that if it should be put in operation by any country, it would be carried out on the plan accepted by the Venice Convention, in regard to the Suez Canal, in which it was arranged that people should be isolated in small groups (*aussi peu nombreux que possible*), so as to avoid the detention of a large number of people if any secondary outbreak should occur.

“In the case of emigrant ships, special precautions may be taken, and special regulations made by the country receiving them, which is, in fact, only what we have done in England by the Special Orders issued last September by the Local Government Board.

“In regard to the navigation of the Danube, provisional regulations have been made until such time as the town of Sulina at its mouth shall have provided itself with a proper water supply.”¹

Dr. Cornet, of Berlin, believes that a person apparently perfectly convalescent from cholera may carry about with him in his intestines active, living comma bacilli.

“The case in which this was noticed was that of a man whose mother, wife, and son died of cholera. He himself had a slight attack, and was put under the care of Dr. Carl Lauenstein of the Seemann’s Hospital. He was nine days in hospital, and received five tannic intestinal injections against his diarrhoea, which was not of a very severe type. The patient recovered

¹ *Brit. Med. Journ.* April 29, 1893.

perfectly, and was on full diet. On Friday he was up and very anxious to go home, but was induced to stay. On Saturday he was still better, and had no motion at all, and it was with difficulty he was induced to remain. On Sunday Dr. Cornet discovered that the stools passed on Friday still appeared to contain comma bacilli.

“The importance of the discovery that a patient apparently perfectly convalescent may still be the means of disseminating the disease cannot be overrated. The fact will probably be as unwillingly recognised and accepted as the kindred one, well known to those who have investigated the subject, that the milder so-called cholérine, which so often precedes cholera epidemics, is true Asiatic cholera.”¹

Cholera bacilli have been found alive in the bodies of persons eleven days after death; at the latest they have been detected in the stools of persons ten days after the commencement of the attack of cholera; as a rule, they disappear from the evacuations on the fourth day after the first symptoms of the disease have set in. By far the most effectual means of preventing the spread of cholera is the isolation of the patient, and the disinfection and effectual disposal of the evacuations immediately they are passed by the patient. Our object being to prevent living cholera bacilli passing into rivers or any sources from which the supply of drinking water is drawn.

From my own observation, and from all that has been learnt on the subject, we can affirm that Asiatic cholera cannot remain latent in the system for more than five days. If, therefore, a person coming from an infected locality has no symptoms of the disease for five days, he may be permitted to pass with freedom among his fellow-creatures.

Disinfection.—Regarding the disinfection of soiled articles of bedding and clothing, steam at a temperature of 100° C. is most effective. A 5 per cent. solution of carbolic acid, or of chloride of lime, may be relied upon; a weaker solution being used to disinfect persons. Vomited matter and the stools passed by the sick person should be received in vessels which contain a disinfectant; or, immediately they have been passed, they should be mixed with a disinfectant, and emptied, if possible, into properly prepared holes in the ground, away from wells or other sources of drinking water. If in any locality there is a suspicion of the water supply having been contaminated, or if cholera exists, it should be boiled before being swallowed; the same remark applies to milk: too much force cannot be placed on this most necessary precaution against cholera.

Latrines must be carefully and frequently disinfected if used by patients suffering from cholera, even in its premonitory stages. It is necessary to bear in mind the fact that all cases of cholera do not pass on to collapse, and that the evacuations in the case of *cholérine*

¹ *Brit. Med. Journ.* October 8, 1892, p. 814.

are capable of causing the disease. An instance of this kind was reported as far back as 1849, in the case of a soldier who arrived at his house in the commune of Hamil from Paris, where cholera was prevalent. This man on reaching his father's house suffered from severe diarrhœa, from which he recovered; his youngest brother was constantly with this man, and on the day after his arrival the lad was seized with Asiatic cholera; the disease extended to other members of the family, and soon throughout the neighbourhood.

Measures to be Enforced in case of an Outbreak among Troops.—The measures at present enforced, on the outbreak of cholera among European troops stationed in the various cantonments of India, are much the same in principle as those adopted by the Marquis of Hastings in 1817. They practically consist in removing the men from the locality in which cholera has appeared, and placing them in such circumstances as will effectually exclude the possibility of their obtaining water or food of any kind contaminated with the germs of the disease. In fact, the bulk of the soldiers under these circumstances are marched off from the place in which some of their comrades have been attacked with cholera, into camps previously prepared for their reception, proper precautions having been taken to guard the drinking water from the possibility of being impregnated with cholera bacilli. Isolation of the sick, and the careful disinfection of their evacuations, are also enforced. I have already referred to the remarkable decrease in the mortality from cholera among our European troops stationed in Fort William which has followed the introduction of a pure water supply into that place, although surrounded, as they are, by a population from among whom Asiatic cholera is never absent (p. 405).

Principles of Prophylaxis.—So important is this subject, that although the following memorandum of Dr. Thorne contains much I have already insisted on, I am convinced the reader may with advantage study it, coming as it does from the head of the medical department of the Local Government Board. Dr. Thorne writes:—

Cholera in England shows itself so little contagious, in the sense in which smallpox and scarlatina are commonly called contagious, that, if reasonable care be taken where it is present, there is almost no risk that the disease will spread to persons who nurse and otherwise closely attend upon the sick. But cholera has a certain peculiar infectiveness of its own, which, where local conditions assist, can operate with terrible force, and at considerable distances from the sick. It is characteristic of cholera (and as much so of the slight cases where diarrhœa is the only symptom as of the disease in its more developed and alarming forms), that the matters which the patient discharges from his stomach and bowels are infective. Probably, under ordinary circumstances, the patient has no power of infecting other

persons except by means of these discharges; nor any power of infecting even by them except in so far as these matters are enabled to taint the food, water, or air which people consume. Thus, when a case of cholera is imported into any place the disease is not likely to spread, unless in proportion as it finds, locally open to it, certain facilities for spreading by indirect infection. In order rightly to appreciate what these facilities might be, the following considerations have to be borne in mind:—First, that any choleraic discharge cast without previous thorough disinfection into any cesspool or drain, or other depository or conduit of filth, is able to infect the excremental matters with which it there mingles, and probably, more or less, the effluvia which those matters evolve; secondly, that the infective power of choleraic discharges attaches to whatever bedding, clothing, towels, and like things have been imbued with them, and renders those things, if not thoroughly disinfected, capable of spreading the disease in places to which they are sent for washing or other purposes; thirdly, that if, by leakage or soakage from cesspools or drains, or through reckless casting out of slops and waste water, any taint (however small) of the infective material gets access to wells or other sources of drinking water, it can impart to enormous volumes of water the power of propagating the disease. When due regard is had to these possibilities of indirect infection, there will be no difficulty in understanding that even a single case of cholera, perhaps of the slightest degree, and perhaps quite unsuspected in its neighbourhood, may, if local circumstances co-operate, exert a terribly infective power on considerable masses of population.

After giving advice as to the water supply and proper condition of the sewers, etc., Dr. Thorne goes on:—

It may fairly be believed that, in considerable parts of the country, conditions favourable to the spread of cholera are now less abundant than in former times; and in this connection the gratifying fact deserves to be recorded that during recent years enteric fever, the disease which in its methods of extension bears the nearest resemblance to cholera, has continuously and notably declined in England. But it is certain that in many places such conditions are present as would, if cholera were introduced, assist in the spread of that disease. It is to be hoped that in all these cases the local sanitary authorities will at once do everything that can be done to put their districts into a wholesome state. Measures of cleanliness taken beforehand are of far more importance for the protection of a district against cholera, than removal or disinfection after the disease has made its appearance.

Protective Inoculation.—The principles above referred to, simple as they appear to be, are effective against cholera if they are promptly and consistently carried out. It is quite certain, unless these principles are enforced, other sanitary arrangements, however perfect, will not stop the progress of the disease. We must, however, bear in mind that desirable as it may be that men and women should have pure water, air, and perfect sanitary surrounding, by far the majority of the human race are unable to command these conditions; and so when epidemic cholera appears among them a considerable number of them will contract the disease, and not

less than 40 per cent. of these will fall victims to cholera. The question therefore arises as to the possibility of protecting such a community from this danger by the inoculations of minute doses of the poison which produces cholera.

I have already referred to the evidence which seems to demonstrate the fact that the symptoms of cholera result from a poison produced by the cholera bacillus in the intestinal canal. Dr. Ferran, following up these observations, proceeded to make pure cultivations of this micro-organism in bouillon; he thus obtained an alkaloid which he injected into the circulation of human beings in minute doses, and he believes that he can thus render them immune for a time against cholera. Dr. E. O. Shakespeare visited Spain during the epidemic of 1885, and carefully investigated Dr. Ferran's practice and method of procedure in obtaining pure cultures of the cholera bacillus. He states:—

From the Government statistics of cholera throughout the province of Valencia, it appears that among the villages invaded there were 62 attacks per 1000 of the population, and 31 deaths per 1000, which gives a mortality of 50 per cent. of those attacked. It appears, from analysis of the published official statistics of cholera, in twenty-two towns where inoculation was performed the inhabitants were divided as follows:—104,561 not inoculated, 30,491 inoculated; of the latter there were 387 attacks of cholera, or 12 per 1000, and 104 deaths, or 3 per 1000, the mortality of those attacked being 25 per cent.; of the former there were 8406 attacks, or 77 per 1000, and 3512 deaths, or 33 per 1000, being a mortality of those attacked of 43 per cent. It appears, therefore, that among the population of villages wherein anti-choleraic inoculation had been more or less extensively performed, the liability of the inoculated to attacks of cholera was 6·06 times less than that of the non-inoculated; whilst the liability of the inoculated to death by cholera was 9·87 times less than that of the non-inoculated.

Dr. Shakespeare adds:—

It would seem that there is *prima facie* evidence sufficient to warrant the presumption, first, that the comma bacillus of Koch is the cause of Asiatic cholera in man; secondly, that there is an immunity following an attack of cholera; third, that an immunity of some duration may be established artificially by inoculation of the products of a pure cultivation of the cholera bacillus; fourth, that in the practice of these inoculations extensively among populations suffering greatly from cholera, an epidemic can be rapidly extinguished. The evidence, such as it is, seems to tend almost universally in this direction.¹

The symptoms produced by the inoculation of the products of pure cultures of the comma bacillus into the circulation in minute doses are as follows:—Some three hours after the injection into both arms, the limbs become painful, and there is inability to use them,

¹ *Report on Cholera in Europe and India*, by Edmund O. Shakespeare, of Philadelphia, A. M., M. D., United States Commissioner.

great prostration follows, with a feeling of intense coldness, and an actual coldness of the extremities, headache, nausea, and frequently diarrhoea, with considerable general malaise; these symptoms increase up till about the twelfth hour after the inoculation, and continue for twenty-four hours, when they subside and gradually disappear. A second inoculation, made a fortnight after the first, produced little or no effect, or any symptoms beyond some local pain. The vaccine is to be kept in a properly constructed flask, so as to prevent the passage of extraneous micro-organisms from the atmosphere into the fluid. In fact, its preservation and mode of injection are similar to those employed for tuberculine, or by Pasteur in his inoculation for rabies. The dose used by Dr. Ferran in his inoculations was one cubic centimetre, into each arm, of a pure culture of the comma bacillus. Five days after the first inoculation, a second one may be used; but, as before stated, as a rule, it then has no effect beyond exciting local irritation at the point of puncture.

M. Haffkine has taken up the subject of vaccination against cholera in a most zealous and scientific manner. He is now engaged in anticholeraic vaccination in India. The progress of this work will be watched with the greatest interest. The reader is referred to the *British Medical Journal* of February 4, 1893, for full particulars as to the preparation and method of vaccination employed by M. Haffkine.

PATHOLOGY.

Intestinal Canal.—On opening the abdomen immediately after death from Asiatic cholera, supposing the person to have died during the stage of collapse, we find that the viscera lie back in a compact form deep in the abdominal cavity.

The stomach is empty, in some cases its mucous membrane is red and congested, small spots of ecchymosis may be observed on its surface. But this is by no means a constant feature after death in the collapse state of cholera; on the contrary, the mucous membrane in many instances, beyond a cloudy swollen condition of its epithelial lining, appears to have undergone no pathological changes.

The small intestines, as a rule, contain more or less fluid, which, if death has occurred within a few hours, in appearance resembles thin gruel. In the more acute cases of cholera the contents of the intestines are almost colourless; flakes of mucous, however, of a pale red colour are usually present. But in the majority of cases the fluid is stained by the colouring matter of the blood. Under the microscope, in many instances, a vast number, and in others

only a few, cholera bacilli may be seen, together with other forms of micro-organisms, and generally quantities of epithelial cells in which comma-shaped bacilli may be detected.

The mucous membrane of the small intestines throughout their length is more or less red, congested, and swollen. In some cases it is of a rose-red colour, with marked swelling of its epithelial covering, a considerable portion of this layer of cells being detached, producing the appearance of superficial ulceration, and sometimes of even diphtheritic changes. The ileum is commonly most affected, extensive lesions such as those I have referred to being found immediately above the ileo-cæcal valve. The solitary lymph follicles and Peyer's patches are of a greyish colour, their margins being surrounded by a zone of dilated vessels, among which hæmorrhages may frequently be seen. These latter appearances are noticed even when the rest of the mucous membrane and its epithelial cells are only slightly affected. But in those cases in which the mucous membrane of the small intestines is much congested, Peyer's patches are seen distinctly raised above the rose-red mucous membrane surrounding them.

Koch states that "on examining sections made of the coats of the intestines of persons after death from cholera, that in those cases in which the intestines by magnifying show the slightest changes, the bacilli had penetrated into the utricular glands of the mucous membranes of the intestines, and had caused there a considerable irritation, as the dilatation of the opening of the gland and the collection of granular circular cells in the interior of the gland showed. In many cases the bacilli had found their way behind the epithelium of the gland, and had multiplied between the epithelium and the glandular membrane. The bacilli had also settled in large numbers on the surface of the villi of the intestines, and had often penetrated into their tissue. In severe cases, which terminated in bloody infiltration of the mucous membrane of the intestines, the bacilli were found in very large numbers, and they did not then confine themselves to the invasion of the utricular glands, but passed into the surrounding tissue into the lower layers of the mucous membrane, and in some places right to the muscular skin of the intestine. The intestinal villi were also in such cases penetrated by bacilli. The chief seat of these changes is in the lower part of the small intestine. If this discovery had not been made in perfectly fresh corpses, one could have made little or no use of it, for the influence of putrefaction is able to bring about similar vegetation of bacteria in the intestines."

The large veins of the abdomen, as well as those supplying the coats of the intestines and the mesentery, are gorged with blood.

The mesenteric glands are enlarged, soft, and infiltrated with a whitish granular matter.

Other Organs.—Klebs observes that marked changes are noticed in the kidneys after death from cholera; they present an abnormally pale colour of the cortical substance. On examining stained sections (gentian violet), the tortuous tubes are not stained, or they readily give up their colour to alcohol. The nuclei have disappeared, or at least they contain only traces of the material which stains. The cellular substance is greatly swollen, and is slightly cloudy; if death occurs at the height of the morbid process, the epithelium will be found to fill the lumen of the tubules. This process, Klebs states, is a "coagulation necrosis" which attacks the epithelia, excited in all probability by a toxic substance affecting the cell protoplasm.

It seems quite possible that the arterial thrombi and small hæmorrhages seen in the pericardium, intestines, and other parts of the body are also caused by alterations in the cells lining the walls of the vessels, and the serous and mucous membranes of the body.

The spleen is small and anæmic.

The liver appears to be shrunken, its portal veins being full of dark viscid blood. The gall-bladder is generally distended with bile.

The urinary bladder is empty.

The lungs, like the liver and spleen, are below their normal weight, and in the greater number of cases are collapsed and found lying back against the spine. On section they appear dry, containing but little blood, and that is confined to the pulmonary arteries and their branches; the capillaries and veins of the lungs are empty.

In some instances there is more blood in the minute vessels, and the lungs are then of a darker colour.

The heart, as a rule, is found distended with dark blood on the right side, its left side being empty. The jugular veins and the vena cava, together with the coronary veins, are full of blood, but the aorta and other arteries are empty, with the exception of the pulmonary arteries. The blood is of a dark bilberry-juice colour, the colouring matter leaving the corpuscles and tinging the serum; it still retains its power to take up oxygen and to give off carbonic acid, but it passes so slowly through the pulmonary vessels that only one-third of the usual quantity of carbonic acid is given off from the lungs during life, and but little oxygen is taken in.

The veins of the encephalon are full of dark blood, otherwise no pathological changes are to be found.

Cholera bacilli are not present either in the blood, or in any of the tissues of the body except the intestines.

Action of the Virus on the System.—With reference to the poison which we believe the cholera bacillus produces, several theories have been advanced to explain its action in connection with the pathological appearances found after death. Among these theories, that advocated by Sir George Johnson takes a prominent position, and by many pathologists is held to be best capable of accounting for the symptoms and the post-mortem changes found after death from cholera.

Sir George Johnson states that in whatever way the poison was introduced into the body that it entered the circulation, and there probably underwent increase by the conversion of some blood constituents, which were then excreted through the mucous surface of the alimentary canal, and were ultimately expelled by vomiting and purging; and thus the patient recovered. In the more severe cases collapse occurred. That this was not the result of the liquid discharges from the system was shown, Sir George Johnson considered, by the fact that, in the most rapidly fatal cases there was rather an inverse than a direct ratio between the degree of collapse and the amount of the liquid discharges. A complete arrest of the discharges during collapse was a sign of fatal import; while, on the other hand, there was a continuance of the discharges, in a greater or less degree, during recovery from collapse. The effect of various and opposite modes of treatment, he believed, was also inconsistent with the theory that the worst symptoms were the result of the liquid discharges. Those methods of treatment appeared to Sir George to have been most successful which had been least repressive in their tendency. The sudden onset and the rapid passing away of extreme collapse were inexplicable by copious exhausting discharges. That the main and essential cause of choleraic collapse was, he thought, due to a greatly impeded circulation through the lungs, as was shown by the appearances found after death, and by the explanation thus afforded of the chief symptoms of collapse. When the chest was opened soon after death in collapse, the left cavities of the heart were found nearly empty; while the right cavities, the pulmonary artery, and the systemic veins were distended with blood. Sir George Johnson holds that extreme contraction of the pulmonary arterioles was the only probable explanation of this arrest of the circulation. The thickening of the blood was the consequence and not the cause of the impeded circulation. The small stream of blood through the lungs during collapse, with the resulting defective oxidation, explained the suppression of bile and urine; while, in the case of nursing women, the mammary secretion, which was not an oxidised product, continued. The marvellous temporary relief afforded by injecting a hot saline solution into the veins, he attributed to the warmth of the liquid relaxing the arterial spasm, and thus allowing the blood to pass on; while the beneficial effect which had often resulted from venesection was explained by its lessening the distension of the right cavities of the heart, and so increasing their contractile power. Other causes of arrested pulmonary circulation, such as pulmonary embolism, exclusion of air, and the inhalation of nitrous oxide gas, produced much the same train of symptoms and pathological conditions as those produced by the poison of cholera.

With reference to this theory, I am aware that one of our earliest observers of cholera in India, Mr. Scott, states that in

some cases there are no spasms, hardly any purging, but “a mortal coldness with arrest of the circulation from the beginning; and the patient dies without a struggle.” But Mr. J. Annesley, a most talented Indian physician, commenting at the time on this passage from Scott’s works, remarks: “This is a type of the disease which I have never seen.” After nineteen years’ residence in the home of cholera, I must endorse Annesley’s opinion. I have never met with a case of cholera such as Mr. Scott describes; like Mr. Annesley, in all the patients I have attended, the disease, even in the worst cases, has lasted ten or twelve hours, and been attended with much more marked symptoms than those referred to by Mr. Scott. Further, I am convinced that a large majority of the officers of the Indian Medical Service would join me in asserting that they had seen many cases in which, to all appearances, they had stopped an attack of cholera in its early stages by means of opium and acetate of lead or sulphuric acid, which checks the elimination of the poison through the intestines. We are bound also to bear in mind the fact, that after death from cholera there is found to be great loss in the normal weight of the lungs, the spleen, liver, and other organs. If the cause of death depended on obstruction to the circulation through the lungs, the blood must have accumulated in other parts of the body; but they all lose in weight, and this loss is due to dehydration of the blood and tissues.

It would seem possible that the condition of the nuclear matter of the cells of the kidneys and other parts of the body, described by Klebs, may be caused by dehydration of the blood and tissues. For we must remember that in Asiatic cholera there is not only a very rapid and copious outflow of serous fluid from the intestines, but absorption of fluid through the stomach is prevented. There is an actual diminution of water in the blood and tissues of the body, and fluid cannot be absorbed by the stomach to replace that which has drained away. A condition of this kind, lasting for some hours before death, must affect the integrity of the protoplasm of all the cells of the body; for it is living protoplasm which has continued to exist for from ten to forty-eight hours deprived of water to a great extent. This living protoplasm is something quite different from dead matter; but its properties must alter to a greater or less extent, although the body of which it forms a part may live, if deprived of water for some hours. It is quite possible that the chemical changes going on in protoplasm in these conditions, may account for its want of power after death to be coloured by staining agents, which in other circumstances is a characteristic feature of this kind of organic matter.

SYMPTOMS.

Onset and Early Stage.—Asiatic cholera is most deadly on the first outbreak of an epidemic, and new-comers into an affected locality are more frequently attacked than persons who have been living in the midst of the disease for some time.

Cholera may come on without premonitory diarrhœa (cholerine), and the patient quickly passes into a state of collapse, too frequently terminating in death within thirty-six hours.

In the greater number of cases, Asiatic cholera commences with diarrhœa; the stools are watery, copious, and frequent; they are coloured with bile, and have an alkaline reaction. The patient complains of extreme lassitude, and a feeling of indescribable sinking at the "pit of the stomach"; he is very thirsty, his tongue is white and clammy, there is great nausea, and not infrequently vomiting. If judiciously treated, many patients recover from this condition; the stools, however, in cholerine contain the infective matter of cholera, and the patient, therefore, and the evacuations should be treated on the principles laid down in the previous section. Should the disease progress, the stools alter in appearance, resembling water in which rice has been boiled; these liquid evacuations are passed very frequently; and the patient vomits water and everything else which he may swallow. He also suffers from excruciating pain caused by cramps in his arms, legs, and abdominal muscles; he is extremely restless, throws off the bed-clothes, and complains of feeling hot, although the surface of his body feels cold. Dr. E. O. Shakespeare states that if the thermometer is carefully applied to the axilla for ten minutes, it will indicate a rise of temperature to 100° or 102° F. The temperature of the rectum is always three and even four degrees above its normal point. In this stage of cholera the patient's pulse is rapid and small, his respiration is quick and shallow, his voice is husky and extremely weak; the eyes deep sunk in the orbits, and the features are pinched. The skin of the body not only feels cold but is inelastic, that covering the hands and feet is wrinkled and of a purplish hue. The duration of this stage of cholera is uncertain; it may last for two or three hours, or may continue for a day or two; but so long as the pulse can be felt at the wrist there is good hope of reaction and recovery.

Algid Stage.—Should the disease progress the patient passes into the algid or collapse stage of cholera, which is characterised by continued vomiting and rice-water stools, but to a less degree than in the previous stage; in fact, the blood and tissues of the body are

well-nigh dehydrated, and if the patient is placed in a large bath it is not easy to keep his body under the water, it floats like a cork. In this, the collapse stage of cholera, the lividity of the surface of the body is increased; the integument having a doughy, inelastic feel, the skin of the tips of the fingers and toes are blue and wrinkled. The eyes are surrounded with a dark areola, and the eyeballs deeply sunk in the orbits; the voice cannot be raised above a whisper, the breathing is very rapid. The pulse can hardly be felt, and the heart's action is very weak. No urine is passed. The patient is still very restless, and his constant cry is for water, and that some one should rub his arms and legs to relieve the terrible cramps. Reaction may after twelve or more hours supervene, but the condition of the patient is alarming, and too frequently terminates in death.

The torpid stage is one through which many cholera patients pass before death: it seldom lasts for more than a few hours. The purging and vomiting almost cease, and the patient remains in a semi-comatose condition, with his eyelids half closed, the conjunctivæ are injected; the pulse cannot be felt at the wrist, and the respiration is laboured; the skin is covered with a cold clammy perspiration. The suppression of urine continues.

Stage of Reaction.—Reaction may, as above remarked, come on at any stage of cholera, though very seldom indeed after that last described. The intensity of the cramps and the vomiting and purging diminish, and the pulse and respiration are more natural; above all, the patient can quench his thirst and obtain some refreshing sleep; after, it may be thirty-six hours or so, he passes a small quantity of urine, and after a few days may be up and walking about; the rapidity with which recovery takes place is in many cases very remarkable. Convalescence, however, may be thwarted by various serious complications: of these the most important are suppression of urine, gastritis and enteritis, pulmonary congestion, a clot in the right side of the heart or pulmonary arteries, meningitis, sloughing of the corneæ, abscesses over the surface of the body and hæmorrhage from the bowels, and roseola-choleraica.

Treatment.—In the early stages of Asiatic cholera, we may frequently stay the further progress of the disease by opium combined with acetate of lead, or with dilute sulphuric acid. Twenty drops of laudanum with three grains of acetate of lead, or twenty minims of dilute sulphuric acid should be given, and repeated every hour for three doses (in the case of adult patients) if the purging continues. At the same time, the patient should be kept in bed, and a large mustard poultice applied over his abdomen. If ice is

available, he may suck as much of it as he pleases, but it is unwise to allow him to drink much water or any other fluid.

Supposing, however, such treatment does not succeed, or that on first seeing the patient he has passed into the second stage of the disease, we should still prescribe the opium and acetate of lead, or sulphuric acid as above; mustard poultices must also be employed, and the patient kept in bed with plenty of ice to suck. Having gone through a severe attack of cholera, I can testify as to the unspeakable relief which ice affords to a person passing through an attack of this terrible disease. In my own case the onset of the disease was so sudden, and the vomiting so incessant that everything I took was immediately rejected, and consequently it was useless taking medicine; but I chewed and swallowed pounds of ice, to my infinite comfort. I think water, though urgently demanded by the patient, should be refused. I would restrict the opium to three grains; it is unwise to give more, although we may be well-nigh certain that much of it has been vomited. If this treatment does not stop the progress of the malady, and the vomiting is very severe, a single dose of twenty grains of calomel will sometimes relieve this symptom. A mixture may be added, each dose of which contains two grains of acetate of lead and fifteen drops of dilute acetic acid, to be taken every second hour; and fifteen drops of dilute sulphuric acid in water every alternate hour, so that the patient should take a draught of first one mixture, and then the other, every hour. In this way the alkaline stools become acid, and perhaps destroy the cholera organisms in the intestinal canal. However this may be, these acids seem to be beneficial in the treatment of cholera.

The cramps are best relieved by hand friction. Hot water bottles should be applied to the feet and sides; if the cramps are very severe the inhalation of ether is often a great relief, the more so, I think, after the stools have been rendered acid by medicines such as those above referred to. If the disease has reached the stage of collapse, there is but little we can do for the patient in the way of medicine, but he may continue to take the acid draught. Friction to the limbs will still relieve the cramps, and ice quench the distressing thirst; a small quantity of iced water may be cautiously given from time to time, provided it does not increase the vomiting.

I believe that alcohol is positively harmful in any stage of cholera. When reaction comes on we must be careful not to fall into the error of overfeeding the patient under the mistaken idea of supporting his strength; he will not die of exhaustion, if small

quantities of milk and arrowroot are administered frequently, for two or three days, together with warm beef tea enemas. But enteritis may certainly be induced if food other than the simplest and in the smallest quantities are allowed. The patient requires rest and the most careful nursing after a severe illness like cholera.

By treatment of this kind the kidneys and other organs of the body gradually recover their functions, and in this way suppression of urine and other complications are best guarded against. If suppression of urine or any of the other complications referred to supervene on an attack of cholera, they must be treated on the same principles as are applicable to these various maladies occurring in other circumstances.

I might fill many pages with a description of the various remedies that have from time to time been advocated for the relief of cholera. Many of these drugs would seem to have given much promise of success, but one after another they have so far failed to take their place as recognised agents in the treatment of this disease. Our hope, for the present, lies in an endeavour to stop its progress in the early stages of the disease, and, above all, to master the cause which gives rise to it, and thus endeavour to preserve those committed to our charge from its deadly influence.

Professor Rumpf, head of the Eppendorf Hospital at Hamburg, one of the best institutions of the kind in the world, has published, in the *German Medical Weekly*, an article on the treatment of cholera, and his experience of the most usual methods employed in about three thousand cases, during the present epidemic of 1892. His experience of drugs has been very unfavourable. Of the various preparations, salol, cresline, creosote, muriatic acid, lactic acid, cresol, chlorine water, sulphuric acid, and morphia, not one, he says, was of any avail. Clysters did good in the less severe cases, and after the crisis was over; these clysters consisted of a quart or more of hot water, containing two drachms of benzoate of soda, or thirty grains of tannic acid. But the best results were obtained by doses of calomel in doses of eight grains, to be given by the mouth, and to be repeated every five hours, in five grain doses. Warm baths and subcutaneous injections of solutions of common salt, and of camphor and morphia, have proved the next best remedies. Dr. Rumpf concludes as follows: "There is no specific treatment for cholera yet known. The discovery of a remedy which would annihilate the virus in the body, without damaging its functions would be an essential step forward in the treatment of cholera. Modern bacteriology will, perhaps, help us on in this direction."

