



LIBRARY

Date *12 April* 1934

Class Mark *by JZ* Accession No. *20981*
1870



A TREATISE

ON

ASIATIC CHOLERA.

BY THE SAME AUTHOR.

A MANUAL OF THE DISEASES OF THE EYE.

*With numerous Coloured Plates and Engravings on Wood,
Fcap. 8vo, cloth, 12s. 6d.*

"A complete, well-arranged, clear, and condensed manual, which is at present without a rival."—*Brit. Med. Jour.*

"Mr. Macnamara's manual is a welcome addition to the list of English educational works, and affords a gratifying proof that it is possible to lay before the student, in a small and readable volume, a complete account of the principles and practice of modern Ophthalmic Surgery."—*Med. Times and Gaz.*

"The therapeutics of the work is its main feature, and the sections devoted to this subject embrace a consideration of almost everything that has of late years been suggested upon points of Ophthalmic treatment."—*The Practitioner.*

*To the Editor of the Supplement
with the author's Consent.*

A TREATISE

K

ON

ASIATIC CHOLERA.

BY

C. MACNAMARA,

SURGEON TO THE CALCUTTA OPHTHALMIC HOSPITAL.



LONDON:

JOHN CHURCHILL AND SONS, NEW BURLINGTON STREET.

CALCUTTA: THACKER, SPINK, AND CO.

BOMBAY: THACKER, VINING, AND CO.

MDCCLXX.

[The right of translation or reproduction is reserved.]

20981



TO
HIS GRACE THE DUKE OF ARGYLL, K.T.,

H.M. SECRETARY OF STATE FOR INDIA IN COUNCIL,

This Treatise
ON ASIATIC CHOLERA,

IS
RESPECTFULLY DEDICATED

BY HIS OBEDIENT SERVANT,

THE AUTHOR.



P R E F A C E.

IN presenting this Treatise on Asiatic Cholera to my professional brethren I must apologize for much that is rough and unfinished in its composition. Had I seen my way to a release from the drudgery of practice, I should have endeavoured to have thrown more force into my argument, and have elaborated my diction so as to have made my work more readable than I fear it is at present. The leisure hour may, however, never come; and what is of great importance, I can now do battle for my own views, if, as I trust, they may be assailed by those anxious to satisfy themselves on this important subject, or to demolish my arguments if they are unsound.

I have not aimed at originality, but simply to record the work I have done, and the opinions I have formed, during nearly fifteen years' consecutive labour in the endemic area of cholera. In doing this I have necessarily had to criticise the views and actions of others; but I have earnestly endeavoured while doing so to keep within the bounds of just criticism, acting upon

the principle of doing to others as I would they should do to me; and if I have in any way transgressed this rule, I may confidently assert it has not been knowingly, but rather in the heat of argument, or from a firm conviction of the great importance of the subject which but few men in power seem to realize.

In conclusion, I have to thank my assistant, Baboo Taraprosunno Roy, M.B., for the kind aid and help he has afforded me in my researches into the nature of cholera.

37, CHOWRINGHEE;
1869.



CONTENTS.

	PAGE
SECTION I.—DEFINITION OF ASIATIC CHOLERA	1—2
SECTION II.—HISTORICAL ACCOUNT OF CHOLERA	2—259
Earliest records of cholera	2
Cholera in India from the English occupation until 1817	6
The Indian epidemic of 1817—21. North-westerly extension to Persia. Special incidents of the epidemic. Cholera on ship-board	13
Cholera in India subsequent to 1821. The epidemic of 1826, and its extension to Europe in 1831—32. Facts bearing on the question of contagion and the mode of propagation of cholera	43
Cholera in India after 1829. Epidemic of 1831—34, reaching the Mediterranean in 1836	77
The Indian epidemic of 1837—39, and its north-west progress to Afghanistan	86
The Asiatic epidemic of 1841—45, and its progress to the western world in 1848—49. Theories of cholera as affecting subsequent research	93
History of cholera in India from 1848. The Indo-European epidemic of 1850—54. Incidents of the epidemic in Europe, and their bearing on the etiology and mode of propagation of cholera	132
History of cholera in the West from 1855. Partial epidemic outbreaks	163
History of cholera in the East from 1853. Asiatic origin in 1856 of the European epidemic of 1859	171
Cholera in India from 1858. Punjab epidemic of 1861. Indo-European epidemic of 1863—66	186
Cholera in India since 1864—selected facts. The Orissa famine and cholera, 1866. Outbreak at the Hurdwar fair, 1867. Cholera in the Andaman Islands	241

	PAGE
SECTION III.—GEOGRAPHICAL DISTRIBUTION OF CHOLERA	259—291
Countries hitherto exempt from cholera	259
Area of endemic cholera	271
Course of epidemics from the endemic area	283
SECTION IV.—THE BEARING OF METEOROLOGICAL INFLUENCES UPON THE SPREAD OF CHOLERA	291—303
The effect of rain and moisture in promoting the diffusion of cholera	292
The influence of the south-west monsoon	295
Effects of temperature	302
SECTION V.—CHARACTERISTIC FEATURES OF ASIATIC CHO- LERA	304—333
Unequal distribution	304
Preference for certain localities	306
Escape of unhealthy districts	310
Never generated afresh out of its endemic area	312
Periods of varying epidemic intensity	315
Complete disappearance, except in the endemic area	320
Exclusive propagation from India	322
Diffusion by drinking-water	328
SECTION VI.—POST-MORTEM EXAMINATION, ANATOMICAL AND CHEMICAL, OF THE BODIES OF PERSONS WHO HAVE DIED DURING THE COLLAPSE STAGE OF CHOLERA	333—364
Condition of the epithelium of the alimentary tract and other mucous surfaces	333
State of the abdominal and other viscera	344
Chemical and microscopical examination of the rice-water dejecta, blood, and other fluids	351
SECTION VII.—MORBID APPEARANCES DISCOVERED IN THE BODIES OF THOSE WHO HAVE DIED FROM CHOLERA AFTER THE STAGE OF REACTION HAS SET IN	364—367
SECTION VIII.—ETIOLOGY OF CHOLERA	367—433
Dr. George Johnson's theory	368
Theories of Bayer and Pettenkofer	379
Views of the author in connection with those of Snow, W. Farr, Pacini, and others	386

	PAGE
SECTION IX.—SYMPTOMS AND TREATMENT OF ASIATIC CHOLERA	434—503
Symptoms of the first, or choleric stage—The second, or rice-water stage—The third, algide or collapse stage—The fourth, or tepid stage The fifth or stage of reaction	434
Prognosis	445
Treatment	451
Preventive measures, based on the laws of the communicability of cholera. Quarantine. Purification of water. Disinfection	463
—	
APPENDIX A.—DR. J. MACRAE'S REPORT, 1818	505
APPENDIX B.—DR. BRUCE'S REPORT, 1848	517
APPENDIX C.—DR MURRAY'S TABLES OF THE PROGRESS OF CHOLERA FROM HURDWAR IN 1867	529
APPENDIX D.—REPORT BY DR. ROSS, 1862	538
APPENDIX X.—DESCRIPTION OF AN IMPROVED CHARCOAL FILTER	550



A

TREATISE ON CHOLERA.

SECTION I.—DEFINITION.

CHOLERA is a disease which is generated at all seasons of the year, among human beings inhabiting certain parts of India; it is capable of being disseminated over the world through the instrumentality of the fomes of those who have suffered from the disease, though it may be only in a mild form, usually described as cholérine. Cholera has a predilection for persons whose general health has been impaired from defective hygienic circumstances, from disease, want of proper food, or any similar cause; in the same way depression of the nervous force, by inducing an abnormal condition of the intestinal secretions, whether permanent or temporary, renders an individual peculiarly liable to an attack of cholera.

The seizure is characterised by nausea, faintness, and a feeling of oppression in the præcordial region, griping pains in the abdomen, frequent watery purging (the stools being alkaline when passed, and in appearance resembling rice-water), constant vomiting, sup-

pression of urine, and profuse perspiration. The skin is inelastic, and that of the hands and feet shrivelled and dusky; the eyes are sunk, and the features pinched; cramps are felt in the limbs; there is difficulty of breathing, intense thirst, excessive restlessness, rapid and small pulse, and suppressed voice. The external temperature of the body sinks below 98° F., and a peculiar sweetish sickly odour (fishy) is exhaled from the body, breath, and dejections.

If left to nature, about one half of those attacked with cholera recover of themselves, reaction supervening, and often being accompanied with fever, and not unfrequently with suppression of urine and various other complications: or the disease may terminate, within a few hours from its commencement, in fatal collapse.

SECTION II.—HISTORICAL ACCOUNT OF CHOLERA.

Earliest records of cholera. — The early Sanskrit writers rank among the most ancient authorities on the science of medicine. Of these Chararka is believed by the Hindus to have derived his knowledge from a mythological personage known as Dhawantari, coinciding in character with Esculapius. Chararka's works are incomplete; but in the Nidàn of his disciple Susruta, we meet with the following description of a form of "Vishuka." The patient is attacked with "vomiting, purging, faintness, thirst, pain in the abdomen, yawning, forgetfulness, burning heat in the stomach, duskiness of the surface of the body, pain in the head and heart." The worst symptoms are "blueness of the gums, lips, and nails, diminution

of the senses, coldness of the body, sunken eyes, suppressed voice, a feeling of complete lassitude;” but “if burning of the palms of the hands and body, accompanied with sharp vomiting,” occur, the patient is likely to recover; and should “he digest his food, all danger is passed,” the patient obtaining immediate relief, the purging stops, and he is in comfort. If this description refers to cholera, the disease must have been in existence for many centuries, Susruta being mentioned in the Mahabharata, which was compiled before the Christian era. These Hindu authorities lived and wrote in the North-Western Provinces of India, and it is remarkable that they describe Vishuka as being a sporadic affection,—a character it has retained up to the present time in the north-west, with the exception of waves of the disease which burst over the country from time to time.

Hippocrates,* Galen, and Whang-shooho† are witnesses to the existence of cholera in their day, both in Europe and China, and their evidence is supported by a series of Grecian, Roman, and Arabian authors, bearing record to the fact of the presence of the disease in the various countries in which they lived.‡

The literature of the middle ages is singularly barren in original observations regarding the science of medicine. Men occupied themselves rather with the ancient terms of art than with actual observation, and, in their critical researches, entirely overlooked

* ‘Hippocrates Coi, de morb. vul.’ lib. v, sec. vii, fol. 1144, ed. fol., Francofurti, A.D. 1624.

† ‘Transactions of the Medical and Physical Society, Calcutta,’ vol. i, p. 204.

‡ Celsus A. C., ‘De Medicina,’ lib. iv, cap. xi; Alexander Trallianus, ‘De Cholera,’ cap. xvi. Aretæus, lib. ii, cap. v. Cælius Aurelianus, lib. iii, cap. xx. Avicenna, p. 492, edit. Rome, 1593.

the important events that were passing before their eyes;* and this is precisely what is even now going on among Hindus and Mahammedans in India: the Baidis and Hakims pore over their ancient works with the greatest avidity, but are utterly blind to the necessity of noticing what is passing around them. Consequently, we have but few records in Persian or other Oriental languages to enlighten us on the history of the diseases of India.† Otherwise there can be little doubt we should have had evidence of waves of epidemic cholera extending over the length and breadth of the country, long prior to the time of our occupying it.

The earliest notice of the existence of cholera in Hindustan, from the pen of a European, occurs in the 'Lendas da India' by Gaspar Correa, a Portuguese. He says that, during the spring of the year 1503, 20,000 men had died in the army of the Zamorin Sovereign of Calicut, the enemy of the King of Cochin, and that the cause of this mortality was enhanced "by the current spring diseases, and also smallpox, besides which there was another disease, sudden-like, which struck with pain in the belly, so that a man did not last out eight hours' time."‡

The same author informs us that in the spring of 1543 he met with cholera in an epidemic form at Goa; that the natives called it *moryvy*, and that the mortality was so great that it was with difficulty the dead could be buried; "so grievous was the throe, and of so bad a sort, that the very worst kind of poison seemed there

* Hecker 'On the Epidemics of the Middle Ages.' Translated by Dr. Babington. London, 1846.

† "Contribution to Literature of Cholera." By G. Gaskoin. 'Medico-Chirurg. Review,' 1867, p. 217.

‡ Idem, p. 222.

(in the stomach) to take effect, as proved by vomiting, with drought of water accompanying it, as if the stomach were parched up, and cramps that fixed in the sinews of the joints and of the flat of the foot, with pain so extreme that the sufferer seemed at point of death; the eyes dimmed to sense, and the nails of the hands and feet black and arched."

In 1563, Garcia d'Orta,* another Portuguese, gives us a vivid description of cholera as he met with it at Goa. He says the Arabs called it *hachaiza* (*haiza*), the name it is known by throughout India to this day. He adds that the disease is always most severe in "June and July."

Linschot, a Dutchman, who resided at Goa for some few years prior to 1589, remarks that "the diseases which these changes of the season bring to the inhabitants of Goa are several, among which that commonly known as *mordexin* occurs, which comes on very suddenly to those subject to it, with swelling of the stomach and continual vomiting, till they fall into a faint. This disease is common, and proves deadly to many."†

There seems, therefore, no reason to doubt that epidemic cholera existed in Goa, the only province in India known to Europeans during the sixteenth century, and that its phenomena, and the time of its principal visitations, were precisely similar to those of the disease as seen there at the present day.

In the seventeenth century we have evidence of the presence of epidemic cholera in Batavia‡ (1629), in

* Gaskoin "On the Literature of Cholera." 'Medico-Chirurg. Review,' 1867, p. 228.

† 'Quarterly Review,' 1867, vol. exxii, p. 32.

‡ 'An Account of the Diseases of the East Indies,' p. 26. By Bontius. Translated and published in London.

the province of Goa in 1638,* and in London during the autumn of 1676,† when Sydenham states that the cholera morbus was raging, and, owing to the unusual heat of the weather, brought with it convulsive symptoms severer and of longer duration than had been observed before. Not only the abdomen but the muscles of the whole body, particularly of the arms and legs, were attacked with spasms of the most terrible violence, so that the patient would again and again leap out of bed. Lastly, Thevenot was himself attacked with cholera some time prior to 1678, near Surat.

Records of cholera in India from the English occupation until 1817.—The earliest account of the occurrence of cholera in India, from the pen of an English physician (Dr. Paisley), is dated Madras, February, 1774, and is to be found in Curtis's Works on Diseases of India, published in Edinburgh in 1807. It is somewhat remarkable that this important communication should not have been brought to light until thirty-three years after it was written, particularly as, in the meantime, Dr. Girdlestone had published a work in London, in 1787, on the "Spasmodic Affections" of India, under which heading he gives an accurate description of cholera. It is evident, therefore, that, in spite of Dr. Paisley's letter, neither Girdlestone nor "a general meeting of the Faculty at Madras" which he consulted in 1782, recognised the disease we now designate cholera, as cholera.

I am anxious to bring this point somewhat prominently forward, not as a proof of ignorance or neglect on the part of the authorities whom I shall quote, for

* 'Quarterly Review,' vol. cxxii, p. 33.

† 'The Works of Sydenham.' By T. Levan. London, 3rd edition, p. 146.

they had a perfect right to follow Cullen's nosology, and class cholera under the heading of spasmodic diseases if they pleased; but, supposing this were the case, we can hardly be surprised at failing to meet with a description of this affection as cholera among the writings of English physicians in India, during the latter part of the eighteenth and the beginning of the nineteenth centuries.

In 1774 Dr. Paisley writes :*—"I am happy to hear you have occasioned the army to change its ground, for there can be no doubt, from the circumstances you have mentioned, that their situation contributed to the frequency and violence of the attacks of this dangerous disease, which, as you have observed, is true cholera morbus, the same they had at Trincomale." (In a footnote Dr. Curtis remarks that this must refer to some occasion long anterior to the war of 1782.) Dr. Paisley goes on to observe that it is often epidemic among the natives. "In the first campaign made in this country, the same disease was terribly fatal among them, and fifty Europeans of the line were seized with it. I have met with many single cases since." In 1770 cholera was endemic among the natives in the Amboo Valley in Arcot, and throughout the Travancore country.†

In 1781 we find cholera prevalent during the month of March in the district of Ganjam. It attacked a division of some 5000 Bengal troops marching through that province under Colonel Pearse. He reports that, besides those who died, no less than five hundred men were admitted into hospital on the 22nd of March.

* 'An Account of the Diseases of India.' By C. Curtis, formerly Surgeon to the "Medea" frigate. Edinburgh, 1807, p. 85.

† *Idem*, p. 16.

He further adds :—“ Death raged in the camp with horror not to be described, and all expected to be devoured by the pestilence. In vain I studied to discover the cause of our misfortune. I attributed it to a poison, but at length found that *there had been a pestilential disorder raging in the parts through which our first marches lay*, and that part of our camp was already drinking the air of death and destruction.” In the course of a few days 1143 men were in hospital affected with this disease. On the 29th of March, however, the sick were reduced to 908, and on the 1st of the following month the force was able to march, leaving 300 men convalescent behind.

It will be observed that Colonel Pearse does not mention the disease as being cholera; he calls it a pestilence, and in the following quotation from a despatch of the Supreme Government to the Court of Directors, no mention is made of cholera. This document is dated 27th April, 1781; the occurrence of the disease is notified, and the destruction which it caused in this detachment mentioned in terms of becoming regret.* After adverting to its progress in the Circars, the despatch proceeds :—“ The disease to which we allude has not been confined to the country of Ganjam; it afterwards found its way to this place (Calcutta); and after chiefly affecting the native inhabitants, so as to occasion a great mortality during the period of a fortnight, it is now generally abated, and pursuing its course to the northward.” The progress of this epidemic has never been recorded; but we have, at any rate, evidence of epidemic cholera raging through-

* ‘ Report on the Epidemic Cholera Morbus as it visited the territories subject to the Presidency of Bengal.’ By James Jameson. Calcutta, 1820.

out the district of Ganjam in March and April, 1781, of its travelling northward to Calcutta, attacking the inhabitants of that city and the intervening country, and passing on in the same northerly direction. Here, unfortunately, a blank occurs in the history of its progress; but we find that in April, 1783, cholera burst out at Hurdwar, and in less than eight days is supposed to have cut off 20,000 pilgrims.

This is precisely the course, and about the same time which subsequent waves of cholera have taken when passing over India; and it seems to me that this fragmentary history is presumptive evidence that the epidemic was of a similar nature to that which occurred in 1817, and on subsequent occasions. This position is strengthened by the fact that Dr. Girdlestone says:—“Spasms was the first disease which appeared among the troops who arrived at Madras in October, 1782. More than fifty of these fresh men were killed by them within the first three days after they landed in that country, and in less than a month’s time upwards of a thousand had suffered from attacks of these complaints.” He goes on to describe the disease thus:—There is “coldness of the surface of the body, especially of the hands, febleness of the pulse, spasmodic contraction of the lower extremities, the hands and feet become sodden with cold sweats, nails livid, pulse more feeble, breath cold, thirst insatiable, vomiting incessant, which last, if not checked, soon terminates the existence of the patient.” This is evidently an account of the disease we recognise as epidemic cholera.

Fra Paolino da S. Bartolomeo also, in a work

* *Essays ‘On the Hepatitis and Spasmodic Affections in India.’* By J. Girdlestone, M.D. London, 1787.

published at Rome in 1796, gives a curious account of cholera.* He says:—"The disease is called *mirtirissa*, or *nircomben*, in the language of Malabar, *viszucega* in Sanscrit, vulgarly *mordexein*, and not *morte de chien* as described by Sonnerat. It is an intestinal colic caused by the cold wind from the Ghattes, or from bathing in the cold mornings. This disease is frequent in Malabar in October, November, and December, when the wind comes from the Ghattes loaded with particles of nitre; it is as common on the Coromandel Coast in April and May, and often carries off thirty or forty persons in a village during one night; for, unless instantly relieved, it destroys life in the course of a few hours. In 1782 the disease broke out with terrible ferocity, and destroyed an enormous number of people."

In the month of May, 1782, cholera was raging in an epidemic form at Trincomale, and our fleet at anchor there was severely affected. M. Sonnerat,† in his 'Travels in India,' also mentions the presence of epidemic cholera along the Coromandel Coast from 1772 to 1781. So that we have independent evidence of the existence of this disease in an epidemic form in Bengal during March, 1781, in Madras, and in fact along the whole of the Eastern Coast of India in 1782, and at Hurdwar in the Punjab during the year 1783.

In the foregoing extracts we have, I conceive, distinct evidence, though far from a detailed account, of the first wave of epidemic cholera which passed over India since the occupation of the country by the English; and it seems that the reason for our not possessing clearer indications of the character of the disease, and of the circumstances attending its outbreak and

* 'Viaggio Alle Indie Orientali,' p. 350.

† Scott's 'Madras Reports,' p. iv.

progress, is to be found in the fact, that it was hardly recognised as cholera. Moreover, it was not till 1786 that the Hospital Board was established in Bengal and Madras, before which period no returns of the sick were made. Mr. Scott adds, that the reports from that date up to 1802 were kept in no regular order. Our possessions in India also, prior to 1781, were surrounded by vast areas of unsubjected country, beyond which the course of the epidemic could not possibly be traced; but the details above given are, nevertheless, important, as evidence of the passage of a wave of epidemic cholera over a considerable portion of Hindustan within twenty-four years of the battle of Plassey.

During the month of October, 1787, epidemic cholera committed terrible ravages at Arcot, and Vellore. With regard to this outbreak, Mr. Davis, a member of the Madras Hospital Board, remarks: —“ I found in what was called the Epidemic Hospital, three different diseases, viz., patients labouring under cholera morbus; an inflammatory fever with universal cramps; and a spasmodic affection of the nervous system, distinct from cholera morbus. I understood, from the Regimental Surgeon, that the last disease had proved fatal to all who had been attacked with it, and that he had already lost twenty-seven men of the regiment in a few days. Five patients were then shown to me with scarce any circulation whatever to be discovered; with their eyes sunk within the orbits; jaws set, bodies cold, and extremities livid.”*

During the year 1790 cholera was very prevalent again in Ganjam; in 1794 at Vellore, where it was described as the “Causis.”

* Scott's ‘Report,’ p. xii.

From the returns kept in the Office of the Bengal Medical Board during the early part of the present century, and which relate exclusively to the European troops, I find that in 1808 five cases of cholera are reported,—one at Meerut, one at Delhi, another at Muttra, and two in Calcutta. In 1809 three cases occurred, and in 1811, 1812, 1813 no less than seventy-nine cases of cholera are reported as having taken place at Chunar, but not a single one from any other station in the Presidency. During the year 1814 instances of cholera occurred at Cawnpore, Nagpoor, Benares, Meerut, and Dinapore; in all forty-six cases, and eleven deaths. These are the first deaths reported from this disease among our European troops in Bengal. In 1815 and 1816 there were no cases of cholera; and in this Presidency only two instances occurred among the troops at Benares in 1817, although the disease was raging throughout the whole of Bengal, showing that statistics, drawn simply from the condition of our European troops, are hardly to be relied upon as a criterion of the prevalence of cholera in India.

The disease appeared in a crowded barrack in Fort William, in 1814, among recruits just arrived from England;* and in an epidemic form at Jaulna during the same year. With regard to this latter outbreak, Dr. Cruickshanks subsequently explained (in 1831) that “he entered these cases in the Hospital Returns as bowel complaint in 1814, because the matter ejected by vomiting and stool was of an aqueous or mucilaginous consistency, containing no bile.” Mr. Scott

* ‘A Concise Narrative of Facts connected with the Disease which occurred in the District of Jessore.’ By R. Tytler. Calcutta, September, 1817. Printed by C. M. Pratt and Co.

observes with regard to this report :—“ This paper of Mr. Cruickshanks is of great importance, inasmuch as it evinces that cholera did exist to an extent not hitherto suspected to have occurred at so recent a date, and also that, even under these circumstances, no trace of it is found in the public records; for, unless we had been guided by the incidental remark of Dr. Duncan, made five years after the occurrence, and had most fortunately been able to refer to Dr. Cruickshanks, the medical returns of the corps never could have led to the knowledge of it. Hence, as already observed, though cholera very rarely appears in the sick returns of former times, it is by no means to be thence inferred that it did not then exist.”*

We are, therefore, I think, justified in arriving at the conclusion that it was nothing new for cholera to spread over India in an epidemic form prior to 1817 and 1819. The nature of the disease was then for the first time fully recognised, and as the greater portion of the country had passed under our rule, British Officers were in a position to trace the progress of the disease over the length and breadth of the land.†

The Indian Epidemic of 1817-21. North-westerly extension to Persia.—Early in March, 1817, a death from cholera occurred in Fort William, but, being an

* Scott's 'Report,' p. xi.

† Prior to 1760 the Company's territories in India were confined to an area containing some 15,000 square miles. In 1765 the Company acquired command over Bengal, but not till 1775 over the Zamindari of Benares. From 1792 to 1799 the Nizam's territory, the Carnatic, Goruckpore, and Barcilly came under their rule; in 1801 Bundelkund; in 1802 Kuttack and Balasore; the Dooab, Delhi, and Ahmadruggar in 1803; Gujrat in 1805; and Kumaon, Saugur, Hutah, and Darwar in 1817. During the following years Ajmere, the Southern Mahratta country, and the districts on the Nerbudda were some among other states which fell under British rule.

isolated case, no particular notice was taken of it. About the 11th of July we hear of the simultaneous outbreak of cholera in the districts of Patna, Mymensing, and Sylhet;* the former situated to the extreme west, and the latter to the east of the Province of Bengal. In August and the following months Calcutta was affected, 25,000 of its inhabitants having been under medical treatment for the disease. Of these 4000 died; but it is worthy of notice that scarcely a case of cholera occurred among several thousand prisoners confined in the Allipore Jail.

Copies of some of the original reports, from which these details have been compiled, are still preserved among the MS. Proceedings of the Bengal Medical Board, and are well worth studying (*vide* Appendix A); but they do not appear among the Office records in the order above indicated, no special reports on cholera having been called for or received by the Board until the end of the year.

The Proceedings of the Medical Board, to which I shall so frequently have to refer in this volume, consist of a series of day books in which entries have been made regarding the current work of the Office from the year 1800 to 1842. These records, therefore, are particularly valuable in tracing the history of a disease such as we are now considering, because they give us the opinions entertained by the members of the Board at the time the events brought to their notice actually occurred,—ideas which might very probably have undergone considerable modification if recorded at a subsequent period, and reviewed by the light of further

* 'Report on the Epidemic Cholera Morbus as it visited the territories subject to the Presidency of Bengal in 1817, 1818, 1819.' By J. Jameson. Calcutta, 1820, p. 5.

experience or knowledge of the matter in hand. This fact is well illustrated by the correspondence regarding the outbreak of cholera in 1817.

The first notice of this epidemic in 'the Proceedings' is in a letter from Dr. Tytler, civil surgeon of Jessore, to the judge of the district, dated August 23rd, 1817. He writes:—"An epidemic has broken out in the bazaar, the disorder commencing with pain or uneasiness in different parts of the body, presently succeeded by giddiness of the head, sickness, vomiting, griping in the belly, and frequent stools. The countenance exhibits much anxiety, the body becomes emaciated, the pulse rapidly sinks, and the patient, if not speedily relieved with large doses of calomel, followed by one of opium, it carries him off within four and twenty hours."* As the disease was spreading rapidly, and the natives were panic-stricken, and rushing from the town, the judge thought it advisable to close his court, and immediately reported the circumstance to the supreme government, enclosing a copy of Dr. Tytler's letter. Upon receiving this communication, Mr. W. B. Bayley, at the time secretary to the Government of India, forwarded it to the Medical Board, urging them to give the matter their immediate attention, and to advise the government on the subject. In their reply (the 6th of September, 1817) the members of the board remark "that the disease is the usual epidemic of this period of the year, increased perhaps in violence by the peculiarities of the present season, and not improbably by certain local causes affecting the health of the inhabitants of Jessore. It is understood that in certain quarters of Calcutta a similar epidemic prevails; and it is probable that

* MS. Proceeding of the Bengal Medical Board for 1817.

there is no considerable town in the low and humid climate of Bengal that is at present entirely exempt from its operation. The obstruction to ventilation in native towns from rank and luxuriant vegetation powerfully aids the influence of the season, and as this cause may operate in a greater or less degree in different places, the prevalence and fatality of the epidemic will probably be increased or diminished.

“A great alarm seems to have spread itself among the natives of Jessore, which the suspension of public business by the magistrate would not be calculated to check, though there is no doubt, however, that apprehension may aid as well the diffusion as violence of an epidemic; yet it is probable that the consequences arising from that cause may in the present instance have been beneficial, correcting the influence of an overcrowded population.”

I have quoted this letter at length, because it appears to me, not only an important document as bearing upon the history of cholera, but also gives us an idea of the recognised views of the etiology of the disease held by Indian medical authorities in 1817. It will be observed that the members of the board, who had probably served in this country some twenty years prior to the date of their letter, remark that the disease is *the usual epidemic of the season*; we may conclude, therefore, that they were perfectly familiar with its phenomena; but throughout the original correspondence, neither the government, the medical board, nor Dr. Tytler mention the epidemic as cholera. Curiously enough, the first notice we have of this fact is in a letter from the magistrate of Calcutta forwarded to government on the 16th of September, 1817. He observes that “a disease is prevalent in

the town and suburbs of the species of cholera morbus." This statement having been sent on to the medical board, they declare the disease to be cholera morbus, and that "it generally prevails to a greater or less degree at the present season of the year. It has, however, of late been far more fatal than at any former period within the recollection of the oldest inhabitants, running a course generally in a few hours, and sometimes in a few minutes,"* features which, nevertheless, had been ascribed to it, centuries before, by the Portuguese at Goa, and in other localities.

I have already noticed the existence of cholera at Patna and Mymensing in July, 1817, and in Calcutta early in August. At this time it also appeared at Dacca and Naraingunge. On the 23rd of the month it was raging throughout Jessore, and in Chittagong on the eastern side of the Bay of Bengal;† at the same moment it appeared in Rajeshahye, a central district lying east of the Ganges, and afterwards in the high and distant tracts of Bhaugulpore and Monghyr. By the middle of September the inhabitants of Purneah, Dinagepore, Balasore, and Cuttack were affected. On the 17th it had spread to Buxar, Chupra, Ghazeepore, and, towards the end of the month, to Mozufferpore.‡

In October the districts of Baulca, Berhampore, and Rungpore came under the influence of cholera; and, in fact, within three months from its appearance, the disease had been generated throughout the Province

* MS. Proceeding of the Bengal Medical Board for 1817.

† Dr. Mac Rae, writing from Chittagong, November, 1818, states: "I had constant opportunities of observing it as it prevails in this district more or less every hot season."

‡ Jameson's 'Report,' p. xi.

of Bengal, including some 195,935 square miles, and within this vast area the inhabitants of hardly a single village or town had escaped its deadly influence. There were some remarkable exceptions to this rule; as, for instance, in the city of Moorshedabad, which appears, upon good authority, to have been entirely free from the disease during the year 1817, although cholera prevailed in every direction around it. Mr. Jameson remarks that, so long as the epidemic was confined to the Province of Bengal, it at once raged simultaneously in various and remote quarters, without displaying a predilection for any one tract or district more than another, or anything like regularity of succession in the chain of its operations; as yet, too, some of the peculiarities subsequently developed by it, and so unerringly marking its progress throughout the Upper Provinces, that they came almost to be considered as laws of the disease, had either not been called into existence, or were still of such feeble and uncertain operation, as to remain unobserved among the accumulated horrors of its attacks. Thus, although there was the same violence in the commencement, and rapidity in the progress, of its visitations, they were unmarked by that earliness of declination, and entire subsidence, which afterwards generally formed so consolatory a fact of their revolutions.

Nor could a town or tract of country, after having once fully undergone the scourge, yet congratulate itself on a probable immunity from further assaults. For although generally milder in form, and less fatal in the latter period of its existence, it rarely altogether disappeared, but seemed rather to keep hovering in the vicinity, as if in mere expectancy of some

fresh occasion to recommence its attacks with renewed vigour.

Early in November the cholera broke out in the district of Mirzapore. Towards the middle of the month it was at Rewah; but previously to this had appeared in the Marquis of Hastings' camp on the banks of the river Scinde, in Bundelcund. The first cases were reported as having occurred on the 7th and 8th of the month; it then burst out with irresistible fury among the troops and camp followers. "The whole camp put on the appearance of an hospital; the dead were left unburied; the natives deserted in flocks, and some of the Governor-General's servants dropped down dead behind his chair, (?) and the Marquis himself was apprehensive of dying here; so that he gave secret instructions, should the event occur, to be buried in his tent."*

The army was moved from its position on the 19th of November, from which time the disease became less virulent, and speedily disappeared. But it is not to be supposed that this terrible outburst of cholera was confined to the camp of the Governor-General; on the contrary, it spread throughout Bundelcund, pursuing a south-westerly direction, and devastating almost every village and town in the province.

During the months of December, January, and February, there was a decided lull in the virulence as well as in the advance of the epidemic, but its influence by no means entirely ceased; for, in the majority of the districts in which it had been generated, we hear of cases of cholera having occurred throughout the cold season.

* 'A Treatise on the Epidemic Cholera.' By F. Corbyn. Calcutta, 1832.

During the year 1818 cholera spread over the greater part of India, invading districts which had previously escaped, and being reproduced in those already devastated by it; so rapidly was it engendered in various directions, that it is somewhat difficult to describe its progress, so as to give an adequate idea of it. We may probably best consider its advance under the following divisions:—

1st. To the north-east of the Ganges from the district of Tirhoot as far as Bareilly.

2nd. From Central India, north-west, west, and lastly southward into the Deccan.

3rd. From Ganjam, along the eastern seaboard, and a considerable portion of the western shore of the Peninsula.

1. During the cold season of 1817-18 cholera appears to have been absolutely in abeyance throughout the districts to the north-east of the Ganges, but in April and May, 1818, it burst out with terrible violence in Tirhoot, Chupra, and Goruckpore, extending northward into Nepaul, and rapidly invading Oude and Azingur to the west. The disease was in full force at Fyzabad and Lucknow. Towards the end of April “the troops and camp followers in personal attendance upon the Governor-General on his return from the Upper Provinces again fell in with the epidemic at Goruckpore, but now its attacks were nearly restricted to such persons as had not been with the central division of the army in the preceding autumn.”*

The inhabitants of Benares were under the influence of the epidemic in April, but did not suffer severely from it. Towards the end of March it appeared at Allahabad, destroying 10,000 of its population, but

* Jameson's 'Report,' p. xxvii.

the troops were not attacked by the disease until the middle of July. Nevertheless, they were in daily and unrestricted intercourse with the townspeople. Not a single case of cholera occurred within the precincts of the Jail, although 700 prisoners were confined within its walls, the convicts working in the streets of the infected city during the daytime.* On the 8th of April, Cawnpore, Bithoor, and the adjoining villages were affected, the disease remaining in full force for some fifteen days; it visited Furruckabad in May, but appeared little disposed to extend in that direction. "Bareilly, Moradabad, and almost every other town in the same line enjoyed their wonted health. The town and district of Shajehanpore formed a remarkable exception to the general healthiness of the Province of Bareilly. There the disease appeared in July, and is reported to have killed upwards of 5000 of its inhabitants."†

2. We may now trace the progress of the epidemic from Bundelcund, in which province it was reproduced in March and April, 1818. In May it had extended in a north-westerly direction to Etwah, visiting only one or two isolated spots in the Dooab. It was at Muttra early in June, and at Agra in July. On the 20th of the month it was generated at Delhi, and on the 28th at Meerut, skipping over all the intermediate towns and villages, but remaining in the above-named localities for a month or so, and then gradually disappearing. On the 23rd of July, a body of European and native troops marched from Meerut to Hansi. They were perfectly free from disease, and passed through Delhi on the 29th (the cholera being then at

* Tytler "On Cholera," 'Lancet,' vol. i, p. 112.

† Jameson's 'Report.'

its height in the town), encamping outside its walls about a mile to the west. They continued their march to the north-west on the 30th, and on the 31st the epidemic appeared among them. On the 6th of August they joined the force at Hansi, and almost immediately afterwards cholera broke out among the entire brigade, and accompanied them to Futtihabad, Rhauncea, and Sirseea. It was the general belief among the medical officers serving with this force that the troops from Delhi had brought the cholera with them, and propagated it through the general camp at Hansi.* Another case of a similar nature occurred among the troops composing the central division of this force. The army having crossed the Jumna on the 28th of October, left a body of troops to defend the bridge-of-boats. On the 29th cholera broke out among the men composing this guard. On the 9th of November the detachment joined the army at Terayt, and immediately afterwards the disease was first observed in camp; and in further proof of the communicability of the virus, it is affirmed that the previously healthy villages around the camp became infected from the diseased army.†

Mr. Jameson traces the cholera on as far as Seharunpore, where, he says, the "high ridge of mountains, which in other quarters proved hostile to its propagation, here opposed its further progress, and saved the inhabitants of the hilly district from a scourge which, in their circumstances of poverty and nakedness, would probably have proved exceedingly fatal to them." This inference was of course drawn from the information at Mr. Jameson's command when he wrote his report; but it is to be observed that eighteen

* Jameson's 'Report on Cholera.'

† *Idem*, p. cxi.

months later (in May, 1820), Moorcroft incidentally mentions the existence of cholera of a virulent type to the north-west of Lahore,* which in all probability was a continuation of the invading cholera we have been tracing from Bundelcund into the north-western provinces of India and the Punjab, for Sir Richard Temple informs us that the Punjab was visited severely by the disease in the year 1820.†

From Bundelcund the cholera spread into the districts of Saugur and Nagpore during the months of April and May, 1818, and may be traced westward to Bhilsa, Bhopal, and Oujein, which it reached on the 9th of May. In June it appeared at Kotah, but does not appear to have crossed the Aravulli mountains. The epidemic extended from east to west along the valley of the Nerbudda and Tapti rivers. We find it early in April at Mundlah, Hoshungabad, and Mooltae. On the 15th of May it was at Nagpore. In this quarter it, as usual, gave evidence of its capricious nature; "it was not met with between Nagpore and Mooltae, a distance of seventy miles, and Bantool, a large town in the direct road from the river to Mooltae, was entirely exempt from its visitation."‡ On the 3rd of July the disease was in full force at Jaulna. "In the province of Candeish, where there is not sufficient population, and but little intercourse between the villages, its progress was slow; it appeared in the capital of the district in the middle of July, and at the end of August at Surat." Dr. Kennedy says the disease was imported from the former to the latter place by a body of

* 'Travels in the Himalayan Provinces of Hindustan and the Punjab from 1819 to 1825.' By W. Moorcroft. London.

† 'The Localities in India exempt from Cholera,' p. 78. By Surgeon Edward Balfour. Madras, 1856.

‡ Jamieson's 'Report.'

prisoners. "At Punderpoor, to the south of Bombay, it happened to break out at the time of the great jatra, and was spread at once in all directions by the pilgrims returning to their homes. The poison would seem to have been more concentrated there from, there being so many sources of production; the number of deaths in a few days was estimated at 3000, and the patients were described as having been knocked down dead as if by lightning."*

After visiting Aurungabad, Amednuggur, and Nas-sick, it reached Seroor on the 18th of July, and towards the end of the month appeared at Poona. "On the 6th of August it broke out with great violence at Panwell, a considerable village on the main line of communication between Poona and Bombay, separated from the latter by an arm of the sea, and distant fifteen or twenty miles, but between which a pretty constant communication is kept up by means of boats. On the 9th or 10th of the same month the first case appeared on the Island of Bombay, and could be traced to a man who had arrived from Panwell the same day; it also spread north and south along the sea coast from the same place, and was imported into a village in the neighbourhood of Tannah, on the Island of Salsett, distant from Bombay about twenty miles, by a detachment of troops that escorted a state prisoner to that garrison from Panwell. The disease did not break out at Maleni on the extremity of the island, distant only five or six miles from the principal native town of Bombay, until it had been established in the latter; it then gradually spread over the Island of Salsett, through which the road from Bombay to Surat and

* 'Report on the Epidemic Cholera of 1818.' Published under authority of the Government of Bombay, 1819, p. 151.

the northern countries lies, and by which, during the south-west monsoon, is the principal line of communication.”*

It will be observed that the cholera had extended itself steadily from east to west through the presidency of Bombay; and Dr. Jukes remarks in July, 1818:—“It was hoped here (in Bombay) that as the disease had for some months been moving gradually south-west, borne along, as it were, by the north-east monsoon, that it might be checked by the violent south-west gales which blew on our coast during that season.”† In spite, however, of these opposing storms, the cholera marched forward, and having arrived at the coast, spread through the Concan.

The following is a valuable record as affording us an idea of the mortality and number of cases of cholera which occurred among the civil population of the Island of Bombay during the year 1818:‡—

Abstract of Cases.

1818.	CASES.	DEATHS.	POLICE.
August	4400	256	409
September	4804	287	478
October	2411	146	181
November	824	44	29
December... ..	806	64	72
1819.			
January	889	144	125
February	517	27	—
	<hr/>	<hr/>	<hr/>
	14,651	938	1254

Proportion of deaths in these cases when medicine was administered, 6·4 per cent. The population of the island may amount to between 200- and 220,000,

* ‘Bombay Cholera Report,’ p. 9.

† Idem, p. 171.

‡ Idem, p. 13, Appendix.

say 210,000. The number of ascertained cases, 15,945, which gives the proportion of attacks of the disease for the population at $7\frac{1}{2}$ per cent.

We must now return to Nagpore, where, as already observed, cholera had made its appearance among the inhabitants of the city and neighbouring villages in May.

Throughout the early part of the year 1818, a considerable body of Bengal and Madras troops had been engaged in the siege of Chundah, a town situated some seventy miles south of Nagpore. The men employed in the arduous operations of this siege escaped the cholera, notwithstanding the excessive heat and many privations they had to undergo. Their work having been accomplished, they were ordered to March to Nagpore, and on the 30th of May arrived at Gaongong, a village nine miles south of the city. "Here they had hardly learnt that the epidemic was raging in the vicinity, when they began themselves to experience its unwelcome visits. As usual, its first assaults were most severe. Many of those attacked, whilst loitering for water in the neighbouring rivulets, were brought in expiring; some dead. Of seventy cases admitted during that night and the succeeding day, about twenty died. On the 31st the instances of attack were equally numerous; but in these the exhaustion was not so sudden, and the subsequent symptoms were less severe. On the 1st of June, the division moved from Nagpore towards the Cantonments of Hoshungabad. The disease then gradually declined, and almost entirely disappeared on the 17th and 18th after some seasonable falls of rain."*

Early in June the cholera had reached Hingumghat, fifty miles to the south of Nagpore, and a few days

* Jameson's 'Report,' p. xxiii.

later it spread to Chundah. The disease first appeared at Jaulna on the 3rd of July, and from that date until the 11th of the month it prevailed both among Europeans and Natives, disappearing before the end of July. The Russel Brigade arrived at Jaulna on the 4th, and left for Hyderabad on the 5th of July, without any cases of the disease having appeared among the troops, but a few days afterwards it attacked them, and produced great mortality. A party of gentlemen, with about 1000 followers, arrived at Jaulna on the 4th, and left it in good health on the 6th. Before they arrived at Aurungabad, however, many of their followers were seized with cholera, and it began to prevail at that place soon after their arrival.* “The disease was most prevalent in the vicinity of the place where the first case occurred. Her Majesty’s Royal Scots, who were stationed immediately in front of the general market-place, in which the disease raged, and with which they had constant communication, suffered much by it; while the horse artillery men, who were a considerable way in front, and had less communication with the market-place, and but little intercourse with the Royals, suffered, comparatively, very little. This fact, however, has been ascribed to another cause. The artillery men lived in tents, and the Royals in old uncomfortable barracks. The latter were removed into their tents, and the cases the day in which this removal was effected were only one third of the number that had occurred on the preceding day. The disease continued to decline after that period. When it appeared in a family, several individuals of that family generally suffered an attack.”†

* ‘Bombay Cholera Report,’ p. 144.

† Scott’s ‘Report on Cholera,’ p. lxxv. Madras, 1822.

The cholera broke out at Hyderabad towards the end of July, and at Gooty on the 6th of October; it visited Bellary on the 8th of September, and had declined in severity towards the beginning of October. About the 20th of that month it broke out again with its former violence among the troops and inhabitants of the town, and did not disappear till November. "Of 500 persons in the jail only one was affected, and he recovered. The jail is situated about twelve hundred yards eastward of the fort, where the disease was very prevalent."

The epidemic appeared at Hurryhur and Chittleedroog in the middle of September, and at Bangalore on the 22nd of October. On the 6th of November it broke out at Seringapatam, which being a "sink of nastiness,"* the mortality among its inhabitants was very great indeed.

3. We may now trace the course of the cholera of 1818, along the seaboard of the Peninsula of India. From quotations already given from the works of D'Orta, Sonnerat, and Fra Bartolomeo, it is evident that cholera was an endemic disease among the inhabitants of the Malabar and Coromandel coasts when these authors wrote, and in 1818 Dr. MacRae, from personal observation in those parts since 1790, corroborates their account† (vide Appendix A). In 1818-19 the mortality from cholera was higher than usual, precisely as it had been in 1782, when Fra Bartolomeo informs us that the disease broke out with increased ferocity and destroyed an enormous number of people.

In the district of Ganjam cholera, as usual, sprung up with renewed energy during the months of March

* Thornton's 'Gazetteer of India.' London, 1857.

† 'MS. Proceedings of the Bengal Medical Board.'

and April ; in May it appeared at Vizagapatam, and in July at Masulipatam. It was generated among the northern villages of Nellore early in August, but did not reach the southern part of the district, a distance of 180 miles, until the 5th of October. Mr. Scott remarks that its progress southward from Ganjam to Nellore, against the south-west monsoons, was much slower than from the latter district to the remaining southern portion of the coast, after the wind had set in from the N. E.*

On the 5th of October cases of cholera were met with in the town of Madras ; “ the disease appeared to be commonly more prevalent in all those situations where considerable humidity existed, combined with putrid effluvia, and where the inhabitants, owing to bad clothing and lodging, were consequently much exposed to the influence of the weather. This may probably account for the greater sickness and mortality at some stations than others, and where the nature of the soil, the alternations of temperature, the degree of moisture and purity of the air, may, I apprehend, be considered as the principal sources from which the increased activity of the primary and essential cause of the epidemic, or greater morbid susceptibility of the human body, may be supposed to originate.” The disease was noticed among the inhabitants of Nagore about the 10th of November, and at Madura on the 30th of the month.

I have already noticed the fact of cholera having appeared on the western coast at Surat, Bombay, and throughout the Concan during the latter part of August ; it was at its height in September and October, and at the same time Calicut, Quilon, and

* Scott's 'Report on Cholera,' p. xlvi. Madras, 1824.

Alleppe suffered; it spread to Tellicherry in November.*

Having thus completed an outline of the course which the epidemic cholera of 1817-18 pursued, I may remark that it must not for an instant be supposed that the disease was confined in its operations to the towns I have named; these are specified simply as landmarks, to enable us to comprehend its general bearings, and as an index to the time when the cholera appeared in certain well-known localities; but we have abundant evidence at our command to prove that, between August 1817 and December 1818, almost the entire people of this densely populated country were subjected to the influence of cholera. It is, nevertheless, remarkable that certain districts, as, for instance, Rohilcund and Bareilly, were exempt from its ravages; the inhabitants also of some more limited localities, as, for example, those of Moorshedabad and the prisoners in the Alipore Jail, escaped absolutely free from the epidemic which was raging around them; but these exceptions hardly invalidate the rule, that within a period of sixteen months cholera was generated throughout the length and breadth of Hindustan.

During the early months of the year 1820, cholera was still very prevalent among the inhabitants of Calcutta, especially in April; at the same time the disease broke out among the troops composing the Nerbudda field force. Special indents poured in upon the Board for medicine and native doctors, required on account of the re-appearance of cholera in various localities during the month of May; as, for instance, from Moradabad, Almora, Meerut, Tipperah, Jessore,

* Scott's 'Report,' p. xlix.

and Berhampore. From Madras we have similar evidence of reproduced cholera, more or less severe, over the whole Presidency, and here and there it was generated with great virulence.* At the close of the year 1820, we hear of the disease at Mhow,† a station north of the Vindhya Mountains, and well to the west of India.

The history of the cholera of 1821 points distinctly to the fact of its becoming more localised in its influence in India than it had been at any period subsequent to 1817; it was generated, however, with considerable activity throughout its endemic area in Lower Bengal, Ganjam,‡ Bombay, and, from time to time, at almost every station throughout the Madras Presidency, but the cases were by no means so numerous or severe as in 1820. The Nerbudda field force again suffered severely from cholera, the disease evidently still retaining much of its former energy in the western part of the peninsula; for not only do we hear of it at Mhow and along the valley of the Nerbudda, but also in Bombay, where, from the 23rd to the 28th of May, 235 deaths occurred from cholera, and, as usual in this part of India, the disease “increased in severity during August and September.”§

In the mean time, cholera had extended both southward and eastward of India,—Ceylon, Arracan, and the Burmese empire being under its influence in 1819. During the following year the country of Siām was absolutely devastated by cholera; it appeared about the same time in Malacca and Singapore. It broke

* ‘Madras Cholera Report,’ p. vii.

† ‘MS. Proceeding of the Bengal Medical Board’ for the year 1820, vol. ii.

‡ ‘Madras Cholera Report.’

§ ‘Calcutta Journal’ for 1821.

out with great violence in the Phillipine Islands, principally at Manilla.*

We hear of it throughout the years 1820 and 1821 in China, Batavia, and Java, but it is impossible to trace the epidemic over this vast area, the information I have on the subject being principally derived from the 'Calcutta Journal' and other local papers of the period; in these, frequent references are made to the fearful ravages cholera committed in these parts, but, in a scientific point of view, they are often silent on the most important circumstances of the epidemic.

We may now briefly trace the course which the cholera of 1817-18-19-20 followed to the west of India, noticing its appearance in Persia in 1821. I have already shown that we have ample evidence to prove the existence of epidemic cholera on the western border of India throughout the years 1819 and 1820.

Mr. Fraser arrived at Muscat on the 8th of July, 1821, and he remarks that, during a visit the Inaum paid the envoy, "he confirmed a report which had before reached us of the epidemic cholera having visited Muscat, where it had committed considerable ravages. His Highness informed us that he had lost by the disease at least ten thousand of his subjects; that Muscat had by no means suffered most, as it had extended over the greater part of Omaun." "It had broken out spontaneously, first at Rooee, a village three or four miles from Muttra, without any known means by which contagion could have been conveyed. A ship with slaves from Zanguebar, which had lost a number on the passage, had, it is true, come to Muscat, but not until after the disease had appeared there."†

* 'Calcutta Journal' for 1820.

† 'Narrative of a Journey into Khorasan in 1821 and 1822,' p. 21. By J. B. Fraser. London, 1825.

On the 18th of July Mr. Fraser's party arrived at Kishmee, where epidemic cholera was raging. Many of the inhabitants had fled to Meenab, to find the disease still fiercer in that locality.* The disease had by this time reached Bunder Abbassee and Bahrein. On the 20th of August it broke out at Bushire;† and on the 29th was heard of at Cauzeroon (Kazerun) and Sheerauz (Shiraz), in which latter place it first appeared in the Prince's Harem.‡ The disease was very severe in this locality, and our author's companion, Mr. Rich, here died of cholera.

Mr. Fraser makes no further reference to the disease until he arrived at Tabreez in July, 1822. He then observes that it is "difficult to say how, or whence, the epidemic cholera reached Tabreez. It was supposed to have travelled from Bagdad along the caravan road, by Hamadan and Sennah"; but no account, to be at all depended on, could be obtained of its gradual progress."§ The disease soon afterwards appeared in Gheelan, at Reshd, and in the King's camp at Sultania, "in spite of quarantine." In August, 1821, the epidemic had invaded the Persian army besieging Bagdad. It committed terrible havoc among the inhabitants of Aleppo, and was generated in various other towns of Asia Minor.

In 1823 cholera broke out at Alexandretta, and reappeared in most of the places it had visited during the preceding year, being also generated in several of the seaport towns on the Caspian; and in September,

* 'Narrative of a Journey into Khorasan in 1821 and 1822,' p. 35. By J. B. Fraser. London, 1825.

† Idem, p. 57.

‡ Idem, p. 83.

§ 'Travels and Adventures in Persian Provinces,' p. 316. By J. B. Fraser. London, 1826.

as far north as Astrachan. In June, 1823, cholera showed itself in the neighbourhood of Laodicea and Antioch, and then spread along the borders of the Mediterranean, but entirely disappeared again, both there and on the shores of the Caspian,* towards the close of the year; nor do we hear of its reproduction, or, in fact, of its existence in these localities from this time up to the autumn of 1829.

It is without doubt most remarkable that cholera should have been hanging about the territories bordering on the Levant for three years, with only a nominal quarantine to stop it, and ample means of communication open, through which it might have spread into Turkey and Europe, supposing human intercourse to be the ordinary means by which the disease is propagated.

Special incidents of the epidemic.—*Cholera on ship-board.*—Before proceeding with the history of cholera from 1821 to 1830, it is advisable to examine any records of interest we may possess bearing upon the circumstances under which the disease appeared among the crews of English vessels, either at sea or in port, prior to 1820. One of the first cases to attract our attention is to be found in Dr. Girdlestone's work.† He observes that the troops under the command of Sir J. Burgoyne, three days after landing in Madras (October, 1782), in perfect health, were seized with cholera. Dr. Corbyn describes a very remarkable outbreak of disease on board the ship "Mangles." The vessel had experienced very bad weather in the Bay of Biscay and at the Madeira Islands. He says

* Graves' 'Clinical Medicine,' p. 299.

† Essays 'On the Hepatic and Spasmodic Affections in India.' By J. Girdlestone. London, 1787.

the lascars were fed merely on rice and salt-herrings, with only half a pint of water per diem, and the sanitary arrangements of that part of the ship in which they lived were fearfully bad. During the month of January 1814, the disease in question commenced, "being sudden in its attacks, and more so in its fatal termination; there were no premonitory symptoms: it at once began in all its terror and violence, and terminated in from twelve to thirty hours. The finest Malay men were the first to suffer, and generally fell victims to the disease.* It commenced with a swelling and hardness about the epigastric region, with a sense of constrictive pressure of the thorax; violent vomiting; the excretions from the intestinal canal were equally disordered, as exhibited by continual watery stools, coldness of the extremities, with a sense of numbness and cramp in some cases. The feet œdematous; pulse low, and sometimes hardly perceptible; the skin dry and cold, with a sense of burning heat in the bowels and stomach; the countenance soon became melancholy, sad, and fallen, but the most predominant and distressing symptom was general spasm; the extreme spasmodic rigidity of the abdominal muscles, and then of the neck and face, produced the most painful contortion of the mouth; a film seemed to cover the vision, and exhausted nature soon sank under such accumulated and dreadful suffering. During the short period of six weeks, sixty-five bodies were thrown overboard, and five men died four minutes subsequent to each other, just as we had cast anchor in Table Bay." The vessel was cleaned and purified

* 'Treatise on the late Epidemic as it appeared in the Central Division of the Grand Army in the month of November, 1817.' By F. Corbyn. 1818.

while at the Cape, and no more cases occurred. Dr. Corbyn had only one opportunity of making a post-mortem examination. He says:—"I found the stomach distended with air, as well as the intestines, but could discover no obstruction, or even fæces; the coronary arteries of the stomach were considerably distended with congested blood. The stomach, lateral convolutions of the ilium, and the liver had suffered inflammation."* The patient having been taken ill at 6 p.m., died within thirty-six hours.

Mr. Scott, in 1824, observes that this outbreak of disease on board the "Mangles" could not have been cholera, the œdema and swelling of the feet being symptoms unknown in this affection; and we cannot overlook the fact that the only detailed account which Dr. Corbyn has left us is contained in a small work, published by him in 1818, upon the epidemic which prevailed in the Governor-General's camp in 1817. Dr. Corbyn says this outburst of disease "approximated in its features more to the disease of cholera morbus than to any other in the nosology." He then proceeds to point out the difference between cholera and the epidemic which he witnessed in the Marquis of Hastings' camp. It seems to me very clear, therefore, that if Dr. Corbyn's ideas were in this state of confusion as to the nature of cholera in 1818, it is not unlikely he may have been mistaken as to the outbreak of disease which he witnessed on board the "Mangles" four years previously.

Surgeon J. Boyle gives us the following history of

* The Russian medical officers at Orenburgh, in 1829, make almost precisely the same remarks regarding the appearances of the intestine; they describe the inflamed state of the parts after death.—'Die Asiatische Cholera in Russland.' Berlin, 1831.

cholera as it occurred on board a twenty-six gun ship, while she lay in the harbour of Bombay :—Six of her officers went on shore “for a spree ;” they remained there a day or two, and “had no sooner returned to the ship than three of them were seized with cholera ;” they all three died.* A few days afterwards a part of the crew were allowed to land ; no less than forty of them were attacked with cholera, and five died. Mr. Boyle goes on to observe that in April, 1819, although cholera was in the town of Bombay, the crew of the “Malabar” were healthy. The ship sailed for England, and on the second night after her departure, cholera made its appearance among the sailors, and continued its ravages for five days ; in fact, until the vessel reached Cochin ; during this time some forty or fifty men were attacked, and eleven of them died.

Mr. Boyle relates another interesting case, that of H. M. Ship “Minden.” “On the 5th of November, 1819, as she was on her passage to Bombay, between that place and Cochin, in precisely the same track as the former ships, she was visited with cholera, which continued with unrelenting violence to the 12th of the month. A few cases occurred after this period, but generally speaking they were of a mild and tractable nature ; altogether there were fifty cases on board the “Minden,” and of that number nine died. For some months previous to this the crew had been comparatively healthy, and from the circumstance of *having been for some time at sea*, had no evident opportunity of predisposing themselves by debauch ; but on interrogating those affected with the complaint, it was

* ‘A Treatise on the Epidemic Cholera of India,’ p. 31. By J. Boyle. London, 1821.

generally observed that their bowels had been previously in a deranged state.”* The value of this history would have been greatly enhanced had we been absolutely certain that no communication had taken place between the crew and the shore at Cochin, prior to the outbreak of cholera.

Cholera occurred among the shipping at Diamond Harbour in 1818, in its usual irregular manner; in fact, the only vessel that entirely escaped was the “General Hewett,” “the men not being allowed to go on shore, and otherwise carefully protected from the sun and damp.”†

In 1819 the shipping again suffered severely; the instance of the “Carnatic” is somewhat peculiar. This ship anchored in Madras roads on the 5th of August, clean and with a healthy crew. She sailed for Calcutta on the 20th, but in the mean time six men had been seized with cholera; seven days afterwards one of the crew was re-seized with the disease, and died on the 20th; and within the three following days, six of the crew were attacked with cholera, and five of them died; subsequently there were six other cases, but they all recovered. The weather was extremely bad, and the ship close to land, being only fifteen miles from the shore at Ganjam.‡ “The disease had no appearance of contagion. It occurred only among the seamen, although between their condition and that of the soldiers on board there was only this difference, that they slept on the gun and the soldiers on the orlop deck. Some were seized

* ‘A Treatise on the Epidemic Cholera of India,’ p. 33. By J. Boyle. London, 1821.

† Jameson’s ‘Report,’ p. 104.

‡ Idem, p. 321.

who had no communication with the sick; while others escaped who constantly sat on their hammocks.”

It is not known what has been the earliest period, after reaching an anchorage, at which cholera has appeared on board ship, but in the instance of the 41st Regiment, men were attacked on the very morning of their landing, which was the second day of their arrival in the Madras roads.*

Before leaving this part of our subject, we have still to consider a very important case which occurred during the period under review; I allude to the outbreak of the epidemic in the Mauritius in the year 1819. The circumstances of the case are briefly as follows, taken from the journal of the surgeon in charge of the vessel:—
“H.M. Ship ‘Topaze’ sailed from Trincomalee on the 9th of October, 1819, having fifty-seven men on the sick list; and immediately after leaving, cholera broke out and attacked seventeen men, four of whom died.

“On the arrival of the ship at Mauritius, on the 29th of October, thirty-six men were taken on shore and accommodated in the Military Hospital, Port Louis; six of these men died, four from the sequelæ of cholera, with which disease they had been seized on board. Three weeks after the arrival of the ship at Port Louis, the cholera made its appearance among the inhabitants, and continued to carry off from fifty to sixty persons daily, chiefly slaves. It appeared immediately afterwards in other quarters of the island with equal fury.”†
Not a single case of cholera occurred on board the “Topaze” after her arrival in the Mauritius, although all the merchant vessels in the harbour were losing men by this disease.

* Scott’s ‘Report,’ p. xliv.

† ‘London Medical Gazette,’ vol. ix, p. 226.

Such is the unvarnished tale of the "Topaze," upon the consideration of which Sir Gilbert Blane lays down the law absolutely in favour of contagion, and with reference to this case exclaims: "Can there be a doubt in the mind of any rational being that this disease, never before known in the Mauritius, was imported by this vessel?" Sir G. Blane carries on the history of the "Topaze" a step further than the surgeon of the vessel has done; he informs us that the Governor of Bourbon, under the strong conviction that the disease was contagious, took measures, by proclamation, to bar all intercourse with the Isle of France; but in spite of this, a boat from the shore of Bourbon had clandestine communication with a small vessel from the Isle of France—probably about the 8th or 9th of January, for she left Port Louis on the 6th; after the usual interval, the disease showed itself in Bourbon, so as to leave no doubt of an infection traceable to the boat and spreading to one quarter of the town. The governor, with that vigilance and energy which was in his character, instantly adopted such measures of police, by cordons of troops, and by conveying the sick to a lazaretto, that the further progress of it was arrested, and in a short time it died away. In the Mauritius, on the contrary, the disease spread to the whole town, and to the rural population, to a calamitous degree."*

On the other hand the Commissioners assembled by Major-General Darling, commanding the Island of Mauritius, at Government House, on the 23rd of November, 1819, assert that they are "unanimous in not supposing it (the disease) contagious, *or of foreign*

* 'Notes on Epidemic Cholera,' p. 256. By R. H. Kennedy. London, 1846. Second Edition.

introduction. From the disease pervading classes who have nothing in common but the air they breathe, it can be believed that the cause may exist in the atmosphere.”*

“The first well-marked case of the present disease occurred on the 6th of September last, and was treated by Mr. Trebuchet in Port Louis” (the “*Topaze*” did not reach the island until the 29th of October); “it differed in nothing from the cases which have presented themselves since the 18th and 19th instants, and which appeared to break out so suddenly in all quarters of the town.”

We may here pause for an instant to consider the conclusions arrived at by the Bengal Medical Board in 1819 regarding the outbreak of epidemic cholera of 1817-19.

The Board called for reports on the subject from all the medical officers in this Presidency, and the mass of evidence thus obtained was arranged by Mr. Jameson, Secretary to the Board, and published under their supervision. Their report will remain as an honorable memorial of the Bengal Medical Service for many years to come, showing what we were capable of forty years ago; nevertheless we must admit, to our shame, that this report of 1819 was the first—the last—the only combined effort made by the Service to unravel the mystery which from that time up to the present has surrounded this disease.

Mr. Jameson states that the Medical Board had arrived at the conclusion that the proximate cause of the disease consisted in a pestilential virus, which

* ‘Report of the Committee appointed by His Excellency the Governor of Mauritius to Inquire into, and Report upon, the probable Cause of the Outbreak of Cholera in the Island of Mauritius in March, 1856,’ p. 143. Port Louis, 1857.

acted primarily upon the stomach and small intestines; and that the depressed state of the circulatory powers and diminished action of the heart were consequent on the severe shock which the system had received in one of its principal organs; these effects being always noticed subsequent to the vomiting and purging. The Board were of opinion that there was no proof of spasm of the extreme vessels; because in the cold fit of ague there was the same retirement of the blood from the surface without the burning heat and general internal tumult of this disorder. On the contrary, it seemed to the Board that there was evidence of atony in the capillary vessels; the clammy skin, suspended secretions, and pale fluid from the bowels pointing to this conclusion. They were of opinion that the hepatic system had nothing to do with cholera.

As to the remote causes of the disease, the Board believed that none of the hypotheses put forward accounted for its phenomena, nor did they consider it profitable to speculate further on the subject.

The notion of cholera depending upon irregularities of the season or upon improper food having been dismissed as untenable, the Board thought the spread of the disease was connected with the east wind; but they hesitated to express an opinion as to whether the wind carried the virus from one place to another, or if its action depended upon the moisture which always accompanies this easterly wind. The disposition of the disease to follow the course of large rivers was explained by these being the natural paths of commerce, and therefore in the line of large towns and overcrowded cities. But beyond this they distinctly pointed to the fact that low alluvial soils are the localities in which cholera loves to dwell.

The Board were of opinion that cholera was not a contagious disease, and if quarantine laws had been found useful people would naturally have resorted to them. The removal of a camp was often useful, and in fact stayed the progress of the disease, although the sick and baggage moved with the camp; the change from one locality to another being often sufficient to stop the disease, which would not have been the case had it been contagious.

Cholera in India subsequent to 1821. The Epidemic of 1826 and its extension to Europe in 1831-32.—Resuming now the history of cholera in India after 1821, we find from the ‘Proceedings of the Medical Board’ that the year 1822 was marked by almost absolute rest as regards cholera; in fact, the great epidemic which had arisen in 1817, well nigh covering Asia within the three succeeding years, had now subsided.* The disease was still generated according to its regular periods of increase and diminution throughout the year in its endemic area, which we have thus far in our history seen to extend over the whole seaboard of British India, including Chittagong and the Delta of the Ganges, but which, as we shall subsequently discover, is by no means confined even to this enormous area.

A fair criterion of the comparative death-rates from cholera, for the years 1818 and 1822, is supplied by the Returns of the Madras Army. In 1818 this force amounted to 69,416 men, and among these 896 casualties occurred from cholera; but in 1822, the force having increased to 85,517 men, only 369 deaths are recorded from this disease. In examining these Returns, we are struck with the marked difference which exists between the death-rate from cholera among our

* Scott’s ‘Madras Report,’ p. xiii.

European and Native troops in India, amounting to 21 per 1000 of the former, and to 10 per 1000 of the latter.

Throughout the early months of the year 1823 cholera was very prevalent in the Presidency, Cuttack, Sylhet, and the Midnapore Divisions; Beerbhoom and Balasore suffered severely during May.* At Dinapore "the greater number of cases appeared upon a sudden change of the weather;" but, with these exceptions, we have no evidence of epidemic cholera in or beyond the Delta of the Ganges.

In the Madras Presidency many stations were again entirely free from cholera; † it broke out here and there, as, for instance, in the 34th Regiment, which was encamped at the Mount near Madras, for the purpose of volunteering preparatory to embarkation for England. "In consequence, apparently, of the excessive heat of the tents, and the great drinking attending the volunteering, a high degree of susceptibility to the disease was reproduced among the men, which appeared to be excited into a severe epidemical visitation by a slight change in the weather. At the same time the disease was not prevailing in the fixed troops at the station, nor anywhere in the neighbouring country, except in the 54th Regiment, just arrived in India, and in the 53rd on its march. While the disease was prevailing in the 34th, a party of volunteers left it for the depôt at Poonamalee, eight miles distant. In the course of a week after their arrival there, twenty cases occurred in that party, but not one in the various other parties of troops previously there, though they were all mixed up together. The 53rd Regiment shortly after under-

* Annesley 'On the Diseases of India,' p. 249. London, 1825.

† Scott's 'Madras Reports.'

went their voluntceering in the same neighbourhood and under the same circumstances with the 34th—of exposure to heat in camp and intoxication—yet escaped the disease. The 53rd had but two months before undergone a severe visitation, induced by marching and atmospheric influences, by which its susceptibility was exhausted, and the causes which proved so fatal to us were insufficient to reproduce it in them.”*

In 1824 cholera was only generated to a slight extent beyond its endemic area. It broke out with considerable violence among the European Artillery and men of the 15th Regiment N. I. at Mhow, “the patients being attacked with vomiting and purging of a whitish-coloured watery fluid, the most awful collapse of the system ensuing, leaving but little time for the employment of remedies; there was nothing like reaction. The vital powers seemed completely exhausted by the first stroke. There were only three cases where spasms appeared.”† Concerning this outbreak of cholera, the Superintending Surgeon remarks—“The only troops of this division that have suffered from cholera were the 15th Native Infantry and European Artillery, which unfortunately passed on their route through the crowded and filthy cities of Indore and Oujein, while the dire disease was raging with great violence; whereas in Mhow, the station they had left, though only twelve miles distant from Indore, not a single case had occurred.”‡

In the Jubelpore district there was rather a severe,

* Essays ‘On the Epidemic Cholera of India.’ By R. Orton.

† Report by Assistant-Surgeon A. M. Clark. ‘MS. Proceedings of the Bengal Medical Board’ for 1824.

‡ ‘MS. Proceedings of the Medical Board.’

but short, outbreak of cholera in July; it did not affect the troops.

During the early months of the year 1825 we have a repetition of the old story—Cholera in Calcutta; the pilgrims at Pooree suffering severely, and the Government urgently called on to exert themselves in favour of these poor creatures. In April, May, and June reports were received from various districts in the Delta of the Ganges as to an increase in the number of cholera cases; from Ganjam and along the eastern seaboard a similar cry was raised, and later in the year from the western side of the peninsula at Mhow. Among the inhabitants of Calcutta and the city of Dacca, cholera was very prevalent again in August and September. Nevertheless, on the whole, India was comparatively free from the disease.

The following twelve months are of special interest with regard to the history of cholera, and I am almost entirely indebted for the information I have gained regarding this period to the reports and returns contained in the 'Proceedings of the Medical Board.' From these we shall find that the great epidemic, which spread over Europe and extended to America in 1830-31-32, arose in Bengal in 1826. This point has never, so far as I am aware, been insisted on. The cholera of 1830-31 is usually described as having originated in Astrachan. "In 1823 it passed the Caspian Sea, and in the month of September showed itself in Astrachan. It made no further progress, however, in Europe until the year 1830. In that year, having appeared again at Astrachan in June and July, it extended rapidly through the eastern part of Europe."* This account gives us

* 'Reports on Epidemic Cholera, drawn up at the desire of the Cholera Committee of the College of Physicians,' p. 118. By Drs. W. Baly and W. Gull. London, 1854.

but a very meager idea of the origin and course of that great wave of epidemic cholera, upon the study of which we must now enter.

During the first quarter of 1826 cholera was evidently on the increase throughout the whole of Lower Bengal. Among the troops in the Presidency Circle no less than 76 cases occurred in April: of these 38 died; but what is of more importance to notice is, that H. M.'s 31st Regiment at Dinapore, was attacked by cholera in April, 1826, 57 men having been seized with the disease: of these 23 died; and at the same time, in the Regiment at Buxar, 49 men were affected with cholera, and 29 died. From Dinapore, Dr. Dickson writes on the 4th of April, 1826—"I am very sorry to report that cholera has again commenced its ravages at this station: the surrounding districts are, likewise, most severely affected."* The Superintending Surgeon at Benares, on the 13th of May, 1826, reports—"that, in the city of Benares, two or three hundred persons were daily carried off by cholera, and yet the troops and prisoners in the jail remained entirely exempt from the disease, which, nevertheless, was most severe all over the Benares division." In the Cawnpore Circle, during the month of June, 64 European and 108 Native soldiers were attacked by the disease. We have clear evidence, therefore, of a most severe outburst of epidemic cholera, commencing early in 1826, throughout the whole of Lower Bengal, and gradually extending towards the north-west as far as the Cawnpore division, during the first six months of the year. Beyond this area, we hear of nothing approaching to an epidemic outbreak of cholera. The

* See also Dempster's account of this epidemic in the 'Transactions of the Medical and Physical Society of Calcutta,' vol. iii, p. 420.

Saugur, Agra, Meerut, Kurnaul, and Nusseerabad divisions were absolutely free from the disease, with the exception of the usual sporadic cases which occur there every season. Before the month of August cholera had subsided, but by no means disappeared, from Cawnpore eastward.

In November, 1826, we notice the first muttering of the storm which was gathering in the west. The Superintending Surgeon of the Nusseerabad Division writes as follows:—"In the stations on the right banks of the Jumna, viz., Delhi, Muttra, and Agra, the returns show that the Corps there have experienced during the month a slight invasion of cholera."

The above details are sufficient to give us an idea of the cholera of 1826; its steady advance from east to north-west as far as a line drawn about half-way between Cawnpore and Agra; its halting precisely as it had done in 1817, but apparently not invading Bundelcund (in the Nagpore Subsidiary Force the ratio of admissions to strength per 1000 for cholera was in 1827, 0·605; in 1828, 1·120; in 1829, 1·517; and in 1830 there were no admissions at all); in other respects the cholera of 1826 presented an exact counterpart to that of 1817, and in all probability to that of 1783.

I would draw special attention to the foregoing observation of the Superintending Surgeon of the Nusseerabad Division, as to the slight invasion of certain cities by cholera on the right bank of the Jumna, towards the close of the year 1826—by the skirmishers, as it were, thrown forward by the invading power; the evidence of the potential force of the disease in these localities.

Sir J. R. Martin remarks :* “ I served in the General Hospital, Calcutta, in March, 1827, the time referred to by Mr. Twining, when the house was filled with cholera patients, and when all of us, Europeans and Natives, were exhausted with the labours of attending on the sick, but none of us suffered from the disease.” Maulmain, Arracan, Chittagong, and the whole Delta of the Ganges were, during the first quarter of the year, under the influence of a severe outburst of cholera.

In May, 1827, Dr. Taylor wrote to the Board from Agra, reporting that cholera “has prevailed, in an epidemic form, in all the villages within several miles around Agra; an immense number have fallen victims to its destructive influence.” Dr. Skipton, from the same place, remarks that 23 cases of cholera occurred among the men of the 58th Regiment N. I., and only two from the lines of the Regiments on either side of the 58th. Dr. Knight at the same time sent information to the Medical Board of the outbreak of cholera at Bareilly. From Meerut, Dr. Ludlow writes: “During the melancholy visitation of cholera the convicts suffered comparatively little;” “of the stations depending on Meerut after Rajpooorah, cholera has chiefly been felt at Dhya in the Dhoon and Moradabad; since the 6th instant we have had easterly winds, but as yet no regular fall of rain.” From Delhi, Dr. Longstaff reports, “During the greater part of June cholera morbus has raged amongst the inhabitants of the surrounding towns and villages to an epidemic extent, but among the European troops only two cases have occurred, and not one among the Horse Artillery.”

* ‘The Influence of Tropical Climates on the European Constitution,’ p. 298. By J. R. Martin. A New Edition, 1856.

As early as May, cholera had been generated at Nusseerabad; "the disease, in many instances, on its first appearance assumed a character of great malignity, and the powers of life were almost exhausted with the commencement of the attack;" it was very severe throughout the provinces of Ajmere and Jeypore, but the inhabitants of Oudepore escaped, with the exception of the usual number of sporadic cases. Dr. Hardie mentions that the disease in this province, according to the native belief, has been endemic from time immemorial, appearing every year towards the end of the hot season.* Dr. Stewart makes a similar assertion as regards the valley of the Nerbudda.†

Dr. Govan informs us that, on the Himalaya at Nahin, some 3027 feet above the level of the sea, cholera broke out in a virulent form on the 4th of June, 1827, and that it "raged at Sabathoo from the 18th June to the beginning of July."‡

Epidemic cholera is said to have existed at Hurdwar§ and throughout the Punjab during the year 1827.||

The disease was reproduced in Cawnpore, Allahabad, and other districts which had been invaded by it during the previous year, although in a less severe form. The Central Provinces seem, however, to have escaped the cholera of 1826-27.

The general features of the epidemic I have now described appear to be somewhat as follows:—We notice a vast increase of the disease in its endemic area, and during the first half of the year its pro-

* 'Calcutta Medical and Physical Transactions,' vol. v. p. 15.

† 'MS. Proceedings of the Bengal Medical Board.'

‡ Idem.

§ 'Sanitary Report on the Hurdwar Fair of 1867.' By Mr. H. C. Cutcliffe.

|| 'Localities in India exempt from Cholera,' p. 78. By Dr. Balfour.

gressive extension towards the north-west, as far as Cawnpore, or a little to the west of it, followed by a gradual subsidence of the disease. During the second half of the year, a few cases occurred beyond the invaded area, and in the same line of country.

Throughout the following twelve months cholera was reproduced over the entire area which had been affected during the previous year, and an outburst of the disease occurred over an enormous tract of country beyond that which had been invaded the year before, the epidemic still spreading to the west and north-west.

Supposing the disease had continued to advance at about the same rate and by the same route, throughout the year 1828, as it had done during the two previous years, we should have expected to meet with it in 1829 to the north and south of the Caspian Sea, in the district of Russian Orenburg, at Herat, and Teheran. A glance at the maps of Europe and Asia will best elucidate this point. It is true we know but little of the epidemic as invading the countries between the Punjab, Russia, and Persia, and, from their wild and inaccessible nature, it was impossible for us to receive much information; nevertheless, my position is strengthened by the fact of our having actual proof that the cholera of 1829 did extend across a part of Afghanistan and Persia; for, in the 'Government Gazette' published in Calcutta, January 14, 1830, I find the following communication:—"We regret to state that the greatest consternation prevails at Teheran in consequence of the appearance of the cholera morbus, which has gradually advanced from Herat, through Khorasan, to the Persian capital. At the former city, King Mahomed and the Prince

Koursan, the last members of the Suddœ Zya Royal Family in Afghanistan who have enjoyed any authority or importance, have fallen victims to the epidemic. His Majesty the Shah has left Teheran and retired to the mountains in the vicinity. The princes and nobles were following his example, and even the lower orders of the people were dispersing, in order, if possible, to escape "the pestilence." Lieutenant Conolly also remarks that the "year before our coming to Herat (*i. e.*, in 1829) the cholera had swept away many thousands of persons from the city and the provinces around."* Further than this, we hear of cholera having prevailed in 1829 "in the province of Khorasan, and likewise in various districts of Bokhara, above all in Chiva (Khiva), a city of the province of Turkestan."†

If now we compare together the phenomena of the three epidemics we have been considering, we can hardly fail to notice the analogy they present. In the outline I have given of the first, that of 1781-3, we find an increase of cholera over its endemic area, and its advance to the north, followed by an outbreak of the disease at Hurdwar during the succeeding year, "after a heavy fall of rain followed by an easterly wind."‡ In the second epidemic (1817-21), cholera raged over its entire endemic area, and spread during the same year towards the north-west as far as Cawnpore. The following year it extended its deadly influence over the Western and North-Western Provinces and Punjab before July, re-appearing in many of the localities it had affected earlier in the year, in the months of

* 'Journey to the North of India, Overland, from England through Russia, Persia, and Afghanistan,' vol. ii, p. 5. By Lieutenant Conolly. London, 1838.

† The 'Edinburgh Medical and Surgical Journal,' vol. xxxvi, p. 126.

‡ 'MS. Proceedings of Medical Board.'

August, September, and November; it subsequently appeared in Persia. In the third epidemic we have traced a precisely similar progress; and I would draw special attention to the fact, that not only did the invading cholera pursue the same course as it followed in 1818, but was also heard of at Hurdwar in April, and throughout the North-Western Provinces, and along the Himalayas, before the middle of June.

In 1828 cholera was reproduced in all the localities affected by it during the two previous years.

Throughout the year 1829, the inhabitants of this Presidency were less subjected to the disease than in 1828; the superintending surgeon of Dinapore reports its existence in some of the jails in his circle, but hardly in an epidemic form, indicating the fact that the cholera of 1826-27 had a tendency to subside more speedily than its predecessor of 1817-18. During the year 1826, some 503 cases of cholera occurred among the European troops, and in the General Hospital of this Presidency, in 1827, there was 812 cases; in 1828, 691; in 1829, 632; and in 1830, 277 cases.

M. Sawas, a member of the Cholera Conference assembled at Constantinople in 1866, thus describes the origin of the European cholera of 1830-31: "In 1829 it broke out at Orenburg, which maintained extensive commercial transactions with Bokhara. From Orenburg it passed to Kiakhta, a town on the frontier of the Russian empire, and the seat of a great fair. From Kiakhta the disease was communicated to Cabul in 1829, after the fair, and thence it passed progressively to Herat and Mushed, and broke out in the following year in Teheran."* From the evidence,

* 'Proceedings of the International Conference at Constantinople, 1866,' pp. 313 and 459. Calcutta, 1868.

however, which I have already adduced, I trust I have made it clear that the Bombay Presidency, Sind, and the Punjab, were under the influence of an invading cholera from the east, during the year 1827, which had reached Khiva* and Herat in 1829; and I shall now endeavour to trace the continuation of this epidemic from India, through Europe, to America.

On the 26th of August, 1829, the disease broke out in the city of Orenburg; it was not, however, until the "10th of September that its true nature occurred to the physicians of the place."† Between the 9th and 25th of the month, 57 cases had been reported, and before the 21st of October, 747 people were attacked by the disease. By the 20th of November, the epidemic had entirely disappeared from the city, into which, in the first instance, it was said to have been imported by caravans from Bokhara.‡

About the 23rd of September, cases of cholera began to appear in other parts of the Orenburg Government; and the first place in which it was known to exist was in the fortress of Rasüsna, sixty miles west of Orenburg; and, between the 3rd and 4th of October, it appeared in various villages and forts to the west and south-west of the district. The disease extended about 200 miles to the north and north-west of Orenburg, and about sixty miles to the westward; this space it traversed between the 26th of August and the 6th of February, but the greater part of it was visited by cholera before the middle of November. On the 23rd of February the disease had well nigh dis-

* The 'Edinburgh Medical and Surgical Journal,' vol. xxxvi, p. 126.

† Idem, p. 122.

‡ 'Proceedings of International Sanitary Conference at Constantinople, 1866,' p. 395. Calcutta.

appeared, though it still cropped out here and there, being generated, for instance, at a few advanced posts beyond the sanitary cordon round the infected localities.

We witness, therefore, in this, the first invasion of Europe by cholera of which we have any description, characters precisely similar to those I have described as marking its progress in India: the invading cholera advancing from east to west and north-west, after a time almost entirely subsiding over the invading area, but only to burst out again in these localities, and simultaneously to be engendered over a vast tract of country to the west and north-west of its former limits.

We must here pause for an instant to notice the progress of the epidemic from India directly westward into Persia. I have already quoted a passage from the 'Government Gazette' as to the advance of cholera from Herat to Teheran in 1829. As this notice was derived from Russian sources, and had, therefore, to travel from Persia to Petersburg, and thence to Calcutta *viâ* London, in days when steamers were unknown, we may safely conclude that the events recorded in the 'Calcutta Gazette,' of January, 1830, had happened at least four months previously; consequently we may assume cholera to have existed at Teheran during the time of its outbreak in Orenburg in the autumn of 1829.* It would appear, also, that the disease had subsided in Persia throughout the winter of 1829-30, for Sir W. Crichton informs us that, *in the spring of 1830*, the cholera broke out in the province of Khorasan, and appeared at Tabreez,

* 'Proceedings of International Sanitary Conference at Constantinople, 1866,' p. 459. Calcutta, 1868.

and in the seaport towns of Reshd and Bakou on the Caspian. In July it was generated at Tiflis;* it soon after appeared in Astrachan, and here "the stream of cholera, which entered Russia from the northern provinces of Persia, formed a junction with that which flowed from Tartary through Orenburg."† In fact, the time for the reproduction and advance of cholera had come round, and as surely do we find it progressing again from east to west, and north-west. The base from which the invading cholera of 1830 extended occupied an imaginary line drawn through Teheran and the western boundary of the province of Orenburg. On the 4th of August, we hear of cholera at Tzaritzin and Saratov, where it raged with great violence, no less than 2367 of its inhabitants having been carried off by the disease. Towards the end of the month it was at Nijnh Novgorod,‡ so that up to the end of August, 1830, the epidemic had advanced to a line corresponding to about 45° E. long. Westward of this we hear of cholera on the 17th of September, at Kharkov, in the south of Russia, and at Moscow in its centre; at the same time it was generated in the Government of Novgorod, the highest point northward which it touched in 1830.§ To the south, it extended further to the west into Bulgaria and the western provinces of Russia.

Throughout the winter of 1830-31, there was a decided lull in the progress of the disease, although cases of cholera were constantly heard of over the area

* 'Edinburgh Medical and Surgical Journal,' vol. xxxvi, p. 137.

† 'Clinical Lectures on the Practice of Medicine,' p. 300. By Dr. Graves.

‡ Idem.

§ 'Report on Epidemic Cholera,' p. 122. By Drs. W. Baly and W. Gull.

it had invaded before the close of the year, especially in the Russian army of Poland; among these troops the disease was very prevalent during the winter. A few cases occurred in Vienna about the 20th of November. Solitary instances of the disease were said to have been observed at Cracow, Kiel, Hamburg, Paris, and London, being premonitory cases analogous to those noticed as occurring in the north-western provinces of India in November, 1826, and to the west of the sanitary cordon at the close of 1829.

True to its character, we find the cholera of 1830 in full force again in the spring of 1831. It first manifested its renewed power in the provinces of Volhynia, Grodno, and Vilna, and was at Warsaw on the 14th of April; it soon afterwards broke out at Riga. It was very virulent among the Russian troops in Poland (the war, in fact, has by some been considered "the great cause of the rapid propagation of cholera in Europe").*

At the very same time we hear that cholera had been generated with fearful virulence among the pilgrims assembled in Mecca.† It showed itself in some few cases previous to the hajj, and was supposed by the Arabs to have been brought by pilgrims from India; but it was not until the whole multitude had assembled that it reached its height. Its virulence became at length so great, that it is computed nearly one half the pilgrims fell victims to it. The governors of Mecca and Jeddah, the Pasha who accompanied the

* 'International Sanitary Conference of Constantinople,' p. 113. Calcutta, 1868.

† 'Report on Epidemic Cholera,' p. 122. By Drs. W. Baly and W. Gull. Official Reports made to Government by Drs. Russel and Barry 'On Cholera,' p. 66. London, 1832.

Syrian caravan, and many other people of distinction, were swept off. So numerous were its victims that the living ceased to bury the dead singly. The disease followed the pilgrims in their passage up the coast, attacking the inhabitants of Jembo, Suez, and Cairo, in succession.* It reached Alexandria by the 2nd of August, but before this period had invaded Asia Minor† and Egypt.‡ Cholera made its appearance at Constantinople in July, and again in Bulgaria; by the middle of July it had reached Pesth, and covered the whole of Galicia. About the same time the epidemic was at Cracow, and, as we have already noticed, earlier in the year at Warsaw and Riga. Nor was this by any means its most northerly point of attack during the summer of 1831, for we find it at Archangel in May. In the beginning of August it was at Helsingford; after this Aland and the neighbouring islands were affected, and so it passed into Sweden.§

In St. Petersburg the first case of cholera occurred in June; the wind from the 1st of June to the 31st of August having blown fifty-one days from the east, thirty-two westerly, and nine days variable. Every available means was employed effectually to surround the city by a sanitary cordon, the whole power of the Emperor being exerted to prevent infected persons from entering the capital, but without the slightest effect; at its appointed time the disease was generated throughout the city, and continued its work of destruction during the months of July and August.

The cholera still continued its undeviating course

* Wellsted's 'Travels in Arabia,' p. 254. London, 1838.

† The 'London Medical Gazette,' vol. ix, p. 756.

‡ Dr. Graves' 'Clinical Lectures,' p. 302.

§ Official Reports 'On Cholera.' p. 107. By Drs. Russel and Barry.

westward. On the 3rd of August it had reached Berlin and Vienna; on the 15th of the month "Bohemia was widely affected; but the disease did not spread from Vienna far to the south or west, and accordingly Carinthia and the Tyrol escaped, all being protected by strict precautionary measures. It is worthy of notice that cholera remained, as it were, stationary, and in a suppressed form, during the winter of 1831-32, in Hungary, Bohemia, and Germany. It did not spread to Saxony, Mecklenburg, Bavaria, and scarcely into Hanover, although these bordered on infected states,—an immunity not to be accounted for by the existence of any natural boundaries, as mountains or rivers, for the limits are mostly conventional between the infected principalities and those that escaped; many have, therefore, attributed their escape to the precautionary measures taken."* In this passage Dr. Graves has given us a concise account of the circumstances of the invading cholera of 1831-32, which, with a remarkable consistency of character, progressed from east to west for a certain time, and then declined for a season to advance any further, precisely as it had done at Cawnpore in 1826-27, in the Punjab in 1827-28, probably in Afghanistan in 1828-29, and certainly in Orenburg and the south of Persia in 1829-30, to the west of Russia in 1830-31, and so now to the west of Germany in 1831-32.

About the end of October cholera appeared at Sunderland,† and was supposed to have been imported from Hamburgh. "The persons first attacked in the port resided on the quay, and were exposed to inter-

* Graves' 'Clinical Lectures,' p. 302.

† 'Observations on the Pestilential Cholera,' p. 19. By W. Ainsworth, Esq. London, 1832.

course with the shipping. No communication, however, was satisfactorily traced between these persons and the particular ships referred to, nor were any of these ships known to have persons sick with cholera on board.”* The inhabitants of the populous village of Deptford, close to the Ayres quay, “where the disease was very prevalent and fatal,” escaped its influence; as did the agricultural villages in the immediate neighbourhood of Sunderland.† The truth is, that cases of cholera had in reality occurred in Sunderland as far back as the 5th, 14th, and 27th of August—two months before the declared importation of the disease.‡ Cholera subsequently appeared at Newcastle, Gateshead, Edinburgh, and in London in February. The number of deaths in England amounted to 97 in November, 282 in December, January 614, February 708, March 1519, April 1401.§

The influence of the invading cholera of 1831 having failed to pass beyond Germany, France remained absolutely free from the epidemic until the following year. On the 24th of March, however, cholera burst out in the very centre of the country at Paris. According to M. Gendrin, on the third day of the appearance of the disease, he received patients from every district of Paris into the Hôtel Dieu. He observes that the patients’ distant residences, and opposite professions, preclude the probability of their

* Drs. Baly and Gull’s Reports ‘On Cholera,’ p. 21. ‘Cholera as it recently appeared at Newcastle and Gateshead,’ p. 104. By T. M. Greenhow.

† ‘Cyclopædia of Practical Medicine,’ vol. i, p. 400. Edited by Drs. J. Forbes, Tweedie, and Conolly. London, 1833.

‡ ‘Quarantine,’ p. 30. By Gavin Milroy, M.D. London, 1847.

§ ‘Report on the Mortality from Cholera in England, 1848-49.’ By Mr. W. Farr.

having derived their disease from human contact. Of the first ninety-eight cases admitted into the hospital, no less than ninety-six died.* Within a week the mortality reached 500 per diem, and the cases to four times that amount; in eighteen days no less than 7000 persons had died of cholera in Paris. M. Meurthe observes that the Luxembourg quarter contained about 20,000 inhabitants, and of these 7532 were indigent people, and 13,330 of the better classes. Among the former, no less than 4500 suffered from cholera, and only 2500 of the latter.† The village of Issy, situated on the road from Paris to Versailles, totally escaped, although surrounded by other hamlets—Vanores, Vangirara, Beau, Grenelle, which were all cruelly ravaged by the disease. M. Gendrin remarks that all other diseases participated in the general features of the epidemic, exhibiting abnormal epiphenomena of a choleraic kind. This tendency was observed by almost every physician of eminence throughout Europe during the years 1830-31-32.

At the time of the advent of the epidemic in France it was also generated in Ireland, and spread over many of the principal towns in that island. The disease was reproduced in England, and before the end of August had visited Hull, York, Leeds, and several other large towns; the total number of cases in England, however, amounted only to 14,796, and of these 5432 died.

Want of space will not allow of my entering upon a detailed account of the phenomena presented by the disease in our own country; the best description of

* 'Monographie du Choléra Morbus Epidémique de Paris.' Par A. M. Gendrin. Paris, 1832.

† 'Histoire du Choléra Morbus dans le quartier Luxembourg.' Par M. H. Boulay de la Meurthe. Paris, 1832.

these is to be found in the 'Cholera Gazette,' published by authority, from documents communicated to the Central Board of Health. Some of the cases are very remarkable; for instance, Dr. J. Douglas describes the appearance of the disease in Hawick, where cholera was absolutely unknown until the 15th of January. On the 10th and 11th a man named H. Halliburton had put up at an inn in Morpeth; on the latter day a commercial traveller arrived at the same inn, was at once seized with cholera, and died. Halliburton returned home to Hawick; on the 14th he was seized with cholera; on the 16th, his son and brother, living in the same house, were attacked with it. These cases were followed by a number of others, all having had direct or indirect communication with one another.

Dr. Anderson gives us a detailed account of the advent and progress of the affection in Limehouse, in which the communicability of the disease from one affected person to another is equally well traced. I shall have to refer to some of the papers contained in the 'Cholera Gazette' at a future period; they are all the more valuable to us, because written at the time, and by persons watching the cases they describe.

The progress of the invading cholera from east to west was not destined to be limited by the Atlantic. On the 8th of June, 1832, it broke out among the inhabitants of the city of Quebec, and on the 10th at Montreal, under the following circumstances: "The brig 'Carricks' sailed from Dublin, then infected with cholera, in April 1832, with 173 emigrants on board. The disease appeared among the passengers a few days after leaving port, and forty-two persons died of it before the 3rd June, when she arrived at Quebec.

The remainder were permitted to land on Grosse Isle, a few miles from Quebec, and no rigid measures were taken to prevent intercourse between them and the city. Several cases of cholera appeared in Quebec on the 6th, 7th, and 8th of June, and on the 9th, fifteen cases were reported officially. This was the beginning of cholera in America.* On the 23rd of the month it appeared in New York, and on the 5th of July in Philadelphia. The disease spread over the whole of the United States before the end of the year. The epidemic continued its original course, attacking the towns and villages along the banks of the St. Lawrence, then following the borders of Lake Ontario, until it entered lake Erie, visiting Detroit and Amertsbergh on the 6th of July.

It will be observed that as yet we have heard little or nothing of cholera in Spain or Portugal. These countries appear to have escaped the influence of the epidemic until 1833. The disease was said at the time to have been imported into Portugal. "The 'London' merchant steamer sailed from England to Oporto on the 25th of December, 1832, and arrived at the mouth of the Duro on the 1st of January, 1833, having lost seven men on the passage by cholera. The troops which she took out with General Solignac landed immediately at Foz, about ten miles west of Oporto."† Cholera appeared at Foz and in Oporto before the 15th of January, and spread to Coimbra and Gallicia.

In Spain quarantine was most rigorously enforced. Every traveller from an infected district was subjected to the performance of quarantine; and if he entered

* 'Asiatic Cholera,' p. 25. By Dr. Burrall. New York, 1866.

† 'London Medical Gazette,' vol. xii, p. 123.

Spain without having gone through the formality, he was liable to be punished with death, his apparel burnt, and goods seized, the same punishment being extended to those who received him.* In spite of all these precautions, cholera raged with great violence in many of the provinces of Spain during the summer of 1833† and 1834.

The disease broke out on the 26th of February, 1833, in Havannah, and continued to the 20th of April. During this period no less than 8253 persons were destroyed in a population of 65,000 souls.‡ Later in the year the epidemic was generated with frightful virulence in Mexico; before August no less than 15,000 individuals are said to have perished from it.§

Throughout the year 1833 we hear of cholera being reproduced over almost the entire area through which we have traced it during the preceding years. Cases occurred in the majority of the large towns of Europe and America. Nevertheless, as a general rule, the disease was far less deadly, and very much more under the control of medicine, than during its period of invasion. °

In 1834 the disease had well-nigh disappeared from Europe, and men's minds began to be at ease on the subject. But this was far from being the case in India, for, as we shall presently notice, the whole of the Madras Presidency and the valley of the Nerbudda were under the influence of a vast wave of epidemic cholera during the years 1832-33-34.

On the 4th of April, 1835, the following passage

* 'London Medical Gazette,' vol. xii, p. 60.

† 'Lancet,' October 5th, 1833.

‡ Idem, for 1834-35, p. 325.

§ Idem, p. 596.

occurs in the *Lancet*:—"We regret to say cholera has prevailed for some time back, if not extensively, yet with great violence in some parts of the south of France; particularly at Marscilles and Toulon." Towards the end of June it was at Villafranca, and a few days afterwards it appeared at Nice and Cannes. On the 12th of August cholera was generated at Turin, and during the same month at Genoa. It extended along the coast of Genoa, as far as Livorno, and in November broke out at Venice, Trieste, and throughout the north of Italy.* The disease then subsided in these parts, until the spring of the following year, when it was reproduced over the whole of Italy. It was very severe at Milan in April, 1836, and also along the Dalmatian coast. In October it appeared at Naples, in spite of quarantine and all the precautions usually adopted in the plague; physicians traversed the streets covered from head to foot with black sacks of waxcloth, into which two pieces of glass were inserted to admit light.† The epidemic appeared in Ancona and the island of Sicily. In Rome, of 9372 persons attacked by cholera, 519 died.‡

On the 9th of June, 1837, cholera was generated among the inhabitants of Valetta, first occurring in a house overlooking the quarantine harbour. The deaths among the civil population of Malta between June and October, when the disease ceased, were 3893; among the garrison (including women and children) averaging 3070, the cases were 315 and the deaths 78. The Mediterranean fleet suffered consider-

* 'Encyclographie des Sciences Médicales,' tom. xiii, p. 20.

† 'Correspondence regarding Quarantine and Disinfection' (Letter from Dr. F. Mouat, P. J. Government of Bengal, 15th October, 1867).

‡ The 'Lancet,' 21st April, 1838.

ably, the first cases occurring in June. In the official report of the health of the navy, it is stated that no instance of the disease occurred in any ship as long as she continued in the open sea, or even in the channel of Malta, unless she had previously communicated either with that island or with Palermo, while it was prevalent in these places.* Malta had been kept strictly under quarantine both before and after the outbreak of cholera. The disease spread, however, to the Island of Gozo about a month after it appeared in Valetta.

Palestine was under the influence of cholera in 1837,† and so also was the African shore of the Mediterranean. On the 14th of October the disease appeared at Algiers; in Bona, where the epidemic had prevailed for some time, the number of cases on the 17th of October amounted to 328.‡ Remarkable outbursts of cholera occurred during the year at various places in Italy, Marseilles, Berlin, Prague, and in England at Coventry, and on board the "Dreadnought." With regard to this latter instance, Dr. G. Budd remarks that there was no trace of infection from foreign parts, or evidence that the disease was propagated from one patient to another. In the "Iphigenia," moored under the stern of the "Dreadnought," there was not a case of cholera, nor did it spread to Greenwich.§ Mexico and Central America were again under the influence of an invading cholera in 1836-37.

* The 'Infectious Origin and Propagation of Cholera,' p. 46. By Dr. A. Bryson, R.N. Also 'Cholera at Malta,' p. 51. By Dr. S. Watson. London, 1848.

† 'Brit. and For. Med.-Chir. Review,' January, 1868, p. 186.

‡ The 'Lancet,' November 18th, 1837.

§ Idem, December 23rd, 1837.

The question naturally arises, as to the circumstances of this remarkable outbreak of disease; was this a reproduced or a fresh invading epidemic? If the latter, we should naturally look for its equivalent in India, for so far as we have yet gone into the history of the disease, we know of no other locality from which Europe can be invaded by cholera. I think we have indications, though by no means complete evidence, of the existence of circumstances in the East explanatory of the above facts.

I shall presently describe the history of a vast outbreak of epidemic cholera which occurred over the Madras Presidency in 1832-33-34; it extended along the valley of the Nerbudda, and into Bombay. In 1835, the Hadjiz* was under the influence of cholera, and I have given evidence of its subsequent appearance throughout the basin of the Mediterranean in 1835-36-37, and at the same time of its being widely scattered over Europe. This outbreak of cholera, when viewed by the light of the epidemic of 1865-66, is certainly very suggestive; and I feel confident its history will yet become clearer, as additional light is thrown upon it by those interested in these matters at home, and who are in a position to consult documents from the various government offices, which it is impossible for me to examine.

Facts bearing on the question of Contagion and the mode of Propagation of cholera.—Before dismissing this period in the history of cholera from our consideration, it will be convenient to notice one or two of the most marked instances advanced as evidence for or against the doctrine of its contagiousness; the battle of opinion

* 'Proceedings of the International Sanitary Conference of Constantinople,' p. 66. Calcutta, 1868.

on this subject commenced with the appearance of the disease in Europe, and has waged with more or less violence ever since.

In the first place I may observe, that there was never, probably, a greater effort made by the combined Governments of Europe to exclude an epidemic disease from their dominions by quarantine, than that exercised in the case of cholera during 1830-31. I have already noticed the fact that in Spain, in 1833, an infringement of these laws was punishable by death. In our own country, among the various instructions issued by the Board of Health in London, the following will give us an idea of the means by which it was hoped, in October, 1831, to stay the progress of the disease in England:—“Immediately separate the sick from the healthy;” conspicuous marks to be set on infected houses; “rags, papers, old clothes, and hangings to be burnt;” “dead to be buried in the vicinity of the houses selected for cholera patients;” “all persons employed about the sick to be kept apart from the rest of the community;” “articles of food to be placed in front of infected houses, and received by one of the family after the person delivering them shall have retired;” “all intercourse with an infected town and the neighbouring country to be prevented;” “troops, or a strong body of police, to be drawn around infected places, so as utterly to keep the inhabitants from intercourse with the country.”*

It is true that, in very many instances, the strictest possible internal quarantine did not succeed in excluding cholera. That such should be the result of attempts at land-quarantine by sanitary lines in the populous parts of Europe, among a people accustomed

* ‘Medico-Chirurgical Review,’ vol. xvi, p. 267.

to the utmost degree of daily intercourse, cannot appear surprising. To look for the rigorous enforcement of quarantine in such circumstances, appears a vain expectation. And accordingly in Russia, Austria, and Prussia, where unlimited command of troops, and the despotic nature of the Governments, present great advantages for the establishment of internal quarantine, the sanitary lines were nevertheless everywhere overstepped by the disease, after it had reached the more civilised parts of Europe ;* as, for instance, in the case of Debreczyn, in Hungary, which suffered more than any other town in the country, although guarded by a triple cordon.†

The greatest efforts were made to keep the cholera out of the Russian capital by means of quarantine ; but these, as usual, having signally failed, a strong double cordon of troops was still maintained around Zarcoselo and Peterhoff, to which the court and nobility, with their attendants, in all 10,000 persons, retired, and resided in seclusion. In the beginning of October, the restrictions were withdrawn ; and it was accurately ascertained that not a single instance of the disease had occurred within the enclosure, though it raged in all quarters around in the close vicinity of the lines.‡

The French ambassador thus writes of the condition of St. Petersburg in 1831 :—“ Kristofsky, situated in the middle of the populous islands of Petersburg, and which communicates with them by ten magnificent bridges, and with the town by a thousand barges,

* ‘Edinburgh Medical Journal,’ No. 37, p. 199.

† ‘Liverpool Medical Gazette,’ vol. i, p. 277.

‡ ‘Official Reports on Cholera,’ p. 58. By Drs. Russel and Barry. London, 1832. Idem, p. 203.

which bring every day, and especially on Sundays, very many people, who go to walk in the beautiful island, has been completely preserved from cholera; there has not been a single patient in the three villages which it contains. During the cholera, most of the French players retired to Kristofsky, and not a single patient was found among them; while out of the small number of their companions who remained in town, many either died from the disease, or were seized with its most violent form.”*

Again: “On the St. Lawrence, opposite to Montreal, and within a very short distance of the city, is a small island called St. Helena. Immediately upon the breaking out of cholera at Montreal, the authorities removed the military to ‘St. Helena.’ The people from the island went every morning to make their bazaar, and mixed with the inhabitants of the infected city; but notwithstanding this daily constant communication, there was never one case of cholera in the island during the whole time.”†

In the report published by the French Government, on the cholera of 1831, it was stated that, of 55,000 persons affected, only 164 were persons whose duties or profession obliged them to be near the sick. These 164 cases were from over 2000 employed in the hospitals. In St. Petersburg, of 58 persons employed in hospital, 1 only had the disease; and at Moscow, of 123 people thus employed, 4 had cholera.

The Brig “Amelia” left New York (where cholera prevailed) on the 19th of October, 1832, with one hundred and odd passengers on board; from stress of

* ‘Observations sur le Cholera Morbus.’ Par l’Ambassade de France en Russie. Paris, October, 1831.

† ‘Report of the Committee on the Mauritius Cholera, 1856.’ p. 156.

weather they were confined below deck. After the ship had been at sea six days, cholera broke out among the passengers. On the 31st of October the vessel was wrecked on Folly Island, and the people on board were at once landed. Up to this period twenty-four passengers had died of cholera, and several remained sick.

A boat's crew of wreckers were sent down from Charlestown to save part of the cargo from the wreck, and immediately after returning to the city one of these men was seized with cholera, and died. The patient resided in a most filthy part of the town, and was visited by "hundreds of curious people," but the cholera did not spread in Charlestown. The remainder of the wreckers were sent back to Folly Island, and during the passage two of them fell sick with cholera and died; these wreckers are described as having been men of exceedingly intemperate and dissolute habits.

The crew of the vessel had from the very first been placed under strict quarantine on the island. Of four negroes, the only persons left on the island by the proprietor, three died, one a child and two adults. Of the wreckers eight died. Of the guard employed to perform the duty of a cordon sanitaire, and who were stationed about one hundred and twenty yards from the sick, nine were reported severely ill, and one died. The three physicians in constant attendance escaped, but a nurse, employed about the first wrecker who died, fell a victim to the disease a week afterwards.*

To take another illustration nearer home: The first case of cholera observed in the village of Moor-Monkton, six miles from York, occurred on the 28th December, 1832. The disease did not exist at the time in the

* The 'American Journal of Medical Science,' vol. xiv, p. 378, 1834.

neighbourhood, or in any place within thirty miles. John Barnes, a labourer, had been suffering for two days from diarrhoea and cramp, when on the 28th December he was taken ill with all the symptoms of cholera, and died the next day. Barnes' wife, and two other persons who visited the sick man, were seized with cholera, but recovered. The son of the deceased man then arrived; it appears that he had been apprenticed to his uncle, a shoemaker, in Leeds, and that his aunt had died of cholera fifteen days before, her effects being sent to Barnes without having been washed. The trunk containing the things had been opened by Barnes in the evening, and the next day he was taken ill and died. This case is cited by the Cholera Commission of Constantinople in proof of the transmissibility of cholera by articles tainted with the dejections of cholera patients.

I cannot conclude my account of the epidemic cholera of 1831-32, without referring to a paper on the subject by M. K. Bayer, in Henke's Journal of State Medicine for 1832. M. Bayer assigns as the cause of cholera a miasm, which, having combined with the water of tardily flowing rivers and pools, is again liberated during the evaporation of these waters, and so mixed with the atmosphere; and that the latter, thus contaminated, becomes the principal pestiferous agent.

“ 1st. In countries surrounded by mountains and abounding in lakes and marshes, the cholera has been found to have prevailed most severely. Poland presents examples of this fact. The cholera appeared in Galicia on the 23rd May, 1831. Galicia is shut in by the Carpathian Mountains and those of Siebenbürgen; the rivers Weichsel, Bug, San, Dniester, Pruth, &c., flowing through it with no very rapid stream, and the

land is composed of bogs and marshes, interspersed with lakes. In this situation the number of individuals attacked, relatively to 10,000, were 571, the deaths being in the proportion of 215.

“ Hungary affords another instance : it is more hilly, but has very many lakes and marshes formed by the Donau ; the climate of the southern portion is warm, and the air heavy and damp. The disease appeared in this state on the 18th of June, 1831, and continued until January, 1832. Although it is not so plain as Galicia, still the proportion of persons attacked out of 10,000 was 512, and the relative number of deaths 223.

“ Prussia may be contrasted with the preceding examples of marshy districts. Its only hilly part is Silesia. Its soil is mostly sand, and its land exposed to strong breezes from the coast, so that although Prussia does not enjoy any superiority over the preceding states with respect to elevation, and although in East and West Prussia and the duchy of Posen there are many lakes, still the geological character of this site contrasts well with that of Poland and Hungary ; and we here observe a corresponding difference in the numerical amount of cases : the number attacked bore the proportion of 62 to 10,000, and 36 deaths.

“ 2nd. In mountainous countries, through which streams pass with some rapidity, where no stagnant or retarded waters are met with, and where the foundation is rocky and the soil sandy, the cholera has made very little impression. In Siebenbürgen, for instance, only 12 of 10,000 were attacked, and 6 of these fatally. Hungary gives a marked example of this : the general average of sufferers proved to be 1-9th to 1-4th of the inhabitants, and the deaths 1-8th to

1-9th or 1-10th ; whereas in the hilly part of Eisenburg, of 10,000 persons only 6 were attacked, and only 1 in 12,000 fell a sacrifice.

“ Silesia must be reckoned as a mountainous country, particularly where the Carpathian Mountains take their rise. The Oder, passing through it, has a fall of about 8 feet in the mile, its general surface being 500 feet above the level of the sea. In its track we find only 14 attacks and 8 deaths in 10,000. So also Bohemia, which, although surrounded on three sides by infected countries, was so little affected that an account is scarcely made of the appearance of cholera.

“ On the whole surface of Prussia, with sandy soil and coasts, the ravages of cholera were comparatively trifling (always excepting the great towns, Berlin, Königsberg, Dantzic, and Stettin) ; the aggregate amount from January, 1831, to January, 1832, may be computed to bear the following relation to 10,000 persons :

	CASES.	DEATHS.
In Pomerania	23	14
Brandenberg	33	20
Magdeberg	17	10

“ In Pomerania, at Stettin, in consequence of its neighbouring marshes produced by the Oder, the disease was more violent than in Koslin.

“ The whole range may be thus particularised, 10,000 being taken as the numerical standard of population, to which the calculation is made to refer :

	CASES.	DEATHS.
Galicia	571	215 to 10,000
Hungary	512	223 —
Wallachia, Moldavia, and Servia	184	111 —
Prussia Proper	62	36 —
Prussia, East and West	138	80 —

Provinces :	CASES.	DEATHS.
Posen	121	72 —
Brandenberg	33	20 —
Pomerania	23	14 —
Magdeberg	17	10 —
Siebenburgen	12	6 —
Eisenburg	6	1 —

M. Bayer next compares the number of cases occurring in inland towns, situated on a plain surrounded by mountains, with the number occurring in towns on the sea coast. Of the former, Sassin had the greatest mortality, being, relatively to 10,000 people, 1936 attacked, with 1030 deaths; this the author attributes to the locality of the town, which is a boggy slough, having streets that are very narrow and laid with planks. The greater portion of its inhabitants is composed of Jews and Gipsies, whose cleanliness is not remarkable.

“Debreczyn, lying in a flat, in Hungary, *notwithstanding a triple cordon*, suffered 2106, the greatest proportion of attacks, and 746 deaths.

“Brody, which consists of wooden houses, overfilled with population, had 1932 attacked and 736 deaths.

“Lemberg, a similarly constituted town (indeed the appearance of these towns in Poland, after rain, is appalling to a degree), had 1003 attacked and 524 fatally.

“Brünn, from not being in the neighbourhood of infected tracks, and from having few interlopers from surrounding places, had rather less of the disease, only 531 attacked and 208 deaths, although it suffered materially from being composed of badly built houses, from being fortified and surrounded with graves containing stagnant pools.

“Thorn and Posen, on the Weichsel, are of the same

character—the former had 452 attacked and 286 fatally, the latter had 356 sufferers and 208 deaths.

“Tilsit, washed by the Memel flowing through greatly infected districts, suffered in the proportion of 346 attacks and 189 deaths, while Bromberg, which is about three leagues from this river, had a more moderate visitation, only 226 being attacked and 161 dying.

“Pressburg, the principal city of Hungary, well built, with wide and open streets, evinced the greatest number of recoveries in this part of the kingdom, not more than 1 in 5 or 6 falling a sacrifice, whereas everywhere else more than one half of the infected died.

“With respect to the towns on the sea coast, they presented a less violent degree of the disease than those inland, but much depended on the quality of the water that was brought down the mouths of the rivers in their neighbourhood. The following is the order of fatality relatively to 10,000 people :

				ATTACKS.		DEATHS.
Riga	...	...	...	1229	...	478
Mitau	...	...	...	712	...	423
Memel	...	...	...	520	...	306
Konigsberg	...	...	...	306	...	183
Elbing	...	...	...	196	...	130
Stettin	...	...	...	112	...	76
Hamburg	...	...	...	77	...	39

M. Bayer remarks that this regular gradation of the cholera's intensity cannot be without a cause equally regularly varying in its potency. He concludes that the power of the contagious matter, evolved from the water with which it had combined, is augmented by the admixture of marsh miasmata, and that the current waters of rivers will carry it in this compound state, and evolve it in different quantities and different degrees

of intensity, according to the powers causing its disengagement. He draws the following corollaries :

“ 1st. That the disease broke out earlier in such situations as lie behind the more easterly places, which, under other circumstances, would much later have become subject to it.

“ 2nd. That the tracks of considerable plains, containing above half a million of inhabitants, remained long free from the cholera, though it might rage on their eastern, western, and north-western borders, from no other reason than that of there being no important stream passing through them in its course to the sea.”

Cholera in India after 1829. Epidemic of 1831-34, reaching the Mediterranean in 1836.—Resuming now the history of cholera in India, we find that the outbreak which occurred in Bengal in 1826-27 had almost subsided by 1829. During the year 1830 the disease was only generated in this Presidency in its endemic area, and in the valley of the Nerbudda. It is very doubtful if the western portion of this valley must not be included among the localities in which cholera is endemic (an original focus). I have already repeatedly had to refer to outbursts of the disease in this part of India, and Dr. Stert remarks* that during August, 1830, the district of Nemaar suffered from cholera in a very severe form, and that “for many years previously it made its annual appearance” in the province. It again broke out among the native troops at Mhow in 1830.

Cholera was very fatal among the inhabitants of Calcutta and Berhampore during the month of November,† and also in the district of Palamow.‡

* ‘MS. Proceedings of Bengal Medical Board,’ December, 1831.

† Idem, October 28th, 1830; also 6th and 12th January, 1831.

‡ Idem, 15th July, 1831.

In April, 1831, the disease was generated with terrible force among the prisoners confined in the jail at Shergotty. Dr. Woodburn reports that cholera made its appearance "in these parts in April, 1828, again at the same time in 1829, but not in 1830; in 1831 it visited us at the usual period. It did not burst out in all its fury on the day of its commencement, as in 1828, but gradually increased till it reached its acme, and then subsided. From the 10th April to the 14th, four cases were admitted; all of these terminated favorably. On the 30th it recommenced, but till the 5th of May only 4 more prisoners were attacked, 2 of whom died. Between the 15th and 31st, 68 cases were admitted and 48 died; from the 1st to the 8th of June, 9 were admitted and 7 died. Of the 58 who died in hospital, 44 died within twenty-four hours of the time of being seized with the disease. Most of the prisoners were natives of the hilly countries of this province, having a climate totally different to what we have here; their difference in food also is equally great." The inhabitants of the surrounding country were under a severe outbreak of cholera at the same time.

Early in May, the superintending surgeon at Dinapore reported that the disease had made its appearance in the Bhaugulpore, Monghyr, and Patna districts during April, "and to a still greater degree in Purneah;" it committed deplorable havoc amongst the native population, and visited some of the jails of this circle with extreme mortality. It prevailed to an alarming extent in Tirhoot during the month of June. In July, 24 of the European soldiers at Benares were seized with cholera, and 12 of them died.

Epidemic cholera was evidently, therefore, severely

felt throughout Lower Bengal, and in fact eastward from about 85° longitude; but was scarcely generated at all to the west of this line, if we except a limited outburst of the disease among the troops at Mhow and Nusseerabad, in July and August.

The civil surgeon at Gaya reports that cholera had, "as usual," reappeared in that station in 1832, confirming Dr. Woodburn's statement as to the disease being endemic in these parts; a fact to which most surgeons, marching along the Trunk Road in charge of troops to the east of Shergotty, will bear witness, for it was hardly possible to pass through this part of the country without some of the men being seized with the disease. The Bengal Presidency was singularly free, however, from epidemic cholera throughout this year.

Our attention is again fixed on the Shergotty jail in 1833. Dr. Marshall, the superintending surgeon at Dinapore, reports on the 16th July that cholera had broken out among the prisoners "with a malignity surpassing all I ever before witnessed."

"In the end of March and beginning of April, cholera was prevalent to the eastward, particularly at Koonda and in the neighbourhood of Hazareebaugh. On the evening of the 7th April, one of the prisoners in the jail was attacked and died. On the 8th, 12th, 16th, and 18th, cases occurred, and 10 more on the 19th. On the 20th, 21st, and 22nd, 8 were admitted, all of whom died, excepting one. On the 23rd, 48 cases were admitted, and before eight o'clock in the evening 36 of them had died, and 6 more died during the night. In the course of the following twenty-four hours, 9 more were admitted, 6 of whom died. From the 25th to the 30th, 27 were admitted and 11 died;

altogether 105 cases occurred, and 75 died :” and this out of a community of about 600 people.

“It is very remarkable that of the 105 persons attacked, only three were men from this side of the Ghauts; there were a few from the hilly districts to the eastward, but the greater number were from the Nagpore prisoners.”

It is no less remarkable that, at the present time, so surely as these hill men (Dhangers) are brought from their homes into the plains during our cholera months, as surely do they die off in the manner described by Dr. Marshall five-and-thirty years ago in the case of these Shergotty prisoners; and not only in this jail, but at Soorie and other localities the same phenomena have been observed.

In August, 1833, cholera was generated among the European troops at Dinapore and Ghazeepore. On the 11th of September, the superintending surgeon at Allahabad reports that “ten casualties have taken place, nine from cholera. Since I last wrote, the attacks of cholera have been less frequent in very many parts of the division; at Banda the mortality was very great.” The superintending surgeon of the Cawnpore circle, in his annual report for 1833, observes: “The year has been remarkable for an uncommon degree of heat, and the prevalence of destructive epidemics. This has not been caused by deficiency of rain, the total fall being 30 inches in fifty-three days, while last year it was only 18 inches, and the season was a most healthy one. From these epidemics the native troops suffered comparatively little; and while cholera raged during the months of August and September, with a virulence hitherto unknown, in the cities of Lucknow, Cawnpore, Furruckabad, Futtehpore, and

other large towns, out of a strength of 11,000 men, only 88 sepoy were attacked, and 26 died." "Every slight fall of rain was attended with an increase of the disease, and it did not entirely disappear till the end of September, when the wind changed to the west and the weather cleared up."

It is evident from the preceding history that the invading cholera of 1831 was only generated as far west as Benares, having apparently died out in 1832. We are naturally tempted to inquire if the exceptional season of 1832, as described by the Superintending Surgeon of Cawnpore, may not have influenced its progress.

It will be observed, that the amount of rain which fell during the year 1832 in the Cawnpore district was far less than usual, a fact also noticed by Colonel Baird Smith, for, on account of the drought thus caused, there was a partial famine in these parts in 1833. But no sooner had the rain of 1833 set in, than the cholera of 1831, which until then we may suppose to have been suppressed for want of moisture, instantly burst out, and committed the terrible ravages described by the Superintending Surgeon of Cawnpore.

In 1834 the North-West was again under the influence of an invading cholera, which, although not characterised by any great power of diffusion, was generated with considerable force in certain localities. On the 7th August, the Superintending Surgeon of Agra writes that "cases of cholera took place towards the end of the month (July); in the city the disease has been very severe, yet in the jail not a single case has occurred." From Muttra Dr. J. McRae reports (5th September, 1834) "during the month of July it rained incessantly; about the middle of the month cholera

made its appearance in the city of Muttra and carried off great numbers. The rains ceased suddenly on the 3rd of August, and none fell till the 22nd; during this interval of hot, dry, sultry, enervating weather, the cholera spread all round Muttra, and from the 14th to the 22nd it prevailed to a frightful extent. Amongst the Europeans of the 3rd Troop of Horse Artillery, it was characterised by early collapse of the system; blueness of the skin had commenced in several cases at so early a period, that the individual seized had no other symptom of indisposition than a feeling of general debility and slight relaxation of the bowels; vomiting scarcely made any part of the complaint, spasms were seldom present in the early stages."

At the commencement of the year 1834, the disease, in a very virulent form, was generated in Sylhet, Cachar, and Assam. Dr. Brown reports from the former district that "about the middle of May cholera broke out in Sylhet for the second time in the year, and spread with great mortality; it raged with equal violence from the 4th to the 22nd, when the weather was excessively sultry." "Cholera generally appears twice a year in this district as an epidemic, and at all times sporadic cases are met with." In fact, the inhabitants of Sylhet and Cachar were never absolutely free from cholera.

The disease was very prevalent at Dinapore throughout the whole of the first quarter of 1834.

We must now briefly consider a few details regarding cholera in the Madras Presidency. In 1833, H. M.'s 62nd Regiment, while on the march from Chittore to Masulipatam, was attacked with a most severe form of cholera; no less than 200 cases occurred in this regiment. Among the troops forming the northern

division of the army, the mortality "in 1833-34 was much increased from the prevalence of cholera" in the Hyderabad subsidiary force, "the mortality being greater than usual in 1833-34 and 1838, in consequence of the great prevalence of fever and cholera."* In the Nagpore division, "cholera was very prevalent during the years 1833-34 and 1837-38, the greatest number of deaths occurring in June, July, August, and October."

In the central division of the army, in "the years 1833-34 and 1838, the mortality was considerably increased, and almost solely by cholera."†

In 1833-34 cholera was most severe among the troops of the Mysore Division. In the Ceded Districts, of which Bellary is the capital, and which includes the table-land lying between the Eastern and Western Ghauts, having an average elevation of about 1600 feet above the level of the sea, "cholera prevails to a greater extent than in any other division of the army (Madras), the percentage of admissions as well as of deaths to strength being much above the average. It has frequently been observed that regiments, while marching through this division, are particularly obnoxious to outbreaks of this disease. The question here arises, to what influence are these attributable? and if to a deleterious exhalation emitted from the soil, how is it to be explained that a regiment shall march over ground from one station to another in a perfectly healthy state, while in another body, on the same road, after an interval of only three days, cholera shall

* 'Report on the Central Division, Madras, 1843.'

† 'Report on the Medical Topography and Statistics of Northern Hyderabad and Nagpore Provinces. Compiled and published by the Madras Medical Board, 1844.'

commit ravages? while, again, instances have occurred where a regiment has been severely attacked with cholera in its march, and another following the same road, after an interval of only two or three days, has altogether escaped." "The mortality was greatly above the average in 1833 and 1838, the result in both years of epidemic cholera."*

The Central Provinces and valley of the Nerbudda were also under the influence of widespread epidemic cholera in 1833-34. The Superintending Surgeon of Saugur states that the disease appeared at Hoshungabad at the close of the year 1833, "having raged epidemically for some time previously in the neighbouring villages. When it appeared, the weather was unsettled, the wind variable, and the temperature unusually high. The disease committed great ravages at Gurrawarra. During the month of October, at Seuni, easterly winds, as in the preceding year, prevailed in the end of June and July when cholera first appeared, raging violently among the population." He adds, "cholera and fever may be considered as endemical" in these parts. During the year, cholera was prevalent among the shipping in the Madras Roads; and incidentally we hear of it breaking out among the crew of the "Peacock" while at Manilla† and at Trincomalee.

In May, 1834, the Superintending Surgeon of Saugur reports "that cholera is raging throughout the high table-lands to the south, and at Mundla with greater severity than has ever before been known. In the neighbourhood of Bhilsa and Jhansi, the roads have

* 'Report on the Medical Topography and Statistics of the Ceded Districts,' pp. 70-72. Madras, 1844.

† Essays 'On the Origin and Progress of Cholera,' p. 107. By D. T. Bankier, R.N. Madras, 1835.

been nearly impassable from the putridity of the numerous bodies. Some of the deaths have been very sudden, only two hours having elapsed from the first moment of attack." Among the European troops in the Bombay Presidency, the deaths from cholera amounted to 35 in 1831, to 113 in 1832, and to 263 in 1834.

It is evident, therefore, as I before remarked, that the whole of the Madras Presidency, Central India, and Bombay* were under the influence of a vast outburst of epidemic cholera in 1832-33-34, which probably spread to the Hadjiz in 1835, and into the basin of the Mediterranean and Europe, where we have already traced it breaking out in 1836-37.

In 1835, epidemic cholera was at a very low ebb throughout Bengal; the districts of Chittagong, Bauleah, Midnapore, Purneah and Hazareebaugh suffered from it, the troops in the latter station being also affected during May and June. The prisoners and troops in the North-Western Provinces and the Saugur divisions were well-nigh free from cholera. The Superintending Surgeon of Meerut, however, described an outbreak of the disease in April:—"The weather early in the month was very hot, with prevailing easterly winds; several cases of cholera appeared among the Cameronians. On the afternoon of the 11th we had much rain; the temperature fell in a few hours 15°. This change was only temporary; the weather soon became hot and sultry. A number of cases of cholera appeared among the Cameronians, the rest of the troops remaining free from the disease." It does not appear that the convicts, civil population, or, in

* 'Transactions of the Medical and Physical Society of Bombay' for 1840, p. 79; also vol. i, new series, p. 97.

fact, any but the Cameronians suffered from the effects of cholera at this time.

The year 1836 was another year of rest as regards cholera, with the exception of a second remarkable outburst of the disease among the Cameronians. The regiment having in the meantime marched from Meerut to Ghazee-pore, cholera appeared among them about the 6th of May, and on the 26th assumed an aggravated form; no less than 113 men were attacked with the disease, and 21 of them died. It appears impossible to account for this outburst; it is remarkable, however, that although the number of men in all the ranges of barracks were equally affected, yet the mortality among those occupying the old barracks was exactly double of what it was in the new ones. The officers suffered fully as much, if not more, than the men; so localized, however, was the disease, that no cases occurred among the native troops, or the prisoners in the station. The Artillery at Mhow were again visited by cholera in December.

The Indian Epidemic of 1837-9, and its N. W. progress to Afghanistan.—The year 1837 commences with the history of cholera among the men of a detachment of H.M.'s 21st Regiment, which left Fort William on the 20th of February for Hazareebaugh. During the march it was ascertained that "cholera raged in the villages on the Calcutta road between Bancoorah and Hazareebaugh; three men and one woman were attacked during the march." "On the 26th of March, two children of H.M.'s 49th Regiment at Hazareebaugh were seized with the disease, and both died. On the next day the pestilence began to prevail generally in the regiment, with the exception of the flank companies, attacking men, women, and children, and raging violently

in the sudder bazaar, 20 deaths having occurred on the 26th—all, in fact, that were attacked; for it was reported that not one had the good fortune to recover. The next day, out of 20 cases from the sudder bazaar, ten died. The immunity of the flank companies from cholera was very remarkable, not a case having occurred in the barracks, but in hospital four men of those companies were attacked, and two died. The exemption of the hospital attendants was no less striking.”* Only one case occurred among the European Artillery, and none among the Native troops.

From Dinapore the Superintending Surgeon writes on the 15th of April:—“Seven men, four women, and three children were admitted with cholera during the morning; the disease raged suddenly and fatally, as the simoon of a desert.” On the 4th of April we hear “that cholera has been raging in the town of Ghazeepore for the last two months among the troops; the first case occurred on the 11th of March. The stage of collapse had begun in almost all of them before admission, and appears to have commenced immediately after the patient was taken ill.” From Tirhoot Dr. McKinnon reports, 1st June, “that cholera is raging very fatally throughout this district.” In July, the disease broke out in Benares, and prevailed to an alarming extent during that and the succeeding month. The Superintending Surgeon at Cawnpore reports, that “the great mortality from cholera among the Europeans occurred between the 6th and 25th of August, since which time the disease among them has nearly disappeared. In the Native corps, throughout the division, there have been occasional deaths from cholera during the month, but chiefly at the station of Cawnpore.”

* ‘MS. Proceedings of the Medical Board.’

From the Saugur and Jubbulpore districts we learn that in May the mortality from cholera was very great; but Dr. Spilsbury reports that the disease "had not spread generally to the villages round Koorlee (where it first broke out), though many of them are situated quite close to it, but it broke out with considerable virulence in several other parts of the district very remote from each other." Jubbulpore was attacked in the middle of June. The districts to the south of the Nerbudda were severely visited by cholera, Seuni in particular; Nursingpore, Hoshungabad, and many other large towns were cruelly ravaged by the disease from June till October. Dr. Spilsbury adds that, since his residence in Jubbulpore, "cholera has usually visited the district every three years, travelling in one direction slowly but surely, eastward, or in the opposite direction, as during the cotton transit in April and May. It seldom visits the lines or regimental bazaars, the jail is quite exempt, yet the intercourse between the town and cantonments is very great; indeed, it is a constant stream of people passing to and fro throughout the day."

During the year 1837, cholera was very prevalent throughout the whole of lower Bengal. Excluding the Alipore Jail, I find that of some 15,000 prisoners in the Presidency circle, no less than 783 were attacked by cholera during the year; whereas in the Agra, Meerut, Kurnaul, and Nusseerabad circles, hardly any of the prisoners were affected by this disease. The same remark applies to the troops in these localities; nevertheless, in the last quarter of the year, cases of cholera were recorded, though few in number, from almost every large civil or military station throughout the North-West. We have, therefore, in the history of

the cholera in Bengal during 1837, a repetition of the phenomena of 1817, 1826, and 1833: a vast outburst of the disease occurring throughout the whole of Bengal, gradually advancing to the west and north-west, as far as a line corresponding to about 78° east longitude; then halting for the cold season, but in the meantime throwing forward its feelers into the provinces beyond the invaded area.

Early in March, 1838, the chief magistrate of Calcutta called the attention of the Medical Board "to the number and severity of the cholera cases among the inhabitants of this city;" at the same time, 126 men of H.M.'s 26th regiment in Fort William were seized with cholera.

The eastern districts, including Chittagong and Assam, were under the influence of a severe outburst of the disease. Among the men of H.M.'s 9th Regiment at Hazareebaugh, cholera was prevalent throughout the year. The 31st Regiment at Dinapore, and the 16th at Benares were similarly affected.

The troops at Cawnpore were terribly stricken with cholera in June. We have abundant evidence, therefore, of the reproduction of the disease over the invaded area of the previous year; beyond this, cholera was generated throughout the North-Western Provinces in 1838, and in Cabul in 1839.

On the 20th of April, 1838, Dr. Ludlow reports from Agra, that "among the great number of destitute poor, amounting now to nearly one hundred thousand souls, collected in and about the city, cholera and fever prevailed to a woful extent." The year 1838 was a year of famine in the North-West; but it is important to observe that the drought of 1837, pro-

ducing this famine, was not felt in the Allahabad circle, and only in one or two sub-divisions of Cawnpore.* We have no history of a deficiency of rain in the latter district as in 1832, and consequently the epidemic arising in Eastern Bengal progressed steadily and surely over the province, as far as its natural limits in the Cawnpore circle.

The troops at Muttra were attacked by cholera in the beginning of April, 1838, "the wind blowing from the south and south-east;" at the same time the district of Etwah was severely affected. Dr. Clapperton reports in May, from Mhow and Mundlairsir, that cholera had been virulent among the people of those districts since March, "the climate of the latter province being very much like that of Bengal." The inhabitants and troops of Meerut, Kurnaul, Deyrah, Seharunpore, and the hill station of Mussouree were under the influence of a fierce outbreak of cholera in July, the epidemic raging more or less violently until September.

The Superintending Surgeon of Meerut remarks that, at the outbreak of cholera in his circle, "the atmosphere had been particularly hot and close, the rains fallen having produced very little diminution of the temperature." "The disease has only in a few instances partaken of the spasmodic form, but has been one of collapse; a few watery motions, succeeded by sudden prostration of all the animal powers, the patient dying without a struggle in a few hours."

It would be useless my entering into further particulars regarding the invading cholera of 1838. The above quotations, which it must be remembered, were written by officers widely separated from one another at the

* Colonel Baird Smith's 'Report on the Famine of 1860-61,' p. 23.

time, and on the spot where the disease appeared, seem to me precisely the independent evidence we require, to prove the fact of the districts belonging to this Presidency, west and north-west of the Cawnpore division, being under the influence of a vast outburst of cholera in 1838.

Our troops entered Afghanistan during this year, but no cases of cholera occurred among them until the following season. Dr. J. Atkinson reports from "near Cabul," that early in August (1839) "the camp at Quetta received a formidable visitation from cholera, which naturally produced great alarm. The cases were numerous and very fatal; the natives of the country were dying daily in great numbers, both in the town of Quetta and the neighbouring villages."* We have in this and subsequent communications, evidence that during August, 1839, cholera had passed into Cabul, as it had done in the epidemic of 1828, 1829; nor would it have been possible for us to have traced the further history of the cholera of the North-West and Punjab of 1838, had not our unfortunate army happened to be in the country at the time.

From the Madras reports, it is evident that cholera was again very prevalent in that Presidency during the year 1837-38. The number of native troops suffering from cholera amounted to 12 in 1835; to 63 in 1836, 762 in 1837, 1108 in 1838, 530 in 1839, and 270 in 1840.† The disease was very severe at Bellary among the men of H.M.'s 39th Regiment. On the 21st and 22nd of March, there were a few showers and much lightning. On the evening of the former

* 'MS. Proceedings of Medical Board.'

† 'Report on Epidemic Cholera,' p. 34. By Dr. Lorimer.

day the first case of cholera appeared, and between that date and the 21st of May, 75 cases of cholera occurred in the regiment.*

Among the European troops serving in the Presidency of Bombay, the deaths from cholera amounted to 62 in 1837, to 53 in 1838, and to 259 in 1839.†

Throughout 1839 we have accounts of cholera from almost every large station in this Presidency (Bengal), the epidemic being reproduced over the whole country invaded by it in 1837-38. The following table, compiled from the reports contained in the proceedings of the Bengal Medical Board, illustrates the preceding facts connected with the progress of the epidemic in this Presidency with considerable precision:—

Table showing the average strength, and number of deaths from cholera, among the European troops in the Bengal Presidency for five years.

Troops stationed to the East of 80° E. Long.			Troops stationed to the West of 80° E. Long.		
Years.	Average strength.	Number of deaths from cholera.	Average strength.	Number of deaths from cholera.	Remarks.
1835	6707	26	4707	3	†Of these, 25 deaths took place among the men of the regiment stationed at Ghazee-pore.
1836	7332	38‡	5359	4	
1837	7144	120	4306	16	
1838	6375	52	7122	86	
1839	6011	38	5970	12	

I may here remark that I find carefully kept returns in the proceedings of the Medical Board regarding the

* 'Report on Asiatic Cholera,' p. 56. By S. Rogers. London, 1848.

† 'Transactions of the Medical and Physical Society of Bombay,' No. i, new series, p. 98.

health of our troops and prisoners in the settlements of Singapore, Penang, and Malacca from 1827 to 1840 ; and, as far as I can ascertain, not a single death from cholera occurred, either among the troops or convicts, at any one of these stations throughout this period. One or two instances of cholera are reported, but the patients recovered. The Madras records confirm the fact that epidemic cholera was absolutely unknown in the Straits during the period under review,* although within these fourteen years we have clear evidence of three great outbursts of the disease over Hindoostan : our Straits settlements were free from the disease although in constant and speedy communication with India, receiving our convicts, and being absolutely unprotected by anything approaching a system of quarantine.

The Asiatic epidemic of 1841-45 ; and its progress to the Western World in 1848-49.—In the early part of 1840, the Government of India despatched a combined European and Native expedition to China ; these troops had hardly landed on the island of Chusan before cholera broke out among them. There were only twenty cases, it is true, out of a force of some 1500 men ; but Dr. J. French expressly states, from inquiries he made from missionaries living on the island, that cholera was apparently imported into the place by the troops arriving from Bengal ; people in Chusan had never heard of or seen cases among the natives until the year 1840.

I have before referred to the existence of cholera in China in 1820. M. Huc informs us that the disease

* 'Report on the Medical Topography of the Eastern Settlements.' Madras, 1844. Also the 'Madras Quarterly Journal,' vol. i, p. 71. Madras, 1839.

was unknown to the Chinese prior to that year; they believe that it first appeared on the shores of the Yellow Sea, as a mist which gradually rose from the water, "winding its course along the hills and valleys; and wherever it passed, men found themselves suddenly attacked with a frightful disease, which was incontestably the cholera.* It ravaged first the province of Chan-tung, then turned northward to Peking, striking in its march the most populous towns; it then crossed the Great Wall. It is probable," continues M. Huc, "that it followed the route of the caravans as far as the Russian station of Khiaktha, and afterwards, passing through Siberia, invaded Russia."

It is evident, therefore, that epidemic cholera had visited China before, and it appeared there again in 1841-42 simultaneously with the arrival of our troops from Bengal. As cholera was not an endemic disease in the country, we can only assume that it was imported into the place by our soldiers and camp followers, arriving from an infected locality (Calcutta). We may, however, trace the disease from the south of China into the north of Burmah, and even venture to assume that it followed the route above indicated by M. Huc, or perhaps a more southern one, into Central Asia and Persia in 1844-45, there uniting with a vast wave of cholera from India, and spreading over Europe and America, as it had done in 1832-33. We must, however, proceed to examine the data upon which this idea is formed.

In 1841, Dr. J. French reported to the Medical Board that cholera, in an aggravated form, had broken out among the Bengal troops at Ningpo. "In August the disease was even of a more malignant form at

* 'The Chinese Empire,' vol. ii, p. 24. By M. Huc.

Chinhai. Of nine men seized with it no less than six died." Dr. Bryson makes almost precisely the same remark as to the health of the fleet in these seas. He says, cholera "seems to have prevailed in its most malignant form at Chinhai and Ningpo. Out of a party of marines serving on shore with the force, 10 were attacked and 6 died."* During the year 1842, 163 cases of cholera and 45 deaths occurred in our fleet; in 1843, there were 131 cases and 35 deaths from this disease. Dr. Bryson observes:—"On a careful perusal of all the medical reports from the squadron (China), it appears that in every vessel employed in the Yang-tse-Kiang, from Woosung to Nankin, between the middle of July and October, cholera, or choleraic diarrhœa, broke out. The disease was alarmingly prevalent at Manilla."† Dr. Bryson expressly affirms that this was quite a new feature in the medical history of our fleet in the China seas, thus confirming Dr. French's evidence regarding the importation of the disease into the country, or rather the fact of cholera not being endemic there.

We have abundant evidence in the proceedings of the Medical Board as to the existence of cholera among the (Bengal) European and Native troops in China, throughout the year 1841-42. No less than seven officers in H.M.'s 49th Regiment were attacked by cholera, and four of them died. "The disease committed great ravages at Canton and Peking, having first made its appearance in the former city."‡ Among the (Bengal) European troops employed in China, during

* 'Health of the Navy,' Part ii, "East India Station," p. 33. Printed by order of the House of Commons, 1853.

† *Idem*, pp. 59, 81.

‡ 'M.S. Proceedings,' 9th February, 1843.

August and September, 1842, amounting to about 3000 men, there were 111 cases, and 49 deaths from cholera.

Dr. Montgomerie informed the Medical Board that, with regard to our Straits Settlements, he had nothing new to report for 1841, excepting the fact that at Malacca, cholera had broken out towards the end of the year. The disease first manifested itself in the island of Sumatra, from whence it gradually and slowly approached along the coast. The inhabitants of Deli, on the shore opposite Malacca, were affected with it for some time before it broke out at Malacca. It spread to Singapore and Penang, but happily disappeared before the middle of 1842. The cases were not very numerous among the inhabitants, but were very fatal.*

It is evident, therefore, that in 1841-42-43, the Straits Settlements and the entire sea-board of China, including Canton, were under the influence of epidemic cholera; and it is somewhat remarkable, without reference to this fact, that Dr. E. A. Parkes should have observed—"Some time in the early part of 1842 cholera appeared in the north of Burmah, and, passing in a southerly direction, committed great ravages at Ava and Amerapura. After traversing these cities it passed down towards Rangoon, pursuing the course of the Irrawady."† Dr. Richardson, Surgeon to the Commissioner of the Tenasserim Provinces, reports that the disease appeared among the prisoners at Moulmein on the 23rd of September, 1842. "It was confined almost entirely to the convicts and to the Burmans;" a fact confirmed by Dr. Parkes, who

* 'Researches into the Pathology and Treatment of Cholera,' p. 158.
By Dr. E. A. Parkes.

† Idem, p. 166.

informs us, that the only "Europeans attacked at the commencement of the epidemic were the sailors belonging to the ships in the river : the ships nearest the shore suffered most. Thus, nine cases occurred on board H.M.'s brig *Britonate*, lying close in shore. She was moved about a mile away, into the centre of the stream, and no more cases occurred. The attacks gradually diminished in number from November (1842) till the middle of May (1843), when the rains suddenly set in. There was then a great increase in the number of cases in the bazaar. On the 21st of the month, the first instance of the disease occurred among the European troops at Moulmein. From this time, up to the 1st of June, forty-one cases were admitted, after which the rains having set in heavily cholera ceased, and did not again attack the Europeans."*

I shall have to return to the circumstances of this outbreak of cholera in China and Burmah, when discussing the history of the epidemic in Central Asia, Cabul, and the Punjab, in 1844-45; but, before entering on this subject, we must examine certain facts connected with the disease in the Bengal Presidency from 1840 onwards.

During the early months of the year, cholera "prevailed to an alarming extent throughout the greater part of Cuttack; it broke out again at the commencement of the rains." In the Berhampore division it was most severe in April, 153 cases and 74 deaths occurring among the convicts. The disease was very bad at Chinsurah; no less than 50 per cent. of those attacked dying. On the 2nd of May, 1840, it rained heavily at Bhaugulpore, and inundated the spot on

* 'Researches into the Pathology and Treatment of Cholera,' p. 166. By Dr. E. A. Parkes.

which the prisoners' tents were pitched. The men remained on the ground till the next morning, when the first serious case of cholera took place; and, until the 24th of the month, the mortality was very great. It prevailed also in the district, but proved less fatal than in other years. In April and May, cholera broke out at Dinapore and Ghazee-pore, and recurred in these stations with renewed severity in November; the North-Western Provinces, Central India, and the Punjab remaining absolutely free from the disease throughout the year.

In the month of December, Dr. Lamb reports from Dacca that cholera had broken out with much severity. "It first made its appearance on the banks of the river. The prisoners working there were attacked; but only a few cases occurred after they were relieved from the work in that direction. Only one decided case was reported from among the sepoy's."

In January, 1841, the 15th Regiment Native Infantry left Dacca for Benares in a fleet of country boats. They met the relieving regiment (the 45th Native Infantry) coming down the river. The latter corps had been perfectly healthy up to this time; "not a case of cholera had occurred among them," whereas, in the fleet of the 15th Regiment, several deaths had taken place from this disease since leaving Dacca. The regiments anchored close to one another on the 25th of February, and on the following evening (the 26th), the first case of cholera occurred among the men of the 45th Regiment. The disease subsequently clung to the corps till it arrived at Dacca. It is further remarkable, that the 45th Regiment there met the 32nd perfectly free from cholera; but no sooner had the 45th arrived among them, than the disease

spread to the men of the 32nd Regiment, and in less than ten days 105 cases and 80 deaths occurred among the sepoys.

A "curious circumstance" is related by the Medical Officer in charge of the 45th Regiment. As I have above mentioned, they were anchored near the infected 15th Native Infantry on the 25th of February. "Opposite the boat of the grenadier company, on the banks of the river, were found some clothes that were discovered to have belonged to a deceased sepoy of the 15th Regiment, who had died of cholera. There was no doubt on this point, as, by some inadvertence, his undress cap was among the other articles. Within a few hours after this the first case of cholera occurred, and it is an odd coincidence that the patient belonged to the grenadier company; the next case was also a man of this company."

Epidemic cholera of a most malignant character invaded the Pooree and Jessore jails in March and April 1841, having been raging for some time previously in different parts of these districts, cutting off a frightful proportion of the population, and in some places nearly depopulating large villages. Among the European troops at Dinapore, five cases were admitted into hospital on the 25th April; they all died within twenty-four hours. From the 15th to the 28th of April, there were no less than 95 cases and 51 deaths from cholera in the Tirhoot jail. The disease broke out at Monghyr on the 6th of April, and at Bhaugulpore about the same time. It is remarkable, however, that although these districts were suffering so severely, not a single case occurred among the prisoners at Gaya, Arrah, Chuprah, or Chumparun. In May the disease appeared among the Europeans at Hazareebaugh. From the

Allahabad and Cawnpore dispensary returns, we hear of the existence of cholera in these districts during June and July, many of the cases proving fatal within six hours; at the same time, the Jubbulpore and Saugur districts received a slight invasion of cholera. The disease was terribly virulent at Lucknow in July, several of the royal family dying from it.

Cholera re-appeared over the whole of the districts above mentioned, including Chittagong, Assam, and Cachar, in September and October. From Cawnpore eastward, the number of convicts confined in the various jails amounted to rather more than an average of 30,000 souls, and during the year 1841, there were upwards of 800 deaths from cholera among them; whereas, to the west of Cawnpore, of some 16,600 prisoners, only 23 deaths occurred from the disease throughout the twelve months. In fact, the inhabitants of this presidency to the west of Cawnpore, with the exception of the slight outbreak in Central India, were free from cholera.

Early in 1842 we hear of the prevalence of the disease again in the Chaibassa, Dacca, Pooree, and Calcutta divisions, and, in fact, throughout lower Bengal. At Barrackpore, for instance, there were no fewer than 93 cases among the European troops in April, and 27 at Benares. It appeared with great severity among various fleets of boats proceeding down the Ganges. A remarkable instance of this kind, which, however, occurred later in the year, is recorded of H.M.'s 9th Lancers. Cholera was very prevalent among the villages about Monghyr, and no sooner had the left wing of the Regiment arrived in this locality, than cholera broke out among the men. "A few days later they emerged from the infected districts, and at the same time the disease left them." About a month afterwards,

the men of the right wing, on their journey down the river, were affected with cholera at the very same spot as the former wing had been, and, pushing rapidly on, they lost it where the first division got rid of it.”*

To the west of Cawnpore, although the season was a remarkably unhealthy one, there is no evidence of an outbreak of cholera among the inhabitants, as we might have expected from the great prevalence of the disease to the east during the previous year.

Throughout the following twelve months we have again details of epidemic cholera in Bengal, and as far west as Ghazee pore, where H.M.’s 29th Regiment, just arrived from Europe, suffered very severely.

“ In July, 1843, the disease became fearfully epidemic at Agra. It raged in the city and suburbs for upwards of two months prior to its assailing the prisoners, European and Native troops, which, however, it did simultaneously in August, though in very opposite degrees. H.M.’s 39th Regiment and European Artillery suffered awfully, whereas the four native corps and camp-followers suffered comparatively very slightly. The European barracks, and the lines of the sepoy, as well as the bazaars, are in juxtaposition, and situated on an extensive open clear plain, elevated many feet above the level of the river; the soil is a sandy argillaceous composition. The season was marked by unprecedented severe thunder-storms, with deluges of rain: upwards of 24 inches fell in July and August, accompanied by great and sudden transitions of temperature.” One hundred and sixty cases of cholera occurred among the convicts in the Agra jail. The disease was very prevalent throughout the Muttra and Allyghur districts, extending west as far as Boolund-

* ‘Medico-Chirurgical Review,’ July, 1848, p. 70.

shahur, but not reaching Delhi. At Bareilly "cholera broke out with some degree of violence,"* and the same remark applies to Moradabad. Among our European troops in the Meerut division there was only one death from cholera throughout the year, and in the native force but two cases. Not a single instance of the disease was met with among some 3000 patients attending the Delhi dispensary during the second half of 1843. It is clear, therefore, that the invading cholera of this year failed to pass beyond a line to the north-west, corresponding to about longitude $77^{\circ} 56''$. To the south-west of this Presidency, however, it broke out in May in the Odeypore territory, and still earlier in the year to the north-west of this state.†

In 1844 cholera was confined to its endemic area in Bengal, and even there appeared only in certain

Names of Stations.	Average strength of European troops during the year 1844.	Number of deaths from cholera among European troops during 1844.
Barraekpore	1369	45
Dinapore	1855	5
Benares	1234	29
Allahabad	735	30
Cawnpore	2055	1
Agra	1333	...
Muttra	102	...
Gwalior	75	...
Meerut	2032	1
Landour	116	...
Kussowlie	1435	3
Subathoo	943	...
Loodiana	1605	...
Ferozepore... ..	195	1
Sukkur	1036	...
Nusseerabad	979	...

* 'Half-Yearly Report of the Government Charitable Dispensaries' for 1843, p. 101. By Dr. Balfour. Printed by order of Government. Calcutta, 1844.

† "On the Vital Statistics of the Bheel Corps." By Dr. Ewart. From the 'Indian Annals of Medical Science,' vol. xii, p. 495.

localities. The foregoing table serves to illustrate this point, and is of interest with reference to the history of the disease during the succeeding twelve months.

Towards the close of 1844, the Medical Board addressed the Government of India concerning a reported outbreak of the plague in Cabul, and in reply they received the following communication from Major Broadfoot, the Governor-General's Agent on the North-Western Frontier:—"In answer to your letter of the 16th December, I have the honour to inform you that the disorder at Cabul, called 'plague' in the newspapers, has advanced steadily from Bokhara to Peshawur, where, since the winter has set in, its violence seems to have decreased, as well as its progress to be suspended, though it still exists in the Eusufzye country. The symptoms of the disease at Cabul and Peshawur are described as similar, and they appear to me to be those of cholera rather than of plague. They are, violent vomiting and purging, ending in death in a few hours, when the disorder is violent; all witnesses concur in this description of it, and it was similarly described to me a few days ago by an huzara of Cabul, who had the disease there and recovered. He had served under me in Afghanistan, and I think his description was probably correct; it was precisely that of virulent cholera described by an unprofessional observer. As to precautions, I think it impossible to provide any which would be efficient on so extensive a frontier, the entrances into which are numerous, and not in our keeping."*

This letter contains the first official announcement I have met with of the cholera which committed such terrible havoc in Central Asia and Afghanistan in 1844.

* MS. Proceedings of the Medical Board, February, 1845.

Dr. F. S. Arnott (at present the Inspector-General of the Bombay Indian Medical Service) informs us that, "about the end of the hot season of 1844, the countries north of the Hindoo Koosh were devastated by cholera. Bokhara and Balkh lost upwards of 25,000 of their inhabitants; Samarkand and Koondooz also suffered to a frightful extent. Travelling south and east, it reached Bamian about the beginning, and Cabul about the middle of October. By the 8th of November it had extended to Jelalabad, and towards the end of November to Peshawur. In March and April 1845 it spread to Hoosun-Abdaul, and Jhelum, destroying 500 men of General Court's regiment at the former place. In May it broke out at Lahore, where it was supposed to have carried off 22,000 people. In June, having shown itself at Umritsur, it crossed the Sutledge, and broke out at Ferozepore, and afterwards at Loodiana, continuing its course towards Central India. It here sent off a ramification down the Sutledge and Indus to Sukkur, which place it reached on the 15th of June. It began to subside at Sukkur about the 26th of June, and by the beginning of July it had altogether ceased. It continued its course, however, down the river, and broke out at Hyderabad about the middle of July, and afterwards proceeded onwards to Tatta and Kurrachee; but by the time it reached the latter place it had abated much of its violence."*

This description of the course taken by the cholera of 1845, exactly coincides with that of the Governor-General's Agent on the North-Western Frontier, and with the information contained in the proceedings of

* 'Transactions of the Medical and Physical Society of Bombay,' No. ii, New Series, p. 178.

the Medical Board regarding the Bengal troops in these localities. Moreover, as Dr. Arnott is at present in Bombay, I wrote to him on the subject, and he has most kindly furnished me with all the information I required. Having been in Sind with his regiment in 1844-45, he was, as he states, at the time most anxiously watching the progress of this terrible epidemic. Dr. Arnott's evidence in fact, regarding this important epoch in the history of Indian cholera, is precisely of that description upon which we naturally place so much value: he was an independent eye-witness of the events he describes.

Ferozepore was the furthest point to the north-west occupied by British troops (Bengal) in 1845; and from the proceedings of the Medical Board, I find that, early in June, 36 cases and 19 deaths from cholera occurred among our troops stationed there; at the same time, instances of the disease were reported from Loodiana and Sukkur. Early in July it broke out with terrible violence among H.M.'s 31st Regiment at Umballa. In this and the following months there were no less than 339 cases and 187 deaths from cholera in this regiment; in the Sirhind division alone, within the three months (June, July, and August), 365 Europeans fell victims to this terrible disease, exceeding in number those killed in England's toughest battle in India—Sobraon, which was fought in the following February.

A sergeant of H.M.'s 31st, who was with the regiment in 1845, and happens now to fill a post in an hospital under my charge, has given me some particulars of this outbreak of cholera, which I repeat in his own words:—"The month of July set in with very heavy rain, which lasted for three or four days, and then the sun came out very strong, at which time the

cholera broke out (about the 7th), and so great was the mortality, that after three days no coffins could be procured, so the men were sewed up in their bedding and buried as on the battle-field. We were ordered into what they call a cholera camp; unfortunately, just as the men got under arms, the rain poured down, and we were all drenched. The walls of the tents were blown in, the bedding soaked, and, I am sorry to say, that during that terrible night there were between 40 and 50 cases of cholera, but the men bore it like soldiers." The sergeant further informs me that the wife of one of his comrades about this time had a baby; he had the child baptized after the eighth day, and had a christening party, getting the usual gallon and a half of rum from the canteen; there were twelve persons present, including the man and his wife, and by the following evening all of them were in their graves, except the baby, who was taken care of by a lady now in Calcutta.

In August, 1845, cholera advanced eastward to Meerut, where during the month there were 29 cases and 9 deaths among the European troops; in September there were 114 cases and 76 deaths from cholera. In October and November the disease was severely felt in the Delhi jail; whereas, at Agra, there was not a single death from cholera among the prisoners or native troops in August or November, and only one casualty from this disease in October.

I have already quoted from Dr. Arnott's paper as to the existence of cholera in Sind, and, before leaving the subject, may add Dr. K. K. Kirk's evidence on the same point. He writes, "during the hot weather of 1845, cholera visited Sukkur and many other parts of Sind with much severity. In the cantonment bazaar, as

many as 30 or 40 people were dying daily for some time. The disease was of a most severe kind, consisting only of a direct collapse, without spasmodic pains in the limbs, or the passive flow of the vital fluids from the skin and bowels. The attack was as insidious as it was dangerous, and some patients I saw presented no symptoms to excite alarm even in themselves, but lay in that quiet state which would have followed the withdrawal of their blood in small successive portions. Inflammation of the brain, with slight accompanying fever, carried off many who had successfully wrestled with cholera.”*

From a careful study of these facts, I can arrive at no other conclusion, than that the cholera of the Punjab and North-west of 1845 was a continuation of the Central Asia epidemic of 1844. I have shown that an outburst of the disease took place in China in 1841-42-43; that it appeared in the north of Burmah during 1842, throwing out an offset into that populous country in 1843; and supposing it to have continued its course to the north of the Himalaya, at about the same rate as we have seen it frequently travel in India, it would account for the outbreak of the disease in Bokhara in 1844, which, in like manner, thrust its branches down into Afghanistan and northern India; at the same time continuing its growth to the west, and appearing in the north-east of Persia, at Mushed, towards the close of 1845.

I must not omit to notice the fact, that while cholera was spreading from the Punjab eastward to Delhi, and down the Indus to Sukkur, appearing also at Kurra-
chce, it was again fearfully prevalent in many parts of

* ‘Medical Topography of Upper Sind,’ p. 41. By Dr. K. K. Kirk. Calcutta, 1847.

Bengal. In April, we hear of its ravages in Maunbhoom, Furreedpore, Purneah, Tirhoot, and other districts. At the same time it "raged fearfully at Allahabad." On the 20th of June, Dr. Darby reports from Cawnpore, "that during the last four days the station has been visited by that dreadful scourge cholera in its most malignant form;" and subsequently he writes that, out of a force of some 2212 Europeans, 94 cases and 46 deaths from cholera had occurred; whereas among 16,000 native troops, there had only been 10 deaths from this disease. "The epidemic only raged for a few days and then absolutely and entirely disappeared." Had we not, therefore, evidence to the contrary, we might have supposed that the cholera I have described as appearing in the Punjab had spread, as we have invariably found it do heretofore, from Bengal; but the fact of the Agra division not having been affected in 1845, and of the steady advance of the disease from Peshawur to Delhi, leaves us in no doubt on this point. These facts demand our most careful consideration, for there is hardly a single circumstance connected with the history of the disease in India, which bears more directly on its etiology than its progress in 1843-44-45.

Cholera appeared in an epidemic form in Madras during the month of June, 1845. Dr. Parkes, on this occasion, observed that "a hot land wind during the day, followed by a heavy shower in the evening, generally produced one or two cases of cholera in the next twenty-four hours."* It spread gradually from Madras towards Bombay and the coast of Malabar.† Among the native troops in the Madras Presi-

* Dr. E. A. Parkes 'On Cholera,' p. 168.

† 'Medico-Chirurgical Review,' July, 1848, p. 68.

dency, amounting to some 74,000 men, there were 1718 cases and 708 deaths from cholera in 1845, and 2699 cases and 1208 deaths in 1846.* From the returns of the Nizam's army, it is evident that epidemic cholera was rife in his territories in 1845-46.† In the Satara district, the disease was very prevalent and very fatal; in May and June, 1845, it was computed 1000 fatal cases occurred in the town alone.‡ In the Island of Ceylon also cholera was most virulent, particularly at Taffrea; out of 4111 cases, no less than 3655 perished during the month of November, 1845.

Early in April, 1846, we find that cholera was reproduced over nearly the whole of Western India, Madras, and Bombay. On the 21st of April, Dr. D. Macleod reports its appearance in the 58th Regiment, near Indore; 20 cases and 12 deaths occurring within a few hours of the outbreak of the disease. The troopers of the 5th Irregular Cavalry were similarly affected near Neemuch, and the 22nd Bombay Infantry on their march to Baroda. Dr. C. R. Francis reports the circumstance of the outbreak of the disease at Nusseerabad; and similar information was received by the Medical Board from Nowgong and Mhow. Dr. Spilsbury further reports that cholera had broken out at Hoshungabad, and that "it raged fearfully for several days at Saugur and Seuni among the natives, but had almost disappeared by the end of May." He adds—"On the whole, however, the troops in this division may consider themselves fortunate to have

* 'Journal of the Statistical Society,' May, 1851.

† 'Medical Topography of the Nizam's Contingents and Army,' p. 74. By Lieut.-Gen. Fraser. Madras, 1852.

‡ Dr. J. Murray "On Diseases of Satara." 'Bombay Medical Transactions,' vol. i, 1853, p. 98.

escaped thus far, when the ravages of the disease have been so frightful in more central India.”*

While the epidemic was thus surging to and fro over the western portion of this presidency, we find it had broken out in Bombay. “An awful visitation of the cholera is stated to have taken place at Sholapore and its vicinity, the disease first appearing in the camp of the 33rd Regiment N. I., when on their march to Jaulnah. Spreading thence to the south Maharatta country, it almost depopulated several villages in its course, and on no occasion, at least for many years past, had it proved so fatal to the native population. It subsequently appeared at Poona, Bombay, and Ahmedabad.†

It will be remembered, that I described the cholera of 1820 as affecting Western India, Madras, and Bombay, in very much the same way as we have seen that it did again in 1845-46; and in the former epidemic I quoted a passage from Mr. Fraser’s work, to the effect that the disease had not only appeared in 1821 in Omaun, but that it existed on the Coast of Zanguibar. It is remarkable that we have almost an exact repetition of these details in the history of the cholera of 1846. Rigler‡ expressly states “that in the month of May, 1846, cholera showed itself at Aden, Mocha, and Jeddah, and invaded almost the whole of the seaboard of the Arabian peninsula; it even penetrated into the interior of Omaun. However, it spared the opposite coast of the Red Sea, and did not even touch Mecca, which is not far from Jeddah.” The fact of

* ‘MS. Proceedings of the Medical Board.’

† ‘Report of the General Board of Health on the Epidemic Cholera of 1848-49,’ p. 3.

‡ Vol. ii, pp. 441-443.

the disease appearing at Aden in the early part of 1846, is confirmed by the Bombay medical reports; the only deaths from cholera among the European portion of the garrison, from 1840 to 1848, occurring in 1846.*

At the time of the outbreak of the disease at Jeddah, the annual fair was being held there, at which merchants assembled from India, the Islands of the Archipelago, and Coast of Africa; as many as 200 vessels have been known to arrive in the port on these occasions. Fortunately for the pilgrims, the celebration of the Courban-Bairan did not take place until November, otherwise there can be little doubt that cholera would have spread to Mecca; as, in fact, it did later in the year, when the devotees had crowded into the holy places for the celebration of this festival.

In consequence of our operations in Sind, Kurrachee had risen to be a place of some importance since the former visitation of Persia by cholera. In 1846 there were three European regiments stationed there, and on the 14th of June cholera broke out with terrible virulence among these men.† Dr. F. S. Arnott, who was at the time stationed at Kurrachee, in medical charge of the 1st Bombay Fusiliers, had, as I have before remarked, noticed the fact of cholera having visited the station during the previous year, and he adds—"isolated cases in the camp, town and vicinity, continued to occur throughout the cold and hot season. It seems not improbable that the terrible disease of June, 1846, may have arrived in Kurrachee in the

* 'Annals of India for 1848,' p. 69. By G. G. Buist. Bombay, 1848.

† 'A Medical Report on the Causes, Character, and Treatment of Spasmodic Cholera in H.M.'s 86th Regiment at Kurrachee.' By Surgeon A. How. Printed by order of the House of Commons, February, 1848.

previous year. That it did not previously show itself in an aggravated form, may, perhaps, be explained by the absence of certain adventitious circumstances necessary to its full development. What was wanting may have been supplied about the beginning of June, when the weather begins to partake of the peculiarities of the south-west monsoon, being loaded with moisture. Clouds accompany the wind sweeping over the southern coast of Sind."* Among the men of H. M.'s 86th Regiment, there were 410 cases and 238 deaths from cholera between the 11th and 25th of June; in the three European Regiments at Kurrachee, no less than 800 cases occurred within the space of a few days.

I noticed the appearance of cholera at Mushed towards the close of 1845, and it burst forth there again with renewed violence in June of the following year, quickly extending to Teheran and Tabreez, and overspreading the province of Ghilan; before the close of the year, it reached as far north as the town of Derbent, on the Caspian Sea.

In September, 1846, cholera had appeared at Bagdad; it advanced up the Tigris and Euphrates as far as Diarbekir and Orfa; it did not, as has been affirmed by some, cross the desert directly from Bagdad to Damascus.† Nor does it appear to have travelled with the Persian pilgrims from Kerbellah across the desert to Mecca. Doubtless, as Verrollot asserts, cholera did break out at Mecca in November; but, as we have seen, it existed at Jeddah during the month of May, when in all probability the seeds of the disease were sown, to be brought into active operation

* "Report on the Health of the 1st Fusiliers." By Dr. F. S. Arnott. 'Bombay Medical Journal,' No. ii. new series, p. 179. Bombay, 1855.

† 'Cholera Conference of Constantinople,' p. 100. Calcutta. 1868.

again by the assemblage of the pilgrims during the later months of the year, some 15,000 of them then falling victims to this pestilence in and about the city of Mecca.

“The further progress of the scourge seems to have been stopped by the approach of winter (1846-47); but early in the following spring it broke out with fresh virulence,”* and was reproduced over the entire area invaded by it during the previous year.

In April, 1847, the disease appeared again at Derbent and spread to Tenir-Khan-Showry, whence it was said to have been transmitted to Kizliar, in June, by a detachment of invalid soldiers. From Kizliar it spread along the steppes as far as the Volga, reaching Astrachan on the 30th of July. It had broken out at Tiflis on the first of the month, and spread from thence to the coast of the Black Sea, *viâ* Gori to Poti, and Trebizond. Following the great military road from Tiflis, the cholera spread over the Caucasus mountains, reaching a height of some 6000 feet, and appeared at Stavropol. During August it broke out among the shipping at Taganrog, to the north of the sea of Azov, at the same time appearing at Saratov (August 20th) and in the Government of Orenburg. In September it reached Simbirsk and Nijnh-Novgorod to the north, and to the west Moscow, where the disease was not severely felt during the year, confining its attacks chiefly to one particular district, near the river. Here, however, it assumed a severe character, for nearly one half of the cases that first occurred terminated fatally.†

Cholera broke out at Constantinople on the 24th of

* ‘Report of the General Board of Health on the Cholera of 1848-49,’ p. 5.

† *Idem*, p. 6.

October, 1847;* but from this time the epidemic began to decline over the area it had invaded. During the winter of 1847-48, some few cases were reported as far west as Alexandrof in Kherson, and Olgopol in Podolia, not above thirty miles from the Austrian frontier, and others near Riga. Sporadic cases were noticed in France and Britain.

In the spring of 1848 we find cholera breaking out with renewed vigour, and by August it had advanced from the east as far as a line drawn through Arabia, Poland, and Sweden.

Having burst out at Mecca† and Medina in April, 1848, it appeared with the returning pilgrims in Egypt in the middle of July, destroying some 3000 of them at the Tantah fair, and committing terrible ravages over the whole country. In Moldavia and Wallachia the mortality from cholera was very great. The whole of Russia, Poland, Finland, and Sweden were under its influence before August, although the Government of the latter country made most strenuous and costly efforts to bar its advent by means of quarantine. As a general rule, however, there were but faint exertions made on the part of the governments of Europe, to restrict the advance of cholera by the enforcement of quarantine laws, during the epidemic of 1848-49. It appears from a statistical paper submitted to the Russian Minister of the Interior by Dr. Rosenberger, that from 1847 to 1849 the deaths from cholera in Russia exceeded the number of one million, and the number of towns attacked was 471, the communication between infected and healthy places being open. On the other hand, in the first invasion from 1829-35,

* 'Lancet,' vol. i, 1848, p. 101.

† 'Cholera Conference of Constantinople,' p. 764. Calcutta, 1868.

when the progress of cholera was interrupted by sanitary cordons, the number of deaths did not exceed 100,000, and there were only 336 towns attacked. From these facts the Cholera Conference (Constantinople), assuming the intensity of the epidemic to have been the same on both occasions, argue that the restrictive measures employed in the first epidemic were, without doubt, useful. The value of this inference evidently rests on the assumption that the two epidemics were equally violent—a fact which Dr. Gavin Milroy evidently questions; and he gives us data for concluding “that the diffusive energy of the epidemic of 1848-49 was considerably greater than that of its predecessor, invading a larger area of the world’s surface, and with more deadly consequences, than in 1831-32.* If so, the force of Dr. Rosenberger’s argument, regarding the advantage of sanitary cordons, is evidently much weakened, if not destroyed.

The disease had broken out at Berlin as early as July, and in September at Hamburgh, and in Holland. The southern portion of the Austrian dominions appears to have suffered to some slight extent, and there was a partial outbreak of cholera near the port of Vigo in Spain. Italy was not affected at this time; Greece and Malta remained free from the disease, having been under strict quarantine from July. A few cases of cholera occurred in France, towards the end of the year.

On account of the insulated positions of England and America, the circumstances of the advent of the disease in these countries could be more satisfactorily investigated than in most continental states. Dr.

* Dr. Gavin Milroy “On Cholera,” ‘*Medico-Chirurgical Review*,’ p. 446, 1865.

Parkes was selected to inquire into the history of the cases that occurred in London. From his account we learn that the first instance of the disease in the metropolis was that of a seaman named Harnold, who arrived on the 18th or 19th of September, in a steamer from Hamburgh; he died of cholera at Horsleydown (London) on the 22nd of the month; the next case was in the instance of a man who slept in the same room with Harnold. There can be no doubt as to the fact of cholera having existed on board the steamer in which Harnold sailed, for the second engineer died from cholera on the passage, and we know the disease had been prevalent at Hamburgh for some time before the vessel started. During the first week of October, twenty-six cases were reported in London, all but four being fatal; of these eighteen occurred on the River Thames, or close to its banks, the remainder being scattered over other parts of the city.

In Edinburgh, cholera first appeared on the 4th of October, 1848. "On the Wednesday before this, three pilots from Newhaven went to the Isle of May to look out for vessels; one of them went on board a ship from Cronstadt, bound to Leith. The other two remained in their boat on the leese of the vessel, and were towed to Leith, a distance of four or five and twenty miles; both of the men were seized with diarrhoea on their passage. On arriving at Leith they went on board the ship; one of them died on the following Sunday of cholera. 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."* Unfortunately, the vessel

* 'An Enquiry into the Bearing of the Earliest Cases of Cholera.'
By E. A. Parkes, M.D. London, 1849.

had left Leith before inquiry could be made as to her having had cases of cholera on board, but the disease was known to have existed in Cronstadt during the summer. The appearance of cholera at Hull and Sunderland was immediately preceded by the arrival of vessels in which cases of the disease had occurred during their passage from Hamburgh.*

The first instance reported in Ireland was in the case of a man who had arrived at Belfast on the 2nd of December from Edinburgh (already infected). He was sent to the workhouse, and died within a few days. Cholera spread to the inmates of the house, and from thence to the town.†

Nor was the disease destined to remain in the British Isles; for on the 2nd of December, 1848, it broke out at Staten Island and New Orleans. Consequently, between May and December, 1848, cholera had extended its influence from Moscow (37° E. long.) to the southern part of the United States of America (90° W. long.). The history of its advent in America is a very instructive one, and although probably familiar to most medical men, I must here briefly recapitulate its circumstances, in order to complete my account of the disease in 1848.

I have already noticed the existence of cholera in Hamburgh, Russia, and Holland. Towards the close of the year, a number of German emigrants arrived at Havre and embarked on board a vessel—the “New York”—bound for America. She sailed from Havre on the 9th of November, with 315 steerage passengers on board. There was no cholera at Havre when the “New

* ‘Report on the Epidemic Cholera of 1848-49,’ p. 140. By Drs. Baly and Gull.

† Idem, p. 142.

York" started, and all remained well on board until sixteen days after leaving port, when cases of cholera occurred. Before her arrival at Staten Island (the quarantine station of New York) seven of the steerage passengers had died, and 12 sick were landed there. Nothing like cholera existed up to that time on Staten Island, or, in fact, in any other part of America. One of the men who assisted in removing the sick from the ship to the hospital was seized with cholera, and died two days afterwards. A nurse in the same building, without having any communication with the cholera patients, took the disease and died. Several other cases occurred among persons brought into contact with the sick, and among the emigrants there were sixty-three cases and twenty-nine deaths. The disease did not spread, "although it is known that numbers escaped from the quarantine and went into the city (New York), and that a considerable intercourse was kept up between those who were within the enclosure and persons visiting them from without. In a filthy German boarding-house, containing about 200 inmates, huddled together in the most disorderly confusion, two cases of cholera occurred in individuals who had escaped from quarantine. The establishment was broken up, and the inmates scattered over the city, and yet the disease did not follow. A sharp frost intervened; the weather, though previously mild and temperate, became wintry, and the disease entirely subsided."*

Nearly simultaneously with this occurrence in Staten Island, cholera was introduced into New Orleans. The "Swanton" sailed from Havre on the 3rd of November, having also German emigrants on board, these people

* 'Report of the General Board of Health on the Cholera of 1848-49,' Appendix C, p. 89. London, 1852.

having arrived, therefore, from an infected country. The passengers all remained perfectly well until the 26th of the month, after which "bowel complaints" broke out among them, and thirteen deaths occurred before reaching New Orleans. On the day after the arrival of the vessel, one of the passengers was brought to the hospital in a state of collapse with cholera, and died soon afterwards. Three other cases of the disease, all fatal, were admitted from different parts of the city the same day. In these cases no communication with the ship was traced; the disease rapidly spread through the city. The weather was very warm and damp; "the streets were as muddy as possible, and the side-walks and walls were reeking with moisture; heavy fogs overhung the city till late in the morning." After the arrival of the "Swanton," the temperature, so far from moderating, increased; so that from the 16th to the 22nd of December the thermometer rose to 84°, and the air was so liberally charged with moisture as to impart a stifling sensation. Under this condition of things the cholera spread with great rapidity.*

It is particularly to be noticed, that the passengers embarked on board these ships had arrived at Havre from countries in which cholera prevailed. When the disease appeared, the two vessels were 1000 miles apart, and both far on their way to their respective ports. The first case occurred in the "New York" on the 25th of November, 1848, when out of port sixteen days, and in north latitude 42°, western longitude 61°. On the following day, the 26th November, the first case occurred on the "Swanton," when twenty-seven

* 'Report of the General Board of Health on the Cholera of 1848-49,' Appendix C, p. 89. London, 1852.

days out of port, and in north latitude $25^{\circ} 47'$, west longitude $57^{\circ} 8'$. These cases appeared immediately after a sudden change in the weather, from an agreeable coolness to one of comparatively unpleasant warmth, accompanied by a particularly hot south wind, such as the captain of the "Swanton" had never felt before, and which he describes as more like artificially heated air than anything else.

From this time, until the arrival of these vessels at their respective ports, they retained the disease on board, and each sent cases on shore. Immediately after their arrival, cases occurred at Staten Island and New Orleans, in persons who had never been on board the vessels, and from this date cholera became epidemic in the United States.* In fact, Dr. Fenner reports, that after the disease had once begun in New Orleans, almost every vessel and steamer leaving the port had twenty or thirty cases on board; and thus persons having cholera and dying with it, were carried to all the landing towns and cities up the river as high as Cincinnati. For instance, the steamer "Convoy," after a run of four days from New Orleans, and having had cholera on board, reached Memphis on the 20th of December. On the 22nd a boy was attacked with cholera; he had been on the wharf selling fruit at the time the "Convoy" arrived. The disease spread through the town and neighbourhood. It is remarkable that from the 20th October to the 29th December, with the exception of two fair days, it had rained incessantly; the ground was saturated with moisture, and the temperature was unusually high for the season of the year.

After a period of comparative rest, during the

* 'Report of the General Board of Health on the Cholera of 1848-49,' Appendix C, p. 77.

winter of 1848-49, cholera was reproduced in the spring over the greater part of Europe, America, and Canada. In Austria the disease did not spread to any considerable extent; there were cases, however, at Vienna early in the year.* The same remark applies to Spain, a few cases occurring at Gibraltar. Portugal remained free from cholera. After spreading over the south of France, the disease reached Marseilles in August; and soon afterwards Toulon, Nice, Genoa, Leghorn, and thence advanced to Naples and Brindisi, notwithstanding every attempt to arrest its progress.† Towards the end of the year, Tunis, Oran, and Algiers were more or less under the influence of the disease.

Cholera broke out at Paris in March, and by the end of June there had been 33,274 cases and 15,677 deaths from it; the disease then gradually subsided and disappeared altogether in October. The epidemic was very general throughout France, and the history of its spreading into several departments has been carefully recorded; for instance, Hamel, a rural commune, was absolutely free from cholera until the 4th of April, 1849, when a soldier named Guilbert arrived from Paris, where cholera was raging. After remaining ill in his father's house from diarrhoea for four days, he was removed to the hospital at Amiens; on the same day the soldier's brother, André Guilbert, who had constantly visited the sick man, was seized with cholera and died. Three days afterwards André's wife took the disease and died. Guilbert's father was attacked on the 11th of April and died on the 15th;

* 'Lancet,' vol. i, 1849, p. 136.

† Dr. Gavin Milroy "On Epidemic Cholera," 'Medico-Chirurgical Review,' October, 1865, p. 445.

his brother and several other members of the family, together with a little girl who was in the habit of frequenting the house, were all seized with cholera within a few days.*

Cholera was diffused more or less completely over the whole of England during the summer of 1849; the greatest mortality that occurred in any one place was at Hull, where it attained "the rate of 241 deaths to every 10,000 persons living."† Dr. W. Farr observes, "if a foreign army had landed on the coast of England, seized all the seaports, sent detachments over the surrounding districts, ravaged the population through the summer, after having destroyed more than a thousand lives a day, for several days in succession, and, in the year it held possession of the country, slain 53,293 men, women and children, the task of registering the dead would be inexpressibly painful; and the pain is not greatly diminished by the circumstance, that in the calamity to be described, the minister of destruction was a pestilence that spread over the face of the island, and found in so many cities quick poisonous matters ready at hand to destroy the inhabitants."‡

The disease in England, as in other places, was apparently very capricious in its habits, leaving the inhabitants of many localities unaffected, and in the serene enjoyment of health. But Dr. Farr on this occasion brought out, with remarkable clearness, the relation which existed between the elevation of the soil and the mortality from cholera; thus at 100 feet above the Trinity high-water mark, the observed average mor-

* 'Constantinople Cholera Conference,' p. 88. Calcutta, 1868.

† 'Report on the Mortality of Cholera in England, 1849,' p. xxxvii.
By Dr. W. Farr.

‡ Idem.

tality was 17, at 70 feet it was 27, at 30 feet 65, and at high-water level 177; showing that human beings living on a low, and consequently, as a general rule, a humid soil, were those most subjected to the influence of cholera.* The relationship thus established holds good, it must be remembered, only so far as this—that where the mortality was high the elevation of the soil was low; it by no means follows that all low-lying places were affected with cholera, and that the high levels escaped. Lyons, for instance, has been always free from cholera, although a part of the city is built on a low alluvial soil, situated on the confines of two rivers, with a poor and dense population; nevertheless, it was unaffected by cholera in the epidemics of 1832 and 1835; the disease appeared in a single building only in 1849; a few cases occurred there in the epidemic of 1853, and none in 1865.

With regard to the spread of the disease in England, in 119 places, of which 69 were district towns or villages, 15 parishes or districts, and 34 public establishments, and the remaining 1 a private house standing isolated in the country, it was ascertained that in no less than 73 instances the disease appeared subsequently to the arrival of infected persons, or to the introduction of other possible vehicles of infection.† In some few towns, as at Shrewsbury and Oxford, and where the first cases occurred in public institutions, it was impossible to trace the importation of cholera to human intercourse. The disease, again, did not appear simultaneously in all parts ultimately affected, but began in one spot, or in a small number of spots,

* 'Report on the Mortality of Cholera in England, 1848-49,' p. lxiv. By Dr. W. Farr.

† Drs. Baly and Gull's 'Report on Cholera,' p. 157.

and increased by attacking a larger number of localities. In large cities, it is true, it appeared in nearly all quarters or divisions within a few days, but still in each quarter it affected one spot first and others in succession.*

I have already described the outbreak of cholera in Staten Island in December, 1848; the disease did not make its appearance in the city of New York until the following May, when it first attacked some of the poorest and most degraded human beings on the face of the earth. Dr. Buel, of New York, states that, on his first visit to these people in Orange Street, he found five of them crowded into a cellar, some ten or twelve feet square, with nothing over them but a few rags, and nothing under them but the mud floor; they were all five in various stages of cholera. It appears that other cases had previously occurred in this cellar, for these poor creatures had been seized with cholera after celebrating a wake in commemoration of a departed friend, who had just died of the disease. From Orange Street cholera spread over New York, and from thence to the various large towns on the American sea-board of the Atlantic, and, in fact, over the greater part of the United States. In several instances the commencement of the epidemic was traceable to persons arriving from previously affected localities, but in New York and in other cities it was found impossible to trace the first instances of the disease to such a source.† Throughout Canada cholera prevailed extensively between the months of July and September, 1850. It does not appear to have extended from the east as in 1832, but rather from the United States.

* 'Drs. Baly and Gull's 'Report on Cholera,' p. 71.

† 'Report of the General Board of Health, 1848-49.' London, 1850.

A few cases only occurred at Gross Isle, the quarantine station on the St. Lawrence, below Quebec; whereas in the first epidemic this station suffered very severely.*

During the year 1850, cholera of a virulent type again broke out in Egypt, and along the whole of the African sea-board of the Mediterranean. It did not, however, in any instance, spread beyond three days' journey into the desert.† Slight outbursts of the disease at the same time occurred over the greater part of Europe and America; in fact, cholera was reproduced over the area invaded by it during the previous years. Beyond this, localities hitherto free from its influence were now attacked, as for instance Malta and Gozo. Cephalonia, one of the Ionian group, was affected in July, "the population being reduced to famine by means of the rigorous quarantine, which excluded them from all intercourse with Greece, and with their brethren;" nevertheless, Greece was preserved from cholera throughout this epidemic, as she had been in the former visitations of the disease to Europe in 1832 and 1837.

During the year 1850 cholera spread over Mexico and California. In October, Cuba and Jamaica were under its influence: this was the first time the latter island had been visited by cholera; and it committed the most distressing havoc among the people. Mr. J. Watson, Surgeon to the Naval Hospital, Port Royal, and whose account of the disease in Portugal in 1833 I have referred to, reports that "for months past American steamers have been in the custom of touching at Port Royal and Kingston, on their voyage between New

* 'Medico-Chirurgical Review,' 1865, p. 446.

† 'Report of the Constantinople Conference,' p. 101. Calcutta, 1868.

York and Chagres. About a week before cholera appeared in Port Royal, two young men arrived from Chagres, their father having died, shortly before they left America, of cholera." This was the only instance of a suspicious person arriving in the town which Mr. Watson could discover; and as neither of these men, or the inmates of their house, were affected with the disease, he concludes that it was not communicated to the inhabitants of Jamaica from a previously affected place.*

Dr. Gavin Milroy observes, in his account of the cholera of 1851, that fewer parts of the earth's surface seem to have been the seat of the disease, during these twelve months, than had been the case for many years previously. In Europe, isolated outbreaks occurred in Poland and Silesia, but nowhere else; so we may fairly conclude that the epidemic of 1848-49 had almost entirely subsided in Europe and America by the end of 1851, with the exception of localities first attacked during the previous year, such as Cuba and Jamaica, where the disease was reproduced in 1851.

A remarkable outbreak of cholera occurred, however, during this summer among the inhabitants of the Grand Canary Island; it was one of those isolated cases upon which we naturally set much value in a history of this kind; and we are indebted to Mr. H. Haughton, the British Vice-Consul in the Canary Islands, for the following particulars regarding the epidemic.† He observes, that during the prevalence of the disease in Europe, even when it reached Cadiz, the Canary Islands, as well as Madeira, were preserved intact. The cholera had latterly been making great ravages in

* 'Lancet,' 1851, p. 40.

† 'The London Medical Gazette,' New Series, vol. xiii, 1851, p. 130.

the West Indies. "About the 8th or 9th of May a vessel arrived from Havannah, *with a clean bill of health*, and was consequently admitted to pratique without any preliminary fumigation. It is said that the first house in San José (a suburb principally inhabited by poor people) in which the disease made its appearance, was that of a washerwoman, who had taken the mattress and foul clothes of one of the poorer passengers to wash, and that her children slept upon them during the night. Death soon followed; one neighbour after another was slowly, but gradually, attacked; the seed had found its appropriate soil, and slowly, but too surely, germinated." Supposing the articles from this vessel to have been landed about the 14th of May, four or five days after her arrival in the port, it was just fifteen days subsequently that the first case of cholera occurred, the disease having commenced on the 30th of May. It spread rapidly from the quarter of San José. Mr. Haughton remarks—"No pen can give an idea of our sufferings. It has been left to this insignificant place to complete the picture of horrors so ably described by Daniel Defoe." No less than 9000 deaths occurred among the inhabitants of this small island, and most of them within the space of a few days; the disease commencing on the 30th of May, and being at its height on the 10th of June. It began to decline on the 16th of the month.

The island was, of course, cut off from "all communication with the other islands" by order of the Spanish authorities; and Mr. Haughton particularly notices the fact, that neither Teneriffe nor any other of the neighbouring islands was affected by the disease; the cholera being absolutely and completely shut up in the Grand Canary Island, in consequence of the strenuous

enforcement of the laws to prevent people escaping from the pestilential spot.

Theories of Cholera, as affecting subsequent research.—It is hardly possible for us to pass over this period in the history of cholera, without alluding to some of the more important theories advanced at the time to explain the phenomena of the disease; for these theories evidently exercised an important influence upon the line of investigation followed by inquirers in subsequent epidemics. I must, therefore, briefly consider these hypotheses, without expressing an opinion at present as to their value; for, as we progress with our history, we shall find that much light has, within the last twenty years, been thrown upon the circumstances attending the outbreak and propagation of the disease, of which we may well avail ourselves before coming to a conclusion on the very difficult subject of the etiology of cholera.

It was from observations made during the epidemic of 1848-49, that Dr. J. Snow promulgated his ideas as to the poison of cholera being swallowed, and acting directly on the mucous membrane of the intestines, at the same time being reproduced in the intestinal canal, and passing out, much increased in quantity, with the discharges; he believed that these discharges afterwards, in various ways, but chiefly by mixing with the drinking water in rivers and wells, reached the alimentary canals of other persons, and produced the like disease in them.*

Dr. W. Budd, of Bristol, in a letter to the 'Times,' dated September 5th, 1849, expresses a somewhat similar opinion as to the cause of cholera. He supposes the disease to depend on a living organism—a distinct

* 'On the Mode of Communicating Cholera.' By J. Snow. London, 1849.

species of fungus, which being swallowed becomes infinitely multiplied in the intestinal canal, and the action thus excited causes the flux of cholera, which, with its consequences, constitute the disease. These organisms Dr. Budd believes to be disseminated through society by their contact with food, but principally by the drinking water of infected places; and he consequently recommends, as the most important means for preventing the progress of cholera, to destroy the poison, which continues to be generated in the bodies of infected persons, by mixing the discharges with some chemical fluid known to be fatal to beings of the fungus tribe, such as chloride of lime. And as water is the principal means of the dissemination of the disease when it exists, too much care cannot be exercised in procuring pure drinking water.

The idea of cholera depending upon the presence of a fungus growth affecting the epithelium of the intestinal canal, had, however, originated with Boehm in 1838. This distinguished observer not only then described, but depicted, forms of cryptogamic growth amid the débris of the epithelium in choleraic dejecta. He remarks, that the matters found in the intestines after death from cholera “teem with vegetations of micro-fungi, and that innumerable round, oval, or elongated corpuscles are to be found in all the vomits and dejections, as well as in the intestinal canal; sometimes single, sometimes two, three, four, or more, joined end to end, as links of a chain.”* Dr. Swayne published drawings of “cholera cells” in the ‘Lancet’ for October 13th, 1849; but these were subsequently discovered by Mr. Busk to be the spores of a species

* J. Simon’s ‘Report to the Privy Council for 1866,’ p. 518.

of uredo, and other extraneous matters introduced into the intestinal canal with the food.*

Dr. W. Farr, reporting on the epidemic of 1848-49 in 1852, states that Asiatic cholera is induced in man by a certain specific matter, the zymotic principal of cholera, which he proposes to call *cholerine*. "A variety of that matter was produced in India in certain unfavorable circumstances; it had the property of propagating and multiplying itself in air, or water, or food, and of destroying men by producing in successive attacks a series of phenomena which constitute Asiatic cholera." He adds—"That *cholerine* is an organic matter cannot, I think, be doubted by those who have studied the whole of its phenomena, and the general laws of zymotic disease. The great questions remain—Is *cholerine* produced in the human organization alone, and propagated by excreted matter? Is it produced and propagated in dead animal or vegetable matter, or mixed infusions of excreta and other matters out of the body? Is it propagated through water, through air, through contact, or through all these channels?" †

The London College of Physicians, in their report on the epidemic of 1848-49, published in 1854, replied to several of the questions put forward by Dr. Farr. The college gave it as their opinion that, on the whole, they consider Dr. Snow's theory untenable, observing "that 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." ‡

* 'Lancet,' October 27th, 1849, p. 460.

† 'Report on the Mortality of Cholera in England in 1848-49,' p. lxxx. By Dr. W. Farr.

‡ Drs. Baly and Gull's 'Report,' p. 213.

The college were also of opinion that "the theory that the cause of the disease is a general state of the atmosphere," a general "atmospheric influence," or "epidemic constitution," has been found untenable;* they believe "that human intercourse has, at least, a share in the propagation of the disease; and that, under some circumstances, it is the most important, if not sole means of effecting its diffusion,"† "the poison attaching itself to the surface of bodies, to the walls of rooms, and to furniture; it will also be collected by the clothes of persons living in infected dwellings, will be carried by them from place to place, and, wherever it meets with conditions favorable to its increase and action, will produce fresh outbreaks of the epidemic."‡ The college, however, observe—"it by no means follows that cholera is always propagated in this way; it may spread independently of communication between the sick and the healthy; the agent then most likely to have conveyed the poison from one spot to another is the wind."

Having discarded Drs. Snow and Budd's theory as to the origin of the disease, they formed the hypothesis, that it was necessary for the spread of cholera that the poison should be received into a congenial nidus, in which it might multiply and exercise its terrible power upon human beings susceptible of, and brought within, its influence. By means of this theory, the extraordinary exemption of certain localities from the disease was explained, the poison itself not having been carried by human beings, or the wind, into these exempted places; or if introduced, and no deleterious

* Drs. Baly and Gull's 'Report,' p. 214.

† Idem, p. 218.

‡ Idem, p. 221.

effect following, it was argued that the poison could not have been delivered into a nidus fitted for its growth. It was impossible to disprove the negative propositions put forward by the college; but they very certainly did not furnish a satisfactory solution to Dr. Farr's questions, although elaborated with extraordinary skill, learning, and ingenuity. Men naturally began to inquire for some more tangible evidence of the existence of this subtle poison, and wished for more explicit information as to the nature of the nidus necessary for its growth and propagation.

We must, however, return from the land of speculation, in which, it appears, most writers on cholera love to dwell, and study the somewhat dry details connected with the progress of the disease from one part of the earth to another. It is only by bringing into regular order the scattered records we possess on the subject, that we can hope to arrive at definite conclusions as to the etiology of the disease. I am confident, however, that, with a history of the kind before us, we shall, by means of a carefully considered process of inductive reasoning, be enabled to form positive conclusions as to the laws which govern the spread of cholera among mankind; and if so, it will not be too much to expect, that we may be in a position to point out the means for its suppression, though not for its cure, when once it has attacked a human being.

History of Cholera in India from 1848.—The Indo-European Epidemic of 1850-54.—I have endeavoured to describe the course pursued by the Indo-China cholera of 1843-44-45 in its passage over Europe and America (1846-47-48-49); we have noticed its steady advance, and its decline towards the end of 1851. In the mean time, epidemic cholera had again broken out

in India; so that, while the disease was on the wane in Europe, it was recruiting its energy in this country, and was destined soon to burst forth again beyond its natural limits, and overspread the greater part of the civilised world with unprecedented fury.

India was, on the whole, comparatively free from cholera in 1847, the epidemic of the previous years having died out, and but few cases being heard of beyond its endemic area. In Bengal proper (that is from Arrah eastward), among an average number of 22,247 prisoners confined in the various jails, there were 747 cases of cholera during the year.

In 1848, out of an average force of 775 Europeans stationed in Calcutta, there were 20 cases and 13 deaths from cholera. From Dinapore, the Superintending Surgeon reported:—"Cholera first manifested itself in her Majesty's 80th Regiment in the beginning of May; it was then raging in the native bazaar and villages around the station, and had attacked and proved fatal in many instances. Among the native troops, the visitation was, however, of mild character, and the mortality less than usual. The disease has always been prevalent at Dinapore, and may be termed rather endemic than epidemic." We hear but little of cholera at Benares, or Allahabad, in 1848; but there was a terrible outburst of the disease at Cawnpore, among the men of the 1st Bengal Fusiliers. (*Vide* Appendix B.)

The Agra circle was affected to some extent at the same time; for Dr. John Murray endorses Sub-Assistant-Surgeon Dhurnodoss Bose's remarks in the dispensary returns dated October 1st, 1848, to the effect that "cholera, though of a mild type, was generally epidemic from the latter end of August. It

continued in the city (Agra) till the end of September, and then took its way towards the cantonments and the adjacent villages."* The disease did not, however, spread to the troops stationed at Agra; the Punjab, and the country to the north-west of Agra, were free from the disease throughout the year 1848. Dr. F. Corbyn, in his annual report from Lahore, remarks upon the great deficiency of rain throughout the Upper Provinces, and the peculiarly healthy nature of the season.†

Towards the end of the year another outbreak of cholera occurred among the 62nd Regiment Native Infantry, which left Dacca for Monghyr in November, in a fleet of country boats. Before quitting Dacca, it was ascertained that some of the boatmen had died of cholera. The evening after the regiment embarked, the first case occurred among the sepoys; the disease rapidly increased, and Dr. Cumberland, the medical officer in charge of the regiment, reported to the Medical Board that the subsequent confusion and mortality among the men was so great, that it was impossible for him even to collect data as to the number of deaths that occurred, much less give any detailed account of this terrible outburst of disease.

Unfortunately, the proceedings of the Bengal Medical Board have never been compiled for the period now under review; but we may nevertheless trace the history of cholera in this presidency, from the published report and returns of the Government dispensaries. From these documents, dated 1st

* 'Half-yearly Reports of the Government Charitable Dispensaries, 1849,' p. 196.

† 'MS. Proceedings of the Bengal Medical Board.'

October, 1849, I find that, from Midnapore, Sub-Assistant-Surgeon Issur Chunder Gangooly reports, "pestilential cholera prevailed to such a fearful extent in and about the station, that its effects in thinning the population were scarcely less powerful than in 1832." The total amount of rain in June was about $8\frac{1}{2}$ inches, that of the same month last year (1848) was $14\frac{1}{2}$ inches; the total number of rainy days in June of both years was, however, equal. The rains set in on the 19th May, since which date to the end of the month there was scarcely a fine day, the partial and unrefreshing showers being productive of more harm than good. From the 5th to the 9th of June the rain was heavy, and from the latter date to the 15th of the month cholera was at its height.*

From Baboo Gobin Chunder Dutt's report of the Pooree dispensary, we learn that "cholera broke out during the Ruth Jattrra festival, in July; the pilgrims suffered principally." In Gyah, "cholera was not so prevalent in the town, during the period under consideration, as on former occasions, although its severity was very great in the district, where it first made its appearance in April, and continued till August." In Patna, the disease "raged with great virulence in May and June;" it was very bad again in August and September.

From Tirhoot, Dr. Kinsey reports that, during the six months ending 1st October, 1849, "cholera had carried off numbers of the population throughout the district." † Sub-Assistant-Surgeon Nilmadub Mookerjee asserts that the disease "invaded the city of

* 'Half-yearly Reports of the Government Charitable Dispensaries, from 1st April to 30th September, 1849,' p. 34.

† 'Dispensary Reports for 1849,' p. 60.

Mirzapore in the month of May, and, although the duration was not long, yet the ravages were comparatively frightful in the adjacent villages, specially those lying on the southern boundary of Mirzapore. The devastation was terribly frightful; it was reported that the inhabitants fled for refuge to other districts, forsaking their habitations, cattle, and property.”*

Sub-Assistant-Surgeon Tarachand Banerjee reports from Allahabad, that “towards the latter end of May cholera broke out with its usual severity, and carried away many; this disease prevailed epidemically throughout the station and surrounding country.”

In Allahabad and Cawnpore, cholera appeared among the European troops in July and August, and “was raging in the city” during these months.

There were no less than 136 cases and 88 deaths among the convicts confined in the Jubbulpore, Saugur, and Nursingpore jails during the year 1849, and the disease was very prevalent among the inhabitants of these districts.

Dr. Leith informs us, that “cholera made its approach (to Bombay) from the eastward, towards the end of the rains of 1849. It had prevailed more or less severely in the southern ‘Malwatta’ country, and the neighbourhood of Shelapore, in the month of May; and, in the middle of July, in the Ahmednuggur and Poonah collectorates; but it did not then extend further northward.

“During the week preceding the invasion of the epidemic, rain, which had been unusually abundant, fell daily, and at the rate of $1\frac{3}{4}$ inches a day, and the southwest monsoon blew during the same week with a force varying from $1\frac{1}{2}$ to 5 lbs., or an average of $3\frac{1}{2}$ lbs. on

* ‘Dispensary Reports for 1849,’ p. 60.

the square foot, which is equivalent to a velocity of more than 25 miles an hour, in a direction contrary to that in which cholera advanced.

“The first four fatal attacks took place in the three different divisions of the island; and from 4th to 12th August the fatal cases that occurred, fifteen in all, were scattered over four divisions, six districts, and twelve streets, some of which were widely separated from each other by densely-peopled portions of the town. These fifteen sufferers belonged to seven different castes, and eight different occupations, and none of them had recently arrived in Bombay.”

Throughout the year 1850, cholera was reproduced with considerable virulence over the whole of Bengal proper; Cachar, Sylhet, and the eastern districts suffering very severely.

In August it “raged with great violence at Jubbulpore;”* the prisoners were attacked by the disease, but, being speedily removed from the jail, it disappeared from among them. Dr. J. Squire reports the prevalence of cholera at Seuni and Baitool † throughout the hot and rainy season. It is evident, therefore, that the south-western districts of the Bengal presidency were under the influence of epidemic cholera in 1850; and at the same time the disease was severely felt in Bombay, as is shown by the following table:—

<i>Years.</i>	<i>Number of deaths registered from Cholera in Bombay.</i>				
1848	69
1849	2269
1850	4729
1851	4020
1852	1135
1853	1339

* ‘MS. Proceedings of the Bengal Medical Board for 1850.’

† Idem.

Dr. W. Mackenzie, C.B., Principal Inspector-General of the Indian Madras Medical Service, has been most kind in furnishing me with information, and, among other papers on cholera, a return showing the number of cases and deaths from the disease among the troops of the Madras native army. It would appear from this document, that cholera was rather more prevalent than usual in the Madras presidency in 1849-50; but it is unnecessary for me to adduce further evidence as to the fact of the progressive generation of cholera from east to west in 1849, the mortality from the disease being very great along the western seaboard of India in 1850.

In 1851, the disease broke out in the south of Persia. M. Robinet submitted to the Academy of Medicine at Paris the following note, dated Constantinople, October 28th, 1851:—"The cholera, after having ravaged Basoorah and the Persian frontier, has arrived at Bagdad, where it is committing great ravages. In twenty days it has attacked 1008 persons."*

In August, 1852, the disease was generated in the province of Azerbaijan, ravaging its capital Tabreez, with great fury. It spread to the shores of the Caspian, but did not pass into Russia until the following year.

The question naturally arises, as to the origin of this outburst of cholera,—did it spread from the Persian Gulf up the Tigris to Bagdad, and so to Tabreez, or did it travel, as on previous occasions, from northern India *viâ* Herat and Mushed? I fear our knowledge on this point is very defective. It is quite certain cholera did prevail to a very great extent over the north-western provinces in 1850-51. The civil surgeon of Muttra, in his 'Jail Report' for 1850, expressly

* 'Medical Gazette,' vol. xiii, 1851, p. 953.

states that the mortality from cholera in the middle of August was very considerable, especially among the pilgrims.

From the half-yearly dispensary returns ending 1st October, 1852, I find that "cholera prevailed to a very great extent in July at Bareilly."* At the same time it broke out in the Mooradabad district, and "prevailed epidemically to the end of September." "In the early part of 1852, extensive works of irrigation were in progress at the foot of the mountains in Kumaon. Several thousand workmen were collected there from the neighbouring hills. Cholera broke out among these people with great virulence, and they fled panic-stricken to their homes, which were generally at a distance of several days' journey in the interior of the hills. Up to this time, cholera had been unheard of in Gurwhal, or in any of the neighbouring mountains. This is a fact that was carefully inquired into and thoroughly ascertained. Many of the work-people who fled from Kumaon died on the way to their homes; many others were attacked when they reached their villages. There, cholera broke out among the other inhabitants of the villages, commencing, in very many instances, in the families of the men who had brought the disease from below. For a considerable time cholera was entirely confined to places which had been in direct communication with persons suffering from the disease; but in the course of a few weeks it had become impossible any longer to trace such connection, and cholera became generally epidemic through the hills."†

* 'Half-yearly Reports of the Government Charitable Dispensaries, from 1st April to 30th September, 1852,' p. 227. Calcutta, 1854.

† 'Report of the Commissioners appointed to Inquire into the Cholera Epidemic of 1861,' p. 202. Calcutta, 1862.

In the district of Kumaon, it “made great ravages,” appearing at Almorah from May till the end of July.* It was fearfully bad at Deyrah Doon and Seharunpore, whence it spread to Umballah.† Sub-Assistant-Surgeon Rajkristo Chatterjee reported from Simla, that “during the hot months of July and August, when the atmosphere was close, and there was an uninterrupted fall of rain, the interior was visited by cholera, which was strictly epidemic in its character, and carried away numbers of poor people. From the intelligence received from W. Edwards, Esq., and the Reverend Mr. Merk, of Kotgurh, we immediately sent a native doctor, with cholera medicines, to meet the wants of the poor people occupying those hills. At about the same time cholera broke out in the western confines of Simla, at Jottogh, whence it entered the station, but did not commit much damage among its inhabitants.” Mr. Tameezkhan only met with “one genuine case of blue or spasmodic cholera at Lahore.” From his returns, however, it appears “cholera biliosa” was more common.

At the same time, therefore, that the disease was spreading over Central India and Bombay, and from thence to the Persian Gulf, it was being generated from east to north-west, over the Punjab and Himalaya; but in this direction I am unable to trace it any further. Supposing, however, the disease to have pursued the path it had followed on previous occasions—through Cabul and Mushed to Teheran—it would have appeared in this latter place in the summer of 1853. And, in fact, a fearful outbreak of cholera occurred in the north

* ‘Half-yearly Reports of the Government Charitable Dispensaries, from 1st April to 30th September, 1852,’ p. 262. Calcutta, 1854.

† Idem, p. 308.

of Persia in May and June of that year, which, I cannot help thinking, must have been partly due to an offshoot of the Punjab epidemic of 1852. It is true we have traced the cholera *viá* Basoorá to Bagdad and Tabreez in 1852, and it may be that the epidemic of 1853, in the north of Persia, was simply a reproduction of this cholera; but the disease was so fearfully destructive, striking with such irresistible force the inhabitants of Teheran, that I am inclined to believe it originated from the sources above indicated, being, in fact, an offspring of the Bombay cholera of 1849-50, and in addition receiving fresh vigour from the Punjab cholera of 1852.

The question has already been put to me more than once, as to the practical advantage of entering into these details regarding the course taken by various epidemics of cholera in their passage over India, and from thence to Europe and America. It appears to me, however, that this is one of the most important subjects we can possibly study in connection with cholera; for, by accurately defining the various outlets from India, which have from time to time been taken advantage of by this insidious enemy of mankind, we may hope to bar its exit from its breeding ground on future occasions; and supposing it eludes our vigilance here, we may still, though with less hope, trust to thwart its advance along its accustomed course, provided we are thoroughly acquainted with its habits. Moreover, the laws which regulate its production beyond India must govern its spread from place to place and from man to man in this country; but here, the fact of its being endemic in many localities very considerably complicates the case; and it is with the hope of throwing some light upon this difficult subject, that I have at-

tempted to describe the phenomena presented by the disease in Europe as well as India.

During the months of May and June, 1853, cholera burst out among the inhabitants of Teheran; 15,000 persons out of a population of 100,000 are said to have perished. It then gradually subsided, having, in the mean time, been reproduced over the whole of the south of Persia.

It is impossible to trace satisfactorily the course of the invading cholera from Persia into Europe in 1853, because the epidemic of 1848-49 had never thoroughly died out. Outbursts of cholera of a very serious nature had, for instance, taken place in 1852 at Moscow, and in several other towns in Russia, and also in Prussia. Egypt, Malta, and the Ionian Islands were still under its influence, as well as many parts of America and the West Indies, consequently we have not the same opportunities for tracing the fresh importation of cholera into Europe from Persia in 1853, which we had in its former visitations. It is now, in fact, beyond our power to determine with any certainty, when and where the former epidemic ended and the new one began.

We may, however, assert with confidence, that cholera of a virulent type was widely disseminated over Russia during the summer of 1853. Sweden, Norway, Denmark, Hanover, and Holland, together with numerous towns in the north of Prussia, suffered from the disease. Nor did the south-eastern and central parts of Europe escape the influence of this epidemic. Numerous places in Bessarabia, Moldavia, and Wallachia, besides the towns of Odessa and Jassy, were attacked in August and the latter part of the year. Piedmont, Barbary, and certain districts of Portugal were af-

fect. France was under its influence in the autumn, but had suffered considerably from choleraic disease in the spring.*

In London a number of "suspicious" cases had occurred in the winter of 1852; but in January, 1853, no instances of death from cholera were registered. As the temperature rose in July, "diarrhœa, as well as the *common form of cholera*, became fatal in the metropolis; and a few deaths from *cholera of the Asiatic form* were registered in August in the low districts by the side of the river. Several deaths by the disease occurred in September and October, while the temperature fell, and diarrhœa decreased from 723 in August to 283 in October; but during this time the cholera spread and became more fatal, so that the deaths from it were 335 in October and 228 in November, 43 in December, 1 in January, and another in February (1854). There were no deaths in March; only 4 in April, 4 in May, and 3 in June."†

New York and New Orleans were both invaded by an apparently fresh epidemic of cholera towards the close of the year 1853. Mexico suffered severely, and the disease was widely extended over the whole of the West India Islands.

In 1854, cholera was reproduced throughout nearly every country in the Old and New World. Europe and America had never before been so terribly stricken by this fearful disease, for hardly a single province, and but few large towns, escaped its deadly influence.

* Dr. Gavin Milroy "On Cholera," 'Medico-Chirurgical Review,' October, 1865, p. 451.

† 'Report of the Committee for Scientific Inquiry in Relation to Cholera of 1854.' London, 1855.

Incidents of the Epidemic in Europe, and their bearing on the Etiology and mode of Propagation of Cholera.—Both Varna and Odessa were known to be affected with cholera early in 1854, as well as the countries near the mouth of the Danube; it attacked the Russian and Turkish forces on either bank of this river. Later in the season, the English and French armies were first affected at Varna, where, as we have already observed, cholera existed earlier in the year. Dr. Marroin, the chief physician to the French fleet, assures us that cholera effected its entrance into the Black Sea on the 13th and 14th of July, with the ships *Primaugult* and the *Magellan*, from Gallipoli. The disease spread from these vessels to the army at Varna. The cases on board the French fleet in Baltchick Bay were by no means numerous till the 7th of August, when free communication was opened between the fleet and General Bosquet's division of the army, at that time ravaged by cholera. Two days afterwards, the disease broke out with extreme violence on board the ships. From the 9th of August the epidemic assumed great proportions; in three days it attained its maximum of intensity, and terminated at the end of ten days.*

Dr. Linton informs us, that the disease was said to have been imported into Bulgaria in the early part of June, 1854, by a French vessel which arrived at Varna from Marseilles, bringing troops from Avignon, already under the influence of cholera. Several cases of the disease occurred on board the ships on their passage to Varna. From the time the troops landed from this vessel, cholera spread progressively through the town

* 'Cholera Conference at Constantinople, 1866,' p. 104. Calcutta, 1868.

and allied forces, attacking the French and Turks simultaneously, and afterwards the English; no class of people, no description of locality, obtaining an exemption from it.*

In the English fleet it first appeared in the *Diamond*, on the 16th of July, ten days after the arrival of a French steamer from Toulon, in which cholera was prevalent. "At the time of the outbreak of the cholera, the population of the British fleet numbered 12,572 men. These men, all living under the same conditions, except in one particular, yielded 710 cases of cholera and 397 deaths. Of these cases in the gross, 91·26 per cent. of the men attacked were supplied with water derived from springs at Baltchick, a spot on which French troops had been quartered while suffering from cholera; the troops had washed their clothing at these springs, and the ground for a great distance around was saturated with their excreta. The remaining 8·74 per cent. of the infected were supplied with water partly from Baltchick. Three other crews of vessels suffered from severe diarrhoea. Of these, two positively took in water from Baltchick, and the third probably so. In one vessel which used distilled water (water condensed from the steam of the engines), cholera broke out; on examination, it turns out that this water was passed to the tank through a foul hose pipe. In all the other ships supplied with distilled water not a case occurred. The officers in such ships as were attacked suffered in the proportion of 1 in 177, the men in the proportion of 1 in 16·29."

* 'Medical and Surgical History of the British Army in the Crimea,' vol. ii, p. 47. Presented to Parliament by command of Her Majesty, 1858.

The comparative exemption of officers may perhaps be accounted for by supposing "that the men partook most freely of the infected water with which the ships were supplied, without disinfecting it by heat. The officer took his wine, tea, or coffee; the sailor, his grog. That the disease did not become distributed amongst the crews by mere personal contact with the infected, is proved by the fact, that in one ship several infected persons were removed, and there was not a case of communicated disease amongst those who received them."*

Cholera commenced in the British army in June; it increased in prevalence for three months and then subsided, disappearing entirely in February, 1855. There were no cases at all among our troops in March; but it burst out again in April, and reached its culmination in June. From this date the disease declined slowly and irregularly.

Dr. Downes, of H.M.'s 97th Regiment, informs us that the troops in the Piræus were all perfectly healthy until the early part of July, 1854, when a French steamer arrived from Marseilles with cholera on board. "Two cases were landed, and admitted into the French hospital at the Piræus. Asiatic cholera of a malignant kind now made its appearance and rapidly spread; and cases of the disease occurred in various parts of the town." The disease continued to prevail from the 19th of July to the 26th of August, when it gradually ceased.† Greece, from her peculiar relations, had been able to isolate herself from the rest of the world

* Dr. B. W. Richardson "On the Propagation of Cholera," 'Transactions of the Epidemiological Society,' vol. ii, part ii, p. 425.

† 'Medical and Surgical History of the British Army in the Crimea,' vol. ii, p. 47, 1858.

in the epidemics of 1832 and 1849, and had been absolutely free from cholera. In 1854, being under exceptional circumstances, and occupied by a foreign force, over which she had no control, cholera effected its entrance into the country. In 1865, this source of danger being absent, she again entirely protected herself from the cholera which was raging around her.

Surgeon De Lisle informs us, that the disease was introduced into Gallipoli by a French vessel from Marseilles, on the 10th of July; on the 19th, several cases occurred in a British hospital, situated in the track of communication between the French camp and the town. Another hospital, the position of which was more unhealthy, but in a retired quarter of the town, entirely escaped a visitation of the disease.*

The ambulance corps were, of course, brought much in contact with the sick, and "there was scarcely any portion of the army more cruelly assailed by cholera. The proportion of admissions and deaths in this small body of men far exceeded that of any division of the army."† No less than 86 per cent. of those attacked by cholera died.

With reference to climatic influences and seasons, there was evidently some connection between the outbreak of cholera and the temperature, the heat of summer increasing its severity; and "it seemed evident that the extension of the disease in connection with the quantity of rain which fell was somewhat more than a simple coincidence." Drs. Linton and Lawson observed at Scutari that, in every instance which

* 'Medical and Surgical History of the British Army in the Crimea,' vol. ii, p. 47, 1858.

† *Idem*, p. 53.

occurred, the outbreak of the disease seemed to have been coincident with a change from dry weather to a humid state of the atmosphere; while the cholera continued to prevail, the barometric pressure was excessively high.*

Few facts were presented among our troops of a kind calculated to support the opinion "that cholera was in any degree capable of being extended by contagion; but it appeared to spread in lines radiating from certain foci of diffusion." "The determination of the pestilence to run a certain course would seem, indeed, to be almost a fixed law of its nature, which acknowledges few diverging causes." If so, how are we to account for the fact related at page 67 of this report, where it is stated:—"We have known a regiment to be exempt from the disease for two years in India, and yet, after leaving the station to proceed on service, five cases, three of which proved fatal, occurred during the first march. In this case, it was curious to notice that, although the regiment subsequently marched without interruption nearly 400 miles, no instances of the disease were presented." Moreover, there was evidently an exception to the rule, as to the invariable course pursued by the disease, in the case of new comers into an infected locality. Recruits, and men fresh from England were far more likely to be attacked by cholera than men who had gone through the campaign.

The symptoms which characterised the disease in the Crimean army were of the ordinary nature. Premonitory diarrhoea very frequently ushered in the attack, but did not usually merge into cholera by

* 'Medical and Surgical History of the British Army in the Crimea,' vol. ii, 1858, p. 82.

gradually becoming more severe. Dr. Muir, of the 33rd Regiment, remarks that, "in many instances, the attack was sudden; there were no premonitory symptoms, but sudden collapse, or violent cramps of lower extremities, diarrhoea and vomiting being altogether absent." The secondary fever was more than usually severe; in fact, Dr. Horne states, that in the fatal cases more than one half the deaths occurred during the stage of secondary fever. The total number of cases during the war amounted to 7575, and of these 4513 died.

Although it is impossible to fix the date and circumstances of the advent of cholera in England in 1853-54, we may with advantage consider its progress in certain localities, as for instance in Newcastle, which suffered most severely during this epidemic.

The Tyne, as is well known, is a tidal river, and during its flow it carries up the sewage of Newcastle as far as Elswick, where, in 1853, the open culvert of the water company supplying the town was situated. A large drainage area at Whittle Dean had usually yielded water for the purposes of the company; but early in 1854, the supply from this locality having been partially cut off, the company took upon themselves to pump water directly from the Tyne at Elswick, into the town; the inhabitants of Newcastle were, therefore, constantly imbibing water contaminated with the filth of their own dirty city. We may conceive the nature of this drinking water when it is stated, that no less than two thirds of the population of Newcastle were without privies, and the filth accumulating in the streets was washed down into the river by the rain, and, as already explained, carried up in a diluted form

to Elswick, to be re-distributed to the inhabitants of the town for domestic purposes. Supposing cholera to have existed in Newcastle, it is evident that the dejecta of those affected would very probably, under these circumstances, have found their way into the intestinal canals of the unfortunate townspeople; the more so as, directly cases of the disease occurred, the authorities betook themselves vigorously to washing out and flushing all the drains and dirty holes in the place, thereby increasing the chances of cholera fomes finding their way into the river, to be consumed by the population. It is quite certain that the drinking water contained organic matter, for Dr. Thomson found it in abundance by analysis, and considered it probable that a portion of it consisted of human excrements. And Mr. Furness, during the height of the epidemic, exhibited a bottle of drinking water to the guardians of the city of "a most noxious quality." I may observe, however, in passing, that although this impure water was consumed from May till the end of August, 1854, it had not up to that time generated cholera among the inhabitants of the place.

On the 29th of August, a woman living at Bill Quay, where cholera was known to exist, was attacked with diarrhœa. She proceeded to Newcastle by steamer, and the case was declared, on the 31st of August, to be one of cholera. On the 1st of September, 3 deaths from cholera were reported in the town; and by the 9th, Mr. Granger states, the disease "was epidemic" in the city. On the 12th, there were 59 deaths, and on the 15th no less than 140 individuals fell victims to the disease. In the mean time the scandalous proceedings of the water company had been discovered, and on the 15th of the month the supply of water to

the town from the Tyne was stopped. From that date the cholera began to diminish.* On the 25th the deaths had fallen to 75 per diem, and on the 30th to 16, after which not more than 4 deaths occurred on any one day.

A still more remarkable instance of the kind is Dr. Snow's well-known Broad Street case, which was one of a succession of partial local outbreaks of the disease, which have always been a marked feature of cholera, attributable, by the majority of authorities at the time, to "the localising cause" plus an "epidemic or pestilential constitution of the season."†

It appears that among the sub-districts of St. Ann's, Golden Square, the mortality from cholera in 1854 was no less than 128 for every 10,000 persons, while the general cholera-rate of the metropolis was only 60 to the same number. The district was not situated on a low level, nor were its inhabitants very poor; it had enjoyed a peculiar exemption from disease up to the time of the outbreak of cholera.‡

A child who had been ill with cholera, or choleraic diarrhoea for three or four days, died at No. 40, Broad Street, on the 2nd September, 1854, and it was ascertained that the child's fæces had been emptied into a cesspool, situated only three feet from the well of the public pump in Broad Street, from which most of the surrounding people took their supply of water. It was further discovered that the bricks of the cesspool were loose, and allowed its contents to drain into

* 'Report on the Epidemic Cholera of 1866 in England,' p. xxxiii. By the Registrar-General.

† Dr. E. H. Greenhow "On Cholera," 'Medico-Chirurgical Review,' 1857, p. 53.

‡ 'Report of Committee for Scientific Inquiries into the Cholera of 1854,' p. 50.

the pump well.* On the night of the 31st of August cholera broke out among the inhabitants of Broad Street, the greater number of cases occurring on the 1st of September. On the following day, the attacks fell from 143 to 116, and the day after to 44; by the 12th of the month it had almost subsided. Dr. Snow and the Reverend J. Whitehead investigated the circumstances of this case with the greatest care; nor have the facts they brought forward ever been disproved. These gentlemen affirm:—"It was found that nearly all the persons who had the malady, during the first few days of the outbreak, drank of the water from the Broad Street pump, and that very few who drank of this water during these days escaped having cholera."

In the weekly return of deaths for September 9th, the following was recorded as occurring in the Hampstead district:—"At West End, on 2nd September, the widow of a percussion-cap maker, aged 59 years; diarrhoea 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

* 'Lancet,' vol. ii, 1855. p. 456.

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 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.* On examining the Broad Street pump water, Dr. Snow found it to contain organic matter in the form of "small white flocculent particles," which, Dr. Hassall thought, "resulted from the decomposition of other matters."

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 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."† 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

* 'Mode of Communicating Cholera,' by Dr. J. Snow, pp. 44, 45. Second Edition. London, 1855.

† 'Report of Committee for Scientific Inquiries into the Cholera Epidemic of 1854,' p. 52.

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. Dr. Thomson had furnished them with an admirable report and analysis of these waters, and Dr. Hassall had given them an equally valuable paper upon its microscopical appearances. He had found, in most of the drinking water, organic matter and living particles, but only of "species which are known, and which have been long since described in systematic works; and since the greater number of them are present in these waters at nearly all seasons, and since they are, therefore, constantly consumed, it is clear they are in no way concerned in the production of cholera."*

Nevertheless, it was shown, that in two large sections of the population of London, "breathing the same atmosphere, comprehending 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

* 'Committee's Report,' p. 47.

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 ten per cent. higher.* 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 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.

The Committee for Scientific Inquiries extended their investigation into the meteorological phenomena of the season of 1853-54, and their efforts in this direction were most ably seconded by Mr. Glaisher, of the Royal Observatory. The conclusions arrived at on this subject were,—“1st, that 1854 and other years, when cholera prevailed, had their marked meteorological characters, the general tendency of which was to

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

render the season defective in those atmospheric changes which renew the purity of the air ; and 2nd, that these characters, apparently so definite in their meaning, are in their kind such as to prevail with greatly increased development in those low levels of London, where all visitations of cholera have most cruelly pressed ; for high barometric pressure, excessive night temperature, and hazy air, with absence of wind, of ozone, and of electricity, would all appear in their most marked degrees throughout those alluvial districts. And when these two statements are compared, it seems probable that, in the atmospheric conditions of the year (or some unknown influence essentially joined with them), there has been an important factor for the problem of that epidemic mortality.”*

After reviewing the whole of the materials at their command, the Committee were of opinion, as to the question of the etiology of the disease, that “the doctrine of epidemic cholera, which has gained almost universal acceptance, does not affect to explain what may be that power,—the exciting cause of the epidemic manifestation—which at intervals of time has forayed from place to place about our globe, sometimes vaguely spreading over a widened area, sometimes seeming to move in more defined procession, and which now for the third time has shed its fatal influence on our land.”

“But with this mystery still unsolved, there has grown more and more into shape a doctrine, which is both intelligible and practical,—that the undiscovered power in its wanderings acts after the manner of a *ferment*, that it therefore takes effect only amid congenial circumstances, and that the stuff out of which

* ‘Report of the Committee,’ p. 34.

it brews poison must be air or water abounding with organic impurity. Taking this as hypothesis, and testing it by the facts before us, we find that it would include and explain them.

“Either in air or water, it seems probable that the infection can grow; but, on the whole evidence, it seems impossible to doubt that the influences, which determine in mass the geographical distribution of cholera in London, belong less to the water than to the air.”*

“Exemption from the mortality has followed more nearly the degree of elevation of the soil than been proportionate to any other general influence; and on the supposition (which this result greatly confirms) that the choleraic infection multiplies rather in air than in water, meteorology explains how the balance of healthfulness is weighted in favour of the higher levels, by their less participation in the high night temperature of the metropolis, by their comparative clearness from mist, and, above all, by the curative resources of more free ventilation.”†

We can hardly fail to trace in this résumé of the etiology of cholera, written in the inimitable style of Mr. Simon, a reiteration of the opinions of Drs. Baly and Farr, as expressed in the College of Physicians and Registrar-General's reports on the epidemic of 1848-49. It will be noticed how admirably the zymotic theory and that put forward by the College of Physicians are interwoven, the combination being such as only a master hand could produce,‡ and yet the work was unsatisfactory, especially to the school led by Drs. Snow and Budd,

* ‘Report of the Committee,’ p. 48.

† Idem.

‡ The committee from whose report I have quoted so freely was composed of the following eminent men:—Drs. N. Arnott, W. Farr, W. Baly, and Messrs. R. Owen and J. Simon.

and which at this time was extending its influence, and attracting the attention of many hard-working and thoughtful men, both in England and on the continent.

Professor Pettenkofer, of Munich, in 1855, attributed the propagation of cholera to the rice-water stools of patients in a state of fermentation;* a doctrine advocated, as I have already shown, by M. Baycr in 1832. Pettenkofer believed in the necessity for the introduction of a ferment from without for the production of cholera, but was of opinion that this ferment can only act where it meets with suitable local conditions. According to this authority, a special leaven sets up a zymosis or series of decompositions in the impure soil itself, and the special poison of cholera is a miasm generated from this earthy fermentation. While, therefore, he considered the presence of a special ferment as essential to the production of a cholera epidemic, he also insisted upon the co-existence of certain local peculiarities. These he supposed to consist of a damp subsoil, sufficiently porous to be penetrable by the decomposition products of human and animal excrements. He was of opinion that it is only in such a soil, thoroughly impregnated with this peculiar organic matter, that the special cholera poison is generated.

Hence, as Dr. Greenhow observes, Professor Pettenkofer asserts the susceptibility or insusceptibility of towns, for a cholera epidemic, to be in exact proportion to their soil relations. The difference between the mortality from cholera in the upper and lower terraces of

* These observations are copied from Dr. E. Headlam Greenhow's review (in the 'Medico-Chirurgical' for 1857, p. 66), of "Untersuchungen und Beobachtungen über die Verbreitungsart der cholera, nebst Betrachtungen über Massregeln derselben Einhalt zuthun." Von Dr. Max Pettenkofer. München, 1855.

London, is attributed to the dry gravelly soil of the former, which allowed all the impure matters for decomposition, to gravitate towards the moist closer soil of the lower levels, where it underwent a much slower decomposition. Single cases may occur, Dr. Pettenkofer says, in towns or houses whose foundations are built on a rock, but never epidemics; and any exceptions to this rule will, upon closer examination, be found more apparent than real. Arguing from this presumed fact, he abandoned all ideas of air or water as the nidus of cholera, and sought for it in the soil alone.*

The ferment supposed by Dr. Pettenkofer to be necessary to set up the peculiar decomposition of which cholera poison forms one of the products, is the matter of the dejections of cholera patients. His notion was that the cholera-germ-bearing excrement, which spreads itself in the damp porous soil already impregnated with faecal matters, produced, by means of the fine division which it there underwent, such a modification in the process of putrefaction and decomposition, that, in addition to the gases usually formed, a cholera miasma was produced, which became diffused through the atmosphere of dwellings, in common with other exhalations. Thus, although the cholera miasma was formed in the ground, the air was the vehicle for its transmission to the patient. He considered the dejecta of persons suffering from diarrhoea or cholericine, equally capable with the cholera dejections of producing the pestilence.

In confirmation of his theory, Dr. Pettenkofer gives the following history of the introduction of cholera into the convent prison of Ebrach, where both the male and female prisoners were attacked, whilst the

* 'Dr. Greenhow "On Cholera," 'Medico-Chirurgical Review,' 1857.

officials, a company of soldiers quartered there as a guard, and the inhabitants of the adjoining village, entirely escaped. In the first place, however, we may notice that the "necessary" accommodation of the prison consisted chiefly of wooden night stools.* Such privies as existed for the use of the prisoners, emptied themselves into a stream, which, entering at the women's division, ran through the institution, and passed out at the men's side. The privies in the female division were thoroughly bad; the brickwork through all the floors being impregnated with excrement; "the stink was a pestilential one," and the excrements were conveyed from the privies to the ditch by means of wooden spouts, passing close to the entrances of the working or sleeping rooms. Into this very objectionable jail a prisoner was brought on the 20th of August, suffering from diarrhœa, which soon became developed into cholera. On the 27th, the man who attended him was taken ill with cholera and died; an epidemic spread through the jail, affecting the male and female divisions equally, although there had been no intercommunication between them, except through the officials of the place, all of whom remained free from the disease. But among the females, it was discovered, that the first case occurred in a woman who had washed the linen of the patient admitted into the prison with cholera.

There were 600 male prisoners, arranged in classes, between which there was little communication, yet the disease showed itself speedily throughout all parts of the prison, reached its climax in the men's division on 11th of September, in the female on the 13th, and then declined, having carried off about ten per cent. Dr. Pettenkofer attributed the

* Dr. Greenhow's 'Review,' p. 77.

outbreak to the fermentation set up in the excreta brought into the jail by the first case, and which were thrown into a large cesspool in the garden, and the badly arranged "necessaries" of the women's department, into which all their dejections were emptied.

The same author also mentions the fact, of cholera having been introduced into the prison of Kaisheim in 1854 by two prisoners. Nothing could have been worse, he says, than the hygienic state of this jail, but the stools of the cholera cases, and all others, were subjected to disinfection, and not a case of cholera occurred among the other prisoners.

The same results were observed at Traunstein, in Bavaria, when sulphate of iron was employed as the disinfecting agent, and the disease in every instance contented itself, contrary to its usual habit, with the first victim.* In England, Dr. Budd used similar means, and with admirable effect, to stop an outbreak of cholera at Horfield Barracks, near Bristol. He recommended that the dejecta of all the patients should be received into vessels containing a strong solution of chloride of lime; that the soiled linen should be burnt, latrines disinfected, the troops to be kept under constant observation, so as to catch the disease in its first stage, and lastly, that the men should be prevented from wandering from their barracks into infected localities.

The above are a few among many cases of the kind recorded during the epidemic of 1853-54, not only as evidence of the value of disinfectants in cholera epidemics, but as proving the direct influence exercised by cholera dejecta in causing the spread of the disease.

Another class of cases occupied the attention of several observers during the epidemic of 1854, from

* 'Constantinople Cholera Conference,' p. 44. Calcutta, 1868.

which it was intended to demonstrate, not only that the fæces of cholera patients generated cholera in otherwise healthy people, but that articles of clothing soiled with these dejecta might induce a similar result. I have already referred to a case in point related by Sir J. Simpson, which occurred at Moor Monkton, in 1832. In 1854, cholera was not known in the county of Bedford, when 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, was seized with the disease and died; his case was the nucleus of the others.* An instance of a similar nature was reported from Lustheim, near Munich, where 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 (September 21st, 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 mean time had been kept locked up.†

* 'On Malaria and Miasmata,' p. 140. By Dr. J. Barker, F.R.S. London, 1863.

† 'Constantinople Cholera Conference,' Calcutta, 1868, p. 95.

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

History of Cholera in the Western World from 1855. Partial Epidemic outbreaks.—During the year 1855, cholera was reproduced over the whole of Europe, a considerable portion of America, and the West Indies. In St. Petersburg and certain other parts of Russia it had almost become endemic, a remark, as we shall subsequently notice, equally applicable to Persia. Our troops, and those of Russia, in the Crimea, were again attacked by cholera in April, May, and June. It was generated over parts of Asia Minor, and Egypt. In France and Great Britain the disease continued to manifest itself in a few scattered localities.†

“The disease appeared in the Island of Fogo, one of the Cape de Verde group, at the beginning of July; it was supposed to have been imported by a Sardinian emigrant vessel from Savona, bound for Buenos Ayres, which had touched Fogo. All that could be learned was, that many of the passengers were in a sickly state, and that there had been some deaths during the voyage; but no reliable information, as to the true nature of the sickness on board, was ascertained at the time. None of the other islands of the group were attacked until the following year.”‡

* Dr. B. W. Richardson “On Cholera,” ‘Transactions of Epidemiological Society,’ vol. ii, p. 427.

† Dr. Gavin Milroy “On Cholera,” ‘Medico-Chirurgical Review,’ 1865, p. 453.

‡ Idem.

In 1856 many parts of Europe again suffered severely from cholera: the coronation of the Czar at Moscow had to be postponed, in consequence of an outbreak of the disease in that city. The basin of the Mediterranean, Spain, and Portugal, were more or less generally affected by cholera; Brazil, British Guiana, and many localities on the Spanish Main and the Gulf of Mexico, were also under its influence.

Cholera had broken out in the Mauritius in 1854. It was said, at the time, to have been introduced into the island by the ship "Sultany," which arrived from India with coolies on board; but, as I have no detailed history of this cholera, I may probably pass on, with advantage, to the consideration of the epidemic in the Mauritius in 1856, of which we have fortunately full particulars, the Governor of the island having at the time summoned a commission to inquire into, and report upon the circumstances of the outbreak.* From this report we learn, that two vessels, the "Hyderee" and "Futtay Mombarrack," arrived at Port Louis, from Calcutta, on the 5th and 8th of January, 1856, having 632 coolies on board. During the passage, deaths from cholera had occurred on the "Hyderee," and probably among the crew of the other vessel. On arriving near the Mauritius they were visited by the health officer of the island, and in consequence of the sickly state of the crew, the vessels were prevented from proceeding to Port Louis, and ordered into quarantine. They were kept at anchor at the Bell Buoy from the 14th to the 16th of January; the coolies were then landed on Gabriel Island, the quarantine station

* 'Report of the Committee, appointed by his Excellency the Governor, to Inquire and Report on the Probable Cause of the Recent Outbreak of Cholera in the Island of Mauritius.' Port Louis, March, 1856.

of the Mauritius. On the 17th, Dr. Finlay went from Port Louis to take charge of the coolies; and on arrival he reported that, after they landed, two deaths from cholera had taken place among them. Within the following month no less than eighty-three of the coolies died from cholera.

Close to Gabriel Island is Flat Island; between the two communication was at all times easy by boat, and on foot at low tide. It was clearly shown that intercourse had taken place between the two islands after the landing of the coolies. On the 12th of February, the wife of the lighthouse keeper of Flat Island was seized with cholera and died.

The coolies on Gabriel Island were permitted to go to the beach, and remove the casks of water and provisions sent to them from Port Louis, nor were effective means taken to prevent their communicating with those who landed the stores on the island.

A creole of the name of Alfred, who had from the first been employed on the contractor's boat, and whose duty it was to carry stores from the boat up the beach of Gabriel Island, and who was thus employed on the 20th, 23rd, and 26th of February, was taken ill on the latter day and, as the steamer "Victoria" was returning to Port Louis, Alfred was put on board. On his passage, symptoms of cholera declared themselves, and he died on the steamer the same night (26th February) of cholera. This was the first case of cholera in Port Louis. The crew of the "Victoria" were allowed to land, and were soon dispersed throughout the town. "A few days afterwards, cholera broke out in Port Louis, only to cease after sacrificing in the Mauritius thousands of victims." "A portion of Savanne was attacked at the very

commencement of the epidemic, which had evidently been introduced into the district by a prisoner arriving from Port Louis, about the 8th of March, and who was attacked with cholera on his journey. On his arrival at Savanne, the disease spread among those who were in contact with him, or near him. It was the same in all other districts of the island, where the disease always first appeared in persons who had come from Port Louis." The Commissioners appointed by the governor of the island, to inquire into the origin of this terrible outbreak, further observed, that they had no scientific opinion to give as to the cause of the disease; in fact, it was not their province to do so; but they expressed their deliberate opinion "that it was impossible to arrive at any other conclusion respecting the appearance of cholera in the Mauritius, in the month of March, 1856, than that it was introduced from Gabriel Island by the steamer 'Victoria' and the man Alfred."

During 1857 and 1858, cholera entirely died out from the greater part of Europe and America.

In 1859, it again appeared in a sudden and mysterious manner in several places. It was generated at Hamburgh, in June, attacking "young and old, rich and poor, in all parts of the town, showing no preference for the waterside over any other locality." In July, several towns on the Gulf of Finland were under the influence of cholera, and it was said to have been imported into the south of Sweden, by a vessel from Rastock, during the month of August. At the same time the disease broke out at Mercia, on the Mediterranean coast of Spain. The French troops in Algiers, and the Spanish army in Morocco, were severally affected by this scourge.

Cholera was imported into London and Hull from Hamburgh, in July, 1859, but did not spread in either of these towns.

“ In the summer, diarrhœa prevailed at the Woolston Coastguard Station from July 3rd to the 17th. On that day, S. Burt and T. Grant, assisted by five other men from the station, crossed the Southampton Water to Hythe, to assist in carrying to the grave one of their comrades, who was registered as having died of phthisis. The following morning, July 18th, Burt and Adams left home at four o'clock to go on board the cutter ‘Harpie,’ moored in the Southampton Water. Whilst on board, Adams was seized with violent cramps in the stomach, sickness and purging; Burt waited on him, and in an hour after was attacked with the same symptoms. They were brought home to the Woolston Coastguard Station at 8 o'clock, and were soon after seen by Dr. Maddox, who found Burt in the collapse stage of Asiatic cholera. He died the following morning. Adams had choleraic diarrhœa, and recovered.

“ T. Fielder, aged 69, staying with Adams, was found in the collapsed stage of cholera the same afternoon. He died in thirty hours.

“ On the 21st July, the families, consisting of forty persons, were placed under tents in an adjoining field. Adams the son, 10 years of age, who occupied the tent next the station, was said to have had a severe attack of diarrhœa on the 22nd July. On the 26th, Mrs. Adams, the mother, was attacked with symptoms of cholera in the afternoon, and was perfectly collapsed at 1 a.m. the following morning. She made a good recovery under calomel treatment. On the 30th, Mrs. Buzzecatt, who occupied a tent about 200 yards from

the station, was reported to have choleraic diarrhoea; no collapse. She quickly recovered under small doses of calomel. Nearly all the inmates of the station had diarrhoea during the outbreak. The privies were in a filthy condition; the water good. The registrar, the collector of customs, the quarantine officer, and the dock master, all declared they had not heard of a single case of cholera in the locality during the summer.”*

With reference to this case, Dr. Parkes remarks, that “the localised character of the disease looks very like a case of water poisoning, although the water is stated to have been good. I have been informed that the privies had overflowed, and the sewage ran over the ground and close to the houses, and caused offensive effluvia. I have also been told that it is probable the water was really impure, and was perhaps contaminated by the overflow of the privies.”

At North Shields, a sailor boy was received into a lodging-house from a steamer, which arrived from Hamburg on the 12th of August, 1859. He had been ill some days with choleraic symptoms, and died of cholera four days after landing. On the day before his death, a child of three years of age, living in the same house, and who had often been in the sick lad's room, was seized with cholera and died. On the following day a maidservant, who had devotedly nursed these patients, was attacked with cholera, which carried her off in eight hours.

With reference to this case, Dr. Babington remarks that, on the assumption that there was no cholera in

* ‘The Outbreak of Cholera at Woolston Coast-Guard Station in 1859. By J. King Sampson, Esq. Mr. Simon's “Eighth Report.” 1866. p. 422.

Shields before the arrival of this vessel from Hamburgh, it affords positive evidence of communication by contagion, which cannot be controverted by any number of negative results.*

From the time that the existence of cholera on the Continent was known, the English Government were fully alive to the necessity of taking active measures against the invasion of the scourge. All vessels arriving from suspected places, especially Hamburgh, were watched for cholera cases; those vessels in which it was found to exist were isolated as far as possible. The sick were at once taken to the "Dreadnought." And the local authorities were furnished with Mr. Simon's admirable memorandum, as to the proper method of dealing with such cases. Quarantine, however, was in no instance resorted to; in fact, it was generally believed at this time, in the words of the famous Bavarian commissioners' report on the cholera of 1854, that "measures with the object of preventing the importation of cholera into a country yet uninfected, or of stopping its extension from a place already attacked, by means of the interruption of communication and isolation, are inefficacious, impossible of execution, and injurious †." Griesinger gave an opinion to the same effect. Nevertheless, it is to be observed, that the disease had been very severe in the province of Mecklenburg-Schwerin, and a plan, similar to that adopted in England, had been resorted to with advantage. Of 42 cases, in which the first case had been at once isolated, and the employment of measures of disinfection adopted, in 35 complete success was obtained, and the epidemic did not develop itself. ‡

* 'Transactions of the Epidemiological Society,' vol. i, p. 13.

† 'Constantinople Conference,' p. 760.

‡ Idem, p. 795.

Isolated cases of cholera occurred in several towns of Great Britain in 1859, but in no locality did it assume an epidemic form, except at Wicks, a fishing town in Caithness, into which the disease was said to have been brought by means of old clothes; this assertion, however, was not fully substantiated. The town was immediately placed under the Nuisance Removal Act, and the disease died out.

Another limited outburst of cholera occurred at Glass Houghton, near Pontefract. A portion only of the village, inhabited by about 60 people, was affected; of these, 30 were attacked and 12 died. "Dr. Simpson ascribed the outbreak to the use of water from a well polluted with fæcal and other noxious matters."*

As I shall subsequently explain (p. 184), this fresh outbreak of cholera in Europe, like that of 1837 following the epidemic of 1832-34, was correlated to an increase of the disease along the Arabian shore of the Red Sea, and the valley of the Euphrates; the north of Persia being also under the influence of epidemic cholera in 1858.

Before returning to the history of the disease in India, I may observe that it re-appeared, on the 19th of September, 1859, in the Mauritius. From the records at my command, which are very meager, it would appear to have broken out in a most unaccountable manner, in some estates situated some seven miles from Port Louis; following the course of the canal, it reached Black Burn Bridge, but did not spread to Port Louis. By the end of February, the disease had disappeared from the island.†

* 'Transactions of the Epidemiological Society, vol. i, p. 16.

† *Idem*, p. 135.

It is now necessary for us to travel back, and examine into the history of cholera in Hindustan.

History of Cholera in the East from 1853. Asiatic Origin in 1856 of the European Epidemic of 1859.—During 1853, the disease hardly existed beyond its endemic area; the Punjab epidemic of 1852 having been reproduced to a very limited extent, as, for instance, in the Kumaon local battalion. It broke out among these men in July, 41 cases and 22 deaths occurring in a few days; the disease disappeared from among them by September. In the Benares division, cholera was said to have existed for a few days, during which time many were seized with it, and that in a severe form; but in the Cawnpore, Agra, and Meerut circles, there was not a single death from cholera among the European troops throughout the year.

The 2nd Bengal European regiment started from Agra in a fleet of country boats for Calcutta in January. Dr. W. Anderson informs us, that the weather was very hot for the time of year, but that the men under his charge were all remarkably healthy, until they came near Dinapore, where they met the Sikh regiment of Ferozepore, “in which, at the time, cholera was committing dreadful ravages.” Means were taken to prevent communication, if possible, between the regiments; but those who have travelled in these straggling fleets of country boats on the Ganges, can best judge how impossible it is to prevent the camp followers, under these circumstances, from having intercourse; however this may be, of one thing we are quite certain,—from the day the uninfected European regiment passed the Sikh infected corps, cholera appeared among the men of the former regiment, and continued to spread

until they arrived in Calcutta.* Dr. Anderson observes, that the only peculiar feature of this epidemic was, that after arrival in Fort William, cholera was frequently succeeded by a low form of typhoid fever. Mr. Jameson, thirty years before, had observed precisely the same phenomena as regards the troops in the lower provinces of Bengal.

During the year 1853-54, cholera was "partially epidemic" among our soldiers in Burmah; at Kyook Phyoo, and other parts of Arracan, it carried off numbers of the civil population.

From Assam, Dr. C. B. Francis reports the following circumstances:—On the 20th of April "a party of 28 sepoy's started from Gowhatty (which was at the time free from cholera) for Gowalparah; on the road they stopped at Palasbaree, where the disease was very bad. Immediately afterwards, one of the party was seized with cholera, and on their arrival at Gowalparah, cholera was generated among the sepoy's of the regiment, who up to this time had been absolutely free from the disease. Later in the year, cholera was prevalent in many parts of Assam, Cachar, and Sylhet. At Dacca, it was very severe in July, November, and December, being of a "decidedly epidemic character."

Among the native troops serving in the Dacca circle, the results were as follows:—

		<i>No. of cases of cholera.</i>		<i>No. of deaths from cholera.</i>		<i>Average strength.</i>
1851-52	...	61	...	18	...	5804
1852-53	...	49	...	30	...	6284
1853-54	...	104	...	29	...	6760

In the jails of Bengal Proper, the average number of prisoners for the year amounted to 20,535, and 1376 cases of cholera occurred among them.

* 'MS. Proceedings of the Medical Board' for 1853-54.

Cholera was epidemic in the Dinapore circle, and, as usual, was more severe among the European than the native troops.

Dr. Guthrie reports from Benares :—"Cholera appeared in the month of June ; the peculiarity of this visitation was its fatal type—patients, getting over the first stage, and giving every hope of recovery, after a time dying from debility and exhaustion of the nervous power. Its fatality was much greater among the Europeans than natives. It prevailed chiefly at Secrole and Chunar." Drs. J. Wilkie and Bonsfield report the circumstance of cholera having been most fearfully prevalent at Lucknow, and generally throughout the province of Oude. Information to a similar effect was received from Azimghur and Mirzapore. Dr. D. Butter, garrison surgeon of Allahabad, states that, "in April, 1853, a detachment of 341 strong left Chittagong, under Captain Bird, of the 11th Native Infantry. When in progress by water to Allahabad, they were attacked, on the 12th of the month, by cholera, near Chunar, where Captain Bird disembarked, and, leaving the sick to come up the river in the boats, he marched the remainder of his men to a place opposite Allahabad. On the 19th, four cases occurred in this party ; they were next day brought over the river and placed in the regimental hospital. Within seven days, 30 cases were admitted from among the sepoy, and 23 died. Up to the 28th, 49 cases had occurred and 31 died. No admission took place after the 25th, and no cases occurred in the neighbourhood, except among the men of the detachment and the camp followers. In July, cholera again visited the regiment, but it was very severe at the time in the surrounding country." Dr. Butter continues :—"The 65th Regi-

ment, proceeding by water to Calcutta in November, was absolutely free from cholera until passing Cawnpore, where the disease existed; the sepoy were then and there attacked with cholera, and their medical officer, Dr. Clemenger, laid low by the disease."

The superintending surgeon of Cawnpore remarks that, "during the year 1853, both European and native troops suffered from cholera, especially the former (among whom there were 261 cases, and 184 deaths); but that this mortality was as nothing in comparison with that of the villages in the surrounding districts."

I find, among the proceedings, reports from officers in almost every station from Agra to Peshawur, and away down into Central India; and, without exception, they all expressly state, that cholera did not make its appearance among those under their charge during the year 1853.

We have, therefore, evidence to prove that cholera was generated throughout its endemic area in Lower Bengal in 1853, and advanced steadily to the North-west, as far as the Cawnpore circle, but not beyond it.

During the following twelve months (1854), the disease did not extend itself into the North-west and Punjab, as we might have expected; on the contrary, the whole of this presidency was remarkably free from cholera. In Bengal Proper, the number of cases was about half as numerous in the jails as in the previous year, and our troops suffered in even a smaller proportion.

In 1855, cholera was again limited to its endemic area in Bengal. The number of cases among the prisoners, however, in this province, had increased to

1015. But, in examining these jail returns, we are struck with the remarkably localised action of the disease. For instance, in the Patna jail, where the average number of prisoners during 1855 amounted to 596, there was not a single case of cholera among them; whereas, in the next station, Arrah, within thirty miles of Patna, of 537 convicts, 127 were seized with cholera. On the opposite side of the Ganges, and almost within sight of Arrah, is Chuprah; in this jail, among 629 prisoners, there was not a single instance of cholera. In the Dacca jail, there were 239 cases of the disease; but in the next station, Furreedpore, not a single instance of it occurred.

I first encountered cholera in this country in 1855, being then attached to the 1st Bengal Fusiliers, at Dinapore; the disease broke out in the regiment in May. Within the course of a few days we had twenty-one cases and six deaths. The disease then absolutely disappeared from among the men of the regiment, but continued hovering about the station and surrounding villages for some time. It appeared soon afterwards in an epidemic form at Chunar, and in Benares; it was very fatal at Goruckpore and along the Nepal frontier.* It did not appear to the west or north-west of these localities during the year 1855, but the following twelve months, as I shall proceed to show, it was generated with terrible force over the whole of the North-western Provinces and the Punjab.

With the exception of an outbreak of cholera in a wing of H.M.'s 53rd regiment, stationed in Fort William, I find no special mention of the disease in Bengal Proper during the year 1856. It will be well, how-

* 'Report on the Attack of Cholera in the Central Prison at Agra in 1856,' p. 3. By Dr. John Murray. Agra, 1856.

ever, in this place, to consider the circumstances of this outbreak in H.M.'s 53rd Regiment, although it occurred in August, as we can then give our undivided attention to details connected with the cholera of the North-west and Punjab.

Dr. J. Grant reports* that the 53rd Regiment, stationed in Fort William, were in excellent health until the end of August, 1856. On the 30th of that month, cholera suddenly appeared among this small band of men, and, within less than a week, fifty-four cases and thirty deaths occurred. The local authorities, as is usual under these circumstances, were of opinion that the defective drainage of the fort was the exciting cause of the epidemic; but if so, how was it that not a single instance of cholera occurred in the fort, except among the men of the 53rd Regiment, who were living in fine healthy barracks, whereas the quarters of the staff sergeants and their families were actually overhanging the offensive moat, which some supposed to be the exciting cause of the disease? There was this difference, however, between the circumstances of the men of the 53rd Regiment, and the staff sergeants: the former were in the habit of wandering about, drinking in the grog shops of Calcutta; whereas the latter were a hard-working orderly set of fellows, and not so likely, therefore, to be exposed to the influence of the disease, which is rife among the lower orders in Calcutta throughout the year.

The superintending surgeon at Barrackpore remarks, in his annual report for 1856, "that in every instance of troops arriving from the upper provinces in country boats, some of the men were attacked by cholera on their passage down the river."

* 'MS. Proceedings of the Medical Board' for 1855-56.

But, as far as I can ascertain from the records of the medical office, the disease did not show itself in 1856, unless in a sporadic form, in the Barrackpore, Dacca, Dinapore, or Benares circles, and to a very limited extent only in the Cawnpore division, where eleven men of the 1st Fusiliers were attacked by cholera early in the season: in the report, giving the details of this circumstance, it is expressly stated that the disease was not epidemic in the station.

Dr. John Murray informs us, that the cold season of 1855-56 was characterised at Agra by want of rain and high temperature. Throughout the succeeding hot season (1856), easterly winds prevailed, with very little of the usual west wind. The rains commenced on the 30th of May and continued till the 1st of September, there having been, during this time, a fall of fourteen inches above the average. Similar remarks are made regarding the weather, by medical officers scattered over the districts affected by cholera. Low barometric pressure, excessive rain, and great heat, characterised the season from Peshawur to Agra.

On the 21st of May, the weather being very hot indeed, cholera broke out among the natives in the city of Agra. On the 25th of the month, three men, at the time actually suffering from the disease, were brought into the jail, and admitted into the hospital. "Five days after this, viz., on the 30th of May, the disease appeared in the jail," and did not cease until it had attacked 349 prisoners. Prior to the introduction of cholera among the convicts, a number of them had been removed to Secundra; they remained free from cholera, with the exception of two cases. On the 12th of June, the disease having assumed fearful proportions in the jail, the convicts were ordered out

of it, and a party of them sent among the men at Secundra. On the 16th, the disease broke out among the Secundra convicts, and rapidly increased till the 21st, when the prisoners were recalled and sent into tents on the Poyah Ghat Road, "where the cholera rapidly declined, the tents being shifted from one spot to another whenever any fresh instances occurred among the convicts. The total number of cases among the Agra prisoners in 1856, amounted to 564, and of these, 230 died.*"

During the month of June cholera was generated in numerous localities round Agra. In July it had extended to Etawah, Furruckabad, Bareilly, and Delhi. In August, Gwalior to the south, Nainee-Tal to the north, Lahore and Ajmere to the west, were invaded by the disease, the majority of towns, and even villages, within this area, were at the same time under its influence.

Dr. J. Ewart reports, on the 1st of September, that for "several weeks past there had been a steady march of the disease from Agra towards Ajmere; and he adds, it appeared, as far as he could determine from native newspaper reports, that cholera was imported into Bhurtpore, into Kishengurh,"† and so to Ajmere, by the direct route of commercial communication.

The first instance of the disease in the Ajmere jail was that of a man awaiting his trial; the next case occurred in the hospital where the first was treated; it then spread through the jail. The epidemic was at once checked in its progress by the removal of the convicts from the prison. The disease extended as far west as Mooltan.

* Dr. J. Murray's 'Report,' 1856.

† 'Report on Cholera in the Meerut, Rohileund, and Ajmere Divisions in 1856.'

Numerous instances are recorded, in the reports of 1856, by the various medical officers of the North-west, of the remarkable manner in which the disease settled on certain spots, often sparing those around in a most mysterious manner. Mr. Edwards, the magistrate of Seharunpore, remarks : “ Its sudden appearance without any visible cause at isolated points, and its immediate fatality, might be likened to the seeds which a bird drops in its flight, and which germinate where they fall. The amount of rain, or the direction of the wind, did not appear to affect it. It was hoped, that on the 8th of September, when the wind changed from east to west, the disease might diminish, but the number of fatal cases, on the contrary, increased.”* At Meerut, a well-drained and healthy place, the ravages of the cholera were very great; whereas, at Seharunpore, a peculiarly dirty city, comparatively few people suffered: in the latter place, the jail and stud lines wholly escaped the influence of the disease. Mr. Edwards observes, that the natives believed there were two descriptions of cholera: in the one, which was rare and almost always fatal, vomiting and purging commenced simultaneously; in the other, the disease began with diarrhœa, and was succeeded by vomiting; in these instances, pills containing opium, assafoetida, and black pepper were found to be very efficacious—some 40,000 of them were distributed to the people by Mr. Edwards.

The lower classes were said, by almost all observers, to have suffered far more than their richer brethren.

Dr. Boyd, of H.M.’s 32nd Regiment, states that cholera was imported into Kolka by the hillmen

* ‘Report on Cholera in the Meerut, Rohilcund, and Ajmere Divisions in 1856.’

returning from the fair of Thunnesir, where the disease was known to prevail. These hill-people carried the cholera with them into their villages, and spread it as far north as Simla. The 32nd Regiment remained free from the disease at Kolka, but having been ordered to march to Lucknow, the men were attacked by cholera within two marches of Thunnesir, and it clung to them until the 27th of November.

The soldiers at Dugshai entirely escaped, although the surrounding country was ravaged by the disease.

Dr. C. M. Smith reported from Lahore, that cholera appeared at Mean Meer on the 6th August, and spread through the cantonment; among the European troops, with a total strength of 1,592 men, there were 495 cases of cholera and 265 deaths.

On the evening of the 16th of August, a prisoner was admitted into the central jail hospital at Lahore, suffering "from diarrhœa of a choleraic character." On the 20th and 21st, unmistakable instances of cholera showed themselves among the convicts; and within the following month, 367 cases and 183 deaths from the disease were reported as having taken place in the jail. The prisoners were then removed into camp with the most beneficial and happy result. "The spirits of the prisoners, which were before depressed, revived, and their thankfulness and gratitude were displayed, not only in expression, but by their orderly and good behaviour; no attempt at escape or *émeute* was even thought of."* Dr. Smith gives carefully compiled tables of the duration of each prisoner's illness. In two instances only did the patients sink within five hours from the time of being attacked by

* 'Report on Cholera in the Meerut, Rohilcund, and Ajmere Divisions in 1856.'

cholera, and in by far the majority of cases they were under the influence of the disease upwards of twelve hours before they died.

Dr. Smith confirms the fact mentioned by Dr. Murray, that more rain had fallen in the Punjab during 1856 than had been known for many years; in fact, the country was inundated with water.

The epidemic did not extend into the Peshawur circle at any rate. Dr. Ransford states that none of the troops under his supervision were affected. He observes, however, that "in October and November some cases of fever assumed a very severe form, and occurred in men who had had frequent attacks in barracks before coming to the hospital for treatment. They were suddenly seized with purging and vomiting, accompanied by cramps in the hands and legs; the matter passed by stool was at first fæcal, rapidly became bloody, and sometimes consisted merely of pure blood mixed with a little mucus. These cases were generally admitted into hospital in a state of collapse. In some instances there was no secretion of urine; the features were shrunk and lips livid. These cases, if not cholera, so nearly resemble it, that many medical officers return them as such; but though the symptoms were very alarming at first sight, every case got well unless complicated with disease of the liver."*

While cholera was thus extending its deadly influence over the North-western provinces of India, it was committing terrible havoc among the inhabitants of Nepal.

Dr. Leith informs us, in his 'Mortuary Report' for Bombay, that, from the aggregate of the last nine years, it was found that cholera was in excess in eleven

* 'MS. Proceedings of the Medical Board' for 1855-56.

districts in 1856, the preponderance of mortality from this cause being in localities lying along the sea shore.

In 1857, cholera showed itself in the north-east of Persia. I simply mention this fact in connection with the spread of the disease over the north-west of India and the Punjab in 1856, but the relation, if any, which existed between the cholera of India and Persia during the time under review, cannot now be determined. It is, however, noteworthy, that from 1851 until 1861 the disease appeared in various localities in Persia, year after year. In 1853, cholera raged at Teheran, and spread to the shores of the Caspian Sea. At the same time the principal towns on the Persian Gulf were affected. It extended also *viá* Bassora to Bagdad, where "the troops of the Shah, ravaged by cholera, scattered themselves, and disseminated the disease throughout Persia."*

In 1855, the north of Persia was again under the influence of cholera; it appeared also on the 14th of October at Beyrouth as well as at St. Jean d'Acre and Tiberias, but Damascus enjoyed perfect health. The caravan from this latter place, on its journey to Mecca, was attacked by cholera; but on arrival at Mecca, was free from the disease. In 1856, the north of Persia and the entire course of the Euphrates were infected. In 1857, as above stated, a fresh outburst of the disease occurred in the north-east of Persia; Kerbellah, Bagdad, Imam Ali, and Bassora were also under its influence. Beyond this, I am informed by Dr. Fagergren, in charge of the province of Fars, that during twenty-two years cholera had appeared three times in the district, the most virulent outbreak of the disease was in 1857, when not only the inhabitants of the sea

* 'Constantinople Conference Report,' p. 319.

coast, but those of the interior, were under the influence of the disease.*

In 1860 and 1861 cholera again invaded Persia, Kermanshah being one of the places principally affected; but the cities above named by no means escaped its influence.

From 1861 to 1865 there was no further epidemic in Persia. I would here draw particular attention to the fact of cholera having existed more or less constantly in Persia from 1851 to 1861, as bearing upon a remark I made to the effect, that throughout the same period the disease had almost become endemic in certain parts of Russia.

In 1858, many places along the Arabian coast of the Red Sea were again subjected to this terrible scourge. "It caused ravages at Mecca, Lohea, Hodeda, and Mocha; it was also very prevalent at Massowah. From these ports, buggalows, with goods of merchandize, were continually arriving at Aden. A ship also anchored in the harbour from Mecca, bringing a large number of pilgrims; two had died of cholera as the ship approached Aden. From these facts, it is very probable, nay even almost certain, that the poison of cholera was imported into Aden from some of the neighbouring places."†

Sub-Assistant Surgeon Ruttonjee Hormusjee, who was at Aden at the time, adds that, with the exception of cases of epidemic cholera which had occurred in the station in 1845, the disease was absolutely unknown in Aden until the 29th of September, 1858; it then increased rapidly, and in three or four days it attained

* Letter forwarded to me from Dr. Fagergren by Lieut. Lovett, R.E.

† 'Transactions of the Medical and Physical Society of Bombay' for 1859, Appendix, p. 33.

its greatest severity. About the 8th of October the number of cases began to fall, and the disease itself showed a more amenable character; and after the 28th of the month, no fresh cases occurred. "After the epidemic broke out at Aden, it made its appearance at Lahadge and Berbera, so that certain ports on the Red Sea, carrying on a regular trade with Aden *viá* Mocha, Hodeda, Jedda, Lohea, suffered from cholera first of all; the disease appeared next at Aden, whilst Aden itself communicated freely with Lahadge and Berbera, where the disease was last seen."

I have above noticed that cholera appeared at Mecca in 1858, and it was much feared that it would have travelled with the pilgrims to Damascus; on arrival there, however, the caravan was found to be absolutely healthy.

In 1859 the disease was reproduced at Mecca, and the mortality in the caravan was very great; but again the salutary influence of the desert seems to have entirely destroyed all traces of the disease, for the pilgrims arrived at Damascus on the 10th of September in perfect health.*

From these historical facts, the bearing of my former remark upon the circumstances of cholera in Europe in 1859 becomes evident. The disease spread over the whole of northern India in 1856, it appeared in the north-east of Persia in 1857, and over a very considerable portion of the country in 1858, where, in fact, it had appeared annually for the previous eight years. At the same time, cholera was spreading along the coast of the Persian Gulf and the Arabian shores of the Red Sea. It is evident, therefore, that Europe was imminently threatened by an invading cholera in

* 'Constantinople Conference,' 1866, p. 392.

1858 from two directions, viz., *viâ* Persia, and Egypt; and though we cannot now recover the missing links in the chain, connecting the European outbreak of the disease in 1859 with its *foci* in Asia, nevertheless, the relation of the one to the other cannot be overlooked, and will form an important piece of evidence in our search into the etiology of the disease.

Nor must we pass over the fact, which is evident from Dr. Leith's Mortuary Returns for Bombay, that cholera was never absent from the island for a single season from 1850 to 1860. Dr. Leith says there was no "regular annual time of its maxima and minima; and in looking at the returns of the successive years, the outbreaks or exasperations of the disease, as indicated by the deaths, are seen to have taken place at apparently irregular periods."

The number of deaths from cholera registered in the island of Bombay were as follows:—

In 1851	...	...	...	...	4020
1852	...	...	...	...	1135
1853	...	...	...	...	1339
1854	...	...	...	...	3353
1855	...	...	...	...	1739
1856	...	...	...	...	2151
1857	...	...	...	...	1741
1858	...	...	...	...	105
1859	...	...	...	...	2285
1860	...	...	...	...	1687
1861	...	...	...	...	1251

Supposing, therefore, as some affirm, that cholera spreads from certain parts of India to Europe *viâ* Persia, or Arabia and Egypt, we find in the history of the disease in Bombay during the ten years ending in 1860, evidence of a source of the disease quite sufficient to account for its presence in these countries,

which, I need hardly say are in constant communication with Bombay. In addition to this, within these ten years, we have traced two vast waves of the disease from Bengal over the north-west of India into the Punjab, and corresponding outbursts of cholera in the north-east of Persia.

Cholera in India from 1858. Punjab Epidemic of 1861. Indo-European Epidemic of 1863-66.—Our information regarding the history of cholera in Bengal in 1857-58 is necessarily defective, on account of the disturbed state of the country; we know, however, that it appeared among our troops before Delhi from June to September, 1857, and some sixteen cases and eleven deaths took place among the prisoners in the Delhi Jail in 1858.* The Lucknow Garrison also suffered to a slight extent from cholera in 1857.†

During the year 1859, cholera was widely disseminated in Bengal, eastward of a line corresponding to about 80° east longitude; to the north-west of this, we hear nothing of the disease. For instance, in the east of Cawnpore, no less than 394 Europeans and 396 prisoners (natives) died from cholera; to the north-west of Cawnpore, not one single death occurred in either of these classes of the community. In the Saugur division, however, there were sixty-two admissions and twenty-nine deaths among the European troops from this disease.

Several of the local epidemics which broke out in Bengal during the year, were attended with considerable loss of life. Dr. Hugh Macpherson reports, that the artillery at Dum Dum were attacked by cholera on the

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

† Dr. Greenhow's "Notes during the Siege of Lucknow," 'Indian Annals,' vol. x, p. 336.

night of the 9th of August, 1859, and that out of a force of 1,407 men, 87 fell victims to the disease within a week; the epidemic then rapidly subsided and soon disappeared. Dr. Macpherson remarks "that the admissions were most numerous when the sky was overcast with clouds and rain fell, and fewest when the sky was clear.* The disease was very prevalent at Barrackpore, Berhampore, and Lucknow about the same time. In May and June, it was generated with terrible virulence in the Allahabad, Banda, and Hu-meerpore† districts; and, as I have already remarked, it extended into the Central Provinces, visiting several stations in the Saugur circle.

Throughout the year 1860, cholera prevailed to a terrible extent throughout Bengal Proper, and, in fact, from Assam to Oude, and from the sea-shore of the Bay of Bengal away into Central India; it even spread far up the Himalaya to Darjeeling. The number of deaths from cholera, among the prisoners confined in the jails eastward of Cawnpore, rose during these twelve months to 1,655, being, therefore, 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 Saugur 4; Nagode 15; and Jubbelpore 5. The prisoners in these 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 generated over the enormous tract of country above indicated, during the early part of the year 1860. And, as we might have expected, the disease spread at the same time to Agra.

* 'MS. Proceedings' for 1859-60.

† Idem.

Dr. Walker, Superintendent of the Central Jail, at Agra, 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.”* On the 10th of August, cholera broke out among the prisoners at Agra, and lasted 23 days, 816 cases and 175 deaths occurring from it; at the same time, there were 24 casualties from this disease among the European troops at Muttra.

Dr. Walker remarks that of a party of 396 prisoners who arrived at Agra from Mynpoory on the 9th of August, no less than 35 per cent. died of cholera; whereas the death-rate among the other convicts was only at the rate of 17 per cent. He attributes this excessive mortality in the Mynpoory party to the fact of their vital powers having been depressed from the fatigue, exposure to damp, and irregular supply of food they had experienced during their march into Agra. He was also of opinion, that “ the epidemic influence appeared to have been on this occasion more widely spread, and more generally fatal, than in former years.” From this statement of Dr. Walker’s, 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

* ‘ Prison Returns for the North-western Provinces ’ for 1860, pp. 123, 124.

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 Deyrah, 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 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 valuable report on the subject. Section 28 of this report refers to the mortality attributable to the famine; but among the 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 them are described as "cholera biliosa." Dr. David B. Smith, who at this time was in medical charge of the civil station of 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. Small-pox 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 think I am justified, therefore, in asserting, that in 1859 a very considerable portion of this presidency (Bengal) was under the influence of epidemic cholera; throughout the following year it was reproduced over the whole presidency, 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.

In 1861 cholera was reproduced over the whole of Bengal Proper ; out of 52 jails in this province, only 11 escaped the disease ; the total number of deaths among the prisoners amounted to 779. In May, the convicts and European troops at Cawnpore and Allahabad were attacked with cholera, and in July, those at Gwalior

and Jubbelpore suffered very severely. It is evident, therefore, that cholera was reproduced over the area in which it was principally generated 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. David B. 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 among 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.* Dr. Smith remarks, "It is important to note, that at this time there was not a single case of diarrhoea 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 diarrhoea. 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.

Of H.M.'s 82nd Regiment, Dr. Smith reports that 80 men were seized with cholera, and 57 of these were in a state of collapse on admission into hospital. "One man had no vomiting or purging throughout; but

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

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.* 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.”

Dr. J. M. Cunningham makes a similar remark respecting the state of the weather at Bareilly, and observes that, “during the year 1861 there have been $49\frac{1}{2}$ inches of rain.” He continues: “In what manner unusually heavy rains are connected with the development of the cholera poison, it is difficult to say; that there is some connection between the two, few can doubt. The heavy rains of 1856 were accompanied by a severe outbreak of cholera at Agra, Ferozepore, Lahore, and Umritsur, just as the heavy rains of 1861 have been accompanied by a severe epidemic of cholera in the same places. Bareilly is little subject to even sporadic cases of the disease; but the inhabitants of the city suffered from it severely during the heavy rains of 1856, and the disease, after four years' absence, has been again prevalent with the heavy rains of 1861.”

Dr. J. C. Corbyn reports that, 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 of July, the first case of cholera occurred among the prisoners, and the malady did not cease until the

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

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.

The disease broke out at Umballa about the 17th of July, and continued to extend steadily to the north-west, reaching Meean Meer on the 31st of the month. In this part of the country, the rains, though plentiful, hardly exceeded the average of former years.

On the 6th of August and five following days, fifteen cases of cholera, all of which were fatal, occurred among the European troops at Meean Meer; 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 move the whole of the troops out of cantonments at once—the country for miles round being under water; and although Captain F. Norman, the assistant quarter-master-general, was as anxious as every one else to see the men out of the station, he found it impossible to select a dry encamping ground for them; 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 her Majesty's 51st Regiment left the station; at the same time the Artillery marched to Shahdera, on the banks of the Ravee, ten miles to the north of Meean Meer. Subsequently, one single case of cholera occurred among the men of this party; but among the troops who 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.

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 Meean Meer, 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 them.

The Government of India subsequently appointed a commission, presided over by a civilian, Mr. J. Strachey, to report on the circumstances of the outbreak of cholera in the Punjab. This action on the part of the Indian Government in 1861, was the first effort they had made since 1817, to gain any information on the subject of cholera among the troops serving in this country. There was no want of material at their command, the records of the medical

board are full of reports and valuable matter bearing on the subject, an epitome of which had been sent up to the Government every year by the board. But it was not until home influence had begun to tell on India, and after the country had passed under the direct rule of her Majesty, that it was found necessary out here to yield in some measure to what, probably, most Indian statesmen consider the prejudices of Europe on the subject of cholera. Hence the appointment of the commission to report on the epidemic of 1861. The first section of the report published by this commission had subsequently to be withdrawn and rewritten, because it contained statements of a personal nature, reflecting on the character of individual officers; and to the revised report, published under the authority of Government, the two most influential of the four commissioners refused to append their names, the dissenting officers being Dr. Linton, the head of the British Medical Service in India, and Colonel Gawler, of the Royal Engineers.

These facts will explain my silence regarding the details and opinions contained in the report on the Punjab epidemic of 1861. Besides, I am credibly informed by officers who were at Meean Meer, and who visited the cholera patients there in 1861, that the account of the hospitals given by the Rev Mr. Sloggett during the epidemic, is, to say the least of it, a very highly coloured picture; and yet this account is the one published by the Punjab Commission as authoritative, and upon which hangs much of their theory, as to the hospitals having been the most direct cause of the dissemination of the disease.

Had Dr. Green's advice of the 15th of August been practicable, and the whole of the men removed from

the station on the outbreak of the epidemic, it might possibly have saved much of the misery that subsequently occurred at Meean Meer; but when once the disease had taken hold of the troops, to have thrust them out into tents in the pouring rain, would probably have been followed by even worse consequences than befel them, and have been made the subject of just criticism, if not of severe censure.

It is a matter for regret, that the members of the commission appointed by the Government, to report on the circumstances of the outbreak of cholera in the North-West and Punjab in 1861, should have entered upon their work with the conviction, "that the mere contamination of the drinking water may cause disease, but it will not cause cholera."

It is quite certain, however, that the water drawn from the well in the Hospital Compound at Mean Meer, and other parts of the station, contained an alkaline fluid impregnated with organic matter;* and in connection with this subject I may mention the circumstances of a case which occurred in another part of the country, but in which the most positive evidence exists, as to the fact of fresh cholera dejecta having found their way into a vessel of drinking water, the mixture being exposed to the heat of the sun during the day. Early the following morning, a small quantity of this water was swallowed by nineteen persons (when partaken of, the liquid attracted no attention, either by its appearance, taste, or smell). They all remained perfectly well during the day; ate, drank, went to bed and slept as usual. One of them, on waking next morning, was seized with cholera; the remainder of the party passed through the second day perfectly well,

* 'Report on the Cholera of 1861,' Appendix, p. xvii.

but two more of them were attacked with cholera the next morning; all the others continued in good health till sunrise of the third day, when two more cases of cholera occurred. This was the last of the disease; the other fourteen men escaped absolutely free from diarrhoea, cholera, or the slightest malaise.

In this case it is certain that the contaminated water was once, and once only, partaken of. Its effects were, that out of a party of nineteen healthy men who swallowed it, five were attacked with cholera within seventy-two hours; the remaining fourteen individuals were absolutely unaffected by the poison. These details leave us no reason to doubt, that water, contaminated by the fresh dejecta of a patient suffering from cholera, produced the disease in five out of nineteen people who swallowed it, and that independently of either the season, nature of the soil, or any other appreciable circumstances, all of which were remarkably in favour of the persons attacked by the disease. Nor was cholera prevalent in the place; I am assured it had not visited the locality for several years, nor has it, as far as I am aware, appeared there since.

Another fact elucidated by the history of the epidemic of 1861 was that, wherever cholera occurred among the troops, the first case was almost certain to be followed by a few others, and then came an outburst of the disease, unless the men in the mean time had been removed from the infected locality.

The disease spread to Lahore in August, 1861, but did not extend further to the north-west in our territories; it was very virulent, however, in Cabul during the month of October; this is accounted for by the fact of its having existed in Western India, especially in Scind, from April to August, and it was probably

from this direction, *viâ* the Goleri pass, and not through Peshawur, that cholera reached Afghanistan in 1861.

The death-rate from cholera among the prisoners, and European and native troops located to the east of Cawnpore, was under the average during the year 1862; to the west of that station the disease was reproduced, being very virulent in many places in the north-western provinces and Punjab. It broke out in July at Peshawur, no less than 168 Europeans out of a force of 1970 men falling victims to the disease in this station alone.

Throughout 1863 cholera was again on the increase in the lower provinces; from Cawnpore eastward, there were some 532 deaths from it among our prisoners, but to the north-west of this station, not a single casualty from cholera was reported. The same remark applies to the troops, both European and native, except in the station of Agra.

Dr. H. M. Cannon gives us the following particulars regarding the disease, in several districts of Oude and Lucknow during 1863. Dr. Cannon writes:

“*1st.*—I have the honour to submit, as an Appendix to my Annual Jail Report, the following Memorandum regarding the visitation of epidemic cholera, as it occurred at Lucknow and in some of the districts during the rains of last year, when, in addition to my other duties, I was Officiating Civil Surgeon.

“*2nd.*—Having ample opportunities, in my capacity as Inspector of Prisons, of watching the advent of this disease, I trust I may be excused for the digression, by stating, in the first instance, what I consider to have been the original route of the epidemic before it reached Lucknow.

“*3rd.*—In the early part of the year (1863) it made

its appearance amongst a large body of pilgrims on their way to Ujoodhia, while on the high road between Allahabad and Fyzabad, numbers of whom died, leaving their sick and dying at Pertabgurh, Sultanpore, and Fyzabad, *en route*, which places for some time afterwards became respectively the nucleus of the disease.

“4th.—At Pertabgurh, as many as 300 pilgrims’ corpses were found in one day on the banks of the Saie Nuddee, and the police had to be sent out to bury them.

“5th.—It appeared in the city and hovered about the cantonment of Fyzabad for several months, and numerous fatal cases occurred amongst the opium Assamees and prisoners in the jail, but, as far as I am informed, there was not a single case amongst the troops in cantonments.

“6th. The next I heard of its progress was, that it reached the station of Gondah, and in the early part of June that it was gradually making its way along the new Imperial Road between Fyzabad and Lucknow.

“7th.—On the 19th June it made its appearance in the Dilkoosha cantonments with little or no warning, and selected three officers and a Madras servant as its victims; two officers and the servant died.

“8th.—Not a single case, that I am aware of, occurred again amongst the troops or in the civil lines, until it made its appearance in the city, on the 2nd July, in a decidedly epidemic form, and from thence it became general, spreading to the fort and civil lines, but, strange to say, it did not reach the Central Jail until the 15th July.

“9th.—I made every arrangement that could be thought of to meet and treat the disease amongst the inhabitants of the City. The King’s and city Hospitals

were ordered to take in all cases within their reach. A cholera dispensary and several cholera posts were established in the different mohullas of the city. The clearing of the thoroughfares and gullies in the city was attended to; and medicines were freely distributed to rich and poor, through the agency of the police, to those who would not or could not have recourse to the dispensaries, and I have reason to believe that the mortality was very much lessened by these arrangements.

“10th.—The last case that occurred in the jail was on the 3rd August, and in the city on the 24th of the same month.

“11th.—On reference to my private notes, dated 26th August, 1863, when the epidemic may be said to have ceased, I find the following remarks :

“‘It is remarkable that, in the civil lines, there has not been a single fatal case amongst the European inhabitants; of the five cases that occurred, each yielded to timely and energetic treatment. I learn that up to date there have been only nineteen deaths amongst the European troops of all branches. At the Central Jail, containing a daily average of 2163 prisoners, I have had 100 fatal cases out of 257 treated. The Lunatic Asylum has lost 5 cases out of 100 inmates; there have been 12 fatal cases in the Huzrut Gunge Civil Dispensary. In the several mohullas of the city, as per daily police returns in my possession, the deaths amounted to 1874, making a grand total of deaths in Central Jail, civil and military lines, including the native city, of 2015.’

“12th.—I can answer pretty confidently as to the tolerable correctness of these returns; I do not, however, mean to state there were no fatal cases after the 24th

August, but this I consider the date on which the epidemic may be said to have ceased in the Lucknow city and district.

“13th.—Cholera made its appearance again at the Lucknow Jail on the 25th September, amongst a very large and sickly gang of 150 prisoners, which had arrived the previous day from Seetapore; and although every precaution was taken to prevent communication with the new prisoners, the disease soon extended throughout the jail, causing 85 admissions and 48 deaths during the months of September, October, and November, 1863.

“14th.—It is worthy of remark, that this outbreak confined itself entirely within the jail walls.

“15th.—The statements herewith attached, show the total number of admissions, deaths, and cures, from cholera and choleraic diarrhœa, in all the Oudh jails during the year 1863, to be as follows: Admissions 786, deaths 349, cures 430, which gives the total number of deaths per cent. (from this epidemic), on the daily average number of prisoners, at 6·96.

“16th.—In deducting the per-centage of deaths from the above causes from the general mortality, it will be found that the ratio of deaths to strength per cent. from the usual causes in all the Oudh jails will be reduced from 13·13 to 6·17, which I do not consider a high ratio for a criminal population in a tropical climate.

“17th.—It is remarkable, that there has been no mortality in any of the jails in Oudh, since they have come under my observation, from epidemic typhoid or low continued fever—commonly called jail fever.

“18th.—Each prisoner in the Oudh jails is allowed 500 cubic and 36 superficial feet in the sleeping wards. In the hospitals, 600 cubic feet is the proportion.

“19th.—In concluding these remarks, I beg to bring prominently to the notice of Government, that the introduction of cholera into this province appears to me to be of annual occurrence, and from precisely the same causes, viz. the pilgrims’ progress from Allahabad to Ujoodhia, which has again carried it into the districts of Pertabgurh, Sultanpore and Fyzabad, and at the two latter stations there have been several deaths in the jails from this disease during the current year (1864).”

During the year 1864, cholera was reproduced over Bengal, extending in the direction of the central provinces, as described in Dr. W. Walker’s letter, No. 187, of the 2nd August, 1864,* in which he draws attention to the fact of the disease being particularly severe in the Banda and Humeerpore districts. It prevailed also at Saugur and Seuni, 45 per 1000 of the prisoners in the former station, and 22 per 1000 in in the latter, falling victims to cholera. It broke out also at Nasik† in the Ahmeednuggur collectorate, and at Mhow. Lastly, it appeared among the pilgrims assembled at Punderpoor,‡ and “raged severely at the Mhyjee Fair in Kandesh;” it was “epidemic among the native population at several stations in Bombay.”§

Here, therefore, we again trace the progress of the disease from Bengal through Central India into the Bombay Presidency, and in the following year (1865) “a wide-spread and severe prevalence of cholera was the cause of the increased mortality” in the Bombay army. “The European portion of this force lost 16 men in every 1000 from cholera alone, the deaths

* ‘Selections from the Records of the Government, North-Western Provinces, 1864,’ part xlii, p. 14.

† ‘Report of the Sanitary Commission for Bombay, 1865,’ p. 263.

‡ Idem, p. 243 and p. 42.

§ Idem, p. 12.

from that cause being 457. The cholera mortality was most severe at the stations in the Mhow division, where 24·4 in a 1000 died; or, if the loss in a detachment which was marching be included, the mortality in the division was 31·3. The marching of that detachment in the middle of April was taken notice of by Government. Forty-six of the cholera deaths in the Mhow division were in the wing of a regiment at Nemuch.”* We may form some idea of the extent and virulence of the disease in the Bombay Presidency during the year 1865, when it is stated that, among the civil population, upwards of 84,000 deaths were registered from this cause alone,† and this number probably falls very far short of the actual death-rate from cholera.

The disease had also been reproduced to an alarming extent in Central India.

The history, therefore, of this epidemic is simply a repetition of those I have previously given, and, as we might have expected from analogy, we have evidence of the disease immediately extending its influence from Bombay into Yeman.‡ In May, 1865, cholera was raging at Makalla and Mocha;§ it had spread to Aden, where our troops suffered from it precisely as they had done in 1846 and 1858; at the same time Adora and Gondor were affected, the disease extending into Abyssinia. ||

My friend, Saeed Bukht of Sylhet, who has lately been in Calcutta, but who was a member of the local council of Mecca in 1865, assures me, that cholera did

* ‘Army Medical Reports for 1864,’ p. 137.

† ‘Report of Bombay Sanitary Commission for 1865.’

‡ ‘Constantinople Cholera Conference,’ p. 356.

§ Idem, p. 349.

|| Idem, p. 356.

not exist in or about the city before the end of March, 1865. On the 24th and 25th of that month, he states that rain fell over Mecca, and about the same time cholera broke out among the assembled pilgrims. Few men are better acquainted with the phenomena of the disease than Saeed Bukht; being a native of Lower Bengal, he had seen cases of it, year after year, from his infancy, and is, moreover, a remarkably shrewd and keen observer. He is well aware of the history of the ships "Persia" and "North Wind," in connection with the outbreak of the disease at Mecca, and his remark on the subject to me was, that very likely cholera was introduced by the infected pilgrims arriving in these vessels; "but who can say, when there were thousands of men coming and going." Moreover, I have already shown that the disease had spread from Bengal into Central India and Bombay in 1864, and had been reproduced over the whole of this territory, with extreme virulence, in 1865; and further, that early in the year it was known to be prevalent along the sea coast of Arabia, and the western shores of the Red Sea, having, doubtless, extended from the various ports in the Bombay Presidency, as it had done on every previous occasion, when it visited Arabia and the shores of the Red Sea, notably as described by Ruttonjee Hormusjee in 1858.

I mention these facts, because by far the majority of the members of the Constantinople Cholera Conference, lay great stress upon the disease having been introduced into Mecca, by the pilgrims arriving from Singapore in the "Persia" and "North Wind." No doubt cholera existed at the time in the Indian Archipelago, and that many cases occurred on board these vessels after they left Singapore, but not before they had

touched at Makalla, to which port cholera had already extended from Bombay. The evidence of the commanders of these vessels on this point is clear enough, for, according to the statement of the British Consul at Jeddah, they declared "that the disease by which their ships had been stricken was cholera, which had broken out on board after they had touched at Makalla."*

I am quite prepared, however, to assent to the proposition of the Conference, "that cholera was imported into the Hadjiz by pilgrim ships from India," and I see no improbability in its having travelled from Singapore by this means; but to attach undue importance to such particular incidents, to the neglect of those broader features presented by the disease in its course from Bengal into Arabia and the Hadjiz, is to complicate the subject, and tends to withdraw our attention from the major to the minor details in the history of this remarkable epidemic.

Saeed Bukht confirms the report given by the Commissioners sent from Egypt to examine into the circumstances of the disease at Mecca in 1865; he describes the mortality among the pilgrims in Mecca, Meenha, and Arafat, as having been truly appalling. It is supposed that, of ninety thousand people assembled in these places, thirty thousand fell victims to this disease, including those who died from it at Jeddah.

At this time there was no epidemic cholera either in Egypt, Europe, or America.

On the 19th of May, the first ship bringing pilgrims from Jeddah arrived at Suez. Many of the passengers had died of the disease during the voyage, and the

* 'Cholera Conference,' p. 529.

captain and his wife were attacked with cholera on the 21st of May at Suez.*

Many of the pilgrims were at once forwarded from Suez to Alexandria by railway, and on the 22nd of May, the first case of cholera was noticed in a body of these people, on their way to the latter port.

“From the 22nd of May to the 1st of June, numerous pilgrims were landed at Suez, and sent by rail to Alexandria, where those who could not be immediately embarked, on the vessels provided to carry them to their further destination, were encamped outside the city near the canal of Mohmoudich.

“On the 2nd June, a case of cholera (the first recognised) occurred among the inhabitants of Alexandria who were in communication with the pilgrims. On the 5th of June, two other cases were reported under the same circumstances. From that date, instances of the disease became more numerous, but until the 12th June they were confined to that portion of the population which was brought into contact with the pilgrims.”†

From this time the disease spread over Egypt, destroying, in less than three months, sixty thousand of its inhabitants.

The panic excited in the minds of both Egyptians and foreigners in the country was extreme ; from 30,000 to 35,000 rushed away from Alexandria by every conceivable means, throwing themselves suddenly into all the large towns of the Mediterranean, to which they could gain access, by steamers or sailing vessels.

“On the 28th of June, at a time when neither cholera, nor anything like what are called precursory

* Mr. Radcliffe's "History of the Origin of the Epidemic of 1865," in Mr. Simon's 'Report to the Privy Council, 1865,' p. 309.

† Idem.

CHART INDICATING THE MARCH OF CHOLERA IN 1865.



Primitive Foci.....○
Secondary.....○
Tertiary.....○

signs of this disease, existed at Constantinople, an Ottoman frigate arrived in the port, having left Alexandria on the 21st; she landed twelve men suffering from cholera, and on the 30th ten more; they were treated in the Imperial Marine Hospital. Within three or four days, some of the workmen engaged on an adjoining building, together with sailors on board a vessel moored alongside the infected frigate, were attacked by cholera, and from this quarter the disease spread over the city and surrounding villages.

“In the Dardanelles, the first case of cholera occurred in the lazaretto on the 30th of June; the disease next attacked a soldier on guard at the door of this establishment, and so extended to the inhabitants of the town and neighbourhood. At Enos, the first case was reported on the 26th of October, in the person of a sailor just arrived from Chio; the following day his daughter was seized with cholera, and the disease spread to a limited extent in the place.

“The introduction of cholera into La Cavalla Salonica and Volo, was most conclusively traced to the arrival of infected persons.”*

But the island of Mytelene and the Grecian Archipelago, although subject to frequent invasions of the disease from the landing of infected persons, protected themselves from cholera by means of strict quarantine; this remark is further applicable to the islands of Rhodes and Crete,† and no less so to those of Sicily and Samos. Greece was herself under strict quarantine, and, although the disease was brought to her very doors on several occasions, she was saved from invasion. The quarantine in Greece lasted, as a rule, for eleven

* ‘Constantinople Cholera Conference,’ pp. 537-8.

† Idem, p. 539.

full days for cholera arrivals, and five days for suspicious arrivals, the time spent on the voyage not being taken into consideration. In Cyprus, a lodging-house keeper, who had received several persons from quarantine, was attacked with cholera on the 7th of July, and the disease then extended through the place.

Cholera spread from Alexandria to Aleppo and Beyruth with the returning pilgrims, a number of cases arriving at the lazaretto in the latter place on and after the 22nd of June. From hence the disease extended all through Syria, visiting Jerusalem about the 21st of September. It is expressly noticed, however, by the sanitary officer at Damascus, that cholera was brought among them by the pilgrims returning *viâ* Suez and Alexandria, and not by those who arrived by the desert route.

We must here retrace our steps a little. It is almost impossible now to ascertain how cholera reached Bassora, but it is certain that it appeared at Muscat and Bunder Abbas in August, if not earlier in the year, in all probability extending to these localities from Bombay, or it may be, as supposed by the Constantinople Conference, with the returning pilgrims from Mecca. But having reached the head of the Persian Gulf, the disease travelled along its accustomed route up the Euphrates, *viâ* Imam-Ali, Kerbela, and Hilla. It reached Bagdad on the 17th of September, and Suleimaniah to the north on the 31st October. The disease may have been carried into this town from Aleppo, *viâ* Kerkouk, a route followed by many pilgrims returning to Suleimaniah. However this may be, it appears certain that the north-east of Persia was not invaded by cholera during this year, and this is a noteworthy fact in connection with the disease in

India. I have frequently traced the extension of cholera from the Punjab into Cabul, Herat, and Mushed, to Teheran; but the North-west of India was free from the disease in 1863 and 1864, consequently we have no history of its appearance in the North-east of Persia, although it was extending rapidly from the Persian Gulf, along the banks of the Euphrates, northwards.

We may now follow the course of the epidemic from Constantinople along the shores of the Black Sea, and up the river Danube, into the very heart of Europe. The outbreak of cholera at Constantinople occurred towards the end of June, and was followed by a few cases at Samsoun and Trebizond in July and August, these localities being protected as far as possible by quarantine. Sinope, Varna, and Bourgas, appear to have been protected by similar means, the disease hardly extending beyond the lazarettos; but at Erzeroum, the seeds of the disease were sown by a party of labourers arriving from the infected capital; no cholera existed in the place before their arrival, but immediately afterwards it burst out and extended through the town.

Cholera was imported into Novorosusk by sailors from Constantinople, on the 18th of August, and from thence extended into the Caucasus; Tiflis, in this epidemic, being invaded from the West, instead of from Persia as on former occasions. The cholera which prevailed in the Caucasus, made itself remarkable by its slow propagation and its feeble development; cramps were rare. The epidemic raged almost exclusively among the indigent classes, and it commenced as a rule with diarrhoea.* The disease was imported

* 'Constantinople Cholera Conference.'

into Sulina, by sailors affected with it, on the 31st of July, and in a population of 3000 souls, 1500 of whom had left the town, no less than 300 persons died out of 350 attacked by the disease. At Saint George, a village situated seven hours' march from Sulina, it appeared after the arrival of persons flying from the town; but Lete escaped its influence, the inhabitants of the place refusing to communicate with those coming from the infected locality.*

The disease was evidently imported from Constantinople by sailors arriving with cholera on them at Toultscha on the Danube, about the 15th of August, and it spread into the interior, being reported at several places in Bulgaria and at Salonica.

No cholera existed in Odessa before the middle of July, when cases were taken into the lazaretto from vessels arriving from Constantinople. On the 17th of August, the disease spread from the lazaretto to the town, and its development was observed with great exactness. On the 17th of August, a man named Gouline, a custom house agent, in the service of the lazaretto, fell ill, and was carried in the first instance to his home, and from thence to the town hospital; the next day he expired. His wife, his son, and a servant were also attacked; the latter died. On the 3rd of September, a workman named Dorfan in the lazaretto was taken ill; he also was carried to his lodgings in the Jewish quarter. His comrade, who attended upon him, fell ill; likewise the wife of the porter of the neighbouring house; then the husband himself, and then their daughter. Of all these, Dorfan was the sole survivor. On the 4th of September, a workman named Bochinski, whilst going from the

* 'Constantinople Cholera Conference,' p. 548.

lazaretto to his home, was seized with cholera, and succumbed to the disease the next day. His two children were attacked the same day, and two days afterwards his wife.

There is another case deserving particular attention in connection with the epidemic at Odessa. The wife of a German workman left Odessa on the 16th of August, for Altenburg in Saxony, with her child, suffering from diarrhœa. On the 24th, after a journey of nine days, she arrived at her father's house. On the 27th, the child's diarrhœa having become considerably aggravated, the mother called in Dr. Genitz. The mother was in perfect health on that day. At 9 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 8 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, whence the disease spread throughout the town. The family of a workman, who had died at Altenberg on the 13th of September, imported the disease into Werdau. The dwelling occupied by this family became the starting-point of an epidemic, which carried off two per cent. of the population of the town. With the exception of this epidemic, the whole of North Germany, Hanover, Holland, and Belgium remained free from the disease throughout the year; in fact, the North of Europe hardly suffered at all from epidemic cholera during 1865; we may therefore, with advantage, return to the consideration of the progress of the disease in the countries bordering on the Mediterranean, and then follow it in its course to England and across the Atlantic.

Italy.—Cholera was imported into Italy by vessels arriving from Alexandria; the first instance occurring at Ancona, on the 7th of July, in the case of a woman who washed the clothes of the sick in the lazaretto. “The epidemic spread in succession throughout the twenty-one communes of the province of Ancona, following, in almost every one of them, the steps of those who were flying from it.”* The members of the Constantinople Cholera Conference assert, that the disease did not spread into Upper Italy, on account of the measures there taken to stifle the primary germs of the disease. These means being neglected in the southern part of the country, cholera extended rapidly among the people.

France.—Cholera was brought by passengers arriving at Marseilles, with the disease upon them, on and after the 11th of June. It soon extended through the town, and from thence to Toulon, Arles, and Aix, where it caused great desolation, and so to Paris.

Spain.—The first case of cholera which occurred in this country, in spite of the strictest quarantine, was in the instance of a Frenchman who arrived at Valencia, from Alexandria, *viâ* Marseilles. The disease spread first to the inmates of the house in which he died, and then became epidemic in the place; 11,000 of its inhabitants were attacked, and of these 5100 died. The disease spread from Valencia to all the surrounding towns. Cholera was imported into Seville by means of soiled linen; the woman employed to wash these things was first attacked, and died the same day. Almost the whole of Spain was ravaged by the epidemic; thirty-one out of forty-nine of its provinces having been more or less under the influence of the disease, from

* ‘Constantinople Cholera Conference Report,’ p. 554.

July till the close of the year 1865; the mortality towards the end of the epidemic, in several places, having been far greater than at its commencement.

Portugal.—Cholera extended steadily from the East into Portugal, the first case having occurred at Elvas. During the time the disease was epidemic in the town, a woman and a child left the place for Porto, where the disease did not exist; both of them fell ill of cholera and died. A man and two children, living on the lower floor of the same house, were the next victims to the disease. The authorities had these patients carefully isolated, their goods and effects burnt, and so stopped the plague, which did not attack another person in the place.

Malta.—Early in June, fugitive pilgrims from Alexandria had arrived at Malta, in one if not more vessels in which cases of cholera had occurred; it was not till the 14th of the month that quarantine was established.* The lazaretto was the scene of much crowding, discomfort, and wretchedness. The first case of cholera which occurred among the inhabitants of the island, was reported on the 20th of June, in the instance of a girl belonging to the Artillery, living 660 feet from the lazaretto; and although no direct communication could be traced between the patient and those in the lazaretto, or affected vessels, still it is important to note the proximity of the house in which she lived to the lazaretto. The girl's mother, and several other people in the same building, were those next attacked by cholera in the island.

On the 30th of June, the detachment of Artillery occupying this infected building were marched into another barrack, and almost immediately after arriving

* 'Sanitary Reports, Army Medical Department,' 1866.

there, the disease appeared among the previous occupants of the place, who had been perfectly healthy till the arrival of their cholera-stricken comrades.

The first case, in the civil portion of the population of Valetta, occurred on the 1st of July, in the instance of a man who had been at work in the lazaretto. From this date the disease spread through Malta.

Gozo.—This little island, situated five leagues from Malta, remained uninfected till the 21st of July, when a man named Michele Cilia arrived there from Malta, and went to lodge with his sisters. Michele was suffering from severe diarrhœa when he reached his home, but recovered. Three days afterwards his two sisters, living in the same house with him, were attacked with cholera, and from that time a number of their relations and neighbours fell victims to the disease.

In the Mediterranean fleet, consisting of twenty-three vessels, there were only seven cases of cholera throughout the year, and of these four occurred at Malta. The three other cases were reported from among the crews of vessels anchored off the mouth of the Danube.

Gibraltar.—The transport “Orontes” left Malta on the 6th of July, with a detachment of H.M.’s 22nd Regiment, for Gibraltar, on her way to the Mauritius. There had been no cholera among the men of the 22nd Regiment before they embarked, but the disease had been very prevalent close to the point of their embarkation. They arrived at Gibraltar on the 10th without having had any sickness on board, with the exception of a case of diarrhœa. On the 18th, a man of the 22nd was seized with cholera; this was the first case in Gibraltar. The camp was at once broken up,

* ‘Constantinople Cholera Conference Report,’ p. 560.

and the men belonging to the right wing of the regiment were put on board the "Star of India," which, after forty-eight hours, proceeded to sea.

The left wing of the Regiment were moved from their former ground to another camp, but on the 31st two more cases of cholera occurred among them. They were then embarked on board the "Devrinport," and both vessels sailed for the Mauritius, where the Regiment landed in perfect health, not a case of cholera having occurred during the voyage.

Three days after the regiment had left Gibraltar, a man and his child, living near the encamping ground first occupied by the 22nd, were seized with cholera and died; other cases followed immediately around this spot, and from thence cholera extended over the town, destroying 580 people before the end of the year. The 9th Regiment, which had formed a part of the garrison during the early period of the epidemic, but had continued healthy, embarked for the Cape on the 19th of August. The one wing left for its destination in the "Windsor Castle," and no cases occurred on board. But the other wing started ten days later, and the next morning one of the men was seized with cholera. The ship was at once hauled into the stream, but as no other cases occurred during the next thirty-six hours, she then put off to sea. On the 29th, two children on board had diarrhoea, but recovered. On the 3rd of September, there were two more cases of cholera; fifteen men were seized with the disease within the next ten days, but after this no more cases occurred.*

England.—In 1865, epidemic cholera first appeared

* Dr. Gavin Milroy "On Cholera," 'Med.-Chir. Review,' 1868 and 'Medical Reports of the Army,' 1866, Dr. Ruttonford's Report.

at Southampton. In former visitations of our island, the earliest cases of the disease had occurred at Hull, London, and Edinburgh, ports in immediate communication with the infected portions of the North of Europe. But in 1865, as I have already remarked, with the exception of one or two places in Saxony, epidemic cholera was unknown in Germany, or, in fact, in any of the northern ports of the continent; and consequently, the towns on the eastern coast of England, receiving vessels from the continent, remained free from cholera. It is no less remarkable, that the disease appeared, on this occasion, in the very town of all others holding the most constant and rapid intercourse with Alexandria, and other infected places in the Mediterranean.

Professor Parkes, who investigated the circumstances of the outbreak at Southampton, states, "that during July, August, and September, there can be little doubt that the Peninsula and Oriental company's steamers ran into Southampton, after having had cases of cholera (on two occasions) and of diarrhœa (on two or three occasions) on board, during the voyage from Alexandria homewards. The crews of these vessels on landing, would disperse over Southampton and its neighbourhood."* Of these vessels, the "Ellora" arrived at Southampton on the 22nd of July, and the "Nianza" on the 1st of October. In the mean time the "Vectis," although she does not appear to have had cases of cholera on board, was in quarantine at Malta and Gibraltar, and on arrival at Southampton on the 21st of September, she steamed up the river and entered the

* Professor Parkes, M.D., F.R.S. "On the Outbreaks of Cholera in and about Southampton in September and October, 1865," 'Mr. Simon's Report' for 1865, p. 413.

docks, without paying any regard to the quarantine regulations of the port, which are invariably observed under similar circumstances. Moreover, the "Delta," which reached Southampton on the 11th of September, had cases of diarrhœa on board, of a choleraic character, and which Dr. Parkes considers to have been cholericine."*

The first instance of cholera reported among the inhabitants of Southampton, was in the case of a man of the name of Rose, a labourer on board the mud engine employed off the town quay, and who lived in a small crowded house with no back outlet, and occupied by three sets of lodgers. The privy was common to seamen and the frequenters of the theatre and brothels only a few yards off. This man was seized with diarrhœa on the 17th, and died of cholera on the 24th of September. The next case occurred on the 28th of September, followed by a third instance of the disease on the 30th. Dr. Parkes found it impossible to trace any direct connection between these cases of cholera and persons or things previously contaminated by the disease. "All the attacks occurred in the low part of the town; they were chiefly scattered, and showed no tendency to aggregation, except in the localities in and about the Rookery, and in Millbank Street, Northam, about half a mile away. It is nevertheless to be observed that, in several of the earliest cases of cholera recorded at Southampton, the victims had actually been at work in, or were the wives of men employed at the Northam iron-ship building yard, whence the workmen were sent to repair the Peninsula and Oriental Company's boats. Eleven of these vessels had been under the hands of these men from

* Mr. Simon's 'Report' for 1865, p. 428.

the 11th of July to the 22nd of October, and among them the 'Ellora' and 'Nianza.' It is further remarkable that, on the '16th or 17th of September, an outbreak of severe diarrhœa occurred among the workmen in the Northam yard, which lasted till the middle of October. No such severe outbreak had ever before been known during the seventeen years the yard had been open."

Cholera was not confined to the town of Southampton; the second case (Rose's being the first) in this locality occurred in the instance of a boy named Hill, living on Weston Common; this happened on the 21st of September. The boy had been employed in driving a coal cart about the country, "and in the smaller cottages the coal-shed is frequently close to the privy. Admit that there was slight cholera really in the cottages of the sailors belonging to the steamers, this boy was likely to have been exposed to the influence of the discharges."* However this may be, as above stated, he was seized with diarrhœa on the 21st of September, and the attack passed on into cholera. His mother threw the dejections on the dust heap, just outside her cottage door. On the 26th, the boy's father and only sister were taken ill with cholera; they both died. On the 2nd October, the man living next door to Hill's house was attacked with cholera and died, and on the 6th, a woman who had nursed the Hills, and whose house was close to the ash-pit upon which the dejecta had been thrown, was seized with cholera.

It would be beyond my province to enter further into the details of these cases; they are minutely described by Dr. Parkes in his admirable report on the subject;

* Mr. Simon's 'Report' for 1865, p. 428.

and although he finds it impossible, in the instance of this boy Hill, to discover any direct connection between his illness and any person or thing previously tainted with cholera, still I would draw the reader's attention to the quotation I have given above from Dr. Parkes' report, in order to show the possibility of the individual having contracted the disease in his rounds with the coal cart, and further would observe, as I have before done, that Southampton was visited on no less than twenty-three occasions by the boats belonging to the Peninsula and Oriental Company, between the time of the outbreak of cholera in Alexandria, and the appearance of the disease in Southampton; the time occupied by the journey between one place and the other, including stoppages at Malta and Gibraltar, where cholera was prevalent, is about fourteen days.

We have not done with Southampton yet, however, for the only other outbreak of cholera, which occurred in England during the year 1865, was connected in a very mysterious manner with this town. A farmer and his wife had gone to Weymouth for change of air, he having been suffering from gastric disorder for some time, which his medical attendant considered to be partly due to the impure quality of the water used in the house. On the 23rd he was attacked with diarrhœa, but he and his wife started for their home at Theydon-Bois, Essex, on the 25th of September; on their way, they passed through Southampton, where cholera had existed for eight days; but did not go beyond the precincts of the railway station. The day after reaching home, the wife was seized with cholera; the husband also continued to suffer from more or less looseness of the bowels. "Both used the same water-closet on the first floor, between the soil-pipe of which

and the well supplying the house with drinking water, there was (subsequently discovered) a free communication. The water, tainted with the diarrhœal discharges, was used by the family, and by a man and boy mentioned, for five full days, during and subsequent to which several members were attacked with malignant cholera, in the following order :—

Water in use.

On the second day of water's pollution	...	...	1
On the fourth " "	...	...	2
On the sixth " "	...	...	1

Water disused.

On the eleventh from pollution and fifth after disuse	...	...	2
On the twelfth " " sixth "	...	...	3

In addition, three cases occurred among individuals who had not consumed any of the water, but had been in communication with the sick; two members of the family, and the visitor, although using the water as the rest of the family, escaped with slight gastric disturbance; and the youngest son, twelve years of age, did not suffer from any indisposition whatever. Of the twelve cases, nine ended fatally."*

America.—Cholera appeared at one point only in America during the year 1865, and this was at the quarantine station of New York, under the following circumstances :—The steamer "Atlantic" sailed from Havre on the 12th of October for New York, which place she reached on the 3rd of November. She carried 540 steerage passengers, all of whom had

* 'Report of the Medical Officer of the Privy Council' for 1866. Appendix, "On Cholera," by Mr. J. N. Radcliffe, p. 304.

passed through Paris, which was then infected with cholera. The disease was not known to exist at Havre when the "Atlantic" started, but the very day she left the place a child on board died from cholera, and before reaching New York sixty fresh cases and fifteen deaths had occurred among the steerage passengers; not one of the cabin passengers or crew suffered. The "Atlantic," on arrival near New York, was placed in strict quarantine, and although fresh cases occurred on board, the disease did not extend beyond the infected ship, America remaining free from the disease throughout the year.

West Indies.—Cholera appeared in the island of Guadeloupe, at the sea-port town of Pointe à Pitre, on the 22nd of October 1865, and subsequently spread over the island. The adjacent island of Marie-Galante also became infected.

The following facts are taken from a despatch, addressed on the 23rd of April, 1866, by the Lieutenant-Governor of Dominica, to the officer administering the Government of the Leeward Islands, a copy of which was received by the Lords of the Privy Council from the Colonial Office. "A brig left Marseilles in the autumn of 1865, bound for the French island of Guadeloupe, and while she was on her voyage, a boy on board died of cholera; the captain kept some of the boy's clothes, and on arriving at Pointe à Pitre in Guadeloupe, sent them to be washed. The laundress was attacked with cholera; other cases quickly followed; and soon the disease spread throughout the island. Up to February 19, 1866, out of a total population of 138,669, there had been 10,808 deaths from cholera registered, including no fewer than 1934 in Basse-terre, the capital, which has but a population of 9576; and

the commander of a French ship of war, which called at Dominica about the end of March, informed the Lieutenant-Governor that, by that time, about one third of the population of the capital, and about a ninth part of the whole population of the island, had perished from cholera. Such was the magnitude of the danger which threatened the neighbouring island of Dominica, and which was, if possible, to be averted.

“Dominica is twenty-two miles from the main island of Guadeloupe, but only fifteen from some of its dependencies, certain small islands called ‘Marie Galante,’ above mentioned, and ‘les Saintes.’ Up to the beginning of November 1865, the communications between these small islands and the north end of Dominica were constant, almost daily; the markets of Marie Galante were supplied with provisions and vegetables from Dominica; and carpenters, bricklayers, and others living in Dominica, went across the narrow channel to work at Marie Galante, leaving their wives and families at home. It was on the 2nd of November that a rumour reached Dominica, that cholera had broken out at Pointe à Pitre in Guadeloupe. On the 4th, the Lieutenant-Governor of Dominica sent to the Governor of Guadeloupe for information; and feeling persuaded, after the return of the messenger, that it really was an outbreak of cholera, he, on the 9th, declared Pointe à Pitre in quarantine. Afterwards, when news arrived that the disease was spreading through the island of Guadeloupe, the whole of the island and its dependencies were placed in quarantine. Despite this precaution, a boat from Marie Galante filled with persons, some still healthy and some sick with cholera, succeeded in reaching Dominica. A strict guard was placed by the Lieutenant-Governor on the village at which these

persons had landed, and for the future 'health guards,' with loaded muskets, were stationed at every place round the island where landing was possible, to prevent persons from Guadeloupe from setting foot on the island. These measures of precaution were entirely successful, and, so far as I can gather from the despatch, only two persons died of cholera in Dominica; and these were two boatmen who landed from the boat mentioned above, and died on the beach, close to the village which was subsequently isolated."*

With the account of this outbreak of the disease in the West Indies our history of the cholera of 1865 closes, and from all I can learn of it I may safely remark, as Dr. Snow did of a similar epidemic some fifteen years previously, that cholera "travelled along the great tracks of human intercourse, never going faster than man travels, and often more slowly. In extending to a fresh island or continent, it always appeared first at a seaport. It never attacked crews of ships, going from a country free from cholera to one where the disease is prevailing, till they had entered a port or had intercourse with the shore. Its exact progress from town to town could not always be traced; but it never appeared except when there had been ample opportunity for it to be conveyed by human intercourse."

Early in 1866, cholera was reproduced in almost all the localities it had visited during the previous year, extending northward as far as St. Petersburg, and appearing in several localities in Bavaria, Saxony and parts of Prussia, as well as in Belgium and Holland. The disease still existed in Paris, extending to the north-west of France about Brest and Caen.† In

* 'Report of the Medical Officer of the Privy Council' for 1866, p. 26.

† Dr. Gavin Milroy's "Report," 'Med.-Chir. Review,' 1868, p. 210.

Luxemburg it early began to manifest itself with virulence. In Spain the disease had continued throughout the winter; but as a general rule the sea-board of the Mediterranean escaped the influence of the pestilence in 1866. Nevertheless, we may safely affirm, that cholera spread over by far the greater part of Europe during the year. The movements of large masses of troops by Prussia, Austria, and Italy, contributed to diffuse the disease, which told terribly on these armies during the summer campaign. It is sufficient for our purpose, however, to know that the disease, in 1866, as on former occasions, was extensively diffused over the continent the year after it had invaded those countries, and in place of entering upon the details of its extension from one locality to another, we may with advantage turn to the study of its advent in England and America, which had hardly been affected by cholera during the previous twelve months.

I must not, however, omit to notice one important case reported by Mr. Simon; the details are from a despatch to the Foreign Office from Her Majesty's Minister at Florence, dated October 26th, 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 for 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 towns-people were attacked; till, by the last returns, above one hundred deaths had taken place within the twenty-four hours.”*

The first case reported in Great Britain in 1866, occurred at Bristol, in the instance of a sailor from Rotterdam. On the 2nd of May, two more deaths were reported from cholera in Liverpool, among persons also just arrived from Rotterdam, *viá* Hull. On the same day the “*Helvetia*” sailed from the Mersey with 925 steerage passengers, chiefly foreigners; but cholera breaking out among them, almost immediately after they had started, the vessel was forced to put back into Liverpool. After having been purified, she again put to sea, and reached New York in safety. From the date of the “*Helvetia’s*” leaving, Dr. French reports that cases of cholera were of constant occurrence in Liverpool, but that they were sporadic, and that it was not until the 22nd of July that the disease broke out in an epidemic form among the inhabitants of the town; it lasted from that time till the end of November, and carried off 1792 victims. Cholera was confined to the lower orders, living in the most filthy part of the city, and in Dr. French’s opinion was not due to polluted water-supply.

The earliest undoubted instance of cholera in or about London in 1866, occurred in the case of a man and his wife living at 12, Priory Street, Bromley, on the 26th of June, but the first outbreak of the epidemic may be dated from the 11th of July, when five deaths

* ‘Report of the Medical Officer of the Privy Council’ for 1866, p. 25.

from cholera were reported in London. On the 12th, and ten following days, eleven, twenty, and fifteen persons died from this disease in the metropolis. From that time, life was fiercely assailed by cholera in its most virulent form; the deaths ran up from fourteen on Sunday, to 105 on the following Saturday (July 21st).

The deaths by cholera in London, for the four weeks ending August the 4th, were 63, 481, 1097, 1178. Dividing London (including West Ham and Stratford) into two portions, one section of which was supplied by seven water companies, and the other by the East London Water Company exclusively, we find that, in the first section, the deaths from cholera for the four weeks above noticed, were 26, 61, 142, 196, whereas, in the second or East London Water-works section, the mortality for the same period was 38, 420, 955, 982. In other words, throughout those parts of the Metropolis supplied by the seven water companies, the death rate from cholera had in no instance exceeded 8 per 10,000 of the inhabitants, and in several instances the mortality was less than one half that amount; but among the tenantry of the East London Water-works, the death rate from cholera had run up to no less than 72 per 10,000. "The explosion of the disease was, in fact, confined to an area supplied with water from one particular company and from one particular source."*

We must now briefly examine the circumstances of this remarkable outburst of the disease. The case is a very important one, being one of those characteristic, circumscribed onslaughts of cholera, which form so prominent and peculiar a feature in its history.

* 'Report of the Medical Officer of the Privy Council' for 1866. Appendix, "On Cholera," by Mr. J. N. Radcliffe, p. 300.

It appears that the East London Company draw their supply from the river Lea, the water being passed through filters into reservoirs, from whence it is forwarded to the consumers.

Now it seems that these filters are very apt to get out of working order in the summer months, their action becoming impeded by sand and a confervoid growth which covers their surface. But a fact still more important to notice is, that two of the reservoirs at Old Ford had never been covered over in accordance with the Act of Parliament. These two open reservoirs were "connected with the filtering beds at Lea Bridge by an open and foul conduit; and they sometimes, but not often, received waste water from them. The impure contents of these reservoirs have been (but it is averred very rarely) used for distribution in the East London Water Company's district, in the event of the filtered water running short from an extraordinary demand occasioned by a fire, or from an impeded action of the filter beds."*

We have the evidence of the carpenter in charge of the water-works at Old Ford, that he admitted water from these open reservoirs into the mains on two occasions, in June and early in July 1866, having been ordered by the Engineers of the company to open the sluices, because the engine was drawing air. "It was precisely in the region of the Old Ford water field that cholera raged. There, in three months, it killed little less than 4000 men, women, and children; while in the Lea Bridge field (another portion of the East London Company's works, supplied from newer and covered reservoirs) and in the other waterfields of London, the epidemic was kept within such narrow limits of fatality,

* Mr. Radcliffe's 'Report,' p. 297.

as could be accounted for by diffusion through sewers, direct contact with cholera matter in various ways, and the slightly contaminated filtered river water of the other companies.”*

I have already observed, that the first cases of cholera reported in or about London in 1866, occurred in a family at Bromley on the 26th of June, and Mr. Radcliffe traced the discharges of these patients into the river Lea, some 600 yards below the open reservoirs at Old Ford. He further discovered that, on the 12th of June, the dejecta of another suspicious case had been poured into the river, only 200 yards below the Old Ford reservoirs.†

We have, therefore, evidence of the *fomes* of cholera patients having entered the Lea on and after the 27th of June. From immediately above their point of entrance, the water from the contaminated river was passed through an imperfect filter into open reservoirs, from whence it was distributed, early in July, to a certain proportion of the inhabitants of London and its suburbs. Among the consumers of this contaminated water, epidemic cholera broke out on the 11th of July, and carried off no less than 72 in every 10,000 of those who drank it; whereas, the consumers of that part of the same company's water which had been more carefully treated, and of the water supplied by other companies to London, only died at the rate of from 3 to 8 in every 10,000. I need scarcely remark, that an incident of this kind could hardly be assigned to any other cause than the impure drinking water. The

* Dr. W. Farr's 'Report on Cholera of 1866,' p. xx.

† Report of the Medical Officer of the Privy Council' for 1866. Appendix No. 7, "On Cholera in London," by Mr. J. N. Radcliffe, p. 311.

tenants supplied from the Old Ford reservoirs differed in no respect from their brethren in other parts of the city, as regards their occupation or other circumstances, nor did they live in a particularly low locality; in fact, it was found, in this epidemic, that the greatest mortality occurred at an altitude of from 10 to 20 feet; the next greatest at from 20 to 40 feet. Nevertheless, Dr. Farr's rule, with regard to the altitude and rate of mortality, was observed to hold in different parts of the affected district, the death-rate "steadily diminishing without interruption from the lowest to the highest altitude, and yielding the series—167 (under three feet elevation above high-water mark), 89, 88, 76, 17, 4, at from 60 to 80 feet elevation.

Another case, which occurred about the same time in London, and which caused some discussion, as an instance telling against water being the agent by which cholera is disseminated, may be briefly considered in this place. It occurred in the City of London Union Workhouse. The whole of the inmates of this establishment were supplied by water from an Artesian well 250 feet deep; the population of the workhouse was 617 souls, out of this number there were 42 cases, and 27 deaths from cholera, and the whole of these cases, with one single exception, occurred among the 148 inmates of the infirmary. The infirmary, though faulty in construction, was in admirable order at the time of the outbreak of cholera, and not overcrowded.

The first person attacked was a woman, who had been admitted into the house for diarrhœa, but the looseness of the bowels ceased, and she seemed well, until struck down by cholera on the 24th of July; she was virtually in a state of collapse from the outset of the attack, and died in twelve hours. The next case

was that of the stoker of the infirmary, living on the basement floor, and having no communication with the inmates of the building. The third case was that of a man in charge of the gates leading into the infirmary yard. In all, there were fifteen cases of cholera among the inmates of the infirmary on the first day of the outbreak, on the following day (the 25th July), nine more persons were struck down by the disease, and during the next ten days, eleven other women and five men, making a total of thirty-nine of the sick in the infirmary, together with two healthy individuals employed upon the infirmary premises.*

Mr. Radcliffe has given us minute details of the circumstances of this outbreak, and endeavoured to discover the source from whence this cholera originated; but he does not mention if the water drawn from the Artesian well was directly conveyed from its source to the patients in the infirmary, or if it was allowed to stand in a cistern or vessels from which the patients drew their supply. If this were the case, it seems very possible that the foul effluvia, which he describes as having been complained of by the patients in the infirmary, on the evening of the 23rd of July, might have impregnated the water; or rather, that the organic matter which affected the olfactory nerves of the patients so sensibly on the evening in question, might also have become absorbed by the drinking water, and have produced the disastrous effects of the few following days. But this is purely a conjecture on my part; of one thing we are certain, which is, that the offensive odour arose from the hospital drains which emptied themselves into the main from Mile End Road, at this

* 'Report of the Medical Officer of the Privy Council' for 1866. Appendix, "On Cholera," by Mr. J. N. Radcliffe, p. 312.

time full of choleraic evacuations. The barometer suddenly fell on the 23rd of July, with a low temperature, indicating atmospheric conditions eminently favourable to upward currents from sewers. It is no less remarkable that the patients first seized were those nearest the traps opening into the sewers, and further, that the people occupying the wards through which the prevailing wind would have directly carried the foul air arising from the traps, were those prominently and chiefly affected on the 24th and 25th of July.

Cholera was more or less diffused over England during the summer of 1866, but it showed here, as in other parts of the world, the most mysterious partiality for some places, leaving others, under apparently similar conditions, absolutely untouched; for instance, Manchester remained comparatively intact while Liverpool suffered severely. The towns along the eastern coast of England, and in direct communication with infected ports on the Continent, were, during this year, hardly affected: in Hull, there were only twelve deaths from cholera, in Newcastle and Gateshead, eight, Sunderland twenty-six, and so on. Of thirty-three counties in Scotland, fifteen only were affected. In fact, the United Kingdom was, on the whole, but slightly visited by the epidemic of 1866, and the same remark applies to Denmark and Sweden.

Dr. Mapother informs us, that cholera was introduced into Dublin in 1866 as follows:—“At 11 o'clock a. m. on the 26th of July, one of the City of Dublin Steam Company's vessels landed from Liverpool, Jane Magee, a girl aged 16. During the voyage she had been severely purged and vomited, which was attributed to sea-sickness; but she recovered so much, that after having rested at the house of her aunt, 22, City Quay,

she spent some hours visiting her friends in that neighbourhood. At about three o'clock, she became very ill, and Dr. Shanahan (Count de Kavanagh) being summoned, pronounced the case to be one of cholera. She died about 10 that night, and I, having received intimation through the police, examined the body, which presented every feature that cholera leaves behind. I had the windows of the rooms and lobbies opened, and some chloride of lime thrown about the premises; but all my efforts to prevent a "wake" were ineffectual, as they would not believe that the girl had died of cholera, and they did not wish to have the funeral until after the arrival of her mother from Liverpool. On the following morning, with the aid of the coroner, interment was insisted on, and directions were given to the family, with the object of preventing the spread of the disease.

"Next day I went to Liverpool, for the purpose of ascertaining how she received the contagion, and of observing the type of the epidemic in that city. At 3, Upper Frederick Street, near the river, this girl's mother had kept a lodging-house for sailors, chiefly those from Dutch ports. It was denied that any cholera had occurred in the house, but the keeper of a warehouse about eighty yards off, in the same street, had died of that disease three days before Jane Magee left, and it was very rife in the neighbourhood.

"At 7 a. m., on the 30th, Mary Meyler, a cousin of the deceased, aged three years, who lived in the same room was attacked; this was ninety-one hours after Jane Magee's arrival in the house. She died at 9 the same night. The third case was that of the father of this child, Andrew Meyler, aged forty, a sailor, of intemperate habits. He came from sea on the night of

the 27th to live in the same room. The circumstances of this case were sudden and melancholy in the extreme. While returning home with a coffin for his child (which he had got in Cook Street, where he imported the disease), at 4 o'clock on the morning of the 31st, he was seized with cramps; and in an hour after, when I saw him, he was in hopeless collapse, dying in thirteen hours from the accession of the first symptom of illness. His wife, the fourth and last victim from the room, was seized at 10 a.m., on the 1st August. She could not be persuaded till the following day to go the hospital; she was then admitted into Sir. P. Dun's Hospital, and survived till the 5th. After her removal to the hospital, the house was completely emptied, and all its premises disinfected, and no cases occurred among the inmates, or in the immediate neighbourhood.

“ The next person attacked was a quay porter, residing in Tennis Court, Townsend Street. He was attacked on 2nd August, and recovered. On the 6th a fishwoman was attacked at 18, Poole Street, and died in fifteen hours. Her father and child succumbed some days after. She dwelt along the quay, where the disease was first developed. She was suffering from dyspepsia at the time, and was of the most filthy habits. Her residence stands on a delta of the Poddle River.

“ Six other cases, distinctly imported from Liverpool, established foci of contagion before the disease could have been said to be epidemical.

“ Except very early in an outbreak in a large city, it is impossible to trace the diffusion of the contagion, a remark which is as true of other diseases, universally allowed to be communicable, as of cholera.

“ The distribution of the disease over the city I will exhibit to you by a map, and I have ascertained that

it almost exactly follows the course of the water-courses, especially those that have been converted into sewers.”*

We must now briefly refer to the circumstances under which the disease appeared in America in 1866. The quarantine station of New York was alone visited by cholera during the year 1865.

The “England” sailed for Halifax from the Mersey on the 28th of March, 1866. Cholera broke out among the crew six days after leaving, and before she arrived at Halifax no less than ninety-two souls had perished; the thirty-seven saloon passengers, however, entirely escaped the effects of the disease.

The crew of the “England” were landed on an island near Halifax, and the sick sent on board the “Pyramus.” Up to this time there had not been a single casualty from cholera among the inhabitants of Halifax. The first persons attacked on shore were the two pilots who brought the “England” into harbour, but without, as they declared, going on board of her; they remained in their boat alongside the vessel till she was moored; one of these men, Terence, was immediately afterwards seized with cholera, from the effects of which he died; and the other pilot, Purcell, recovered, after a very severe attack. Of Terence’s family, four children were attacked with the disease, and two of them died. Three of Purcell’s children sickened, one severely, the others slightly; they all recovered.

No other cases occurred in or near Halifax except in a family living on the beach. On the 22nd, one of the children was seized with cholera and died, the

* ‘Lectures on Public Health,’ p. 440. By Dr. Mapother. Dublin, 1867.

mother took the disease on the 25th and died also. This circumstance has been accounted for by the fact of a lot of bedding having been thrown overboard from the "England," which had floated ashore near the house inhabited by this family, and the children were known to have handled and played with these contaminated articles.*

In spite of the most strenuous efforts to stop the ingress of cholera into New York, by means of quarantine laws and regulations, it broke out in that city about the beginning of May, and from thence gradually spread over the country. Its course has been admirably described as it affected the army of the United States in 1866.†

The first case of cholera reported among these men, occurred in the person of a recruit on Governor's Island, New York, on the evening of the 3rd July. Of the previous history of this case nothing is known. "Recruits from Governor's Island carried cholera to Hart's Island, where the first case occurred on the 8th of July. The epidemic becoming severe among the troops at this post, they were moved on the 20th to David's Island, where the disease subsequently prevailed." Cholera was clearly introduced by troops from Hart's Island among the inhabitants of Tybee Island, and to their comrades in New Orleans, and along the stations down the Mississippi. For instance, "the steam ship 'Texas,' with recruits from Hart's Island, left New Orleans on the 19th of July, and arrived at Galveston, Texas, on the 22nd. The day after their arrival, one

* A full account of this case is given by Dr. Barrow in the 'Army Medical Reports' for 1866.

† Circular No. 5, War Department, Surgeon-General's Office, Washington, May 4th, 1867.

of the recruits was attacked with cholera, and died in thirty-six hours. In the outbreak which followed, forty-four cases and twenty-four deaths are reported among the white troops at Galveston."

I should weary the reader by going further into these details, but would refer him to the admirable report on the subject by Dr. J. J. Woodward of the United States Army. The conclusions, however, at which this officer has arrived, regarding the principal influences at work in the dissemination of cholera, are too important to be passed over in silence, and I may best give them in nearly his own words. Dr. Woodward remarks, that "a thoughtful consideration of the facts embraced in the foregoing brief general statement, and in the appended reports, shows that they possess a twofold significance; on the one side, in connection with the question of quarantine; on the other, in connection with that of local hygienic and therapeutic agencies."

As to the question of quarantine, the facts are not perhaps conclusive, yet they are too numerous and too important to be overlooked, and although certain breaks in the chain of evidence exist, there can be no doubt as to the general facts of the case.

The epidemic appears from the record to have radiated distinctly from two chief centres. Originating in the overcrowded barracks of Governor's Island, New York Harbour, in the immediate vicinity of an infected city, through which recruits passed with more or less delay before arrival, the infection spread by readily traceable steps to Hart's Island and other posts in the harbour; to Tybee Island, Georgia; to Louisiana, by way of New Orleans; to Texas, by way of Galveston; to Louisville, Kentucky; to Richmond, Virginia, and to La Virgin, Nicaragua

Bay. From Richmond it was carried to Norfolk, Virginia; from Louisville to Bowling-Green, Kentucky. The probabilities appear to be that the disease was carried from New Orleans up the Mississippi to various points on that stream, and west of it, and though the whole chain of evidence is not complete, yet there are a sufficient number of known cases of the transfer of the epidemic from one post to another, in this region, to put this view of the whole movement beyond reasonable doubt.

The other principal centre appears to have been Newport barracks, Kentucky, where the disease was plainly introduced from the infected city Cincinnati, on the opposite side of the Ohio river. It did not prevail to any great extent at this post, yet it is in evidence that it was carried thence to Augusta and Atlanta, Georgia, to Nashville and Memphis, Tennessee.

At several points, as for example, at Augusta and Atlanta, Georgia, the epidemic did not extend beyond the infected recruits by whom it was imported. In many cases, however, it involved the rest of the community, and it is highly probable that this would have been the case far more generally but for the stringent hygienic precautions adopted.

As a particular example of the value of such precautions, attention may be appropriately drawn to the reports of Brevet-Major E. McClellan, Assistant-Surgeon, United States Army, from which it appears that cholera broke out at various points in the vicinity of Fort Delaware, in fact, encircled the post, but did not invade the garrison, although one case, which recovered, occurred in the family of an officer on the island.

On the whole, it must be admitted, that the general

tenor of army experience during 1866 is strongly in favour of quarantine, and especially points to the danger to the army incurred by the distribution of recruits, or other bodies of men, from infected points.

As to the question of therapeutic agencies, it cannot be said that any new light has been shed upon the existing obscurity of the subject by the army experience. The chief modes of treatment employed are indicated in the appended reports, and the general tendency of the facts recorded must be to direct attention rather to hygienic precautions, intended to mitigate the violence of the epidemic, than to methods of treatment, which have hitherto, unhappily, proved so unsuccessful.

Among these hygienic precautions, besides cleanliness, the use of disinfectants, ventilation, proper air space, and so on, especial attention is directed in the report of Brevet-Brigadier General J. A. McParlin, Surgeon, U.S. Army, to the efficacy of pure drinking water in arresting the spread of the disease, even after it has made its appearance. The troops exposed in New Orleans were, by his direction, supplied with cistern water (rain water), as far as practicable, and where this could not be obtained distilled water was, in some instances, purchased by the quartermaster's department. The disease did not spread to any extent among the troops thus supplied; and the majority of the cases at New Orleans occurred in the detachments of the 6th United States Cavalry, and 1st United States Infantry, and in the 81st Coloured, at times when these troops were so situated, for the most part, as to be obliged to use the water of the Mississippi river for drinking purposes. The interesting details of this important practical experiment will

be found in the following extracts from the reports of Surgeon McParlin and of Assistant-Surgeon Hartsuff:

“Whenever cistern water was not at hand, and could not be purchased, the quartermaster’s department has procured distilled water for issue to troops. The supply at Jackson barracks, at the barracks’ Hospital adjoining, and at the Sedgwick Hospital, Greenville, has been rain water in cisterns.

“The troops at the barracks have enjoyed great immunity from disease. The 116th Regiment, United States Coloured troops, camped near the Sedgwick Hospital, and supplied thence with cistern water, has continued entirely free from cholera. Quite recently, on muster out of the 81st United States Coloured troops, the 116th was moved into quarters in the city (near Hunter Street). The supply of distilled and rain water for a day or so was scant, and some of the men used hydrant (river) water. Soon two cases of cholera occurred. Pure water was supplied, and there have been no more cases in the regiment.

“The 9th Regiment, United States Coloured Cavalry, and the 39th United States Infantry, were supplied, but not sufficiently, with distilled water, until the cisterns at the Sedgwick were repaired, filled, and furnished rain water to them. At first, the distilled water, sent up hot in casks, could not become cool before it was needed. The men preferred to drink the river water because it was cold, and did so against orders and repeated warning, accepting the risk of disease rather than wait for the water to be cooled and aerated. Case after case of choleraic diarrhœa followed. Critical inspection failed to develop any other probable cause except the use of river water, and a recommendation was made to move the regiments

away from the river, far enough to prevent the men obtaining it. To avoid moving, the cavalry put on a strong guard to keep the men from the river, and cistern water was supplied from the Sedgwick Hospital. Cholera, since that, has ceased in the regiment. The 39th United States Infantry has been moved to the ground adjoining the hospital (former healthful camp site of the 116th), and receives cistern water from the hospital. Its sanitary condition is good.

“The 9th United States Coloured Cavalry kept part of two companies guarding and attending to horses in the city, in old stables on Derbigny Street, Second district. A few cases of cholera occurred among these men, until they were restrained the use of hydrant water, and put into improved quarters elsewhere.

“Circumstances have confirmed so strongly the importance of pure water, that even for troops in transit, remaining a few days, its supply is recommended.

“The camps in Greenville were infested, at one period, with vendors of liquors, pies, and other deleterious articles, until orders were issued and enforced against them.”*

“The early history of the disease, as it occurred in the 81st United States Coloured Infantry, was precisely similar to that of the 1st Infantry, described above. The occasion that demanded the services of the 1st, also required the 81st, who, in obedience to orders, vacated their comfortable quarters and bivouaced on the levee, where, for a few days, they were subject to all the irregularities and privations consequent on a speedy change of quarters. Their food was badly prepared;

* Report by Brevet-Brigadier General and Surgeon J. A. McParlin. Dr. Woodward's 'Report,' appendix, page 37.

their soiled linen was unchanged; their drinking water was from the dirty Mississippi; and to add to their bad condition, heavy and continued rains rendered their camp little better than a quagmire. These changes were so great and sudden, that the previous good health of the regiment succumbed to their influence, and on the 3rd of August a large number were admitted to the hospital with cholera."

Cholera in India since 1864: Selected Facts.—I do not propose at present entering fully into the history of cholera in India subsequently to the year 1864. Nevertheless, before I close this part of my subject, I have one or two facts connected with the disease during this period to lay before the reader.

In 1865, cholera was reproduced in a virulent form in the central provinces and Bombay, as I have already had occasion to remark, but Bengal Proper was comparatively free from the disease during this period, and the Punjab equally so; there were, in fact, only four cases and two deaths in this latter province, among a European force numbering some 14,000 men.

During the year 1866, cholera was again on the increase in Bengal Proper and Behar. Among the prisoners confined in the jails of these provinces, there were no less than 1455 cases, and 635 deaths from cholera, out of an average strength of 20,353 convicts. In many of the districts of Lower Bengal, especially those affected by famine, the mortality from the disease among the prisoners was very great indeed; for instance, at Raipore the death rate was 100 per 1000; at Cuttack 132 per 1000, and no less than 368 per 1000 at Chyabassa. Fearful as is this death rate, it was probably trifling in comparison with that which prevailed in the same districts among the civil population.

With the exception of one case of cholera in the Agra jail, the prisons in that province, as well as those in Meerut, Rohilcund, and the Punjab, were absolutely free from cholera throughout the year.

We may here revert to the prevalence of famine and cholera in Orissa at this period in connection with the amount of rainfall, as contrasting with the condition of the north-west in 1861. I have attempted to show that, so long as the drought of 1860 lasted, cholera did not invade the famine-stricken districts. It may be asked, why then did the disease spring up in the famine districts of Bengal in 1866? The Commissioners appointed to inquire into the Bengal famine report, that "the natural cause of the scarcity and famine may be stated to be simply the premature cessation of the rains of 1865, throughout the Lower Provinces of the Bengal Presidency, in the middle of September, 1865. Speaking generally, it may be said that no rain of any consequence fell after the middle of that month. A portion of the Madras coast to the south-west of Bengal was similarly affected."

The total amount of rainfall for the year was not unusually small in most of the districts of Bengal, but it fell abnormally and out of time. For instance, at Pooree, although no rain fell in January or March, there were nearly four inches in February and six in April; the total quantity of rain for the year was seventy-seven inches. In the Midnapore district, rain fell during every month of the year, 113 inches in all. Dr. David B. Smith informs us that in February, 1866, cholera appeared at Pooree, and that it continued till March, and again reappeared in August and September, during which months, an unusual amount of rain having fallen, half the district was inundated.

When the heavy rains ceased in September the outbreak of cholera passed off. It is evident, therefore, that the season, particularly as regards the rainfall in Bengal, during this year of famine and cholera, was very different from that of the north-west drought and famine year without cholera.

Although the prisons in the provinces of Agra, Meerut, and the Punjab, were free from the disease in 1866, cholera appeared among the troops and civil population towards the close of the year.

From the commencement of the rains of 1866, cholera had been more or less prevalent in several of the Rajpootana States; Jodhpoor had suffered severely, and the Governor-General's agent, on his way from Aboo to the Agra Durbar, was obliged to march out of the ordinary route, in order to avoid the infected districts. He arrived at Halena, a village in the Bhurtpore district, on the 8th of October, 1866, and halted the following day, continuing the march on the 29th towards Agra. Two cases of cholera, the first which occurred in the agent's camp, proved fatal on the morning of the 29th. His party then marched in two divisions towards Agra, halting the main portion of his camp at the village of Buronda, ten miles from Agra, on the 2nd of November. On the following morning, the agent took his personal staff and office establishment into the cantonments. Agra was at this time absolutely free from cholera, "but about noon of the 4th of November the disease appeared in the agent's camp, and a few hours afterwards reappeared in a virulent form in the main encampment at Buronda. It subsequently gained a footing amongst the European and Native troops, during the Viceroy's Durbar, and also in the city of Agra."

“The disease continued to follow some of the regiments on their march to their various destinations: notably, the 36th Native Infantry, *en route* to Meerut, suffered after leaving Agra. Dr. Bryden’s tables show that among Native troops in camps, and on the march in the Agra and Meerut districts, during the months of November and December, 1866, twenty-eight cases of cholera occurred in all, of which nineteen were fatal. In December there were two fatal cases in 2nd Battalion, also one in the Royal Artillery at Delhi, and one in the Sappers and Miners at Roorkee, both of which recovered.”

Among the general population it is difficult to determine to what extent cholera prevailed at this time, but from the Punjab returns it is evident that the disease existed to a considerable extent in the Delhi district after the Agra Durbar, and also at the Goormooktesur fair; and two deaths occurred from cholera on the 4th and 23rd of December at Roorkee, which is close to Hurdwar.

Further, Dr. J. Murray informs us that, during the cold season of 1866-67, the disease prevailed along “a belt of land skirting the Terrai, at the foot of the Himalaya Mountains. In February, cholera was prevailing in the Terrai villages, in the vicinity of Nainee Tal, and extended, skirting the hills in a westerly direction, in March. From the 5th to 12th of April there were nineteen cases in the village of Bazpore, which is sixty miles to the east of Hurdwar; and from this place, doubtless, pilgrims went to Hurdwar.”*

We have therefore, in the above history, abundant

* ‘Report on the Hurdwar Cholera of 1867.’ p. 3. By Dr. J. Murray.

evidence to show that, cholera having been imported into the mass of people congregated at the Governor-General's Durbar in Agra, during the month of November, 1866, the disease had subsequently extended, with the troops and camp followers, over the North-west of India and into the Punjab, appearing close to Hurdwar in December; and further, that it had been generated more or less constantly throughout the cold season of 1866-67, among the inhabitants of the Terrai, in fact, up to the very time of the Hurdwar fair, and it is well known that numbers of people from the infected districts visited Hurdwar. Cholera was very prevalent at Allahabad and Benares in March, 1867, and a considerable concourse of people from these places were also present at Hurdwar. Lastly, the disease had not died out in the Bhurtpore territories during the cold weather; it certainly existed there in February and March; the Rajah of Bhurtpore, with a large retinue, visited Hurdwar; supposing, therefore, cholera to be a communicable disease, we can hardly wonder at its having broken out among the multitude of pilgrims assembled at Hurdwar in April, 1867.

In the following history of this outbreak of the disease, I shall follow closely the published reports on the subject by Dr. Murray, Inspector-General of Hospitals, Upper Provinces, and Mr. H. C. Cutcliffe, F.R.C.S. The latter gentleman was at the time sanitary officer in charge of the Hurdwar fair; he commences his admirable report by informing us that the town of Hurdwar is situated on the bank of the Ganges, in a gorge of the Sewalick Hills, about thirteen miles from where the river escapes from the Himalaya. The elevation of the place is about 1000 feet above the level of the sea. The hills on which

the town is situated are of tertiary formation, and are composed of massive strata of grey sandstone, covered in parts with a superstructure, either of clay or loose boulder gravel. Cholera had been unknown at Hurdwar during the nine years prior to 1867.

The encamping ground at Hurdwar consists of a narrow slip of land, nine miles long by three broad, with the river running through the middle of it. Dr. Cutcliffe considers that some twenty-two square miles were occupied by the camp, containing nearly three million pilgrims. The very best possible arrangements had been made with regard to the sanitation of this prodigious encampment.

With regard to conservancy, the rules laid down by Dr. Cutcliffe were,—1st. That the principle of dry earth conservancy should be everywhere adopted.

2nd. That all filth, from whatever source, should be as quickly as possible disposed of, either by (a) burying it in trenches, or (b) burning it in furnaces, *i.e.* by rapid combustion.

3rd. That decently screened latrines should be provided in situations convenient to the people.

4th. That no latrine or trench should on any account be made on ground that at any time could form any part of a watercourse.

5th. That dead bodies of animals should be speedily buried in graves of six feet deep, in grounds selected with similar restrictions.

“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.

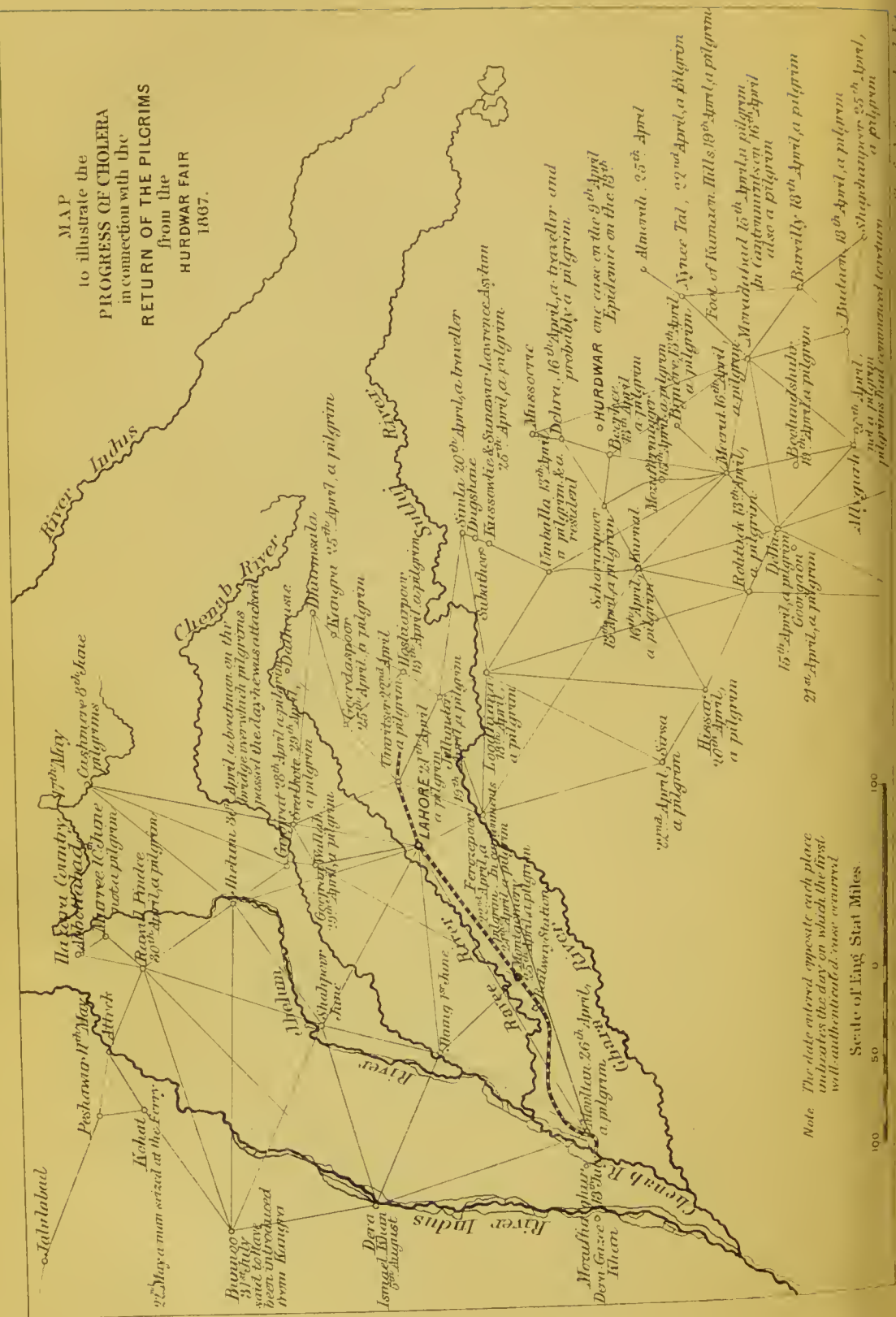
With the exception of a case of cholera on the 9th, under the care of Dr. Kindall, the entire mass of pilgrims appears to have remained in good health up to the 12th of April, and I cannot do better than describe what then occurred in Dr. Cutcliffe's own words. He says, "The bathing place of the pilgrims 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. Now, 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 encompassing ground was again left a barren waste. Dr. J. Murray has given us a careful report of the events that occurred after the pilgrims left Hurdwar; his knowledge of these localities, and his great experience in matters of the kind, enabled him to trace the pilgrims along the various routes they took on their return homewards from Hurdwar.

He states that the immense crowd at Hurdwar, having entirely dispersed by the 15th (cases of cholera had occurred among them on the 13th before they left), the pilgrims "passed, at a favorable season of the year, through a healthy country; supplies were abundant, and extensive arrangements had been made for their convenience. They travelled chiefly on foot, and slept in the open air or under trees. Some had camels to carry their luggage, and there were a great many bullock hackeries and bhylees, which carried families with their supplies. The ordinary rate of progress was from fifteen to twenty miles a day. A few travelled

MAP
to illustrate the
PROGRESS OF CHOLERA
in connection with the
RETURN OF THE PILGRIMS
from the
HURDWAR FAIR
1867.



Note: The date entered opposite each place indicates the day on which the first well-authenticated case occurred.

Scale of Eng. Stat. Miles

quicker by horse dawk carriages, and many continued their journey by rail after reaching Gazeabad and Umritsur. The moving mass crowded the road in a continuous stream for nearly a week at Meerut, where I remained to watch them. This pilgrim stream carried with it 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 with them to their houses, over the whole of Hindoostan." (*See Map.*)

Dr. Murray continues, "There were cases of cholera on the 13th April at the first stage on each of the four main lines of road from Hurdwar; 1st, at Bajwanpore, twenty-three miles from Hurdwar, on the way to Mooltan, to the west; 2nd, at Roorkee, nineteen miles on the road to Hissar and Jeypore, to the north west; 3rd, on the third line of road *viá* Meerut to Allahabad, to the south; 4th, at Nujeebad, fourteen miles on the road *viá* Bijnore, skirting the Himalaya mountains towards Oude, to the south-east." It really seems almost impossible to have clearer evidence than Dr. Murray's tables afford (*vide* Appendix C), as to the fact of cholera having been disseminated throughout the country by means of the infected pilgrims. He says that, in the reports he received on the subject from medical and civil officers, there are numerous illustrations of the manner in which the disease was transmitted to families by the arrival of relatives; to people of villages communicating with pilgrims; to those who ate the food of the pilgrims, or travelled in the same carriages with them, and were afterwards affected by the disease. He traced cholera

in this way south-eastward to Shajehanpore, on the 24th of April, and so on into Oude; southward, to Allyghur, on the 20th of April; northward as far as Simla; and to the north-west, right away to Peshawur, and so into Cabul. The disease reached Peshawur on the 11th of May, and, in the opinion of the civil surgeon, "was due to importation; no cases having occurred in the place for years, and not until after these Hurdwar pilgrims had arrived." He adds, "Although the time of incubation was limited, I think there can be little doubt on this matter; I hear the mortality among these pilgrims on their way up was severe." It was ascertained that 548 men, women, and children, left Peshawur for Hurdwar, and 524 returned, twenty-four having died of cholera or other disease on the road; besides which, Peshawur was on the high road to Cabul, between which country and Hurdwar great numbers of pilgrims went and returned.

The circumstances of the first case of cholera in Peshawur are clearly given by Sub-Assistant Surgeon Cheytur Shah, the patient having been one Shunken Doss; the case occurred on the 11th of May, and the disease was epidemic in the city by the 21st of the month. Cholera spread to the European troops in the cantonments, the first cases being reported on the 20th of May, and did not cease until it had carried off ninety-two men out of a force of some 2511 troops.

In connection with this outbreak of cholera, I have given, in Appendix D, a report on the subject by Dr. J. I. Ross, at present Secretary to the principal Inspector-General, Indian Medical Service. It gives us an admirable account of the means he took to preserve the men of his regiment from cholera; and forms the third of a series of reports I have given,

from officers in the Indian Medical Service, on this disease, the first written in 1819, the second in 1849, and the third in 1862. They are specimens of the work done by officers in our service, and of the valuable records from which I have abstracted the details of the Indian portion of this history; as a whole, they illustrate the gradual change of opinion which has taken place among Indian officers, as to the causes and means to be employed in warding off the attacks of this terrible disease.

The epidemic of 1867 did not cease at Peshawur, for it crossed our frontier into Cashmere and Afghanistan; in this latter country it broke out with fearful virulence early in July, and continued until the month of September. This circumstance probably accounts for the appearance of cholera, towards the close of 1867, at Teheran, where it is also said to have been reproduced in the autumn of 1868. Europe, therefore, is threatened at the present time with the disease *viâ* Russia and Turkey, and also from Central India and Bombay, for cholera was very severely felt in many parts of the central provinces last rains; it appeared in Bombay towards the close of the year, and early in 1869 has again been heard of in that presidency, particularly in the districts about Mhow.

Before bringing the history of cholera to a close, I must advert to a few facts regarding its occurrence in the Andaman islands. These islands, or rather the places we occupy on them, are situated in north latitude $11^{\circ} 42''$, and east longitude 93° , and therefore, by steamer, about three days' journey from the Sand heads and Madras, and some 300 miles from the coast of the Tenasserim provinces. In 1858 the Government of India determined to plant a penal settle-

ment on the islands, and it has since received upwards of 15,000 convicts from the shores of British India.

Dr. Rean, the Superintending Medical Officer of Port Blair, assures me that he has never seen a case of genuine cholera among the convicts, except when it has been introduced into the island by prisoners arriving from Calcutta. I shall give instances in detail; but the fact I would particularly notice is, that although the convicts sent to the Andamans are natives of India, and the islands situated in the Bay of Bengal, cholera has never occurred there spontaneously, in spite of the circumstances by which these convicts are surrounded being almost precisely similar to those of their fellows in other parts of India. It is true, cases have from time to time been entered as cholera in the returns, but Dr. Rean, a man of wonderful energy and great ability, who was himself nearly killed by cholera when serving with the gallant Meer's Regiment at Cawnpore in 1857, distinctly states that, with one exception, his belief is, that no genuine cholera has occurred among the convicts in the Andamans, unless the disease has been introduced into the place from without.

Dr. Rean took me to the house in which this one suspicious instance had happened last December; and although, unfortunately, the medical officer in charge of the case could give us little useful information on the subject, still it appeared to Dr. Rean and myself, from the statements which the patient's attendant made, that the man did not suffer from suppression of urine; and it is further evident that he was an extremely sickly individual, who had constantly been suffering from attacks of hemorrhagic dysentery. It is true, deaths have been reported among the convicts from bilious cholera, the disease being precisely

analogous to our English summer cholera, but clearly the genuine Asiatic form of the disease has been unknown among the inhabitants of the Andaman Islands, up to the present time, with the exception of the following instances, when it was imported from foreign sources.

The first occurred in 1864, in the case of some prisoners brought to the Andamans in the steamer "Arracan." This history, like so many of our records on the subject, is contained in various reports, and until these are brought together, loses more than half its value.

Dr. Rean was kind enough to point out to me the following passage in Dr. Plank's annual report for 1864, on the jails of British Burmah. Dr. Plank writes,—“There is a circumstance connected with one of my visits of inspection to the Rangoon jail, which should, I think, find a place in this Report. On the 19th of November last, I observed within the jail enclosure a party of 250 transport prisoners, who had come down from Calcutta in the steamer 'Arracan' on their way to the Andamans, and had been landed by order of the Chief Commissioner, for a day or two. I had them drawn up in lines and carefully inspected them.

“I found most of them looking below par, perhaps in great measure the result of sea sickness. They were nearly all small men from Bengal Proper, and many faces with bad expressions were observed amongst them. I found that of this number, 250, ten were sick in the jail hospital, and that eleven more had been left on board ship, who had been thought too weak to bear removal on shore. I observed that all the prisoners had irons on their legs, and iron handcuffs on their wrists. They clamoured to be

allowed to wash, and some had lice in their heads ; many had long hair, bushy beards, and long moustaches. There was no attempt at uniformity of dress amongst them. Some had the warm caps of the North-west, and said they came from Allahabad, and some had little cotton caps, one a particoloured cap of a native sepoy regiment ; most had scraps of turbans.”

“ I observed that their bedding, clothing, and eating vessels were good and sufficient. One man showed me some common uncooked grain, moist with water in a tin pot ; he complained that this disagreed with him. I asked to see a specimen of the dry article, and he produced dry grain from the corner of his sheet, where it was tied in a little bundle. The Havildar of the guard said this was given to the prisoners a handful at a time, when they asked for it, that it did not form an item of their regular diet, which consisted of a preparation of rice, called ‘ Choorā,’ made by boiling rice with water, then crushing it, and afterwards drying it in small flaky pieces. Some was given to me, and appeared to be good food. A sufficient quantity of ‘ Choorā,’ with one chittack of sugar, formed the daily ration of each prisoner. There seemed to be little discipline amongst these men, who were bad looking and noisy.

“ In the afternoon of the same day I visited the steamer ‘ Arracan,’ in which these prisoners had arrived. I found its ‘ between decks ’ clean, and well arranged to secure the prisoners, the decks being partitioned off on each side, through its whole length, by a wooden palisade, enclosing the machinery also on all sides. These two long cages had doors at each end, and perhaps were large enough to accommodate 150 men, but I had no opportunity of measuring them. I found eleven

prisoners on board, who had been thought too weak and ill to bear removal to the shore; they were all lying exposed to the sun on the upper decks: one man, who was dying of choleraic diarrhœa, had been placed with his body slanting conveniently towards a scupper hole. One prisoner was found with extensive gangrene of a great part of his left thigh, his gangrenous limb partly covered by a piece of calico, scarcely long enough to cover all the dying skin.

“In the evening these men were removed in covered carts to the jail hospital, the one with gangrene being admitted to a separate ward in the charitable dispensary of Rangoon, where he afterwards died, his case being hopeless from the first; but common humanity requiring that, to his end, he should be nursed and kept clean.

“On the 22nd, a fatal case of cholera occurred among the prisoners who had been landed, and I began to fear that an epidemic of that fatal disease would appear in the jail; but, to my great relief, after the lapse of a day or two, the steamer having taken the living freight on board, continued her voyage. I have since heard that six, if not seven of these prisoners died of cholera before they reached the Andamans.”*

I have fortunately been able to follow up the history of this vessel after her arrival at Port Blair, Dr. Rean having kindly placed the following details from the MS. records in his office at my disposal.

* I cannot allow this account of the unfortunate prisoners on board the “Arraeon” to go forth to the world, without declaring my firm conviction that it was not only an exceptional case, but one for which the Government is in no way responsible. Those in charge of these poor convicts must have been terribly in fault, and would surely have met with their deserts had the matter been promptly brought to the notice of Government.

“A somewhat severe outbreak of cholera occurred amongst a batch of convicts, consisting of 273 males and 21 females, who arrived here on the 26th of November, 1864, in the steamer ‘Arracan’ from Calcutta, *viá* Rangoon and Moulmein, and who landed at Ross Island (the Andamans) on the evening of that day. One of the prisoners who had been ill on board expired almost immediately on being landed, and five others succumbed to the disease during the same night. It continued to prevail until the 8th of December, when it ceased, its progress apparently having been arrested by the measures taken to prevent its extension.

“Although fifty-one convicts were attacked by the disease (of whom four were females, and of this number twenty-three died, all males, and the remaining twenty-eight recovered, including the four female convicts), it was particularly remarked by the superintendent and myself, on our inspection of the convicts the evening they were brought on shore, that the *whole batch* more or less exhibited a dejected and harassed appearance. As soon as it was discovered that these convicts had brought cholera with them, they were located in two of the detached airy barracks recently constructed on the island (Ross), and a ration of rum served out daily to each, so long as the disease continued—precautions which were evidently attended with the best results.

“This outbreak of cholera was characterised by early and rapid prostration of vital power, many of the sufferers having been brought to hospital in a sinking state, very shortly after passing a few loose motions. The treatment I adopted varied according to circumstances; but I think it right to record that I

found Condry's fluid (manganate of potass), in one-drachm doses, administered every hour or two, in conjunction with stimulants, to be productive of the greatest benefit in several instances. In the stage of collapse, I have found no remedy to be so powerful to arouse the system as the frequent affusion of cold water over the head and face; several cases, indeed, which appeared quite hopeless, having rallied, and eventually recovered, when this was adopted.

“None of the hospital attendants took the disease, although several of them were necessarily employed in rubbing the cholera-sick with stimulating liniments; and I may here state, that considerable personal experience in epidemic cholera has led me to the conclusion that it is *not contagious, but that the exhalations given off by the evacuations are decidedly infectious, when allowed to remain exposed until decomposition takes place.* I therefore make a point of having the evacuations received in chatties, charred, and immediately removed from the ward, the contents being emptied into pits in the earth previously dug for the purpose, between two and three feet deep, at some distance from the hospital, and then covered over with a layer of charcoal. These pits I do not allow to remain open longer than four hours, and should the hospital floor become the least soiled with the evacuations, I have the spot forthwith sprinkled with the chloride of lime, afterwards well washed, and chloride of lime again sprinkled over it, with the understanding that it is to remain for three or several hours.”

These measures absolutely and entirely prevented the spread of the disease among the other convicts, some eight thousand of whom were located on the spot.

In the following year, cholera was again imported

into the island, and the Governor of the settlement reports, that "on the experience of November, 1864, when cholera broke out on the arrival of convicts from Calcutta, measures have been taken that happily have prevented, under similar circumstances, the reappearance of that disease in this settlement. Though cholera was again brought to these shores among the Sepoy Guards over convicts on board the steamer "Golden Fleece," which vessel arrived in the settlement on the 14th of November, 1865, yet, fortunately, the cholera did not extend among the convicts, though some of them were taken with illness that might have rapidly changed into that disease, had not immediate measures been taken on arrival."

Dr. D. B. Smith was in charge of this steamer, and, as he assures me, had great difficulty in getting his men landed at all. Dr. Morton at first refused to receive them; but his objections being overruled by the Governor, he had them all washed in the sea, and their clothes destroyed before landing, and the men entirely separated for some time from the rest of the population. With all these precautions, however, some days after landing, several bad cases of diarrhoea occurred among the party, but they and their excrements were handled upon the principles already laid down by Dr. Morton, and the disease was stayed, as described in the Governor's report.

With this account of cholera in the Andamans, I must close my history of the disease. It remains for us now to judge calmly, without prejudice, and thoughtfully, of these facts. So judged, we shall be able the better to understand the past history of the disease; so judged, we may learn what its future will be among the races of mankind; so judged, it is in our power to in-

dicating rational means by which nations may be saved from its deadly influence, and cholera confined to its natural limits, if not, in the course of time, destroyed.

SECTION III.—GEOGRAPHICAL DISTRIBUTION OF CHOLERA.

We may probably most conveniently consider this part of our subject under three headings :

I. As to the circumstances of those countries which have as yet remained free from cholera.

II. We may attempt to define the endemic area of the disease.

III. We may trace the routes cholera has pursued in its extension from its endemic area over the world.

I. With regard to the distribution of the disease, we have Dr. Gavin Milroy's authority for stating that the only countries which have up to the present time remained free from cholera are, Australia, New Zealand, and the other islands of the Pacific; the Cape of Good Hope and its adjoining settlements, the West coast of Africa from the Cape as far northward as Gambia, including the islands of St. Helena and Ascension; the Azores, Bermuda, Iceland, the Faroe, and also the Orkney and Shetland islands, and lastly the western coast of South America.*

But even in India we find that the inhabitants of certain localities have escaped the influence of cholera in a very remarkable manner. For instance, Dr. W. J. Moore assures us that the disease is unknown at Mount Aboo, and that it had never visited Otocamund prior to 1861. It is very difficult to account for the

* Dr. Gavin Milroy "On Cholera," 'Med.-Chir. Review,' 1865, p. 434.

exemption of the former of these stations from cholera, for we know that it has frequently prevailed in the immediate neighbourhood of the place, and the mountain is the resort of numerous pilgrims. Nor is there anything remarkable in the altitude of Mount Aboo to account for its exemption from cholera. I have had occasion to refer several times to the fact of cholera having been imported into Simla, and among the Himalayas, at elevations considerably greater than Mount Aboo; in fact lofty chains of mountains are evidently no effectual bar to the progress of the disease; in spite of them cholera has on several occasions raged throughout Nepal, and Afghanistan; it has crossed the Caucasus chain at an elevation of 7000 feet, and has committed terrible devastation among the inhabitants of the table land of Mexico. And since our Himalaya sanitarium have been increasing in size, it is evident that cholera is becoming more common among the people who resort to them. Hardly a year passes now without deaths from cholera occurring at Simla. Nor can we wonder at this when, as late as 1865, the Sanitary Commissioners inform us that "the sides of the hills are everywhere studded with human excrements, and the smells which arise in every direction are a disgrace, especially to a place which professes to be an asylum for the sick. Moreover, the sheep which browse on the hills are known to be most unclean feeders, and it is no matter of mere surmise that they devour these human excreta.

The water must also be more or less contaminated. In summer the dry beds of the mountain torrents are places of convenience; it is not difficult to understand how filth lying in their beds, or on the hill sides from which they are fed, should poison the whole water of

the station. In one particular locality there is a striking illustration of what must, to a certain extent, occur all over the district. The edge of a hill at a few yards distance from the public road is lined with filth, and is evidently the resort of the numerous servants in the locality; and at some distance lower down the slope, is the spring from which the water supply of Peterhooff (the summer residence of H.M's Viceroy), and many of the large houses in the vicinity, is drawn. What must occur after every fall of rain is too obvious.

Thus not only are the air and the water polluted, but the very food of the European inhabitants is tainted by the want of the commonest care and precautions. It is possible that the diarrhoea, for which Simla has been so noted, and which has for so many years in no small degree affected the health of the community, has been due not to any defects in the climate, but to the fact that man himself has set all sanitary laws at defiance.* In 1866, '67, and '68, cholera appeared in Simla in a deadly form; and as late as the 5th of July, 1869, we learn from *The Englishman* that—"Dr. May, who is at present at Simla, has just finished an elaborate series of analyses of the waters of Simla. He has given it as his opinion that the water is, naturally, the purest he has found in India; but as it reaches the consumer, it is the most impure he has ever analysed. The amount of nitrates in it, in an active state of fermentation, is something appalling. Such an opinion as this brings the onus of the unwholesome state of the water supply entirely on the Municipal Commissioners, whose duty it certainly is to keep the sources of supply free from

* 'Proceedings of Sanitary Conference for Bengal,' 13th Oct., 1865.

all pollution. Simla is acknowledged to be the most beautiful hill sanitarium in the world, and it will be a pity if the reproach now existing as to the impurity of its water should be allowed to continue a single day, now that it is known that the remedy is within reach of the controlling sanitary officers.”

From a very cursory study in fact of the history of the disease, we cannot but arrive at the conclusion that, at times, cholera breaks out with terrible violence among the inhabitants of the Himalayas and other mountainous countries, and consequently that there is nothing in the geological formation, or other circumstances of these regions, precluding the generation of the disease among their population. The fact of the inhabitants of these localities being comparatively few, together with other causes which we shall subsequently notice, prevent the disease from taking such a firm and lasting hold upon them as it does upon those dwelling in the plains ; but probably among no class of human beings has the death rate from epidemic cholera been higher, than among the inhabitants of the mountainous countries bordering the north and north-west of Hindustan.

Dr. E. Balfour, in 1856, referred to the fact, that certain localities in the Madras Presidency enjoyed a remarkable exemption from cholera ; of these the most notable was a place called Honore on the sea shore in the province of Canara ; the disease had been frequently generated in the surrounding country, but had never been known to cross a broad bund of laterite which surrounds the land side of Honore. This case was cited to prove that this laterite formation, in some inexplicable manner, prevented the ingress of cholera into the town.

The facts related are doubtless, as in the instance of Mount Aboo, very singular; but as in the latter case we can trace the immunity to no special geological or geographical circumstances, so in the matter of this bund of laterite, we do not find in it a sufficient cause for the exemption of Honore from cholera, more especially as we have evidence at our command to prove, that towns and buildings, situated on a laterite formation, have over and over again been the scenes of terrible explosions of cholera. Take for example the districts and stations of Midnapore, Sourie, Banchora, and Raneegunge, in lower Bengal; these places are built on laterite formations, in many places from forty to eighty feet in thickness, which crop up amidst the alluvial soil common to this part of the delta of the Ganges, a similar formation being also met with over large tracts in Orissa; and yet these towns, and the jails attached to them, have been the scenes of fearful visitations of cholera; they are in fact situated in its endemic field. Again we find the same laterite formations over the Deccan, and yet the inhabitants of this part of the country are by no means exempt from the influence of cholera. I cannot, therefore, accept the inference, that the laterite bund round the town of Honore was the cause of its preservation from cholera; that is, I cannot believe that because the bund was of laterite, it had any inherent or specific property of warding off the disease from the place. I can understand the protective influence of this bund, if, adopting the theory of water being a medium for the communication of cholera, we suppose that it cuts off the tanks and wells of Honore from the surface drainage of the surrounding country; for under these circumstances the disease must have first been carried into the town, and

the dejecta been deposited in the wells or tanks of the place, before it could have reached the intestinal canals of any large number of the inhabitants of the town.

Dr. Balfour mentions another very remarkable instance of exemption from cholera, occurring among the inhabitants of the hill tracts of Orissa. These low hills stretch away from Orissa down into Nagpore and central India, and they send off a spur at right angles, which reaches northward as far as the Ganges at Rajmahal; they are inhabited by the aborigines of the country.

The hill tribes of Bengal appear to have the greatest possible aversion to the people of the plains, and, on the other hand, the latter look on the hill men as little better than dogs—unclean creatures—without caste, whose presence is to be avoided; their touch is a source of contamination to the orthodox Hindoo; food, water, or anything which hillmen have handled, if partaken of, being sufficient to destroy the caste of the person who eats it, thereby inflicting upon him innumerable ills in this world and the next.

It is hardly possible for those who have not lived among the people of India, to understand the extent and depth of this feeling; it is tantamount, as far as all personal contact or relations are concerned, to the most stringent laws of quarantine between these races. The hill men, so long as they remain among their mountains, are absolutely isolated from domestic intercourse with the people of the plains. From among the latter, cholera is never absent, but the former are rarely visited by the disease when in their own homes. Colonel Dalton of Chota, Nagpore, the Rev. W. Storrs at Paljheri, and many other persons I have spoken to on this subject, confirm the information given by Dr. Balfour; cholera

certainly does not exist among these hill men in an endemic form, and very rarely indeed appears among them as an epidemic disease, and yet their hills crop up in the midst of the Gangetic Valley, in many places being adjacent to towns and villages from which cholera is never absent.

We naturally ask if there is anything in the mode of living of these people that accounts for their exemption from cholera. I think not; they are like most hill tribes, dirty in their persons; their habits are far from clean; they do not object to half rotten or even raw meat, and frequently live on the fruits and roots of jungle plants; they are a singularly merry-hearted, jovial people, but their best friends would hardly accuse them of living under favorable hygienic circumstances when at home.

Is it then that these hill men, like canine animals, are insusceptible of the influence of cholera? certainly not; for of all men, they probably suffer most severely from it when they visit the plains, especially during our cholera months. I have given an instance of this in the case of the Shergotty prisoners in the years 1832-33. It will be remembered that in this outbreak of disease, Dr. Marshall expressly states that it was the hill men in the jail who were killed by cholera, that only one or two of the people belonging to the plains were affected by the disease, though living within the same walls, partaking of similar food, and existing under precisely the same circumstances. We have had illustrations of this fact over and over again, especially of late years among hill men passing through the plains of Bengal, on their way to the tea gardens of Cachar and Assam; the mortality among them from cholera has at times been fearful, until it was discovered

that they were peculiarly sensitive to the disease; but by taking them over the Gangetic valley during the cold season, they reached their destination in Cachar and Assam free from cholera, and when once they had passed this danger, were by far the healthiest and best men the tea planters could secure.

If the hill men are so easily attacked by cholera in the plains, and yet remain free from it in the hills, their mode of living being what most people conceive would actually conduce to the generation of cholera, it seems natural to suppose that the hills must have something to do with their immunity from the disease.

The low metamorphic hills, however, upon which they dwell, seldom rise to a greater altitude than a few hundred feet above the level of the plains, and I have referred to frequent instances of the inhabitants of far more lofty ranges, of the same geological character, being severely visited by cholera, as, for example, the inhabitants of the European part of the island of Bombay and the surrounding country. I am perfectly ready to grant, as was first pointed out by the Medical Board in 1817, and more strongly asserted by M. Bayer in 1832, that among the inhabitants of mountainous countries through which streams pass with some rapidity, where no stagnant or retarded waters are met with, and where the foundation is rocky and the soil sandy, cholera is less apt to make an impression, than among people living on an alluvial soil. But admitting all this, it does not by any means sufficiently account for the exemption of the Bengal hill people from cholera. The population of Nepal and the Himalaya are not spared from the ravages of an invading cholera; it rushes in among them, and destroys them at a fearful rate, and yet the hill people

of lower Bengal escape. The essential difference between the two is this, that the latter are, as I have described, when at home, isolated from the men of the plains, the real source of contamination, while the inhabitants of the Himalaya are guarded by no such protecting influence; being Hindoos, they flock down in masses to perform religious rites at Hurdwar and other holy places; there they meet their brethren of the plains, and imbibe, it may be, the washings of their bodies and clothes contaminated by cholera matter, as at Hurdwar in 1867, which they carry back and disseminate all over the Himalayas. The hill men of Bengal perform no pilgrimages; seldom, if ever, wash their bodies or clothes at all; are cut off from all social ties with the men of the plains; and they escape the cholera till they come among us, and partake, probably, not so directly of our contaminated food as of our contaminated water, the consequences being such as I have described. So long as they remain isolated in their houses, like the convicts in the Andamans, neither wind, climate, food, or any other circumstances can generate cholera to any extent among them, but bring the hill men into the plains, where cholera prevails, or take the disease to the Andamans, where it does not naturally exist, and the result is the same—an immediate outburst of cholera among those brought into contact with it.

After a careful study of the history of the distribution of the disease, a desert appears to me to be the only country in which cholera is unable to establish itself under existing circumstances. The disease speedily dies away in an arid, uninhabited waste of this description.

Dr. W. J. Moore, who as Medical Officer in charge

of the Rajpootana political agency, has peculiar advantages for gaining information regarding the desert tracts of western India, informs me that, although he has a dispensary "on the verge of the desert districts, and should certainly have known, had there been any cholera in the locality, he has never heard of any epidemic there." He adds "that, in 1865, our camp marched into the western districts and left the cholera behind them." Dr. Dickson, from careful inquiries into the circumstances of the disease in the north of Africa, came to the conclusion which I have before noticed, that cholera in these regions never spreads beyond three stages into the desert. And in the history I have given of the disease, I have frequently referred to the fact of the deserts of Arabia and Syria having been the most effectual barriers to the propagation of cholera by companies of pilgrims crossing them. In fact, as the cholera conference (Constantinople) assert, "a great desert is the best of all obstacles to the propagation of cholera." Further than this, we have seen an invading cholera in India pursuing a progressive course from east to west and north-west, brought absolutely to a stand-still on the borders of a country which had temporarily been converted into a desert, from the suppression of the usual rains; I allude to the cholera of 1833, and 1860, in the north-western provinces. It is evident that, in these instances, it was neither the geological formation of the soil, the occupation or mode of living of the people, or, in fact, any other conceivable cause, except the want of moisture in the air and soil of the drought-stricken country, which stayed the progress of the destroying power among the population; for these districts had, on previous occasions, frequently been

affected with cholera, and no sooner did the copious rains of the following season set in, than cholera burst out among the inhabitants of the country which had been a desert the previous year.

My impression, therefore, is, that so far as the geographical distribution of cholera is affected by desert tracts, we must look to the absence of moisture in air and soil over these regions, as being the influence which shields those who travel over them, or dwell in them, from cholera. These remarks, of course, do not apply to persons crossing a desert country in a railway train, but to caravans and such like bodies of people, who spend weeks and months in travelling over these sandy plains.

As I develop my ideas regarding the causes of cholera, we shall find that this exemption of desert tracts from the influence of the disease, is in accordance with the views I hold as to the conditions essential for the spread of cholera among mankind.

With regard to Australia, and the other countries I have named as being exempt from cholera, I may observe that, as a general rule, they are all at a great distance from India, and having very little communication with her, or with other countries while affected with cholera. In fact, from their geographical relations, they may be said, as regards cholera, to be strictly under quarantine, the restrictions being those of Nature, and not of man's imposition.

It may appear that the Cape of Good Hope forms an exception to this rule. True, the great high road from India is now turned through Egypt; still, formerly, every one leaving India had to go home by the Cape, and yet the place remained free from cholera. With regard to this case we must take into consideration

the fact, that the voyage from India to the Cape was seldom if ever performed under two months, and beyond this, the old East Indiamen were probably the most roomy and best managed passenger ships in the world. And what is of even more importance with regard to the spread of the disease, comparatively little merchandize, and but few passengers arrived in these vessels for the Cape, and there was no unloading of cargo, or going into dock. The goods, the people, and in fact all belonging to the ship, passed on from the Cape as they had arrived there. Supposing cholera, therefore, to be a communicable disease, and to have been introduced into a vessel sailing from India, the chances are that its influence would have been destroyed before reaching the Cape; but even on arriving there, as the vessel was not unloaded and but few passengers and none of the crew remained, the probabilities of the disease being communicated to the inhabitants of the place, were infinitely less than if the Cape had been a port in which cargo and passengers were landed, and the vessel taken into dock and cleaned.

It would seem, therefore, as I have before said, that the characteristic features of those countries which are exempt from cholera are, that they are at a great distance from India, separated from her by a wide expanse of ocean, and having very slight intercommunication with her. Otherwise, there appear to be no peculiarities common to these countries, or in which they or their inhabitants differ from places which have been devastated by cholera from time to time. Their geographical position has isolated them from the home of the disease, and it is to this circumstance we must, I think, attribute their immunity from its influence.

But these cases teach us another vitally important lesson, which is, that no meteorological changes, filth, want, or any other similar conditions we know of, are capable of generating the disease *de novo*. If otherwise, are we to suppose that these circumstances only act in certain parts of the world, notably in the route of human intercourse between the East and West, since the disease passes only from India into Europe, and from thence to the North of Africa, and across to America? That the meteorological, epidemical, or other influences which we may choose to imagine as generating cholera, should be confined in their operation to these particular sections of the earth's surface, is certainly an obstacle to any such view, and we can hardly help feeling, I think, that the exemption of the inhabitants of Australia and other countries from cholera is presumptive evidence against the spontaneous generation of the disease.

II. We must pass on to consider in what parts of the world cholera is now endemic; and I would have it understood that I use the word endemic in its ordinary sense, that is, I understand by an endemic disease one that is common to the inhabitants of a particular country—a native disease, because a different meaning appears to have been lately attached to the word. For instance, the Secretary of the Madras Sanitary Commission argues, as no deaths from cholera were reported among the inhabitants of Madras for a few weeks in 1867, that this “immunity from the disease clearly disproved the assertion of the endemicity of cholera in Madras, so unhesitatingly put forward by the Cholera Congress at Constantinople.”*

* ‘Proceedings of Madras Sanitary Commission’ for Sept., 1867, p. 389.

According to my ideas of the meaning of the word endemic, an exceptional circumstance of this kind would not in the least invalidate the inference that cholera is endemic in Madras, provided it were known that, for the last sixty years, a considerable number of the population have annually been killed by the disease. Dr. Montgomery's own tables show that, for the past seven years, deaths have constantly been reported from cholera.

I am not writing as a statician, and simply mean, when stating that cholera is endemic in a certain locality, that it has been known to prevail there, year after year, for forty, fifty, or it may be sixty years; but that it by no means follows that the inhabitants of these towns or districts are never free from the disease.

It will probably simplify our subject to determine, in the first place, if cholera exists as an endemic disease beyond the confines of British India. The Cholera Conference at Constantinople have done much towards clearing up this point: after long deliberation they distinctly declare that cholera is not endemic in Arabia or Persia, and I quite agree with them. I have made the strictest inquiries among men who have lived in Mecca and parts of Persia for years, and they all confirm the decision of the Constantinople Conference on this point, as also do the English and native captains of vessels, trading between Calcutta and parts of the Persian Gulf and Red Sea, and whom I not unfrequently meet in this city.

I mentioned, when referring to the medical returns from our officers in the Straits settlements in 1839-40, that cholera was not then endemic among the people of that part of the world, and I have the best

Table showing deaths from cholera in all Madras for each month of seven years 1860—66, and for eight months of 1867.

Years.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.	Weekly average.
1860	3	2	2	6	22	87	1218	637	276	160	91	76	2580	49·6
1861	38	75	54	150	204	76	183	599	786	343	107	161	2776	53·3
1862	425	485	229	102	189	267	126	222	242	501	519	328	3635	69·9
1863	372	452	455	154	84	19	5	8	2	46	10	77	1684	32·3
1864	133	110	106	45	3	4	4	97	38	15	9	10	574	11·0
1865	121	72	54	20	10	4	3	302	120	118	45	45	944	18·1
1866	99	73	149	83	77	160	577	544	534	283	93	312	2984	57·3
Total ...	1191	1269	1049	560	589	617	2116	2409	1998	1466	874	1009	15177	...
Average .	170·1	181·2	149·8	80·0	84·1	88·1	302·2	344·1	285·4	209·4	124·8	144·1	2168·1	41·6
1867	364	178	58	1	1	...	...	1	*					

authority for asserting that, up to the present time, Asiatic cholera is neither endemic in the Straits nor in China. No doubt cases of sporadic or bilious cholera, arising from the use of unwholesome food, occur from time to time among the people of these parts of the world, as they do everywhere else; but these cases are not communicable, they never spread in an epidemic form, are not accompanied with suppression of urine, the evacuations usually contain bile, and above all they seldom if ever kill people in the fearfully rapid manner that Asiatic cholera does.

I need hardly say that cholera is not endemic in any part of Europe, Africa, or America.

We are, then, driven back upon British India as the only country in the world having the unenviable reputation of being the abode of endemic cholera; that it is endemic there is a fact which none who know the country will feel disposed to dispute.

From the returns published by Dr. H. Macpherson for twenty years ending 1860, as shown on the next page, it is evident that cholera is endemic in Calcutta.

Again, it is presumed that the population of Madras is about half a million, and in the table, page 276, Dr. W. R. Cornish has given us the mortality from cholera in that city for ten years ending 1864; I have already given a table from Dr. Montgomery's report bringing these returns down two years later. It is evident, from the figures contained in these tables, that cholera is endemic in Madras.

Lastly, I have referred, in the history of cholera in India from 1853 (p. 185), to Dr. Leith's tables of the mortuary returns for Bombay, extending over a period of fourteen years; from these we find, as Dr. Leith observes, that the disease was never absent from the

Table showing the mortality among Hindoos and Mahomedans from cholera, smallpox, and all other diseases, in each of the ten years from 1841 to 1860 inclusive.

Years.	HINDOOS.					MAHOMMEDANS.					TOTAL.						
	Cholera.	Smallpox.	All other diseases.	By cholera, per 1000 of total deaths.	By smallpox, per 1000 of total deaths.	Cholera.	Smallpox.	All other diseases.	Total.	By cholera, per 1000 of total deaths.	By smallpox, per 1000 of total deaths.	Cholera.	Smallpox.	All other diseases.	Total.	By cholera, per 1000 of total deaths.	By smallpox, per 1000 of total deaths.
1841	3417	24	4826	8267	413.5	2.9	1760	32	1933	3725	472.4	5177	56	6759	11992	431.7	4.6
1842	5195	18	4742	9955	521.8	1.7	1350	14	2699	4063	332.2	6545	32	7441	14018	466.8	2.2
1843	2571	247	4563	7381	348.3	33.4	1168	88	2109	3365	347.1	3739	335	6672	10746	347.9	31.1
1844	4061	1703	4744	10508	386.4	162.0	1750	1137	2138	5025	348.2	5811	2840	6882	15533	374.1	183.4
1845	4335	28	4675	9038	479.6	3.0	1905	39	2204	4148	459.2	6240	67	6879	13186	473.2	5.0
1846	4301	56	4743	9100	472.6	6.1	2126	22	2435	4583	463.8	6427	78	7178	13683	469.6	5.7
1847	2071	28	5521	7620	271.7	3.6	970	5	2757	3732	259.9	3041	33	8278	11352	267.8	2.9
1848	1450	85	5468	7003	207.5	12.1	1052	22	2395	3469	303.2	2502	107	7863	10472	238.9	10.2
1849	2602	1239	5696	9537	271.7	129.9	1265	485	2133	3883	325.7	3867	1724	7829	13420	288.1	128.4
1850	2324	3270	5940	11534	201.4	283.5	1024	1160	2259	4443	230.4	3348	4430	8199	15977	209.5	277.2
1851	3089	20	5879	8988	343.6	2.2	1285	12	2072	3369	381.4	4374	32	7951	12357	353.9	2.5
1852	3078	46	5841	8965	343.3	5.1	1111	13	1703	2827	392.9	4189	59	7544	11792	355.2	5.0
1853	4546	17	5667	10230	444.3	1.6	1086	2	1549	2637	411.8	5632	19	7216	12867	437.7	1.0
1854	2169	96	5749	8014	270.6	11.9	913	17	1699	2629	347.6	3082	113	7448	10643	289.5	10.6
1855	2794	50	5754	8598	324.9	5.8	950	11	1891	2852	333.0	3744	61	7645	11450	326.9	5.3
1856	3458	146	6526	10130	341.3	14.4	1082	32	1818	2932	369.0	4540	178	8344	13062	347.5	13.6
1857	2584	2358	6528	11470	225.2	205.5	1254	819	2362	4435	285.0	3838	3177	8890	15905	241.3	190.9
1858	3653	72	5717	9442	386.8	7.6	1542	51	2358	3951	390.2	5195	123	8075	13393	387.8	9.1
1859	3126	44	6626	9796	319.1	4.4	1550	10	2561	4121	376.1	4676	54	9187	13917	335.9	2.8
1860	4255	39	6705	10999	386.8	3.5	2298	25	2449	4772	481.5	6553	64	9154	15771	415.5	4.0

Table of mortality from cholera in Madras 1855-1864.

Years.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
1855	305	351	136	30	14	2	6	45	390	358	207	112	1956
1856	167	128	181	132	147	29	12	2	1	3	1	2	805
1857	4	152	161	135	81	126	114	74	117	115	158	160	1378
1858	433	323	126	28	116	92	94	111	128	128	136	249	1965
1859	349	463	130	72	20	10	12	7	6	3	2	8	1082
1860	3	2	2	6	22	87	1218	637	276	160	91	76	2580
1861	35	75	54	150	204	76	183	599	786	346	107	161	2776
1862	425	485	229	102	189	267	126	222	242	501	519	328	3635
1863	473	452	455	154	84	19	5	8	2	46	10	77	1684
1864	133	110	106	45	3	4	4	97	38	15	9	10	574
	2226	2541	1580	354	880	712	1774	1802	1986	1675	1220	1183	18435

island of Bombay. Clearly, therefore, it is hardly correct to suppose that cholera is only endemic in the valley of the Ganges: it is more than probable that the disease is endemic in all large towns along the seaboard of British India, including Chittagong and parts of the Pegu division.* I have already referred to its frequent appearance in the ceded districts of Madras, of which Bellary is the capital, and which includes the table land between the Eastern and Western Ghauts, having an elevation of some 1600 feet above the level of the sea. Cholera was doubtless endemic in these districts in 1833-34, and remains so up to the present day, breaking out year after year during the annual festival at Humpi. From these districts, passing northward, we come to those of "Saugor and Nagode, which belong to the Gangetic basin,"† and in which cholera appears to a greater or less extent twice a year. We shall probably not be far wide of the mark if we draw an imaginary line to the north-east through Saugor, Allahabad, and Gorruckpore, to the foot of the Himalayas; throughout the whole of the plains to the east of this line cholera is endemic, the intensity of the disease increasing as we approach the seaboard of the Bay of Bengal, the cities of Dacca and Calcutta being pre-eminently the stronghold of this terrible malady. Cholera is less frequently met with as we advance to the north-west and west from the line I have above indicated, until the disease may with certainty be said not to be endemic in the Punjab, Rajpootana, and Sind. But along the valley of the Nerbudda and Tafty rivers, and throughout a very

* "Report on Cholera at Thazetmzoo." By Dr. E. Balfour, Madras 'Quarterly Journal,' October, 1863.


† "Rough Notes." By J. Oldham, F.R.S. 'Indian Annals,' p. 276, March, 1868.

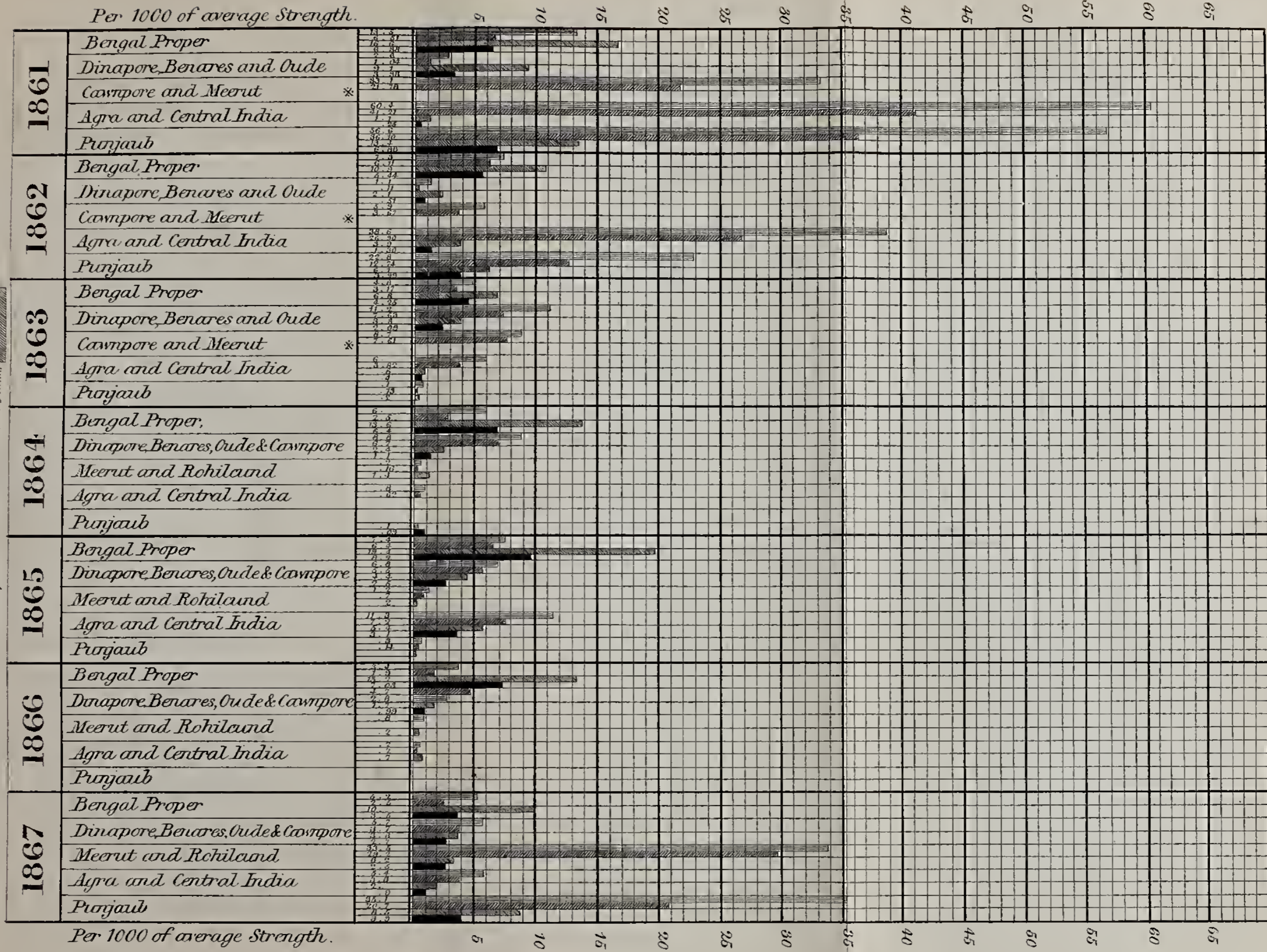
Statement showing the strength, admissions, and deaths from cholera which have occurred amongst the European and Native Troops and Jails of the Bombay Presidency, from 1840-41 to 1867-68.

Years.	EUROPEANS.				NATIVES.				JAILS.				
	Strength.	Admissions.	Deaths.	Per-centage of deaths to strength.	Strength.	Admissions.	Deaths.	Per-centage of deaths to strength.	Strength.	Admissions.	Deaths.	Per-centage of deaths to strength.	Per-centage of deaths to admission.
1840-41	6393	121	41	6	33437	259	113	3	5466	159	61	1.1	38.4
1841-42	7665	128	31	4	28926	82	29	1	5402	47	21	.8	44.5
1842-43	7670	1085	426	5.5	26290	429	158	6	5213	417	162	3.1	38.8
1843-44	8449	140	61	7	33099	275	99	2	5438	138	55	1	32.6
1844-45	8744	161	74	8	38746	237	80	2	6060	284	99	1.6	34.8
1845-46	8594	234	83	9	36886	434	190	5	6655	411	202	3	49.1
1846-47	9390	992	487	5.1	47142	170	51	1	6834	551	203	2.9	36.8
1847-48	9598	26	1	.01	44435	100	31	.06	5509	8	...	...	...
1848-49	10031	16	1	.01	40451	22	4	.01	8034	9	1	.01	11.1
1849-50	9329	153	78	8	36735	144	69	1	6589	295	54	.8	18.3
1850-51	9948	183	56	5	35915	190	84	2	6850	164	69	1	42.1
1851-52	9711	92	54	5	33700	152	56	1	6647	270	85	1.3	31.5
1852-53	9559	4	1	.01	33641	51	9	.02	6330	24	5	.08	20.8
1853-54	8298	43	22	.02	33529	206	78	2	5426	48	19	.3	39.6
1854-55	8305	103	45	5	34607	347	154	4	5748	118	40	.7	33.9
1855-56	8973	16	5	.05	34470	59	19	.05	6296	36	118	.03	50
1856-57	8995	36	11	1	34362	80	36	1	6374	40	17	.3	42.5
1857-58	16737	365	150	9	39714	97	38	1	6308	90	33	.5	36.6
1858-59	20347	27	4	.2	39891	247	152	4	6591	6	2	.03	33.3
1859-60	21297	317	169	7	39921	275	112	3	6037	129	53	.8	41.1
1860-61	16855	174	105	6	37226	187	87	2	6080	183	66	1.1	36.1
1861-62	13846	68	38	2	31411	180	94	3	5223	198	97	1.7	49.1
1862-63	11937	78	53	4	28980	99	51	2	7015	52	26	.4	50
1863-64	12585	14	7	6	26986	118	63	2	7557	63	27	.4	42.8
1864-65	12645	54	22	2	26539	251	113	4	7266	133	46	.6	34.6
1865-66	11661	282	188	1.6	26412	280	129	4	7663	176	59	.8	33.5
1866-67	11958	14	7	1.06	26635	19	10	.04	7450	22	6	.08	27.3
1867-68	10657	73	58	5	26525	9	2	.01	7423	6	2	.03	33.3

Table A.

DIAGRAM TO ILLUSTRATE THE ADMISSIONS AND DEATHS FROM CHOLERA, AMONG THE EUROPEAN AND NATIVE TROOPS, IN THE DIFFERENT GROUPS OF STATIONS, IN THE BENGAL PRESIDENCY, DURING THE SEVEN YEARS, 1861-1867.

European indicated thus 



* Native troops not shown separately for this Group.

Table B.

DIAGRAM ILLUSTRATING THE COMPARATIVE PREVALENCE OF AND MORTALITY FROM CHOLERA IN THE SEVERAL GROUPS OF JAILS IN THE BENGAL PRESIDENCY, FROM 1859 TO 1867.

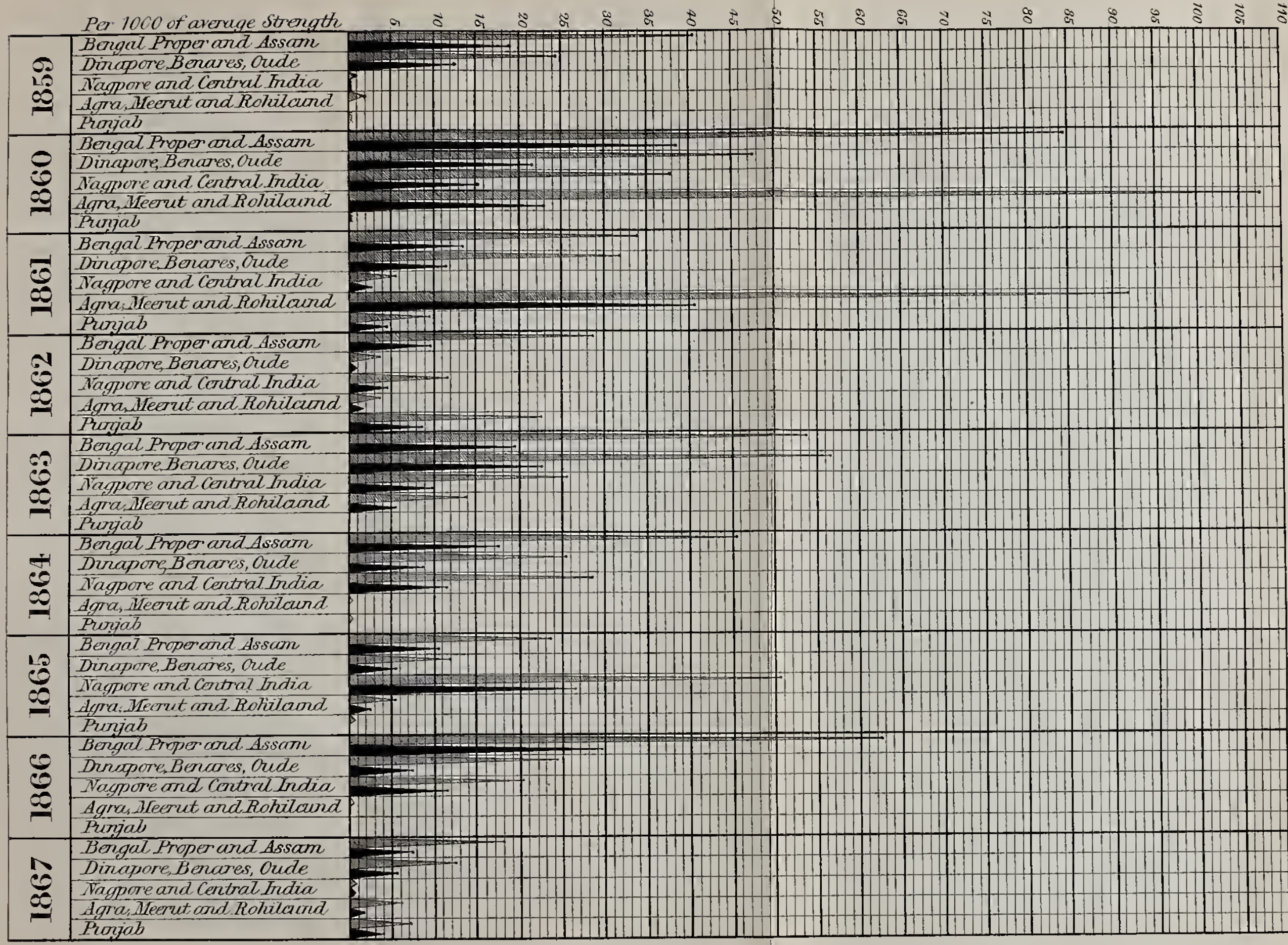


Table C.

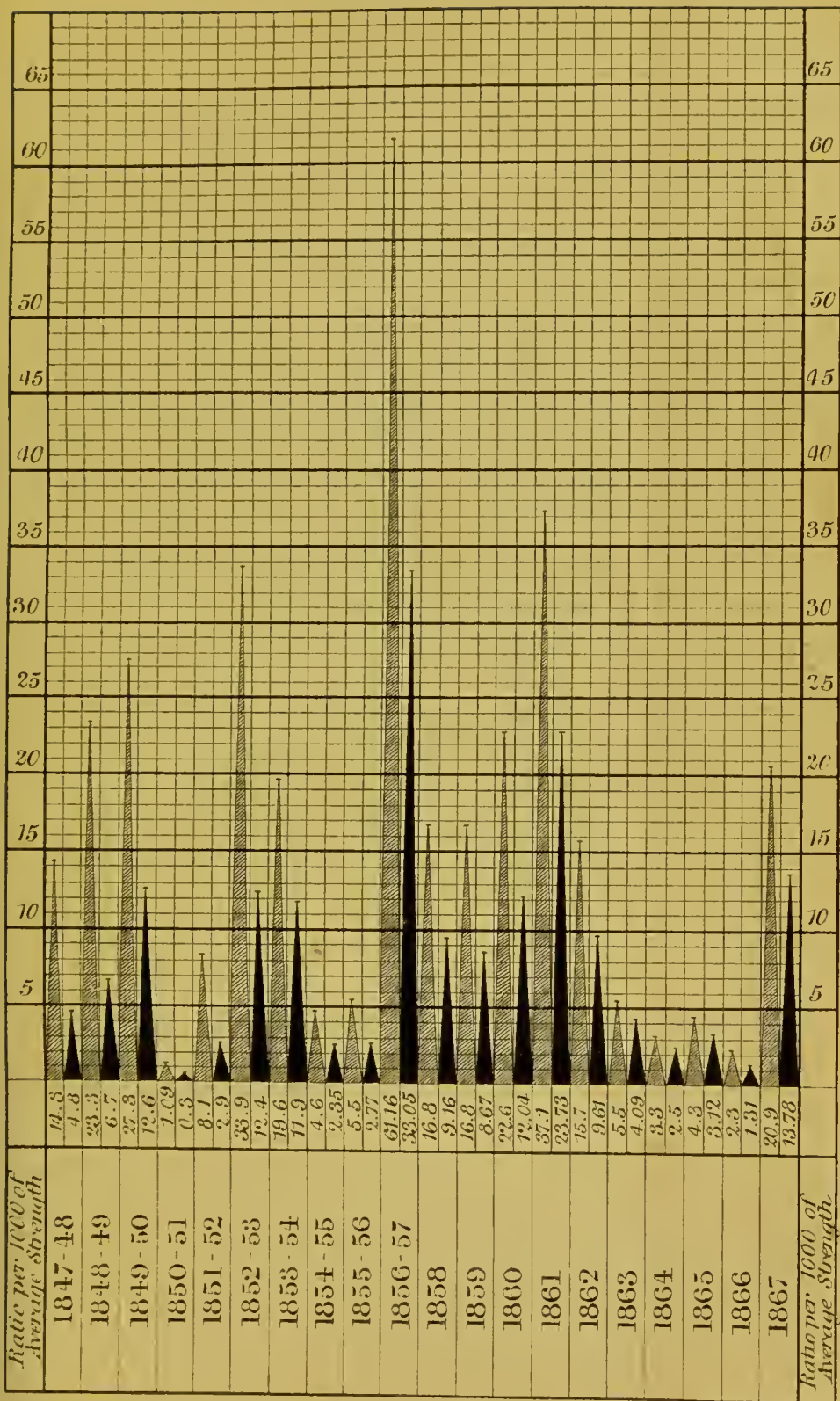


DIAGRAM TO ILLUSTRATE THE COMPARATIVE RATIOS OF ADMISSIONS AND DEATHS FROM CHOLERA AMONG BRITISH TROOPS IN THE BENGAL PRESIDENCY DURING THE TWENTY YEARS FROM 1847-48 TO 1867.

considerable part of the Bombay Presidency, cholera is endemic.

No doubt it would have been more satisfactory, if we could have confirmed these statements by statistical facts of the death rates among the civil population in these localities; but as this is impossible, we must content ourselves with such details on the subject as we have at our command. For this Presidency Dr. Bryden's tables (Tables A, B, C), as to the mortality from cholera among the military and convict population, are valuable, as confirming the statements I have made; and Dr. J. Johnstone, Secretary to the Inspector-General Indian Medical Department, Bombay, has kindly furnished me with the foregoing return (page 278) as to the death rates among the military and convict population of the Bombay Presidency for twenty-six years.

Before leaving this part of my subject, I must refer briefly to the geological features of the three localities, regarding the inhabitants of which our statistical returns are the most accurate, and in which there can be no possible doubt as to cholera being endemic. This is rather an important inquiry, because it has been affirmed, and there seems no reason to doubt the truth of the assertion, that the disease can only flourish as an endemic affection on alluvial soils.

With regard to Calcutta, and the large cities near the mouths of the Ganges, there can be no question as to the alluvial nature of the soil upon which they are built, consisting, as it does chiefly, of soft incoherent beds of fine sand and silt of enormous extent and thickness. But, as I have before observed, within this area, large plains of laterite crop up, as in the Orissa, Midnapore, and Beerboom districts, where

cholera is without doubt endemic, and that in towns built on these laterite formations. As we proceed up the Ganges, extensive beds of clay and runkur begin to crop out from its banks; even as low down as Bhaugulpore this formation is still alluvial, in that it consists of a strongly coherent reddish-yellow clay, abounding in runkur, and which forms excessively hard beds, often just below the surface soil, and materially alters the geological features of the country and the drainage of the districts. Patna, Dinapore, Benares, and Mirzapore are built on beds of runkur of this kind, and cholera is certainly endemic in these localities.

We may, however, turn to the island of Bombay as being unquestionably of a different geological formation from that of Bengal, the European part of the city being built upon trap-rock of igneous formation, greenstone predominating, but some of the rocks resembling varieties of felstone. No doubt strata of aqueous formation do occur among the trappean rocks of Bombay, but these only form small detached parts. Upon this mass of igneous rocks the city of Bombay is built, and from among the inhabitants of this place, Dr. Leith informs us that, for many years past, cholera has never been entirely absent. But we cannot overlook the fact, that a very considerable portion of the *native town* of Bombay is built on an alluvial soil, an arm of the sea having silted up the space between the rocks upon which the European town is located. And in all probability it is from the native town of Bombay that cholera spreads; and though the disease is endemic over the island, still it is probably among those inhabiting the alluvial soil that it remains and germinates.

Madras, like Calcutta, is situated on a deep alluvial deposit; the mount, however, is of igneous formation like parts of Bombay.

In connection with the subject of the nature of the soil on which the dwellings of people subject to endemic cholera are situated, we cannot overlook the sanitary condition of many of these towns. The following description of the native dwelling-places scattered over Calcutta, for instance, gives us a faithful picture of the condition in which a very large proportion of the native inhabitants of this, as well as other large towns and villages in India, reside. Dr. Tonneore says, "A bustee or native village generally consists of a mass of huts constructed without any plan or arrangement, without roads, without drains, ill-ventilated and never cleaned. Most of the villages and towns are the abodes of misery, vice, and filth, and the nurseries of sickness and disease. In these bustees abound green and slimy stagnant ponds, full of putrid vegetable and animal matter in a state of decomposition, whose bubbling surfaces exhale, under a tropical sun, noxious gases, poisoning the atmosphere and spreading around disease and death. These ponds supply the natives with water for domestic purposes, and are also the receptacles of their filth. The arteries which feed these tanks are the drains that ramify over the village, and carry out the sewage of the huts into them. Their position is marked by a development of rank vegetation.

"The entrances to these bustees are many, but not easily discoverable, whilst the paths are so narrow and tortuous, that it is difficult for a stranger to find his way through them. The huts are huddled together in masses, and pushed to the very edge of the ponds,

their projecting eaves often meeting together, whilst the intervening spaces, impervious to the rays of the sun, are converted into necessaries and used by both sexes in common. In these huts often live entire families, the members of a hut all occupying the single apartment of which it is not unfrequently composed, and in which they cook, eat, and sleep together; the wet and spongy floor, with a mat spread on it, serving as a bed for the whole.

“The distinction of caste extends to these bustees, but it assumes in these places a new form, by the fact that some portions of them, called parrahs, are inhabited by people of one occupation or trade, whose habits of living give a distinctive feature to each parrah, and modify its general appearance. Amongst the Hindoos, the worst and filthiest bustees are those occupied by Gowallahs, Coloos, Chumars or Moochees. Amongst Mahommedans, the worst and filthiest bustees are those occupied by Garrywans and Khallasees. In bustees occupied by Gowallahs, in addition to the usual filthy tank, the water of which is used by them to dilute the milk sold for public consumption, there are pools of liquid filth covering a large surface; the area of one of them I have ascertained by actual measurement to be over 150,000 square feet.

“None of these villages possesses a single road or thoroughfare properly so called, through which a conservancy cart or even a wheel-barrow can pass in order to remove the filth. This filth is laid at the door of every hut, or thrown into a neighbouring cess-pool. Not a single hut in the villages is properly built. The dwellings are badly constructed, crowded together without regard to ventilation or the means of being kept clean. The principal defects are due, not

only to ignorance and utter disregard of all sanitary considerations by the ryots, but also to the apathy and negligence of the impropiators, who care very little about the welfare of their tenants, provided that their rents are paid regularly.”

In this description we have a true picture of the localities cholera delights in. Nor must we overlook the fact that it is the practice of the natives, rich and poor, to defecate upon the soil around their dwellings, if they have the chance of doing so. Further, I may observe that I have never seen such a thing as a pump for domestic purposes in use in India; all our drinking water is drawn from large ponds or tanks, sometimes from open wells, being carried from thence to the vessels from which we drink in leathern bags—the skins of sheep, having a hole in them once occupied by the neck of this animal; they can never be properly cleaned out, and are often in constant use for several years. Now, considering the practice of the natives above referred to, and the constant heavy downpour of rain we experience from time to time in this country, it is easy to imagine how frequently the tanks containing our supplies of drinking water must, from receiving the surface drainage of the surrounding localities, become contaminated with all manner of organic impurities, the nature and properties of which we shall discuss more fully upon a future occasion.

III. I must now pass on to consider the geographical distribution of cholera, with reference to the routes it has followed in its progress from its endemic area in India over the face of the earth.

It will simplify matters if I recapitulate the course followed by each successive wave of cholera from

Bengal over Europe to America. One of the principal objects I had in view, in writing a detailed history of the disease, was, that I might give quotations and references to various contemporary authorities on the subject of each outburst of disease, written, however, by men in different countries and in various languages, and with no further object than to record what they saw of the disease. From a compilation of facts of this description, I can with confidence place the following summary before the reader; but it seemed to me that, without evidence of the kind, it was impossible for any one to arrive at trustworthy conclusions on this subject. A bare statement as to the extension of epidemic cholera over the face of the earth, especially if brought forward as evidence in favour of some particular theory, would be hardly likely to carry conviction with it, the more so as the progress of the disease is so remarkable, that a statement of the case, unsupported by facts, would appear to many men as bordering on the marvellous, and for that very reason deserving to be rejected. I would therefore beg those who are interested in this subject to wade through the details I have given in my history of the disease; unless they take this trouble they will not be in a position to form a sound judgment as to the true nature of cholera.

1st. In March, 1781, cholera was epidemic in Bengal, and throughout 1782 along the whole of the seaboard of India and Ceylon; it broke out at Hurdwar in 1783.

2nd. In 1817 cholera was epidemic over the whole of Bengal, and as far to the north-west as Cawnpore; it extended into Bundelcund.

In 1818 the disease spread over the north-western

provinces, and was traced as far as Seharunpoor; it extended westward to Bombay, and in fact during the year invaded the whole peninsula of India.

In 1819 it was reproduced over the country, extending also into the Punjab, and eastward to Burmah, Siam, and China; it burst out in the Mauritius with the arrival of an infected vessel from Ceylon.

In 1820 Muscat and the various ports of the Persian Gulf were under the influence of cholera; it appeared in the Province of Farris.

In 1821 cholera passed up the Tigris and Euphrates, appearing to the north of Persia at Tabreez, and in various parts of Turkey in Asia.

In 1822 it reached as far north as Astrachan, and broke out in many towns in Asia Minor. This epidemic then died out and did not extend into Europe.

3rd. In 1826 epidemic cholera burst out over the whole of Bengal, and advanced to the north-west as far as Cawnpore, cases being heard of at Agra, Muttra, and Delhi, towards the end of the year.

In 1827 it extended over the north-western provinces, appearing at Hurdwar, along the Himalayas and over the Punjab.

In 1828 it was reproduced throughout the whole of the area invaded by it in the two previous years.

In 1829 it appeared at Herat, and spread *via* Bokara to Khiva and Orenburgh, and also from Herat to Mushed, Teheran, and Tabreez.

In 1830 the north of Persia, the western shores of the Caspian Sea, Astrachan, and Russia as far west as Moscow and northward to Novgorod, were under the influence of the disease.

In 1831 cholera appeared at Mecca with the arrival of pilgrims from India; it spread with them into Egypt,

Asia Minor, Turkey, and the whole of Europe as far as the west of Germany, were affected by the disease; it reached England from Hamburgh *viâ* Sunderland.

In 1832 the cholera extended over the whole of Europe, and travelled across the Atlantic with emigrants to Quebec, and from thence covered Canada and the United States.

4th. In 1833-34 there was a fresh outburst of the disease over the Madras Presidency, which extended its influence into Central India, along the valley of the Nerbudda and into Bombay.

In 1835 cholera was epidemic in the Hadjiz.

In 1837 it prevailed over Palestine and the basin of the Mediterranean, and occurred in many isolated places in Europe.

5th. In 1841-42 cholera was epidemic in China, having apparently been imported by our troops from Bengal into the country; it appeared in the north of Burmah, and, spreading along the course of the Irrawaddy, extended over that country.

In 1844 it was very severe in Central Asia and Bokarah, and spread down into Cabul.

In 1845 it appeared at Peshawur, and extending eastward over the Punjab reached Delhi; the disease likewise travelled down the river Indus into Sind, appearing at Kurrachee. It broke out also at Mushed.

In 1846 cholera extended over the north of Persia. It appeared in Western India, Bombay, and at Aden, Mocha, Jeddah, and Mecca; the disease spread up the Tigris and Euphrates, reaching Aleppo, and Diarbekir, and from the former locality invading certain towns in Turkey.

In 1847 cholera broke out over the whole of Persia.

Following the military road over the Caucasus it appeared in Astrachan, and spread over Russia as far west as Moscow, and also to Constantinople.

In 1848 the disease was reproduced at Mecca, and was carried by the pilgrims over Egypt and Asia Minor, extending throughout Europe, and appearing at New York and New Orleans with the arrival of infected persons from France.

In 1849 Europe, America, and the West Indies were under the influence of epidemic cholera.

6th. In 1850 cholera was epidemic over the whole of Bombay.

In 1851 in the south of Persia.

In 1852 it extended along the Persian Gulf and up the Tigris to Bagdad; at the same time the disease had spread from Bengal over the north-west into the Punjab.

In 1853 the whole of Persia was under its influence, and it burst out in many places in Russia.

In 1854 the Continents of Europe and America were more grievously afflicted by cholera than they had ever been previously.

7th. In 1863 cholera was epidemic from Cawnpore eastward over the whole of Bengal.

In 1864 the disease extended into Central India, and covered a large portion of the Bombay Presidency.

In 1865 Bombay was under the influence of a most severe outburst of the disease; it appeared along the Arabian seaboard and then at Mecca with pilgrims from India, and spread with the returning pilgrims into Egypt. From Alexandria it was disseminated over the whole basin of the Mediterranean; and appeared in Southampton and a few places in the north of Europe.

In 1866 the greater part of Europe and America were under the influence of cholera.

One of the first things that strikes us in this history is that, in every instance in which cholera has extended beyond the confines of its endemic area, it has originated in an outburst of the disease in Lower Bengal, or in Madras, as in 1833-34. Excluding this latter epidemic, the details of which are far less clearly ascertained than those of any other epidemic outbreak of the disease, we may state, as a general rule, that cholera has two well-defined routes from Bengal, the one its westward course along the basin of the Ganges into Nagode and Saugur, and from thence into the Bombay Presidency. The other its north-west route from Cawnpore (or up the Jumna) to Agra, and Muttra, to Delhi and so over the north-western provinces into the Punjab.

Cholera appeared in Central India, and from thence extended to Bombay, in 1818, 1834, 1845, 1850, and 1864; and in 1820, 1835, 1846, 1850, and 1865, it had burst out either in the south of Persia or along the seaboard of Arabia and the Red Sea, usually in both localities at the same time.

From Mecca cholera travelled with the returning pilgrims into Egypt, and from thence over Europe, in 1831, 1848, and in 1865.

And in connection with outbreaks of cholera in Europe, we have traced the disease up the Persian Gulf and the rivers Tigris and Euphrates in 1823, 1846, 1852, and 1865.

It appears very certain, therefore, that the course usually followed by cholera, in its advance westward into Europe from India, has been either along the Red Sea (notably from Mecca) into Egypt, or else along

the shores of the Persian Gulf, and up the Tigris or Euphrates into the north of Persia or into Turkey in Asia, passing into Europe *viâ* Astrachan, or else gaining Orfa and Aleppo, and so reaching the Turkish dominions in Europe. Its passage in this direction is impeded at present, on account of the difficulty presented in the navigation of the Tigris and Euphrates, the country to the west of the former river being protected by the desert separating Bagdad from Syria.

It is evident, however, from a perusal of the history of the disease, that cholera has on several occasions travelled from the Punjab into Cabul, appearing at Herat, and from thence extending to Mushed, Teheran, and Tabreez, or along the shores of the Caspian Sea. It followed this course in 1829, 1845 (from Cabul), and in 1853. Each of these years was followed by an outburst of cholera over the north of Persia, and its extension into Europe over the Caucasus mountains, or more commonly by the sea route from Reshd to Astrachan.

I need hardly observe that the route I have indicated, as being the course followed by cholera in its passage from Bengal to Western and North-western India, and from thence to Arabia, Persia, or Mecca, is clearly that by which the natives of these various countries travel. I say advisedly the natives, because it is quite certain that cholera has never yet reached Suez by means of the Peninsula and Oriental Company's steamers, although it has without doubt been imported by pilgrims passing up the Red Sea from Mecca in several instances. Mecca and Kerbella are extensively resorted to every year by pilgrims from India; besides this, there is a very considerable trade kept up between the various ports of India and Muscat, Makalla,

Mocha, and Jeddah, and still more extensive commercial relations between India and the various ports (particularly Bassora) on the Persian Gulf.

And so, again, in the passage of cholera from the west and north-west of India, it evidently travels with human beings through Peshawur and the Kyber pass, or else from Dera Ismael Khan to the Kattawaz plain, south of Ghazni, this being the great caravan route from the Indus valley to the Candahar Steppes. It may also pass from Sind *viá* the Bolan pass into Afghanistan. From this latter country the disease has on several occasions travelled *viá* Herat into Persia; and this is the only possible route it can take westward by land into Persia, the deserts of Rajpootana, and those again of Beloochistan, protecting Persia from the disease, except by way of Herat, or by sea from Bombay and the Persian Gulf.

I shall not enter further on the geographical distribution of the disease after it has once gained access to Europe; its ramifications then become as numerous as those followed by men in their wanderings to and fro, and I have already given a general outline of the subject in connection with the history of the disease. Nor is a more extensive inquiry into this matter of the same interest, in a practical point of view, as the distribution of the disease immediately beyond its endemic area—a subject we shall have to consider more attentively, when discussing the measures necessary to prevent cholera from being carried beyond the confines of this country, and sown broad-cast over the face of Europe and America. For this wide-spread distribution of the disease, the inhabitants of these countries have to thank England in great part, for though it has not been her countrymen who have

disseminated the material that causes cholera over the globe, it has been and is in her power, as ruling over the endemic area of the disease, to prevent her native subjects from extending this terrible pestilence beyond the confines of British India.

SECTION IV.—THE BEARING OF METEOROLOGICAL INFLUENCES UPON THE SPREAD OF CHOLERA.

Some of the earliest records we possess upon the subject of cholera refer to the supposed influence of the wind over the disease. Fra Bartolomeo in 1796 says, that the natives on the Malabar coast believed that cholera was caused by the cold winds from the Ghauts. In more precise accounts of the disease, as, for instance, that of Dr. MacRae in 1818 (Appendix A), we find great stress laid on the intimate connection between the east wind and cholera. The Bengal Medical Board, in their report on the cholera of 1817-18, confirmed this view, although they hesitated to express an opinion as to the nature of the apparent connection between cholera and the easterly wind; they supposed it might either be the vehicle of the poisonous matter, or act merely "from its superior moisture in the light of a strong exciting cause, eliciting the disorder in places where the virus had previously existed, although it were not yet brought into action."* But the Board expressly stated their belief, that of all the predisposing causes to cholera, the one most frequently and unmistakably in operation

* 'Report on Cholera.' By J. Jameson, p. 100. Calcutta, 1820.

was “ alternations of heat and cold combined with rain, or a very humid state of the atmosphere.”*

The meteorological phenomena of the years 1817-18 are fully described in the Medical Board’s Report, and they clearly demonstrate that the outburst of the disease, in almost every instance, was preceded “ by a long course of unusually humid and sultry weather ; and that its subsequent periods of increase and decline were always modified by changes of the weather. Thus (Bengal) in February 1818 and April 1819, the two most marked periods of its aggravation, the days were sultry, and the nights cold and raw, with heavy storms from the south and east.”†

The history of cholera in this country is full of similar accounts of the weather during various outbursts of the disease. And I would here reiterate a remark I have repeatedly made before, to the effect that the records contained in the office of the Medical Board were written by men detailing the circumstances of the disease as they witnessed them, and reporting day by day on the subject to superior authorities. They had no theory to support, but simply to tell the truth, and satisfy the Medical Board that they were performing their duties to the best of their ability. I maintain that evidence of this kind, accumulating year after year for some forty seasons, is strong presumptive proof of the influence of rain in favouring if not generating cholera in India.

I may go a step further, and observe that throughout this long series of years I have carefully examined the reports contained in the office of the Board, and in every single instance of an outbreak

* Jameson’s ‘ Report,’ p. 163.

† Idem, p. 156.

of epidemic cholera of any magnitude, if the state of weather is alluded to, it is asserted that the meteorological phenomena were similar to those described in the above extracts from the Medical Board's report of 1820. It would be simply wearying to the reader's patience to reproduce the quotations I have already given on this subject in the history of the disease; the author's words have, as a general rule, been copied verbatim, and references given to the originals, so that there can be no mistake or misinterpretation of the facts they have recorded.

I would not have it understood, however, that I contend that cholera has never broken out in isolated localities, as in Southampton for instance in 1865, unless in very wet weather, but I assert that no widespread epidemic has ever occurred in India unless during, or immediately after, rain. In this country our cold, hot, and rainy seasons are constant and well marked, and succeed one another in regular order, and we are, therefore, far better able to judge of the influence they exert upon the spread of cholera than residents in Europe can be.

But it will be observed, as in the instance described by Dr. Bruce of the 1st Fusiliers at Cawnpore in 1848, that an excessive amount of rain may at times seem to remove the disease instead of increasing it (*vide* Appendix B). The Regiment had been shifted from one barrack to another, without any apparent benefit. On the 1st of September they marched out into camp, and on the 6th and 7th there was continuous heavy rain, so much so that the camp was flooded, and the Regiment returned to cantonments on the morning of the 8th. On this Dr. Bruce observes, "the move had the desired effect, for although we found

the disease raging in the city and bazaar as severely as before we went out, not a single case occurred in the regiment from that time forth." It was precisely the same with the 31st Regiment at Umballa in 1845, and we might multiply instances of the kind.

Similar phenomena are witnessed on a large scale in the province of Bengal. Cholera is at its height with us every year in March and April, and again in September and October, and these are the very months in which we get heavy downpours of rain, washing the surface soil and its contents into the wells and tanks from which we procure our drinking water; these storms are generally followed by intensely hot days. As soon as the regular rains set in, and we get a more or less continuous downpour for some three months, cholera ceases for the time, and in fact until the close of the year, when it breaks out again in the stormy weather, which, with intervals of intensely hot days, succeeds the rain.

The law which I am endeavouring to elucidate is simply this, that cholera in India is epidemic after downpours of rain followed by intensely hot weather. A country deluged with water is not so likely to be the scene of epidemic cholera as one under the circumstances above described. In districts absolutely free from moisture cholera can only be generated to a very limited extent.

There is an exception, however, to be made with respect to the comparative immunity of a country inundated with water. During a heavy downpour of rain (I am speaking of the tropics), supposing the inhabitants of a town or barracks to be under the influence of cholera, the disease will probably diminish as the superabundant rain reaches the earth; but as a

downpour of this kind can only last for a limited period, say five or six days, and as in all likelihood a few cases of cholera or cholérine continue to occur in the locality during this period, the disease is prolonged through the heavy rains, and directly the weather clears up there will be a renewed outburst of cholera, unless under some exceptional circumstances, such as those of the 1st Fusiliers at Cawnpore. In that case the whole of the regiment, including the cholera cases, were removed from the infected locality during the rain, and the inundation of the country was clearly attended with marked benefit.

I will not here stop to interpret these facts more particularly, I simply put them forward as bearing on the question of the influence which meteorological changes have upon the progress of the disease; and I would appeal to the historical section of this work as evidence of their truth, while their significance will be further considered in a future section.

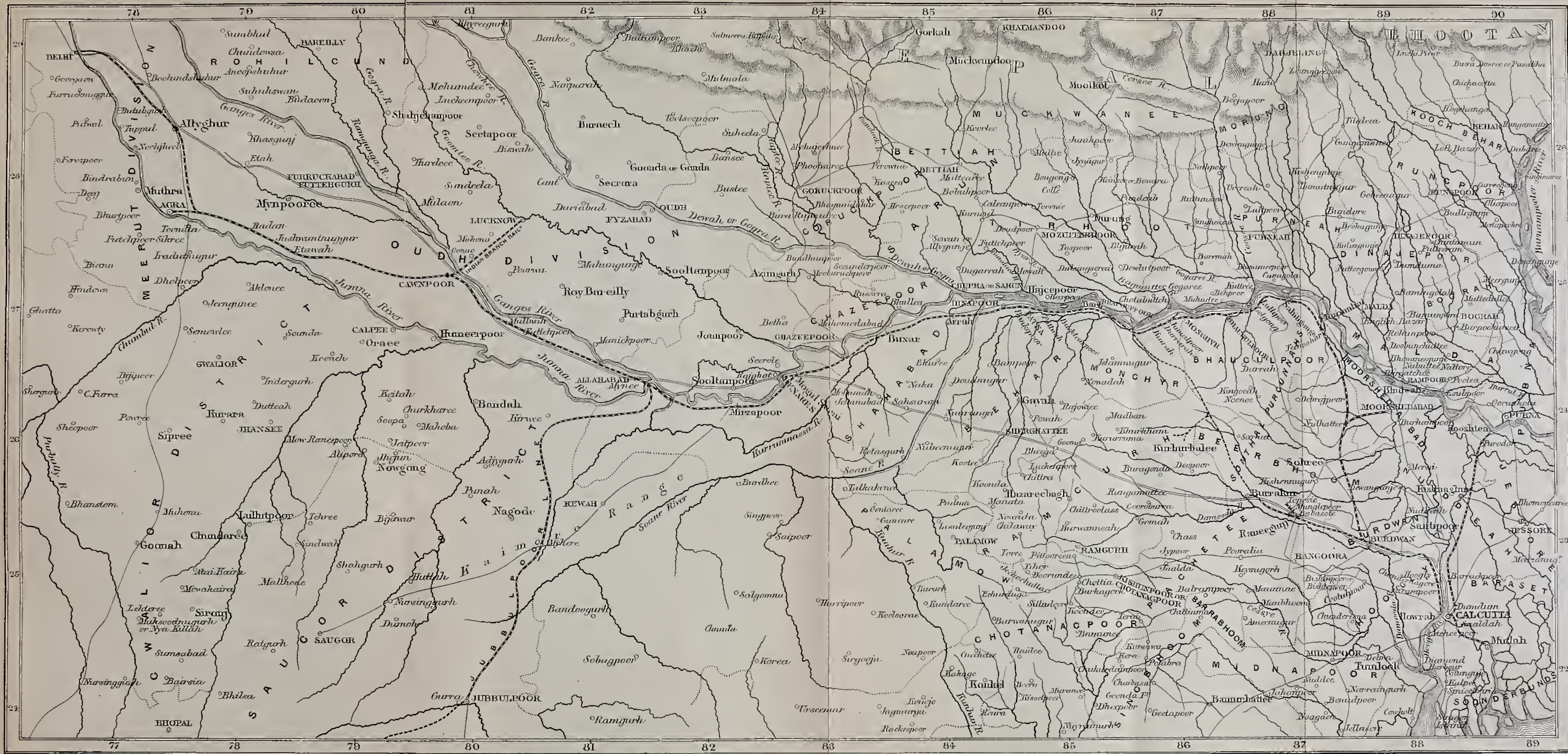
I may now endeavour to explain what I conceive to be the influence which the monsoons exert upon the extension of cholera over this country. When the sun is to the north of the equator the desert of Gobi and the arid wastes of Central Asia become intensely heated, a vast volume of air covering them expands and ascends, causing an indraught of cool air from the surrounding medium. In this way a volume of air laden with moisture from the evaporation taking place in the Bay of Bengal, is drawn northward and eastward, causing our south-west monsoons. Now the effect of this water-carrying wind is felt over Lower Bengal in the form of storms from the north-west, in February, March, and April; and towards the end of May or middle of June the regular rains set in; the

farther west the later the rains, so that at Cawnpore they hardly commence before July, when they are also felt over the north-west provinces and Punjab.

I have had to record the progress of cholera on several occasions from Eastern Bengal, during one season, as far to the west and north-west as Allahabad and Cawnpore, a few cases at the same time occurring in the principal cities situated on the River Jumna—at Agra, Muttra, and Delhi. During the subsequent rains the whole of the north-west and Punjab have been under the influence of the disease. It seems to me that these facts are best explained as follows:—When the south-west monsoon sets in over Bengal, the river Ganges becomes the great high road of traffic between the home of endemic cholera and the north-western provinces. After the cold-season crops have been gathered in, and the monsoon has fairly begun to blow over Bengal in April and May, large fleets of country boats start on their journey from Calcutta, Dacca, and other emporiums of trade, for Patna, Benares, Allahabad, Mirzapore, and Cawnpore, which latter place they reach about August. A few of these boats sail up the Jumna as far as Agra and even Delhi (*vide* Map). They return to the lower provinces before the Ganges subsides in September.

In the history of the disease but little mention has been made of the city of Mirzapore, for not being a military station we have no reports regarding the health of troops in this locality; but with regard to cholera it is probably second in importance to no place in India, being the chief commercial depôt for merchandise passing to and from Bengal, from Central India and the north-western provinces. It is to Mirzapore that the majority of country boats from

MAP SHEWING THE GENERAL COURSE OF THE GANGES & JUMNA RIVERS.



Dacca and Calcutta proceed; here they disembark their cargo, and the goods are carried away into the central provinces and all over the neighbouring districts. The Mahawarrh merchants flock to this town in large numbers, and from thence scatter themselves all over India.

I have given an abstract account of several outbursts of cholera as they occurred in fleets of country boats; for instance, in the 15th and 45th Regiments, N. I., in 1841, of the 2nd Bengal Regiment in 1853, and other cases of a similar nature, in which we have the evidence of European officers as to the fact of cholera, when once generated, having "stuck to the boats" for long journeys, as, for example, from Dacca to Dinapore, or from Cawnpore to Calcutta, and so on. Doubtless, if we could trace their history, this must frequently be the case with a great number of the large fleets of country trading vessels proceeding up the Ganges and Jumna every year. I believe it is by this means, and also by the land journey, that cholera of a virulent type, arising in Bengal, has been carried up to Cawnpore and the intermediate country on so many occasions.

The south-west monsoon, therefore, would appear to me to be the indirect cause of the dissemination of cholera over the country, in that it brings with it moisture, a necessary element for the development of the disease, but more especially because it is before this wind that the large fleets of country boats move up the Ganges, conveying men and goods from the home of endemic cholera to be disseminated over the upper provinces. Thus the disease springs up, not only in the great cities on the Ganges at which these boats stop, but it also appears in the large towns on the Jumna. We

have in these details a repetition of the old story—cholera progressing with man along the great high roads upon which he travels, spreading no faster than he moves, and being generated in wet and hot weather.

No sooner do the rains cease and the dry west winds of the upper provinces set in, at the latter end of September or beginning of October, than cholera begins to decline over the north-west. In Bengal our rains cease later in the year in showery weather, and we get a fresh outburst of the disease, which never dies out, in fact, in our comparatively hot and moist cold season. It is certainly very remarkable how little those who have never visited India seem to comprehend the circumstances of the disease in this country. So eminent a man as Professor Pettenkofer, in a letter recently sent to Dr. Parkes regarding the appointment of two officers to inquire into the disease in India, remarks of cholera that “from the soil there are two main roads to man—the water and the air. It appears to me that the cholera germ is neither in the water nor in the air ripened to cholera-infecting matters, *for nothing is more antagonistic (destructive) to the cholera in Calcutta than the cessation of the rainy season in August, and the fresh free air.* I consider water and air only vehicles for the infecting matter after it has ripened in the soil.” Would that the Professor could experience our “fresh and free” August breezes, he would scarcely so miscall them again; for of all the dank, depressing seasons of the year, August and September are the worst in Calcutta.

In the north-west, as I have above stated, cholera begins to decline in September, and from the end of that month until the following June there is often hardly a drop of rain over these provinces; the disease

consequently remains in abeyance (unless under exceptional circumstances), extending its influence over the country when the next south-west monsoon arises, bringing with it moisture to enable the material cause of cholera to break forth into renewed life, and recommence its awful work on the bodies of those subjected to its influence.

We have seen, however, that an outburst of cholera may occur earlier in the year over the north-west, as for instance at Hurdwar in the spring of 1783, and in April, 1866; but these cases hardly form an exception to the rule above laid down, for it will be remembered that Dr. MacRae expressly states that in 1783 cholera broke out after an east wind and rain, and in 1866, three million pilgrims being collected at Hurdwar with cholera among them, down came a pouring rain which lasted nearly twenty-four hours, and on the very next day we hear of that outburst of the disease which we have traced over the whole of the north-west into the Punjab, Cabul, and Teheran.

I am perfectly aware that it is advanced by Dr. Bryden,* and has been maintained by observers as far back as 1818, that the south-west monsoon has a far more direct influence in spreading the disease over the country than I am disposed to attribute to it. I am not prepared to meet Dr. Bryden's arguments, for at the time of writing this, his work on the subject of cholera has not appeared, although I am given to understand it is in the press; but I may observe that, upon the following grounds, I cannot accept the notion of the monsoons being the means by which cholera is disseminated over India:—

1st. Because we find that people living on the hills

* 'Indian Medical Gazette,' vol. i, p. 283.

of Lower Bengal, and therefore under the influence of winds blowing over the endemic area of cholera, are yet free from the disease.

2nd. The wind has never conveyed the disease from the coast of Burmah or India to the Andaman islands.

3rd. We have the direct testimony of independent observers that, in the great epidemic of 1818, cholera advanced down the Madras coast and across to Bombay *against* the prevailing monsoon. Again, in 1849, Dr. Leith informs us that cholera advanced from the east in the teeth of the south-west monsoon, then blowing with a force equivalent to a velocity of twenty-five miles an hour.

4th. If the south-west monsoon carries the seeds which engender cholera in the human body from east to north-west as far as Cawnpore, why does it stop there? The disease should be disseminated over the whole country, including the north-west and Punjab, every year, if carried by the prevailing wind.

5th. It is impossible to explain the extension of cholera from Alexandria over Europe in 1865, and its steady progress from east to west over Europe and America on previous occasions, upon any theory which obliges us to accept the wind as the chief influence which causes the spread of cholera.

6th. Still less can we explain its advent in isolated localities, as the Mauritius, Fogo, and Guadaloupe, and numerous other places, if we accept the monsoon theory.

7th. Quarantine when practicable, as at Peterhoff in 1831, in Palermo in 1865, and on several occasions in Greece, has prevented the ingress of cholera into these places, which could not have been the case had the disease spread by means of the wind.

In fact I believe most firmly in the conclusions arrived at by the Cholera Conference of Constantinople on this subject, "that cholera is scarcely ever carried beyond a very short distance by the agency of the open air (let us say 109·36 yards as an approximate idea of what we mean), and that in the immense majority of instances the transmission does not extend as far as this." *

Without going further into the question of the meteorological conditions which favour the generation of cholera over the face of the earth, I may observe that the results of Mr. Glaisher's investigation of the subject in England very nearly coincide with those derived from observations made in this country. I have already given a summary of his researches when discussing the history of the cholera of 1854: "High barometric pressure, excessive night temperature and hazy air, with absence of wind, of ozone, and electricity," have characterised all those seasons in which the disease has been epidemic in London. With regard to rainfall, it is hardly possible to appreciate its influence on cholera in England; moreover, what the rain does in this country towards spreading the disease, water companies and rivers from time to time accomplish at home; in the one case our rivers, tanks, and wells are contaminated by the dejecta of cholera patients, which according to the custom of the country are broad-cast over the soil, or thrown into open drains, to be washed into our tanks and other sources of drinking-water by heavy showers of rain. In England, water companies appear occasionally to distribute contaminated water through their pipes, or the leaking underground drains and cesspools allow their contents to flow into the

* 'Proceedings of International Sanitary Conference,' p. 128.

rivers, wells, and other sources from whence drinking water is obtained.

Before passing on to the next section I must make a few remarks upon the apparent influence which heat and cold have over the generation and spread of cholera.

As a general rule it may be stated that cholera will not extend during the cold of a European winter, or even of our Punjab cold season. We have, probably, no better exemplification of this law than in the instances of the cholera outbreaks in America in 1849. The "New York" arrived in Staten's island with cholera on board, but soon afterwards "a sharp frost intervened; the weather, though previously mild and temperate, became wintry, and the disease entirely subsided." On the other hand, the "Swanton" arrived in New Orleans at the very same time, but "the streets were reeking with moisture; heavy fogs overhung the city till late in the morning; the thermometer rose to 84°, and the air was so liberally charged with moisture, as to impart a stifling sensation. Under this condition of things cholera spread with great rapidity."

Similar facts were noticed in Charlestown in 1832; the brig "Amelia" carried cholera into the place during the month of November, but it failed to spread in the town.

We have observed over and over again how cholera has declined in Europe as winter has set in, and broken out again in the summer, demonstrating the fact that a low temperature tends to retard the progress of the disease. I am aware that cholera has sometimes extended its ravages in the winter season, as in the army of Poland in the winter of

1830-31; but we must take into account the high temperature at which many of the hospitals and houses in Russia are maintained during their long winter. An exceptional circumstance of this kind, therefore, does not invalidate the law that a temperature below 40° Fahr. is sufficient to stay the progress of epidemic cholera, and when the thermometer stands even as low as 50° it will often sensibly affect its power of diffusion, especially if the weather is dark and gloomy.

The disease is most active when the thermometer stands at from 70° to 80° Fahr., or even 94°, in this country, rising in the sun to 120° and upwards.

With regard to the supposed influence of certain states of the atmosphere, having reference to the amount of electricity and ozone it may contain, on the generation of cholera in the human body, all such ideas are purely hypothetical; we have no evidence at all in favour of such views, and reason points out to us the extreme improbability of any such agencies affecting the production of cholera, because we find the inhabitants of the Andaman islands and the Rajmahal hills almost free from cholera, although living under the same atmospherical conditions as the people around them, who are constantly subject to cholera. The same train of reasoning applies to the case of Australia and other countries as yet free from the disease, in contrast with Europe and America, which have so often been affected by it.

SECTION V.—CHARACTERISTIC FEATURES OF ASIATIC CHOLERA.

I. *The unequal and very partial distribution of cholera forms the first of its characteristics which I shall notice.*—In this respect cholera is probably more nearly allied to influenza than to any other known form of disease. Influenza travels, as it were, from one place to another, and usually follows a definite course, in spite of opposing winds and variations of temperature; it has generally pursued a westerly direction. Nevertheless, the agency which gives rise to this disease, although, perhaps, akin to that which produces cholera, differs from it in its more rapid diffusion over towns and countries; and from the history of the disease we cannot but conclude that it may appear among the crews of vessels far out at sea, the ship having had no communication with an infected country, and that it differs, therefore, in a most essential feature from cholera. Dr. Aitken remarks of influenza, that “it is a disease of extraordinary rapidity of progress, and as its diffusibility is great, so are its periods of recurrence frequent—those cycles of its visitation which are as yet beyond our comprehension.” On the other hand, the defined action of epidemic cholera beyond its endemic area has always been a matter of surprise to all observers. Mr. Jameson, in 1820, most distinctly and forcibly refers to this fact: he remarks upon the localised power of the disease as being one of its characteristic features in the north-western provinces, but as having been wanting in Lower Bengal (its endemic area); and from his

time down to the present day we find epidemic cholera presenting precisely the same phenomena.

We can hardly have a better proof of this, than by referring to Dr. W. Farr's map of the various places affected by the disease in England, during those years in which the country has been under its influence, or by following the history of cholera in our Indian jails. Mr. Jameson informs us that the prisoners in the Alipore Jail were free from the disease in 1817, although it was raging outside the walls of the prison; and even more remarkable was the case of the convicts confined in the Allahabad Jail, who were daily employed in the streets of the infected city and yet escaped the influence of the disease. On the other hand, I have referred to the death-rate from cholera in the various jails of Bengal in my history for 1856, showing that the mortality from this disease among the prisoners in jails in neighbouring districts, during the same season, varied to a remarkable extent.

It is true, smallpox, measles, scarlet fever, and such-like diseases, sometimes appear in isolated localities in England, as in other parts of the world, but they differ in one very important point from cholera, namely, in the protecting influence usually imparted to an individual once attacked by them, which completely obscures the law of their extension in a society unprotected by this means.

Supposing the inhabitants of Europe never to have been visited by scarlet fever, or that, as in the case of cholera, a person once attacked by the disease were not protected from a second seizure, we should, under these circumstances, find scarlet fever extending itself in a very different manner from that which we observe at present.

This localised action of cholera, whether occurring in countries, towns, villages, or however small the community may be, is, in fact, a characteristic which is more readily admitted than any of its other distinctive features, but it is, nevertheless, a most important factor in our argument concerning its etiology. We can hardly conceive limited outbursts of disease, such as mark the progress of epidemic cholera, to be due to any general atmospherical or (as they are commonly called) epidemic influences; this localised action must be associated in our minds with some more tangible and specific cause than an imaginary something, floating about in the air, or carried by the winds from place to place. We can hardly help feeling that there must be some force at work more definite and limited in its operation than this, when we see our soldiers in a particular barrack or station struck down by cholera, while regiments on either side of them entirely escape, precisely as though the one set of men had been exposed to a murderous fire on the battle field, while the other had been kept as a reserve in camp, and out of range of the enemy's bullets. I am convinced that, if we would rightly appreciate the circumstances of cholera, we cannot too strongly impress upon our mind's eye this most prominent and universally accepted feature of the disease; it forms one of the most conspicuous objects in the picture I would attempt to draw of cholera, and without it the effect of the whole would be dull and lifeless.

II. *The second characteristic of cholera which we may notice is hardly peculiar to this disease; the inhabitants of certain localities are especially liable to be visited by cholera, and these localities have features in common with*

one another, differing from other places which have usually escaped its influence.—As a general rule cholera has been most destructive in large sea-port towns, and the majority of these are built on low-lying, alluvial soils, at the mouths of rivers; they are frequently densely populated. Dr. W. Farr has shown that, in districts affected by cholera, there is an inverse ratio between the mortality and the elevation of the dwellings above high-water mark: the lower the level the greater the mortality from cholera. The question naturally arises as to the nature of the connection between this condition and the generation and fatality of the disease.

Mr. Jameson, as far back as 1820, had noticed the circumstance of cholera being most prevalent in low-lying towns along the banks of rivers, and the Medical Board were evidently inclined to interpret the fact by supposing that, as cities built in such localities were the centres of commercial enterprise, they were likely to be inhabited by an overcrowded and poor population, living under the worst hygienic conditions, breathing impure air, drinking impure water, and consuming impure food.

But before attempting to analyse the relative power which the various factors have in inducing the result above indicated, it will be well to observe that there are several well-known exceptions to the rule laid down by Dr. Farr, indicating that, although cholera is generally more prevalent in towns, such as I have described, than in any other localities, nevertheless, people living under these conditions do not necessarily breed cholera, although it may exist in neighbouring places. For instance, in this country, I may refer to the case of Honora, already described as being a sea-coast town, which up to 1856, at any rate, had been free from

cholera. In Europe, the city of Lyons, not on the sea-coast it is true, but situated on a low alluvial soil at the junction of two rivers, its inhabitants poor and existing under peculiarly insalubrious circumstances, has been remarkably free from cholera up to the present time. But even in London we find that the population of Bethnal Green in 1849 suffered a mortality from cholera nearly double that of St. George's, although farther removed from the Thames and at a higher level. And so again, in 1865, the localities principally affected by cholera were by no means the lowest in altitude of the whole of London.

With these exceptions before us to the rule of cholera being most virulent in localities on low levels, and many other similar instances at our command, we can hardly admit that the characteristic feature of the disease above-noticed is due simply to the circumstance of the population of these towns inhabiting low, alluvial soils, especially when we consider how very virulent the disease has been at times in places built on high elevations, and even on lofty mountain ranges. We naturally look for some more general cause influencing the populations of all densely-peopled cities, and which would be applicable to the circumstances of the poor of all countries and nations. It seems probable that in this lies the secret of cholera committing the greatest devastation among the inhabitants of large towns—they constitute, numerically, the bulk of our population, and their habits of life, poverty, and the nature of their dwellings, render them less capable of resisting a disease like cholera, than those who live in greater affluence and under more favorable hygienic circumstances.

I have remarked, in my definition of cholera, that

persons in an exhausted or bad state of health are most susceptible of the influence which engenders the disease, and it is hardly necessary for me to argue the point, that the poor of our large towns are, as a general rule, in less robust health than those living in rural districts; the former become pale and anæmic, their blood is poor in red particles, and it is probable that the secretions of their stomachs and intestinal canals become impaired, this (as I shall attempt subsequently to explain) directly inducing a state of the system, which is, beyond all others, favorable to the admission and growth of that material in the alimentary canal from which cholera is produced. In this way, therefore, and by the fact of the accumulation of a considerable number of the inhabitants of the civilised parts of the world in large cities, we may account for the prevalence of cholera among such communities: the people are in a less perfect state of health than those living on high land, whose occupation is for the most part agricultural, leading them to pass the greater part of their lives in the pure and invigorating atmosphere of the country.

We may allow, for the sake of argument, that the food of both classes is equally nourishing; but with regard to water, we cannot place them by any means on an equality. In the country, the population being scanty, there is far less chance of the drinking-water becoming contaminated with the dejecta of persons suffering from cholera; and on high lands, accidents of this kind must be even less frequent, on account of the natural drainage of the country towards a lower level, and because much of the drinking-water consumed would be drawn from small but rapid streams, having their source in pure springs among the hills.

The reverse of all this is to be found in low-lying sea-port towns: the lower the level the more sluggish the surface and underground drainage, and the more likelihood, therefore, of the accumulation of contaminated water in drains and cesspools; and the less the chance of its finding a natural outlet, the greater the probability of its percolating into wells and other sources from which drinking-water is supplied. The influence of rain, again, over these low-lying localities must often be very deleterious, making cesspools overflow, bursting drains, and in fact disseminating all the filth of our large cities into many of their almost stagnant rivers and wells, and that, occasionally, in spite of their being protected by the best of all remedies under the circumstances—a good and free supply of water delivered by properly-organised water companies.

While, therefore, admitting the characteristic feature of epidemic cholera we have been discussing, in that the disease affects most virulently the inhabitants of definite localities having certain features in common, I am not disposed to concede to these places any special power of generating cholera in themselves, but believe that they cause (on account of their insalubrious nature) deterioration of the health of their inhabitants, which, in combination with a defective water supply, renders them peculiarly susceptible of cholera. Beyond this, a vast number of the inhabitants of the civilised world congregate in large towns, so that they are, numerically, more liable to suffer from cholera than the population of rural districts.

III. *A third characteristic of cholera is, that it by no means, even in the majority of instances, attacks the inhabitants of the most insalubrious localities even in our*

large towns. Mr. Simon remarks, in his second annual report on the sanitary condition of London, that it is unquestionably true, that many habitual seats of fever were visited by cholera; on the other hand, many of the worst fever nests in the whole metropolis were unaffected by it. Messrs. Leigh and Gardener give us instances of a precisely similar nature in the case of Manchester. The argument I have advanced with regard to the deleterious influence of overcrowding as a predisposing cause of cholera, inasmuch as it tends to break down nature's greatest safeguard against the growth of the disease in the human body, by impairing the digestive powers of the stomach, will of course have its weight in accounting for the appearance of the disease in certain fever-stricken spots. The marvellous way, however, in which the inhabitants of many of these localities escape cholera, is a far more difficult matter to explain. It is evident that these localities, although situated on low alluvial soils, and under the very worst hygienic conditions, will not generate the disease among their inhabitants *de novo*. We must clearly and without doubt accept this fact, or we shall find ourselves at fault in our endeavours to comprehend the etiology of cholera. I can quote no higher authority than Mr. Simon on the subject, and would appeal to each man's individual experience of the disease in proof of this assertion.

In India, we have no statistics to guide us, but we may, I think, fairly conclude that, in many outbreaks of cholera, the mortality among our prisoners is greater than in the surrounding population, and yet the convicts exist under incomparably better sanitary conditions than the free portion of the native community.

Now this circumstance, though an apparent anomaly, and a fact which at first sight we might be almost inclined to discard, as being one of those remarkable phenomena connected with the disease which baffle our comprehension, will, in reality, prove one of the strongest arguments we can adduce in favour of the views I shall propound as to the cause of cholera. This disease appears to differ in this respect from some reputed malarious forms of fever, and other similar affections, and the fact should lead us to look for a more special influence ruling over its production.

IV. *The fourth characteristic of cholera I have to notice is, that no amount of overcrowding, no special condition of the soil, nor any circumstance with which we are acquainted, has ever been known to originate Asiatic cholera de novo among men, removed from its endemic influence, or unless the disease has been epidemic at the time beyond the confines of India.*

For a confirmation of this distinctive feature of cholera I must appeal to my history of the disease, which I have drawn from every source accessible to me, and in no single instance can I discover a well-authenticated case which would form an exception to the above rule.

We have traced the disease on several occasions to the Mauritius, but always after the arrival of vessels from India, with persons on board who had been among those suffering from cholera. The same thing has occurred in America, Guadaloupe, the islands of the Grand Canary group, and so on. In fact, I may with confidence challenge any one to cite an instance of epidemic cholera occurring beyond the precincts of British India, unless connected by a direct chain of

cases with an outbreak of the disease in this country. I do not say that it is always possible for us to trace cholera immediately from man to man in its progress over the world, and this for two reasons : First, because our evidence must frequently be wanting in precise data ; and, Secondly, because articles of clothing, or goods soiled with the dejecta of cholera patients, are capable of propagating the disease.

As an instance in point I may refer to the case of the "New York" and the "Swanton" in 1849. We are unable now to determine, who were the parties that carried cholera on board these vessels, which in their turn transmitted the disease to America ; nevertheless, this does not weaken my proposition, because we know that the passengers on these vessels came from an infected locality, into which we had traced the disease directly from India ; on the other hand, cholera did not exist in America until the arrival of these vessels, but within twenty-four hours of the passengers' landing at New Orleans, it commenced among the population of the town, and spread from thence all over the Southern States, thus, as I maintain, establishing the transmission of the material cause of the disease, which had been conveyed from India into America.

It has been argued with respect to this case, that cholera must have been generated *de novo* among the crews of these vessels when fifteen days out at sea. In opposition to this statement I may observe, that not one single instance has ever yet been recorded of cholera breaking out at sea in a vessel which had not had intercourse with a country affected with the disease. An apparent exception may be offered in the instance of the "Mangles," but I believe I have shown that the evidence in this case should be received with

considerable caution, and I cannot admit it as in any way invalidating the rule above laid down, as to the immunity of vessels which have not communicated with ports or countries under the influence of cholera.

Moreover, considering the filthy state of many merchant vessels, we can hardly suppose that cholera can be generated from dirt alone, if it has never appeared in ships of this description unless the men have been exposed to sources of infection.

And here, again, let me draw the reader's attention to the facts, that Australia and other large tracts of country have as yet been free from the disease, and that these places are separated from India by extensive oceans or seas ; on the other hand, that as our communications with Europe have become more constant and rapid, so has epidemic cholera become more frequent in its visits to that continent, invariably pursuing the route followed by man in his passage to and from India, halting for a time in intermediate countries, where the seeds of the disease have been sown to bear fruit in due season, whence fresh germs have been again transmitted to other men, who have carried it a step further towards the west. Thus has the malady been propagated from one human being to another, until its influence has spread from the east as far as the western shores of America. But cholera has never appeared in America unless Europe has been first affected ; it has never broken out in the west of Europe unless the eastern part of the continent has been previously under its influence ; and it has never been generated in the east of Europe unless correlated with an outburst of the disease in Turkey-in-Asia, Arabia, or Persia ; nor have these countries been affected until the disease had previously burst

out with violence over Bengal, and travelled by slow and steady steps to the west of India.

If a single flaw can be found affecting the accuracy of this statement, then I have studied the history of the disease in vain, and will freely confess my ignorance of the subject; but I am confident no discontinuity can be shown in the transmission of the disease—it is as impossible as that man himself should be generated from the earth or spring into existence without antecedents. Turn to the history of the disease in the Andamans, or in any known part of the globe, and we shall find that epidemic cholera has never originated unless the possibility, nay the probability, of its seeds having been imported has been demonstrated; and the more searching our inquiries have been into the history of the first cases of cholera, occurring in countries previously free from the disease, the more certain has been the proof of the connection between the earliest cases and persons or things previously in contact with those suffering from the disease.

V. *A fifth characteristic of epidemic cholera is, that its intensity varies during its continuance in a country or a large town, so that it has periods of little and great activity, in fact, usually well-marked periods of increase, culmination, and decline.* This characteristic feature of cholera has frequently been adverted to in these pages under the terms of “generation,” “outbursts,” “onslaughts,” of cholera, and so on, expressing the extremely rapid way in which a community, probably previously healthy, have suddenly been smitten with cholera. Whenever the disease has appeared, either in India, Europe, or America, we have had numerous

instances of this kind brought to our notice. Take, for example, the advent of cholera in Paris in 1831: M. Gendrin informs us that, on the third day of the appearance of cholera in the city, he received patients into the Hôtel Dieu from every quarter of Paris. The same rule holds good in instances of small communities as well as of large ones; and as a general rule the first outburst of the disease is the most malignant. We find this fact also illustrated in the case of the Paris epidemic above referred to; for, of the first ninety-eight cases admitted into the hospital, no less than ninety-six died. Instances of a similar kind are constantly presented to our notice in the history of cholera among our European regiments and native convicts in this country. The disease usually declines far more gradually than it commences, and often exhibits periods of renewed activity; these, however, become fewer and less virulent in the course of time, and finally the malady disappears from the affected locality, perhaps to burst out in some neighbouring town or province with a repetition of the same phenomena.

I have alluded to meteorological changes as influencing the spread of cholera over India, but we can hardly concede to this cause (well-marked as its power undoubtedly is on a large scale) any such subtle influence as that which evidently governs these local outbreaks of disease. For example, in the instance, again, of Paris, in 1831, we find certain villages in its neighbourhood severely visited by cholera, while others absolutely escaped. We cannot explain a circumstance of this kind by supposing that the atmosphere over Paris differed materially from that in these villages, and still less that the atmosphere of one village was

different from that of another village within a few miles of it. No doubt facts of this description have tended to throw a mystery around this disease, which has been intensified by the terrible malignity and the suddenness of its attack.

I must confess that I hardly find any of the prevailing views, as to the *modus operandi* of the causes which are supposed to produce cholera in the human body, to account satisfactorily for this feature of the disease. But supposing we adopt the theory, that cholera is mainly propagated by the excreta of those affected by the disease finding their way into the drinking-water, and that it is only in the vibrio stage of decomposition that this organic matter is capable of exciting a similar action in the intestinal canal of those who swallow it, we may thus explain much which otherwise appears very mysterious in connection with cholera. The development of this theory, and the facts with which I shall attempt to raise a superstructure upon it, must remain for subsequent consideration. But I may here remark that, if we allow the possibility of the Seine having been contaminated in the manner I have suggested in 1831, and suppose that its waters became poisonous when the vibrio stage of decomposition was at its height, and that this condition gradually declined as oxidation progressed, the water after a certain period no longer presenting vibriones but ciliated forms of infusoria, we may, if we allow the former to be the dangerous stage of decomposing choleraic dejecta, thus account for the sudden onslaught of the disease.

The intensity of this stage would be greatest, probably, within twenty-four hours from the introduction of the cholera-stuff into the water; but this would vary

with the depth of the water, the state of the atmosphere, and so on, meteorological changes influencing to a considerable extent the intensity and length of time the vibrio-formative process or stage of decomposition exists, supposing, of course, the water to be once only contaminated. If the organic cholera-infecting matter found its way from time to time into the drinking-water, then, as each successive quantity of the nitrogenous stuff passed through the vibrio stage, a fresh outburst of the disease would occur among those who partook of the water at that particular period.

I maintain that, if a theory of this kind is supported by fact, it demands our serious consideration, for, as I have said before, we may thus account for the suddenness of the outbreak of cholera. This theory, moreover, includes what I am convinced of as a fact, that epidemic cholera has invariably sprung from a pre-existing source of disease; that it is impossible for it to break out in a locality beyond its endemic area, unless the organic matter from another person suffering from cholera has been introduced into the place through the agency of man; and that as the vibrionic decomposition cannot be set up in organic matter, unless with the aid of moisture and a certain temperature, so cholera depends greatly for its diffusion upon drinking-water and the range of the thermometer. Lastly, this contaminated water must be swallowed during a particular stage of the decomposition of the organic matter in order to produce any ill effects, for as oxidation goes on the water purifies itself, and in the course of a few days becomes innocuous. I would, however, have it distinctly understood, that I do not consider vibriones to have anything to do with the

generation of cholera, but simply that the organic matter from which they are formed, if derived from the evacuation of a cholera patient, is capable, in this particular stage of decomposition, of setting up a similar morbid action in the intestinal canal of those who receive it. The vibriones are simply a manifestation of the changes going on in the organic matter, which, when it has passed into or through the form of vibriones, appears to lose its terrible property of inducing cholera.

I believe we must adopt some such theory as this to account for those characteristic features of cholera which we are now discussing; a freshly-contaminated water explains the outburst of the disease, the oxidation of the organic matter its decline. We may in this way explain how certain villages around Paris escaped the influence of cholera, while others were terribly affected by it; supposing, in the first case, that the drinking-water had escaped contamination, and in the other, that choleraic matter had been introduced into it. An explanation of this kind is, of course, no less applicable to the case of other cities and countries than to that of Paris; in fact, if the history of cholera be read by the light of such a theory as this, much which is otherwise dark and mysterious becomes comparatively easy of comprehension, and apparently discordant facts range themselves into intelligible order; and, as I shall presently explain, we have some weighty facts to adduce in favour of this argument, although it is necessary, before handling them, to endeavour to clear away much of the jungle which entangles the subject—the growth of years, of which we must be rid before we can hope to work the soil we are breaking to advantage.

VI. *A sixth characteristic of cholera is that, after having been a certain time epidemic in a locality, it entirely disappears, unless in its endemic area.*—In considering this feature of the disease we must again appeal to its history. I have already pointed out the fact, that cholera is endemic in no country beyond the Peninsula of India, and the eastern provinces of the Bay of Bengal. It has appeared over Europe and America on several occasions, but after exercising its baneful influence for a period of two or three years, it has gradually died out and disappeared, until again rekindled by a fresh importation of the disease from India. Like certain tropical plants, cholera appears incapable of a long continued existence beyond the region from which it originally sprang; it may, however, live and bear fruit even in the cold of a European winter, if fostered in carefully-warmed conservatories, as, for instance, in the overheated houses of the Russians. Unless cared for in this way, it becomes dormant in the cold of a European winter, to sprout out again in the heat of summer, but with less vigour than in the year of its primary invasion.

As regards this feature of cholera we cannot explain why the disease does not continue in vigorous growth in Europe, or, in fact, in any part of the world beyond India, but we may surely rest content with a statement of the fact. It is equally impossible to explain why certain plants and animals can only flourish in particular regions of the globe; why, for instance, we cannot keep up a vigorous European stock of human beings in India. We know this cannot be, and in the present state of our knowledge must be content to receive the statement as true, because experience teaches us that it is so. And so with cholera: we

know no physical laws which can account for the limitation of endemic cholera to India, nor why the disease gradually dies out after a few years of life and vigour in any other country; but this in no way detracts from the certainty or value of the facts. This feature, moreover, does not exclusively belong to epidemic cholera, but is common to other zymotic affections, though probably in none is it so strongly marked as in that before us. Meteorological conditions certainly influence the progress of the disease: heat and cold, moisture and drought, have a most direct and important bearing on its generation and diffusion, but the nature of their operation on the material cause of the disease is unknown to us.

Facts such as these appear in a clearer light when viewed in connection with others of an analogous kind, with which we are more familiar. Much of my experience of cholera was gained in the district of Tirhoot, a great indigo-producing country, and every planter knows very well that, if he would get good produce from his plant, he cannot rely on the indigenous seed, he must import year after year from the north-west; if he sows seed from plant reared in the district he may have a fine crop, but he will get little or no produce out of it. He acts upon the experience he has gained, and imports his seeds from localities far less famed for their indigo than Tirhoot; but this imported seed yields largely in that district. And so it is with cholera: the imported disease is terribly prolific and fatal in its first year's growth on a new soil, and from that time it deteriorates in its power of destroying life and gradually declines.

We find this same character further illustrated in the case of new comers into a locality under the

dominion of cholera; here the virgin soil is brought to the seed, but the same effects as in the former case have been noticed over and over again, and notably in this country, among the inhabitants of the Rajmahal hills. In other parts of the world facts of a similar kind have been observed, as on the arrival of recruits in the Crimea, when the country was under the influence of cholera.

I admit that in this, as in every other department of science, there is much that is completely incomprehensible, but this should neither discourage further inquiry, nor the practical application of what we already know. He surely would be counted an insane planter, who refused to import his indigo seed from Cawnpore to Tirhoot, because he was unable to understand why the latter produces a plant which yields more abundantly than that of indigenous growth. And so with cholera: let us accept the teaching of observation and experience, and while bringing together phenomena of a kindred character, and comparing them one with another, as a step to the discovery of natural laws, let us not rush into loose and hasty speculation, but rather turn our limited knowledge to what practical account we may, feeling sure that, as time advances and observation widens, what is now obscure will become plain enough, and the thread at last be found which will unite our disjointed facts into a connected and intelligible whole.

VII. *A seventh characteristic feature of epidemic cholera is, that every outbreak of the disease beyond the confines of British India may be traced back to Hindustan, through a continuous chain of human beings affected with the disease, or through articles stained with their dejecta.*—In other

words, the train of phenomena resulting in cholera beyond the confines of India must have commenced in this country; consequently, America, Europe, and the greater part of Asia may justly blame India for all they have suffered from cholera.

I have already entered somewhat at length into this subject when discussing the geographical distribution of the disease, nevertheless I must briefly touch on it again. It is to my history that I appeal in proof of the above statement; I have there given an account of the gradual advance of the disease from Bengal over the north-west of India, and into the Punjab, Cabul, and Persia; or from Bengal to Bombay, Persia, Arabia, and Turkey in Europe, on every occasion in which the disease has appeared in Europe. Cholera has in this course invariably followed the routes by which man travels, and if it has thus spread from country to country by his agency, then we may fairly assume that it has extended continuously from man to man.

It will be observed how careful I have been, in tracing the history of the disease, to give the very words of my authorities, and to cite them as evidence in proof of the localities affected, and the route taken by each wave of cholera. I am perfectly aware that the character of my reasoning from these facts is by no means original; I am aiming at no such distinction, but simply to gather together scattered records and observations on the subject of this terrible disease, and shape them into a consistent whole. It seems to me, however, that the key to the complete understanding of this part of our subject has, in a measure, been overlooked; it lay stowed away in the MS. Proceedings of the Medical Board, which were open to the inspection

of any respectable observer, but up to the present time have not been sufficiently studied with reference to the subject of cholera.

True, it was no slight task to undertake the examination of nearly three hundred thick folio volumes of MS., but the result has amply repaid my labour, and convinced me that the characteristic feature of the disease above enunciated is a fact, and one which I could never have fully realised had I not thoroughly examined these Reports. These inquiries, moreover, have brought out the great value of the work contained in the Proceedings of the Medical Board, and the vast amount of evidence of all kinds bearing on the subject which has been penned by officers of the Indian Medical Service. Want of space has prevented my doing more than simply tracing the course of the disease in India, and its leading characteristics, by the light of these reports. They nevertheless contain a mine of clinical teaching upon the subject, not surpassed in accuracy by anything I have elsewhere met with, and of which I shall subsequently avail myself as far as possible.

The Constantinople Cholera Conference, in 1866, confirmed the views laid down by Dr. Snow regarding the cholera of 1849; they affirm, as he did, that cholera has never been known to extend from one place to another faster than man can travel. For instance, in the passage of the disease across the Atlantic, we never find cholera breaking out in America before the arrival of one or more vessels from Europe at a time when the disease was epidemic there. It has invariably commenced in America at one of the large sea-port towns directly in communication with Europe: as in 1832 at Quebec, in 1849 at New Orleans and New York, and

again in 1865 in this latter city. I am not at present arguing as to the nature of the cholera-producing matter, but simply with reference to the broad fact that, whatever it is, it never appears to spring up in a new locality, unless introduced by men or articles of clothing from an infected place.

It is hardly to be supposed that we can always trace the disease from A, B, and C, to D, E, and F; but if we can so follow it from A to D, and the evidence is in favour of its extending in the same way from B to E, and from C to F, it requires no great stretch of the imagination to conclude that the disease did thus extend from man to man in the latter cases, because we are convinced it did so in the former. I have shown, for example, that out of nineteen men who drank water contaminated with cholera dejecta, five were seized with cholera in less than three days. There was no possible chance of error in this case; the organic matter contained in the drinking-water without doubt produced a disease in these people, the prominent feature of which was, that the epithelium of their intestinal canals underwent a change precisely similar to that of the organic matter entering with the water, and this occurred in a community free from the disease, and living under good hygienic circumstances. Here, therefore, is the evidence of the direct communication of the disease from A to D, and from it are we not justified in concluding that, under precisely similar circumstances, B and C communicated the disease to E and F, as, for example, at Hurdwar in 1867, and that they in their turn spread it over the country as described by Dr. Murray? By the evidence afforded by these cases let us thoughtfully and without prejudice examine the history of the disease in all times and

places, and we cannot but conclude that cholera is a communicable disease from man to man.

I fear that I may have trespassed on the reader's time and patience by reiterating this doctrine in a variety of forms, and repeating it over and over again; my apology must be, that it is the first principle we have to establish, and one which has already become a reality to my mind.

I know that several of the leading practitioners in this part of India are of opinion, that cholera is "a something generated in the bodies of those attacked by it, quite independently of all external influences." How it grows, or whence it springs, are supposed to be mysteries beyond our range of knowledge; in fact it arises, according to these persons, from nothing tangible, it comes of itself, and is generated in the system. So long as opinions of this kind are entertained, and in fact are gravely maintained by leading men in our profession, I may be excused for returning so often to the charge with this trusty weapon—the communicability of cholera; with it alone we can hope to contend successfully against the ravages of this disease. Refuse to accept it as a characteristic feature of cholera, and we may grope on indefinitely in search of a remedy; believe in it firmly, and we must force the outside world to do so too, and sooner or later lead them to protect themselves by suitable means from this terrible pestilence.

It is necessary, however, to be explicit as to the form of cholera which is thus communicable; it is Asiatic cholera we are discussing, and I have given the definition of the disease in the first section of this work. I need hardly say, this differs essentially from sporadic cholera, which no one ever supposed to be

communicable, either in this country or in any other parts of the world; and which evidently arises quite independently of any pre-existing disease, usually from over-indulgence in food, or from eating unripe fruits, or suchlike unwholesome matters. I am quite prepared to admit that there is an analogy between the diseases; I believe they are both connected with changes in the epithelial lining of the intestinal canal; but in the sporadic form, there is no evidence to show that the fomes are capable of setting up a special and deadly molecular action in the intestines of otherwise healthy people, which is characteristic of Asiatic cholera, giving rise to the rice-water alkaline stools, and the rapid death which too frequently follows this form of disease. On the other hand, it cannot be denied that cholera is not easily distinguishable from sporadic diarrhœa; and I should chiefly rely upon the fact of cholera being present, and choleric epidemic, at the same time, in order to connect the two together, believing as I do that choleric is simply a modified form of Asiatic cholera, and is capable of engendering this more deadly form of the disease in other people by means of the dejecta.

It is almost superfluous to remark, that if death takes place with symptoms *resembling* those of cholera, it does not follow that the person has died from that malady. I have given an instance in point from Dr. Ransford's report (history of cholera for 1856), in which he states that the form of fever at Peshawur so nearly resembled cholera, that, at first sight, it was mistaken for it. Dr. Rean tells me that he has seen, on several occasions, precisely the same form of fever among the convicts on the Andamans; in fact, he seems to have little doubt that cases of this description have been

returned as sporadic cholera. The experience of these officers is in accordance with that of most men who have been in practice among the malarious districts of India. It is therefore necessary to be on one's guard in admitting a case to be one of Asiatic cholera: although death may take place as rapidly as in that disease, vomiting and purging being prominent symptoms, yet the patient may be actually sinking from exhaustion in the cold stage of ague. I need hardly add that, now-a-days, we seldom meet with cases of this kind, unless, as Dr. Ransford remarks, among patients who have had frequent attacks of fever—anæmic and debilitated subjects, whose hold on life is at best very insecure, and who sink quickly after a bloody or serous discharge from the walls of the intestinal canal.

The phenomena of Asiatic cholera, however, are so well marked that, taken as a whole, it is difficult to mistake it for any other form of disease. I would only suggest, whenever it is affirmed that instances of cholera have occurred, at times or in localities where the influences I have indicated, as determining the spread of this disease, were inoperative, that it would be well to make quite sure that we are considering the same form of disease, viz. Asiatic cholera.

VIII. *The eighth characteristic of cholera which I would notice is, that the more explicit the examination, the clearer the fact appears, that the disease, in the majority of cases, spreads from one human being to another by means of the cholera fomes finding its way into drinking water, and thus into the intestines of other people.*

This statement is simply a repetition of the doctrine put forward by Dr. Snow in reference to the epidemic

of 1849, and which, as I have shown, was so ruthlessly handled by the London College of Physicians in the report of Drs. Baly and Gull. These Physicians well-nigh nipped this doctrine in the bud; and had there been less truth in it than there is, their unqualified and positive condemnation of this theory would have utterly crushed it. As it is, their opinions have done much to retard the progress of our knowledge of the etiology of cholera up to the present time.

If we examine all the reports with reference to the epidemic of 1865-66, we shall notice how directly they tend to support Dr. Snow's theory, and to refute the view expressed by the London College of Physicians in 1854, which was to the effect, that it was never likely that water would be found to be the medium of communication in cholera. In investigating this matter we must again return to the history of the disease, and I would especially point to the instance I have mentioned in connection with the epidemic of 1861 in the Punjab, as positive evidence of water, contaminated with cholera evacuations, being a medium of the communication of cholera from one person to many others. It is true, there is a limit to the power thus possessed by water, as I shall subsequently more fully explain with reference to this particular case. The fact of the drinking-water having been contaminated with organic matter, was, in this instance, first detected by means of the microscope, the surface of the fluid being covered with numerous large vibriones. As these were known only to arise from decomposing organic matter, it led to the discovery of the contamination of the water in question, and to the fact of the organic matter having been in the first or vibrionic stage of decomposition. It is well known that, if a solution of organic

matter be poured into a shallow vessel, so as to expose a considerable surface of the infusion to the action of the air (oxidation), under the heat of an Indian sun, the vibrionic stage of decomposition will not last for more than three days, supposing the water not absolutely offensive, that is, containing a very considerable quantity of organic matter, such as would be refused for drinking purposes.

I may here state as a fact, that, so surely as water contaminated with choleraic dejecta is capable of reproducing the disease when consumed during the vibrionic stage of decomposition, so certainly it may be drunk with impunity after this stage is over, and when various forms of ciliated infusoria have replaced the vibriones. Not that the vibriones have any influence in inducing cholera in the human body, but they indicate that the organic matter in the water is passing through a certain stage of decomposition, during which process it seems capable of imparting a similar action to the epithelium of the intestinal canal—a conversion of force, as Dr. W. Farr calls it. There are, of course, steps of transition between the vibrionic and subsequent stages in the process of decomposition; and when the latter have been reached, if a fresh supply of organic matter is introduced into the water, it will pass through the vibrionic stage, and thus be a source of poison to those who drink it, although the water may at the same time contain ciliated infusoria from former contamination. I am not writing at random, or upon theoretical grounds, but from actual experience, gained during a constant study of the disease for fifteen consecutive years in Lower Bengal.

Dr. Snow's Broad Street case, in particular, was a remarkable illustration of the influence of contaminated

water in spreading the disease. Doubtless the choleraic dejecta of the first patient in this locality had passed into the well of the Broad Street pump, and, while undergoing oxidation, had affected many of those who partook of the water. No more definite evidence of this fact could possibly have been afforded, than when the Broad Street pump-water was accidentally carried out to Hampstead, and generated the disease in two out of the three persons who there partook of it.

Dr. Richardson's investigations into the spread of the disease among the men of Her Majesty's Navy in the Crimea, in 1854, is hardly less to the point; and Dr. W. Farr's account of the outbreak in Newcastle during the same year, affords a very remarkable example of a similar kind, which, in conjunction with the explosion of cholera in the districts supplied by a certain portion of the East London Water Works in 1866, leaves us hardly any room to question the part played by water, contaminated by the excreta of cholera patients, in the production, or rather in the extension, of the disease. We may safely assume, that cholera never would have been generated among those who suffered, had it not been for the circumstances described in the history of these cases.

Turning now to India, we have a remarkable illustration of the same facts in the instance of the outbreak of cholera at Hurdwar in 1867. First, we have evidence of the assembling of an enormous congregation of pilgrims, some of whom had come from districts and villages in which cholera was prevalent; but the disease did not spread among them, until the down-pour of rain occurred on the 11th of April, the night before the great bathing day. The assembled crowd (three millions in

number), having been soaked to the skin for twelve hours, rushed down in a body to the river, with their wet clothes on, and drank of its water, which must thus inevitably have been contaminated with any organic matter washed off their saturated cotton garments. Within twenty-four hours, cholera burst out in all directions among those unfortunate people, and they afterwards disseminated it throughout the country.

It seems to me that these cases, in conjunction with the history of the disease in America in 1866, and the direct influence there shown to exist between the contaminated waters of the Mississippi and the extension of the disease, are as clear a proof as we could possibly have of the spread of cholera by means of cholera-polluted water, especially when confirmed by the instance I have given, at page 196, of the influence which water, thus contaminated, had in producing the disease, in five out of nineteen persons who partook of it.

Nor must we omit the consideration, that if the organic matter of cholera dejecta lives, grows, and is destroyed in water, it accounts for much concerning the disease which has hitherto been a mystery. Take, for instance, the case of the ship "Carnatic" in 1819, or of the "Britannia" in 1854. The mortality that took place on board the latter vessel, in which cholera broke out sixteen days after leaving Varna, was very great; and yet they supplied themselves from an uninfected ship with additional hands, and transferred some of their sick in return; but in neither case did the crew, in or from the uninfected vessel, suffer. So again with the "Carnatic," some of the men landed at Madras, cholera being endemic in the place; they returned to the vessel, and several of them were seized

with cholera, but none of those who nursed these patients or lived with them, suffered.

The "Britannia" had left an infected port. Supposing the water contained in her tanks to have been contaminated, it would have been poisonous to many of the men drinking it during the vibronic stage of decomposition, probably lasting from five to eight days. The organic matter having then passed through this condition, might have been, and probably was, drunk with impunity by those subsequently coming on board. On the other hand, the disease did not extend to the crew of the second vessel, although cholera cases were put on board, because the drinking-water was preserved from contamination. The same features are illustrated by the case of the "Carnatic;" some of the men landed at Madras, and may have been supposed to have drunk water contaminated with choleraic matters in a particular stage of decomposition; they were seized with the disease. The drinking-water of the vessel remaining pure, those who attended the cholera patients kept perfectly well.

I shall have much more to say on this subject, but it is well to touch on it in this place in connection with that character of the disease we have been discussing.

SECTION VI.—POST-MORTEM EXAMINATION, ANATOMICAL AND CHEMICAL, OF THE BODIES OF PERSONS WHO HAVE DIED DURING THE COLLAPSE STAGE OF CHOLERA.

Condition of the Epithelium in general.—Before entering on the subject of the abnormal changes observed

in the various organs of the bodies of persons after death from cholera, it may be well to clear the way to a right comprehension of the matter, by first discussing the condition of the epithelial-cells lining the alimentary tract and other parts of the body, to which we shall subsequently have to make such frequent references.

It matters not if the epithelial-cells to be examined are passed with the rice-water stools during life, or are taken from the intestines after death, so long as the specimen is a *perfectly fresh* one. This point cannot be too strongly insisted on, for the alterations in the epithelium in this disease may be simulated by post-mortem changes, even in those who have been free from any affection of the bowels. *The characteristic feature of cholera is, that the changes in the epithelium to be described occur during the life of the patient; they are evidence, in fact, of the rapid destruction of these cells taking place before death.* For instance, a man may go to bed in apparent health, he wakes in the morning with cholera, and in the very first stool he passes we find disintegrated intestinal epithelial cells. The patient dies, perhaps, within twelve hours, having passed numerous watery dejecta, all containing epithelial particles similarly diseased, and after death we find in the contents of the intestinal canal a vast number of these detached and altered cells. We must keep these facts prominently before us in endeavouring to appreciate the changes I am about to describe.

Supposing, therefore, we examine some of the columnar epithelial-cells covering the villi of the small intestines, or those lining Lieberkühn's follicles, taking care that the specimen is a fresh one, and that the cells are kept moist on the slide of the microscope by means of some of the fluid from the rice-water dejecta,

epithelial cells

or other alkaline medium. If now we employ a quarter of an inch object-glass, we shall notice that the cells contain a vast number of minute, dark specks, precisely similar to those seen in a pus-corpuscle. The extent to which the epithelium of the intestinal canal is occupied by this molecular matter, varies very considerably in different specimens taken from various parts of the intestinal canal of the same subject; even in the most quickly fatal cases which I have examined, patches of almost healthy epithelium were to be found on the walls of the intestines, and in the fluid it contained; nevertheless, as a general rule, the majority of the epithelial-cells are invaded by this molecular matter, and in rapidly fatal cases the rice-water dejecta invariably contain abundance of these disintegrated particles.

If a comparatively healthy patch of cells be examined as above described, we shall notice that, in the course of a few hours, the quantity of molecular matter they contain increases, and as it does so the outline of the cells becomes altered, their margins jagged, and ultimately their shape is completely destroyed, the molecular matter increasing at their expense. If these changes be carefully and continuously watched in a small collection of these cells, the result of the process, at the end of a few hours, is an irregular mass of molecular matter—granular, diphtheritic, or amorphous deposit, as it has been variously called by authors. It is an aggregation of these molecular masses which constitutes the bulk of the flocculent substance noticed in the rice-water stools of cholera patients. I say the bulk of these intestinal contents are thus constituted, because I am well aware that the mucus, lining the canal, and a vast number of the cells contained in the

villi and intestinal glands, also contribute to form the flocculent matter in the watery dejecta of cholera.

If, instead of examining the epithelial-cells by means of a quarter of an inch power, we place them under a twenty-fifth of an inch object-glass, the same conditions being observed, and the temperature of the apartment maintained at from 80° to 90° Fahr., we shall discover that specks, which appeared as one under a low power, are composed of smaller particles, and that these have often an independent but limited motion among themselves.

I have examined these molecules for hours together, with, probably, the highest magnifying power yet constructed (the one-seventieth of an inch, by Messrs. Powell and Lealand), in order to bring all the resources of the microscope to bear on this point. I confess I have learned but little through the aid afforded me by this marvellous piece of optical work. The molecular matter, when examined by it, is still nothing more, apparently, than molecular matter—small specks in the epithelial-cells. I conceive, however, that the higher the power used, and the more careful the search instituted, the more certain it becomes that this molecular matter is formed in, and at the expense of, the epithelial-cells, blood-globules, gland-cells, or, in fact, any organic matter brought within its influence.

It seems to me that this molecular matter, if introduced into the intestinal canal of men, is capable of setting up during life, in the cells lining the intestines, an action similar to that by which it was itself produced; but whether this conversion is due to chemical affinity, or is brought about by the introduction and growth of a cholera germ, or “cholera zymes,” as Dr. W. Farr

calls it, I am at present unable to determine. But I believe that this rapid molecular formation in the epithelial-cells of the intestinal canal is peculiar to the disease we call Asiatic cholera, and in no other malady is anything similar witnessed, if we take into account the rapid course which cholera runs, the epithelium being invaded by this matter in the space of a few hours, and that without any evidence of pre-existing illness, or the introduction of unwholesome food, purgatives, or, in fact, any known cause of disease or death but the one we have indicated. All this terrible injury may, in fact, be established in the intestinal canal in the course of a few hours, if the patient has swallowed a minute quantity of this molecular cholera stuff in his drinking water.*

Dr. W. Farr speaks with more confidence than I can do of the nature of this molecular substance, because, as I have before said, I have as yet failed to convince myself of its individuality and growth. He says that "every one of these little, living molecules, moving under the microscope, has the power of producing out of suitable matter, by conversion of force, alone or conjunctively, molecules identical in nature and power: they have all its characters of life; they generate, they die, that is, they are turned into other forms by other forces; and, as with the ova of higher species, the secret of their metamorphic power has hitherto eluded the finest analysis of chemistry and the higher powers of the microscope."†

If we examine the subsequent changes which take place in the molecular matter of cholera dejecta, we

* See the case already referred to of nineteen men, five of whom took cholera under these circumstances, p. 196.

† 'Report on the Cholera Epidemic of 1866,' p. lxxvii.

shall find that, little by little, the black specks increase in size at the expense of the material by which they are surrounded, so that the speckled mass gradually presents an honeycombed appearance. The dark spots in this mass then become elongated, and those nearest its edges are detached, and instantly commence rushing about in the field of the microscope; in fact, they have become what we call vibriones. So that I trace in these changes of the epithelial-cells of cholera patients, precisely the same stages as those described by Dr. Hughes Bennett as common to the decomposition of all organic matter; the molecular matter is formed at the expense of the organic materials of the epithelial particles, and this molecular stuff in its turn gives rise to vibriones; these, under favorable circumstances, increase rapidly in size, and after a certain stage of decomposition disappear, giving place to amœbæ, paramecia, vorticellæ, and other infusoria; these in their turn are supplanted by fungi.

It will probably be asked, Are then all these molecular changes in the epithelium in cholera simply the result of decomposition? I must say, carefully as I have studied these matters for fifteen years, I can discover no difference between the changes I have described, and those noticed in healthy epithelial-cells undergoing decomposition; there is, nevertheless, this most vitally important distinction between the two—*the decomposition, or molecular change in the cells, due to cholera, commences when the patient is in possession of life and vigour; it is the rapid death and destruction of the intestinal epithelium during life, which is the characteristic feature of this disease, and renders it so deadly.* I have failed, as numerous other observers have done, to discover any peculiar or new elements in the cholera

dejecta, or among the epithelial-cells of the intestinal canal; and I am not disposed to speculate on the existence of any such material, but simply take the facts of the case as I find them, and shall attempt to elucidate their significance as we proceed with the pathology of the disease.

We may now return to the inquiry more immediately connected with the morbid appearances noticed after death from cholera.

The epithelium of the nasal passages and mouth will be found almost completely destroyed after death during the collapse of cholera, the cells having been disintegrated in the early stages of the disease by the molecular changes I have described; they consequently die and are thrown off, leaving the basement membrane bare and denuded. We know that in cases of cholera the patients speedily lose all power of taste and smell, and this is accounted for by the fact of the epithelium in the nose and mouth being destroyed, and preventing the absorption of the particles necessary to stimulate the olfactory and gustatory nerves.

The epithelium of the pharynx and œsophagus is shed in large patches, and near the orifice of the stomach is often entirely destroyed. Similar changes in the cells lining the stomach are observed, the basement membrane between the orifices of the gastric follicles being covered by a whitish, mucilaginous-looking substance, beneath which the injected walls of the stomach may be seen. The trunks of the peptic glands are full of a similar material, which consists of epithelial particles, many of the cells having been destroyed, and massed into patches of molecular matter, imbedded in the mucus stratum lining the walls of these tubes. Some of the epithelial cells, however,

are comparatively healthy, and others may be seen undergoing conversion into the molecular matter above described.

In the small intestines we find that the villi through extensive tracts have shed their epithelium, and if the cream-like substance, lining the walls of this portion of the intestines, be carefully removed under a stream of water, we shall notice that considerable patches of basement membrane are denuded of epithelium. The villi are contracted, so that, as Professor Pacini remarks, the mucous membrane of the intestines in these parts looks like velvet which has lost its pile. This simile appears to me to be remarkably apt, because the mucous membrane presents no visible changes beyond these denuded spots: the submucons tissues are healthy, with the exception of the granular contents of the villi; these, like the epithelium covering them, are invaded by the molecular matter. The cells contained in the mucus lining the walls of the intestinal canal, and in fact the material of the mucus itself, are also rendered opaque and speckled by molecular matter; this combination was described by Dr. Gull in 1853, upon the authority of Böhm, as "an effusion of a yellowish, finely-granular, fibrinous matter, such as occurs in diphtherite. The textures thus affected subsequently underwent a gradual process of disintegration, leaving an irregularly abraded surface, often rendered more distinct by a stain of colour from the contents of the intestines."*

Dr. Beale refers to the changes in the villi of persons who have died during the collapse stage of cholera, and says that, "in a given area of the intestines in cholera cases, there are fewer villi and fewer Lieberkühn's

* Dr. Gull's 'Report on the Cholera of 1849,' p. 15.

follicles than in health ;” in almost all the villi he observes that no lacteals could be seen at their summits, but they could often be discovered near their bases.*

I will not now discuss the mooted question, as to the shedding of the epithelium, found in the fluid contained in the intestines after death, being an ante- or post-mortem change ; but I may observe, in passing, that large numbers of epithelial cells may be seen in the stools of cholera patients, especially in those passed during the early stages of the disease, and if the specimen is examined when perfectly fresh. On the other hand, we may assert with confidence, as pointed out long since by Dr. Parkes, that the fluid contents of the intestines after death contain many more masses of epithelial cells than are to be found in the dejecta during life ; and this circumstance may probably be accounted for, by the fact of the drain of serum from the intestines having in great measure ceased before death, their contents, therefore, becoming concentrated. But what is of more importance is, that the villi contract, their blood and lacteal vessels becoming drained of their contents before death, very probably in the latter stages of collapse, when the purging ceases ; and as this contraction goes on, their epithelial coating is detached, and falls off into the intestinal canal, forming the masses of conical cells so often found there, moulded to the shape of the villi which they formerly covered, and forming, as it were, the finger of the glove, after the hand has been withdrawn.

On carefully examining the walls of the intestinal canal under a gentle stream of water, we shall notice that a very considerable portion of the epithelium still adheres to them, and that a vast number of these

* ‘ Medical Times and Gazette,’ January 5th, 1867.

cells are apparently healthy ; others will be found full of molecular matter, and many have lost their shape and been converted into patches of a granular or honeycombed appearance, in fact undergoing decomposition and conversion into vibriones.

The cells covering the walls of the large intestines participate in these changes.

The epithelium in other parts of the body is also affected in cases of death during the collapse stage of cholera ; we find the urinary tracts, from the calyces of the kidneys to the extremity of the urethra, lined with a layer of cream-like matter, consisting of detached and altered epithelial cells, in combination with a sero-mucous fluid. The cells lining the tubules of the pyramidal portions of the kidney are likewise involved, but those of the contorted tubes of the cortex are less altered.

Similar changes in the cells lining the alveolar portion of the lungs are always to be seen, and are often very extensive, accounting for the number of deaths from pulmonary lesions following reaction. But, during collapse, "respiration, as shown by chemical analysis of the inspired and expired air, is greatly diminished ; the circulation cannot pass on ; the blood gets vitiated, and vitiates all other organs, and death results. The lung-tissue is sometimes found as soft and rotten as tinder."

"The stagnation of the blood in the capillaries of the lungs is sometimes striking and permanent. Rarely in the adult, but mostly in children, spots of ecchymosis are observed. In the foetus in utero affected with cholera, spots of punctiform ecchymosis are very numerous, and are a constant feature."*

* Simon's 'Ninth Report,' p. 480. Observations by Dr. Thudichum.

Dr. Thudichum adds that the cylindric epithelium of the trachea and bronchi is seldom much affected, and, in consequence, bronchitic cough does not come on till after reaction has set in.

The epithelium of the pleuræ, the abdominal cavity, and choroidal plexuses, is involved to a greater or less extent, being granular, and containing, in fact, the molecular matter I have described as existing in the cells of the intestinal canal.

Dr. Thudichum asserts that the cranial membranes "participate in receiving a precipitate of finely granular matter,"* in cases when the tepid stage becomes violently febrile, and mania, and oft repeated convulsions, indicate a considerable lesion of the brain. "This lesion," he observes, "affects the nerve-tubes and ganglionic cells of the grey matter. The cylinder axis separates, the nerve-marrow curdles, in the algide stage."

He also makes an important statement to the effect that many brain lesions are due, in this disease, to arrest of the circulation in its capillaries, by altered blood and epithelial-cells, forming plugs which effectually close the vessels.

It must be remembered that the extensive alterations in the epithelium lining the secreting structure of the kidneys, lungs, and other organs of the body, which I have described, are post-mortem appearances, succeeding the stage of collapse. It is very improbable that such a vast amount of change in these cells should take place in all cases, even of severe cholera, during life; because, in many instances, we notice that the recovery of patients to convalescence and health is comparatively rapid after cholera, which could hardly

* Simon's 'Ninth Report,' p. 480. Observations by Dr. Thudichum.

be the case if, as a rule, the changes I have noticed occurred before the last stage of collapse; they probably continue after death.

Abdomen.—On opening the walls of the abdomen, we observe, after death in the collapse stage of cholera, that the viscera lie back in a compact form, deep in the abdominal cavity.

The Stomach.—The mucous membrane is often very much congested, and in many places spots of ecchymosis may be observed. But beyond this, and the changes already described in its epithelium, no constant abnormal condition of the organ has been noticed after death from cholera.

In many cases this organ is not even congested, the cells lining it presenting, absolutely, the only vestiges of disease discoverable after death. The same remark is applicable to the state of the pharynx and œsophagus.

The Intestinal canal.—Its mucous surface, in the greater number of cases, is found to be in a state of uniform arborescent injection; but still, this is by no means a constant appearance after death during the collapse stage of cholera; we frequently meet with instances in which the mucous surface of the intestinal canal, like that of the stomach, is pale and exsanguine, from one end to the other. Or, again, venous congestion may occur in patches, the redness thus occasioned being punctiform, and of a bright colour. Spots of ecchymosis are common in these congested patches.

If a portion of the injected intestine be placed under the microscope, a half-inch power used, and pressure made on the covering glass, it will be observed that

is the
usual
condition.

the blood contained in the congested vessels is not squeezed uniformly out of the veins, but breaks off into little masses, reminding one of the detached patches of mercury seen at times in a broken thermometer, or other narrow glass tube, conveying the idea that the blood in the vessels, although not formed into a clot, has become thick and tenacious; and it is quite possible to suppose, if the vessels beneath the mucous membrane were filled with this viscid blood, that it might offer a serious impediment to the circulation of a less dense fluid through the neighbouring structures, especially if the heart's action were weak, and the *vis à tergo* of the circulation at a minimum. That is to say, this condition of the parts favours the view entertained by Dr. Pacini,* that, as reaction occurs in cholera, the vessels of the mucous membrane, beneath the detached epithelium, become clogged with this viscid blood, which acts, in fact, as an impediment to the circulation through them, serving a curative purpose, just as a coagulum would do in the case of a wounded artery; for, by arresting the circulation, new epithelium is allowed to form over the abraded portions of the intestine, preventing the outpouring of serum from the denuded vessels, which, according to many pathologists, is the essential and primary cause of all the symptoms of cholera.

In a *post-mortem* examination there would, of course, be less of this plugging of the minute vessels of the mucous membrane to be seen, than we might imagine to exist in the cases of persons *recovering* from the disease, for the simple reason that it was the failure of this reparative process which led to the patient's death.

* 'Du Choléra Asiatique,' par le Docteur Ph. Pacini, de Florence.
Traduit de l'Italien par le Docteur E. Janssens.

Had the circulation been arrested by this means during life, the dehydrated blood would have regained its lost water, to a great extent, from the tissues of the body, and there being no further drain of fluid through the occluded veins of the intestines, reaction would have progressed and the patient recovered.

The large intestine is found in much the same condition as the small one, with regard both to its epithelial layers and the condition of its vessels.

In the majority of cases (about two thirds) the solitary and aggregated glands throughout the whole length of the intestinal canal are more prominent than in health; they look like little hard grains beneath the denuded mucous membrane. It is to be observed, however, that the contents of these glands are, as far as I have been able to ascertain, perfectly normal; unless, as frequently happens, some of them have become ruptured, in which case the cells and materials they contain are invaded by the molecular matter from the intestinal canal.

The contents of the solitary glands, and of Peyer's patches, are not unfrequently seen in the rice-water stools of cholera patients, during the early periods of the collapse; when they are apt to be mistaken for pus-cells, either free and floating about under the field of the microscope, or entangled in the flocculent matter of the dejecta.

I have already referred to the condition of the villi; they are, in large patches, not only denuded of their epithelium, but shrunken, and their granular contents are often the seat of active molecular changes. Under the microscope it would be impossible to distinguish the contents of the larger lacteals from the intestinal rice-water liquid, excepting that they contain no

columnar epithelial cells, but their tessellated cells are detached, and often extensively involved in the molecular action so frequently referred to.

The Mesenteric Glands are always found to be in a state of hyperæmia, their contents, as Virchow remarks, being infiltrated with a "whitish granular exudation, like the milt of a herring; this was quite characteristic; the glands principally affected were those belonging to the duodenum." I cannot agree with this eminent pathologist in considering this speckled matter, found in the mesenteric glands, in the light of an exudate, but rather as evidence of the normal gland structure having been invaded by the molecular matter, carried to it by the lacteals from the intestinal canal.

The Spleen.—No abnormal appearance has been observed in this organ after death from cholera, but it is invariably lighter than in health, seldom weighing in the adult more than two and a half or three ounces. This loss of weight arises from the small quantity of blood it contains.

The Liver, from the same cause, weighs less than normal, its cellular structure is contracted, and in consequence its capsule becomes wrinkled. The portal veins are loaded with viscid blood. The lobular structure is usually indistinct, and of a lighter colour than normal.

The gall-bladder is generally distended with dark viscid bile, and its mucous membrane is occasionally the seat of molecular change, which may extend back along the bile ducts and affect the secreting structure of the liver.

The Kidneys.—I have already referred to the condition of the epithelium lining the kidney tubes.

lighter

lighter

dark
viscid
bile

These organs are of their natural size, their surface is mottled with stellate venous injection, and on section the same venous hyperæmia of the medullary portion is well marked, imparting a reddish blue, or darker colour than usual, to these structures. The veins passing from the medullary cones to the surface of the kidneys are very distinctly seen; the capillaries are mostly empty, as shown by the pale steel-grey colour of the cortical portion. It is evident that, as in the liver, the blood in the kidneys is collected on the venous side of the organ; but beyond this, with the exception of the changes described in the epithelium, no abnormal conditions have been noticed in the kidneys after death during the collapse stage of cholera.

The Lungs will be found about one half their normal weight, and in the majority of cases collapsed, lying back against the spine. Dr. Sutton describes them as being dry on section, containing very little blood, which is principally collected in the pulmonary arteries. He remarks, "It was black-looking blood, thicker than normal, but not by any means so thick as some have described it; nor was it so thick but that, on accidentally puncturing the jugular vein, it escaped in such quantities that the right side of the heart was in one or two minutes completely emptied. There was, I think, no reason, as regards its thickness, why the blood should not have circulated through the capillaries."*

The anterior portions of the lungs were often pale, but when cut into and exposed to the air, they became of a bright scarlet colour; the posterior portions of the lungs were of a darker colour, soft, and easily broken down under pressure. In the other cases, about one

* Mr. Simon's 'Ninth Report to the Privy Council,' p. 418.

half of the whole, Dr. Sutton states that the lungs were congested throughout, and of a dark red colour, but even then they weighed less than normal, although the blood had evidently penetrated into the capillaries, as shown by this dark red colour, and “was not arrested in the minute branches of the pulmonary artery.” “Judging from the very dark colour of these organs, the blood had not been properly aërated.”

Of sixty-four *post-mortems* made by myself, and of which I have kept careful notes, I find that in thirty-six, where death occurred during collapse, the lungs were congested; and from Dr. Chuckerbuty's published cases,* it appears that he found, after death during collapse, that the lungs were congested in “more than one half the cases.”

Dr. Parkes states that “the most common appearances in the lungs are, the collapse and the deficient crepitation, arising from the more or less complete absence of air and blood, and from the approximation, from some unknown cause, of the molecules of the pulmonary substance.

“In other cases there is more blood in the *minute* structure, a corresponding dark colour of the lungs, and a variable amount of frothy serum; the quantity of frothy serum bears an inverse ratio to the degree of collapse.”†

Dr. Gull, in his report to the College of Physicians in 1853, remarks, “In the majority of cases fatal in the algide stage, no other morbid change existed than engorgement of the lower and posterior parts of the lungs. In some instances this was so complete as to

* ‘Indian Annals,’ 1867. ~~X~~

† ‘Researches into the Pathology and Treatment of Asiatic Cholera,’ p. 20. By E. A. Parkes. London, 1847.

cause portions of the pulmonary tissue to sink in water. The anterior and superior parts were drier than natural.”*

The Heart.—In by far the majority of cases the right side of the heart is found full of blood, as well as the jugular veins and the cava; the coronary veins are in a similar condition, the left side of the heart being empty and contracted. Dr. Chuckerbuty remarks, that “the right cavities (of the heart) contained dark blood, fluid or clotted, in thirteen cases; in five of these the left cavities also contained similar blood;—therefore, in exactly one half of the cases, the right cavities were full of blood, and in about a quarter likewise the left cavities.” Dr. Parkes says “that in twenty-six out of thirty-nine cases, the right auricle and ventricle were flaccid, or distended with large fibrinous clots, or with dark semi-coagulated blood, while the left auricle was partially, and the left ventricle completely and firmly contracted, containing little or no blood, or only a small soft clot.”

The pericardium, like the pleura and peritoneum, contains but little if any fluid, or even moisture, after death in the collapse stage of cholera; the drain from the blood through the intestines evidently drawing off the fluid contained in these cavities, as it does from the various parenchymatous tissues of the body.

Encephalon.—The sinuses of the dura mater are generally more or less loaded with dark blood. The veins of the pia mater are in the same condition; serous effusion is often observed to have taken place into the arachnoid cavity, and into the meshes of the pia mater. Effusions of a similar nature have also, in several cases, been observed in the sheaths of the

* Dr. Gull's 'Report,' p. 38.

spinal cord. The ventricles of the brain are generally empty, and the choroidal plexuses more or less injected.

The venous congestion and serous effusion beneath the membranes are the prominent pathological changes noticed in the cranium, together with the plugging of some of the smaller vessels of the brain by epithelial cells and altered blood already referred to.

The Skin often becomes lighter in colour after death from cholera, and the shrunken appearance of the hands and feet diminishes; but the peculiar inelastic condition of the integument, consequent on its dehydration, continues. The superficial veins, especially those of the scalp, are often much congested.

The Chemistry of the Rice-water Dejecta, Blood, and Urine, in Cholera.—For the information I have been able to gain on this subject, I am almost entirely indebted to the researches of Dr. Thudichum, published in Mr. Simon's ninth and tenth reports to the Privy Council.

Concerning the rice-water stools, Dr. Thudichum remarks that they contain—"Vibriones, cells from the surface of the intestine, granular débris of cells, mucine, modified hemochrome, albumen, an albuminous body giving a rose-pink reaction, butyric acid, acetic acid, ammonia, leucine, inorganic salts." The matter is in "a state of active decomposition and evolves gas, which at first is composed almost entirely of nitrogen; soon, however, carbonic acid prevails, and ultimately nothing but carbonic acid is evolved. At one period some hydrogen is developed.

"We cannot discover any specificity in the above ingredients, but many of them are analogous to the products of ordinary processes of putrefaction. If it

be admitted that the cholera evacuations acquire infective powers only after a period of fermentation, it is also easy to understand that the specific infecting power may belong to albumen or mucine at a particular stage of disintegration or chemical cleavage. The next knowledge which it is necessary to acquire is evidently this: namely, the exact period at which the rice-water evacuation acquires infective properties; and its chemical composition at that period.”*

I have endeavoured, and I think succeeded, in solving the first part of this problem; but I must leave it to Dr. Thudichum to determine, if possible, the chemical properties of the cholera stuff at that particular stage of decomposition.

It is somewhat remarkable that a mixture of all the excreta in cases of cholera yields an abundance of the peculiar fluorescent matter found in cases of tetanus, but which is not, however, peculiar to that form of disease.

With regard to the rice-water stools of cholera patients, I have already alluded to their microscopic appearances. They are always alkaline, consisting of a watery gruel- or cream-like fluid, composed of thinner and thicker portions; its consistence varies according to the varying quantity of its component parts. The thicker portions are flaky, stringy, curdy, or clotted. When first passed, the rice-water evacuation soon separates into two portions, the flocculent curdy matter sinking to the bottom of the glass or vessel in which it is contained, leaving a whitish fluid above. This separation of the material into two parts takes place rapidly in many instances, say in from one to three hours, and is evidence of the severity of the

* Mr. Simon's 'Ninth Report to the Privy Council,' p. 486.

*affected
flaky
stringy
curdy
clotted
above*

disease; for if the more solid matter of the dejecta collects in the lower part of the fluid very speedily, it indicates the complete death and disintegration of the organic matter. On the other hand, if the separation of the fluid and more solid components of the rice-water product takes place slowly, it is on account of the evacuation containing a considerable quantity of comparatively healthy mucus, and the case, so far, allows of a more favorable prognosis.

The flocculent matter of the stools is composed of epithelial cells, and the mucus lining of the intestinal canal, in various stages of decomposition; but the perfectly fresh dejecta, in the active stages of the disease, contain no vibriones. Towards the end of collapse, when the evacuations are passed less frequently, probably remaining in the intestine for some hours, vibriones may be seen in the fluid immediately it is passed.

The epithelial cells are often shed in large quantities during the early stages of cholera. For instance, in the case of a little boy, three years of age, whom I was called to see last season, and who had gone to bed apparently in perfect health, and slept soundly through the night; on rising next morning he had a call to stool, and the mother noticed something peculiar in his appearance; on examining the pot, she discovered it to be full of a dirty brown-looking fluid. The child lay down and seemed much exhausted. I was sent for, and within half an hour arrived at my patient's house, to find him almost pulseless, and passing fast into a state of collapse. The first stool had been kept for my inspection; I secured a specimen of it, and had it under the microscope within two hours of the time it was passed: it contained a vast number of columnar

epithelial cells

epithelial cells, all of them more or less under the influence of the molecular changes I have so frequently referred to. The stools passed by this poor child at 10 p.m. contained comparatively few cells which could be identified as such, though I am not prepared to say that much of the flocculent matter was not composed of disintegrated epithelial gland cells, and mucus, doubtless combined with albumen and other organic matters in a state of decomposition.

When considering the history of cholera, I pointed out that, in 1832, Böhm had advanced a theory as to the disease depending upon the presence of microfungi, which he supposed the patient to have swallowed, and that these, entering the intestinal canal, preyed upon its epithelium, which they gradually destroyed, growing in fact at the expense of these cells.*

This theory has been prominently placed before the profession lately by Professor Hallier, or rather a modification of it. He maintains that "moulds are mere unripe forms of ustilagines. If, for instance, *tilletia caries* be cultivated on weak poor soil, we get only unripe forms, *i.e.*, moulds make their appearance." So that any one of the ustilagines series of fungi may appear under various forms, according to the substratum on which it grows. Each species of ustilago has three ripe forms of fructification, and each of these a corresponding unripe representative, the use of the unripe form being to prepare a more nitrogenous soil on which the higher forms may be developed.†

But Professor Hallier considers, that "the only form of the series associated with cholera, which is peculiar

* 'Die Kranke Schleimhaut in der Asiat. Cholera.' Berlin, 1838.

† Drs. Cunningham and Lewis's "Report of a visit to Professor Hallier," 'Lancet,' Jan. 16, 1869.

to the disease, is the cholera cyst or schizosporangium (Fig. 1); this can only be developed on a nitrogenous basis, and under a high temperature." Cholera originates under the same conditions as those in which

FIG. 1.



(Professor Hallier's preparations of cholera stools. Magnified 250.)

a. Schizosporangium, or cholera cyst.

b, b. Macroconidia, or dilatations such as occur in mucor racemosus.

Professor Hallier believes they are unripe forms of fructification.

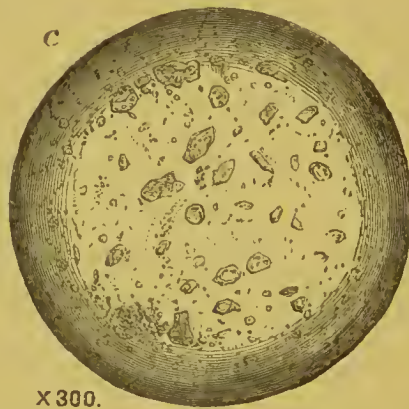
c. Macroconidia, in process of developing into tilletia spores.

these true cysts can be produced. This may possibly account for the difference between Asiatic and European cholera—the first being due to the 'micrococci' of the schizosporangia; and the second to the 'micrococci' of their unripe representatives, mucor sporangia, as well as to the indigenous ripe form, tilletia spores.

Professor Hallier does not state positively that cholera is due to the fungus, and he does not believe that any infectious disease can be caused by spores *per se*. It is only 'micrococci' that are efficient agents in producing disease, and these he describes as "particles of plasma without any cell wall (See Fig. 2). When

these particles acquire such a wall, they become either 'cryptococcus' or 'arthrococcus,' according to the nature of the medium in which they are contained. Micrococcus, on being introduced into a fluid capable of alcoholic fermentation, becomes cryptococcus, corresponding with the bodies which are generally included under the vague term 'yeast cells.' If, on the other hand, micrococcus be introduced into a fluid capable of sour fermentation, it becomes arthrococcus, *i. e.*, assumes an elongated form, and becomes one form of what are commonly termed bacteria. The term bacteria, as usually applied, includes both arthrococcus and micrococcus, but no idea of their nature and relations had been attained, until Professor Hallier discovered that they were merely the ultimate elements of fungi."*

FIG. 2.



Preparation of blood, exhibiting more or less disintegrated blood-corpuscles, associated with granular matter, and numerous minute circular bodies, which Hallier describes as various stages of micrococcus, cryptococcus, and arthrococcus.

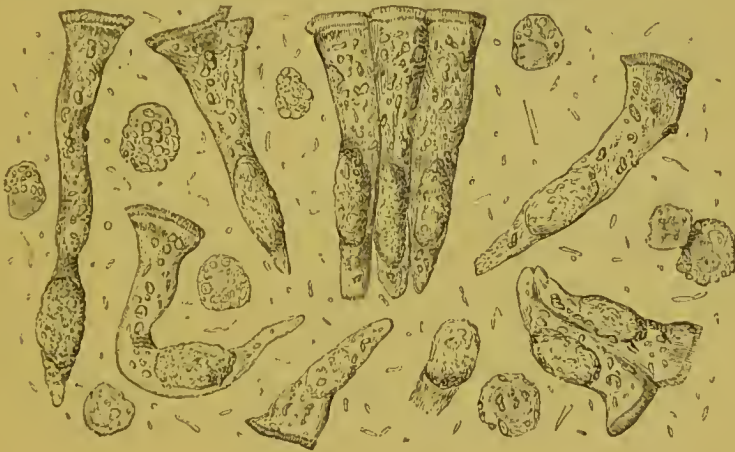
It appears to me that we are most of us agreed as to the intimate connection of cholera with the presence in

* 'Lancet,' Jan. 16th. 1869.

the intestine of particles having no cell wall; that is, the first indication we have of the existence of the disease is the appearance of molecular matter in the epithelium of the intestinal canal, such as I have already described, and analogous to that represented in the preceding drawing, Fig. 2, from a preparation by Professor Hallier.

Dr. Beale has depicted much the same appearances in his more defined drawings of the microscopical objects met with in the rice-water stools; he calls them "germs of bacteria or altered oil-globules." Figs. 3 and 4.

FIG. 3.



Detached columnar epithelial cells and small cells from the jejunum, about a foot from the pylorus. The cells contain numerous altered oil-globules. Between the cells are seen bacteria, which were alive and exhibited active movements. (*After Beale.*) Magnified 700.

Professor Hallier formerly held that urocystis and his cholera cysts were identical; the former he maintained infected the rice plant, and so found its way into the intestines of man; he has since abandoned this view, so that we need not enter on the subject further. But I must assert my firm conviction, after a long and attentive study of this subject, that fungi,

peculiar to cholera dejecta, have not yet been discovered. No doubt fungoid growths appear in this as in other nitrogenous matters undergoing decomposition; notably, the *oidium lactis*. Under other conditions *mucor racemosus*, in its various stages of growth, may

FIG. 4.



Summit of columnar epithelial cell under the $\frac{1}{25}$ object-glass. The bodies seen within are either germs of the same kind of bacteria as are seen outside, or altered oil-globules.

a. Thick summit of the cell, exhibiting longitudinal striæ, supposed by many to be pores.

b. Free bacteria. (After Beale.)

Magnified 1800.

be watched, but, I need hardly say, neither of these fungi are peculiar to decomposing cholera dejecta; moreover, I would particularly affirm that neither these nor any other fungoid growths can be discovered in *fresh* cholera stools; the more recent the specimen the clearer this fact appears. Even after protracted collapse, I have examined the contents of the intestinal canal diligently for the appearance of mycelial threads, or sporangia, and have absolutely failed, in numerous instances, in detecting any characteristic elements of the kind. They may exist there, but I should be sorry to have to define them, and much less to determine to what species they belong. Of this I feel confident, that they do not produce, in the dejecta from cholera patients, species differing from those which are grown in decomposing epithelium and mucus from the intestines of human beings dying from other diseases.

I have varied my observations bearing upon this point in every conceivable way, and although hoping, year after year, to discover a fungus peculiar to cholera, and thus settle much that was obscure in the etiology of the disease, I am reluctantly compelled to abandon my faith in the existence of any such growth.

The Blood.—In consequence of the alvine flux in Asiatic cholera, the blood loses its water albumen and salts, so that to a considerable extent it ceases to pass with freedom through the capillaries. And it seems more than probable that, by exhausting the water and other matters from the blood-corpuses, it renders them incapable of absorbing, and carrying the necessary amount of oxygen to the tissues; the oxidation of the organic constituents of the body being thus interfered with, its temperature falls. The colouring-matter of the blood remains unaltered.

loss of
water
albumen
& salts.

Dr. Thudichum says, it is not certain whether the blood, or any part of it, is primarily fermented in the manner in which the intestinal contents are; on the whole, such a fermentation is very improbable. It is, however, certain, that fermentation products, such as those contained in the rice-water dejecta, may at certain stages be found in the blood; but their appearance has always been subsequent to the period at which absorption from the intestinal canal has probably been resumed. Thus the butyrate of ammonia in the blood, and the rice-water smell of the breath in other cases, are due to absorption. During the progress of the patient towards collapse, the blood absorbs all the watery particles of the body, in order, if possible, to restore its own water which has been lost by the alvine flux, and at the same time it doubtless takes up other matters, and sucks in the contents of the intestines

through the denuded villi, and this may account for the presence of the butyric acid in the blood.

We may fairly suppose that the molecular matter found in the mesenteric glands has also been conveyed through the villi and lacteals from the intestines; and if this be the case, it explains the presence of the molecular action observed in the epithelium of the lungs, kidneys, and other organs of the body. I cannot, as I before observed, conceive that these organs are involved during life, or at any rate unless in extreme collapse, to the extent we find them implicated after death; for if so, it would be well-nigh impossible for any one to recover from cholera. I mean, if the epithelium of all the most important organs of the body were permanently affected in cholera, the disease would necessarily prove fatal in almost every case; whereas, supposing the cells of the intestinal canal to be first affected, and if, as the collapse increases, the lacteals suck in the pre-existing matter in the intestines, and afford it a passage into the blood-vessels in small quantities, up to the time of death, and even after the patient has expired, we should expect to find exactly the lesions in the epithelial lining of the vessels, and other organs of the body, which are actually present on *post-mortem* examination.

It seems quite certain that, so far as science can guide us, there is "no chemical evidence of the presence in the blood of any particular poison in cholera." The characteristic feature of the blood in this disease is the great loss of water, albumen, and salts; we know of no morbid additions to it; but it may be safely affirmed that, however rapidly fatal a case of cholera may have been, the blood will always be found notably deficient in these fundamental components, and that in spite of an

unlimited supply of water which the patient may have been allowed to swallow during life. It seems evident, in fact, that in the collapse stage of cholera little or no absorption goes on through the walls of the intestinal canal; we find that the stimulants taken fail to affect the heart, drugs remain in the intestinal canal, or are rejected unchanged by the mouth or rectum, and absorption being thus in abeyance, probably on account of the destruction done to the epithelium of the intestinal canal, the lost ingredients cannot be restored to the blood by the usual channel, and the tissues of the body part with their water. We shall have to consider this subject more fully in the next section, but it is well to allude to it now, in connection with the changes noticed in the condition of the blood by Dr. Thudichum and other observers.

The Bile becomes altered in cholera for two reasons, first, because the character of the blood having been changed, its constituents are not duly supplied; and secondly, the secreting structure of the liver being affected in cholera, it fails to elaborate bile of a normal character. Dr. Thudichum states, that in some cases the fluid found in the bile ducts consists of little more than water. In other cases, the bile ducts contain a pale yellow fluid, with only a trace of bile acids, or cholephæine in it, but in the liquid taken from the gall-bladder it is often present in large quantities. In several cases of this kind, Dr. Thudichum found the common duct plugged with disintegrated epithelium, and a coagulated material resembling that noticed in the kidney tubes. It seems probable, that the accumulation of bile in the gall-bladder, noticed in so many cases of cholera, is due to its muscular coat having lost its contractile power.

The condition of the *Urine* will occupy our attention when discussing the phenomena of the tepid stage, or that of reaction; no urine being secreted during collapse, it can evidently neither be collected nor examined. I may here remark, however, that in cases of death during collapse, little or no urea is to be found in any of the fluids or tissues of the body; as reaction comes on, traces of urea are detected, and in advanced stages of reaction the amount of urea increases to a considerable extent, especially in the brain and cerebro-spinal fluid. The rice-water dejecta of cholera patients contain no urea.

Condition of the Muscles.—Before leaving this part of my subject, I may make a passing allusion to the remarkable muscular movements, and to the rise in temperature of the body, noticed after death in the collapse stage of cholera.

The movements of certain muscles after death from this disease are not always noticeable, they are most marked in young and muscular subjects, more particularly when the disease has been very rapidly fatal.

This phenomenon is not, however, peculiar to this form of death; similar muscular contractions have been noticed after sudden death from apoplexy. In cholera these movements vary from a slight quivering of one or more muscles, to contractions sufficient to displace the body. The eyelids have been noticed gradually to open and the eyes to move slowly, but more commonly the flexor muscles contract, the arms being carried over the front of the chest, and the fore-arms bent as in the attitude of prayer.

The only changes noticeable in the muscles after death are, that they are usually of a dark, almost bluish colour, and yield, on spectrum analysis, bands

indicating the presence of reduced cruorine or myochrome, the red colouring-matter of muscle.* Consequently, there are grounds for believing, that the painful contractions of the muscles during life may have been due to diminished, if not altogether suspended, oxidation. While admitting this as a probable cause of the cramps and state of the muscles after death from cholera, we cannot overlook the fact, that these conditions must be very much influenced by the loss of water, which the muscles, as well as other tissues of the body, undergo in cholera. And it seems by no means improbable, as Professor Pacini remarks, that the muscular movements noticed after death from cholera, may be due to the water of the tissues passing by endosmosis into the empty vessels, and thus supplying one of the principal elements necessary to organic life. It will be advisable, however, to discuss this point more fully in the next section, confining ourselves here to a simple statement of facts; and so with regard to

Temperature.—A rise in temperature occurs shortly before and after death from cholera. The thermometer often rises from 94° in the axilla to 98°, or even 100°, a few hours after the person expires, and the corpse may continue at this temperature for some time; in one case in which the body was kept in sawdust its temperature was retained for no less than three days.†

As I shall subsequently attempt to show, this rise in the temperature of the body after death from cholera is probably best accounted for upon the same principles

* Report by Dr. Thudichum, in the 'Tenth Report of Mr. Simon to the Privy Council,' p. 186.

† 'London Medical Gazette,' 1850, case reported by Mr. F. W. Barlow.

as those which govern the muscular movements above referred to, and which I shall discuss when considering the etiology of the disease.

SECTION VII.—MORBID APPEARANCES DISCOVERED IN THE BODIES OF THOSE WHO HAVE DIED FROM CHOLERA AFTER THE STAGE OF REACTION HAS SET IN.

Stomach and Intestines.—The epithelium throughout the whole of the alimentary tract will show unmistakable evidence of the terrible mischief that has been going on in it during life. We may often notice in the stomach considerable patches of denuded mucous membrane, resembling in appearance superficial ulceration of this organ, those portions of its walls over which the epithelium is retained being also much congested and œdematous. Beyond this, we shall discover in the stomach, and, in fact, throughout the whole length of the intestines, evidence of imperfectly-constituted cell-growths, in the shape of numerous pus-like cells—abortive epithelial products, which have been ineffectually formed to supply the lost epithelium. The process of reparation, however, may be clearly traced over the denuded portions of the stomach and intestines, young and healthy looking epithelial cells having been formed upon the basement membrane, and covered with imperfectly grown epithelium in the form of pus-cells.

In the stage of reaction, therefore, very considerable quantities of pus are often passed with the stools, being formed in the intestines, as I have above explained. The contents of the small and large intestines will

still be liquid but of a bilious character. We shall find the walls of the canal covered with disintegrated and newly-formed epithelial particles, in various stages of death and life; the appearances thus induced must of course vary in every conceivable degree, but they may be all traced to the self-same process.

The Lungs.—The cells of the alveolar portion of the lungs will be found very much diseased. The extent of the change is often very great. The living tissue may still be crepitant, though denser and more congested than natural, and, in fact, frequently well-nigh hepatised. The parenchyma of the lungs being involved, a frothy yellowish fluid oozes out of its cut surface, consisting of altered epithelium, and, as in the case of the intestinal canal, of pus, the representative of imperfect cell-formation. Any one conversant with cholera must be aware of the frequency and danger of these living complications. The extent to which these changes have gone will vary much in different instances.

The Liver.—This organ is one of the earliest in the body to resume its function after collapse, and we find therefore, so soon as this stage has fairly set in, that it presents no abnormal appearances worthy of special notice; many of its cells will be found healthy, and others more granular than usual, from the remains of molecular matter among them. The liver, however, will, in the majority of instances, have recovered its normal weight and colour, if death has occurred after reaction has fairly set in.

The gall-bladder will be found to contain more or less yellow bile, and its mucous membrane, together with that of the bile ducts, still covered with the remains of altered epithelium.

The Spleen will have regained its weight and normal appearance, in proportion as the circulation is fully established.

The Kidneys.—In cases where urine has been secreted, we shall find the kidney tubules becoming gradually freed from the disintegrated cells and casts which form there during the stage of collapse. In instances where urine has not been passed, I have found the tubules of the pyramids absolutely choked up with cells and albuminous matter, and even the contracted tubes and Malpighian corpuscles may seem more or less full of a hyaline substance. It seems to me, that the retention of urine is very probably increased in these cases, from the pressure of this matter upon the Malpighian tufts preventing the free ingress of blood into these vessels, and therefore impeding its passage into the tubules.

I have certainly seen cantharides act favorably in these cases, and have noticed an enormous quantity of débris in the first urine passed after its action; so that it would seem to me, that the mechanical obstacle, preventing the passage of blood into the Malpighian tufts, is overcome by the action of the diuretic, and when once a small quantity of fluid has found its way into the Malpighian corpuscles, it loosens and gradually washes away the débris contained in the tubes, and the secretion of urine is thus re-established.

The Heart and Blood-vessels present no appearances worthy of notice, unless in some few cases, where small apoplectic clots have been found behind concretions of epithelial cells, combined with the altered colouring-matter of the blood, which had effectually closed some of the smaller vessels. These changes have been most commonly observed in the brain substance.

The Brain.—In addition to the changes just noticed in its capillary vessels, the most common abnormal appearance met with in the brain is venous congestion, and serous effusion beneath the membranes, and into the ventricles. The cells lining the choroidal plexuses may be found to some extent affected by molecular changes, but abundance of young epithelial products rapidly spring up, and supplant the disintegrated cells.

SECTION VIII.—ETIOLOGY OF CHOLERA.

Having studied the history, geographical distribution, meteorological relations, characteristic features, and pathological anatomy of cholera, we should now be in a position to arrive at a definite idea as to its cause. My own impressions on the subject have been pretty plainly indicated in the foregoing pages, but it will be well to bring these scattered observations together, and also to examine the features of the disease by the various theories in circulation at the present time, and, if possible, decide by which of them the phenomena of epidemic cholera, in all its phases, may be best explained. Upon the conclusions thus formed we must be prepared to base our system of preventive treatment, which, after all, it is the main object of this work to develop.

The theories I propose referring to, are 1st, Dr. G. Johnson's; 2nd, M. Bayer's, in conjunction with Professor Pettenkofer's theory; 3rd, Drs. Snow and W. Farr's theories, as illustrated by Prof. Pacini and other observers.

1st. In considering Dr. G. Johnson's theory of cholera, I may observe, in the first place, that this author seems to assume as a fact, that cholera depends upon a poison which enters the blood, and thereby produces the symptoms of the disease. But I need hardly say, that this is taking for granted the point of all others we have been anxiously endeavouring to determine for years past. If this blood-poisoning in cholera were an ascertained fact, many of the difficulties which beset our attempts to account satisfactorily for all the circumstances of the disease would vanish at once. Our author says "that the symptoms of cholera result from a morbid poison, which may enter the blood either through the lungs or through the gastro-intestinal canal;" he adds, "this is so generally admitted, that I will not now stop to discuss the question, or to adduce any of the numerous facts upon which this view is based."*

On a point of this kind, most English readers would turn for reference to Mr. J. Simon's works, as being certainly one of the most eminent pathologists living, and as having had peculiar opportunities for studying the phenomena of cholera for some years past. On the question of blood-poisoning in this disease, Mr. Simon observes, "the belief that a primary blood-poison is the proximate cause of cholera, the direct source equally of its intestinal and of its asphyxial manifestations, is, so far as I know, mere hypothesis. It has been much accepted as the only possible explanation of certain supposed, but very questionable facts, in the natural history of the disease, especially in explanation of the supposed fact, that the utmost collapse of cholera may concur with little or no affec-

* 'Notes on Cholera,' p. 35. By Dr. G. Johnson. London, 1866.

tion of the intestinal canal." "The notion of a primary blood-poison in cholera seems tending more and more to be superseded."*

As an analytical chemist and physician, Dr. Thudichum is probably second to few men of the present day, and after carefully examining all the structures and fluids of the body in cases of cholera, he has arrived at the conclusion, that "there is no chemical evidence of the presence in the blood of any particular poison."†

It would seem to me, therefore, that as Dr. G. Johnson bases his theory of the pathology and treatment of cholera upon the idea of a peculiar blood poisoning, it is incumbent on him fully to discuss the evidence he has on the matter. It is quite plain, that the fact which he assumes to be settled by common consent, is far from having gained that firm hold on the minds of those best able to form an opinion on the subject which he takes for granted to be the case, and which is the key stone to all his subsequent arguments; for unless the blood be poisoned and the muscular fibres of the smaller arteries of the lungs thereby thrown into spasm, Dr. Johnson's theory breaks down and cannot be entertained.

We may, however, briefly consider this very plausible theory of cholera from another point of view. Dr. Johnson insists upon a fact referred to by almost all observers, that the severity of an attack of cholera by no means depends upon the frequency of the vomiting and purging; on the contrary, the worst cases are often those in which there is very little vomiting and

* Mr. Simon's 'Ninth Report to the Privy Council,' p. 430. London, 1867.

† Idem, p. 477.

purgings. He proceeds to explain this by assuming, that in the one case the discharge from the bowels being very copious, the poison in the blood is speedily eliminated from the system; whereas, in instances of the disease where the evacuations are but scanty, the poison, being retained in the body, speedily destroys the patient. Consequently, he strongly advocates the castor-oil plan of treatment in this disease, so as to keep up the action of the bowels, and thus eliminate the cholera poison from the blood through the dejecta.

Now, while I quite concur with all Dr. Johnson says with regard to the great danger which attends all cases of cholera passing quickly into collapse, the dejecta being but few in number, I nevertheless resist the conclusions he draws from this fact, for the simple reason that I am convinced a vast number of lives are saved in cholera by checking the disease in its early stages with opium and astringents, or with opium and sulphuric acid; in fact, if Dr. Johnson's theory be true, by locking up the poison in the system, we yet cure the patient. I am not arguing that all cases of incipient cholera may be stopped by these means, for I am quite aware such is not the case; but I am convinced, if the past and present officers of the Indian Medical Service were consulted on the point, 90 per cent. of them would assert they had seen numerous cases in which, to all appearance, they had stopped attacks of cholera in its early stages by means of the drugs above mentioned. I specify the Indian service, because we live and practise in a country where cholera is more or less endemic, and must, therefore, have constant opportunities of meeting with cases of the kind. Some practitioners think differently, and among us, notably, Dr. Cannon of Lucknow; never-

theless, on referring to the majority of Indian authorities, or to the MS. proceedings of the Medical Board, the assertion I have made above will be found correct.

In Europe, the opinion of the greater number of persons who have had much to do with cholera, is very decided upon this matter, and in harmony with that of their brethren in India, provided, as I have distinctly stated, that astringents are administered before collapse comes on.

With reference to this point there is another circumstance to which I would allude : it is that, although the worst cases of cholera may be, and often are, very suddenly fatal, still, to describe the attacks in many instances as being "so sudden that men fell as if they had drunk the concentrated poison of the upas-tree,"* is certainly high-flown language. In the majority of cases of cholera, vomiting and purging last for some hours before collapse comes on ; and there is one point we must never lose sight of, which is, that although death may appear to have been almost instantaneous in some cases, the small intestines in such instances have always been found full of rice-water fluid. Moreover, when the patients were dying at the rate of 84 per cent. in London in 1866, Dr. Sutton found "the greatest loss of weight in the lungs, and in the other organs."† The diminution in weight was not confined to the lungs, but extended to the spleen, and other organs of the body. If, as Dr. Sutton argues, the cause of death in these cases depended on obstruction to the circulation through the lungs, the blood must have accumulated in the spleen, liver and kidneys, or some of the organs of the body ;

* 'Notes on Cholera,' p. 48. By Dr. G. Johnson.

† Mr. Simon's 'Ninth Report,' p. 422.

but they had all lost equally in weight, and this diminution in weight was due, as Dr. Thudichum informs us, to dehydration of the blood and tissues.

With regard to these sudden deaths from cholera, Mr. Scott states that, in some cases, there are no spasms, hardly any purging, "a mortal coldness, with arrest of the circulation from the beginning; and the patient dies without a struggle." But James Annesley, one of the most talented observers India has ever seen, commenting on this passage from Mr. Scott's works, remarks—"This is a type of the disease which I have never seen. Death may take place in this manner suddenly, and when no person can give information as to how long the patient had been complaining, or as to the nature of his complaints, before he was brought for medical aid; but in every case in which I had an opportunity of marking the progress of the disease, I have seldom found it terminate in a shorter period than that of ten or twelve hours, or without much more marked symptoms than those above referred to. I have certainly seen patients die in the state described by Mr. Scott, and a great many have died as described by him; but, in all these instances, the symptoms indicating a more violent commotion of the system had passed off, and the fatal collapse had proceeded before they were brought under treatment."* By far the majority of Medical Officers in this country will agree with Mr. Annesley upon this point, and I for one most assuredly do.

I am not, therefore, disposed to yield to Dr. Johnson's argument, as to the cause of death in cases of cholera attended with only an apparently slight

* 'Sketches of the most Prevalent Diseases of India,' p. 35. By James Annesley, Esq. London, 1825.

But James Annesley is a more accurate observer than Scott.

amount of purging and vomiting. Although the disease may kill very rapidly, no fatal case has ever yet been recorded, where at least four pounds of serous fluid have not passed from the blood-vessels into the intestinal canal. It is quite possible that a less amount of serum, say three pounds, if instantaneously poured out from the intestinal vessels, might be sufficient to destroy a person having a fatty heart. But, as I have before observed, we have three factors to consider in these cases—1st, the quantity of serum withdrawn from the blood; 2nd, the length of time it takes to pass from the vessels into the intestinal canal; and 3rd, the condition of the epithelium; for if this is extensively diseased, no fluid can be absorbed, and consequently the blood and its corpuscles become dehydrated, and cease to carry oxygen to the tissues; the *vis à fronte* fails in consequence, and the patient must inevitably die, unless this condition of things be speedily relieved.

Dr. Johnson lays stress on the idea, that the symptoms of cholera are not those of loss of fluid from the blood, in fact, are not those of syncope; he says, that “a patient in the collapse of cholera, whose skin is blue and icy cold, and whose pulse is imperceptible, or extremely small and feeble, is often able to stand up without becoming faint, and even to walk a distance which must require a considerable amount of muscular exertion.” Here again my experience is at variance with Dr. Johnson's; I don't deny that men in collapse may rise in bed, and even stagger across a room, but to suppose they can sit up and walk about without a feeling of deadly faintness is a mistake. A faint and sickly feeling is one of the earliest symptoms complained of by most cholera patients, and those who

have recovered from collapse have often told me that the whole illness has seemed to them a swoon; their own words have been, it was like a "deadly faintness." In the last agony, men make terrible efforts to shake off this feeling—to breathe—to resist death—but how often have we seen a poor fellow after a struggle of this kind fall back on his pillow and expire!

There can be no doubt that the collapse of cholera differs from the syncope of hæmorrhage, and there is very good reason why it should do so. In collapse, the coldness of the body, failure of the circulation and so on, are due to loss of serum, rendering the blood viscid and its corpuscles unfit agents to carry oxygen; and the dehydration of the blood cannot be relieved by the fluid swallowed by the patient, because no adequate absorption of fluid takes place through the intestinal walls. But in hæmorrhage (unless fatal) the vessels of the intestinal canal eagerly soak in any water that the patient drinks, the circulation is kept up, and oxygen, being diffused over the body, maintains organic life. In the case of cholera, the solid constituents of the blood are retained in the vessels, the serum draining away, and the water thus lost can with difficulty be restored through the diseased mucous membrane of the intestinal canal, and hence the black, treacle-like blood found in the arteries during life and after death in cholera collapse. On the other hand, in hæmorrhage, the whole of the constituents of the blood flow away, the hydrostatic pressure on the walls of the vessels being lessened, syncope results; a clot forms in the wound, and instantly the tissues of the body begin to pour the water they contain into the empty vessels, the circulation is thus re-established, and the thirsty patient swallows water, which is rapidly absorbed

through the walls of the intestinal canal, and his life is thus saved, supposing, of course, that means are taken to arrest further hæmorrhage.

We may conclude, therefore, that the results induced by the cholera process can hardly be compared with those of hæmorrhage,—cholera is not hæmorrhage, nor is hæmorrhage cholera, yet a drain from the vessels, and consequent syncopal symptoms, occur in both.

Upon these grounds I demur to Dr. Johnson's conclusions upon the point under consideration; and even if my argument should prove at fault, I cannot concede to him the accuracy of his statement, as to patients in a state of cholera collapse being, as a general rule, able to move about without feeling faint.

Dr. Johnson goes on to argue, that the effects of the various modes of treatment lend no support to the idea, that the collapse of cholera depends on a drain of liquid from the blood. He remarks, that alcoholic stimulants, swallowed in any quantity in collapse, do not improve the pulse as they would do in syncope. Here I quite agree with Dr. Johnson: stimulants have no such effect in cholera collapse, but how could they be expected to rouse the circulation? In the first place they cannot be absorbed into the blood, and if absorbed they would probably tend rather to consume the small quantity of oxygen which it contains, and thus smother the little life left in the patient.

Dr. Johnson further adduces a very remarkable, I may say unique case, related by Sir Ranald Martin, in support of his position, that cholera collapse cannot depend on the amount of the alvine discharges, because in this instance, a man in collapse, after being bled, rose up as if by magic and declared himself cured. Now if cases of this description were common, or in fact if

bleeding were a mode of treatment which was ordinarily successful in cholera, we might lean towards the conclusion at which Dr. Johnson has arrived. But it is well known that bleeding, at any rate in the collapse of cholera, is rarely employed, because, if practicable, which it seldom is, it certainly is not successful. Any inferences, therefore, drawn from a single case of the kind, are rendered nugatory by the vast number of instances in which bleeding has been employed without inducing any such result. It seems to me, that it would be almost as reasonable to conclude that, because a man has been run through the abdomen with a lance and recovered, or another has had a portion of his skull and brain sliced off and got well, accidents of the kind are generally followed by no injurious consequences; for it is absolutely and entirely contrary to the experience of most men who have employed venesection in collapse, or in fact in any stage of cholera, to see their patient derive any benefit from the operation, much less to be restored to health as if by magic, as was Sir R. Martin's patient.

When on the subject of drugs, Dr. Johnson reads rather a severe lecture to a correspondent of the *Lancet*, because he refused to believe in the eliminative treatment of cholera. Dr. Johnson remarks, "this gentleman will probably argue, that those who recovered while taking purgatives, did so in spite of an erroneous and mischievous treatment; while those who died under the opiate treatment, succumbed to the disease in spite of treatment which was theoretically correct, and which ought, therefore, to have saved them."* Nevertheless, it seems to me, that Dr. Johnson proceeds upon very much the same principle

* Op. cit., p. 33.

himself, as the one he has criticised in the case of the writer in the *Lancet*; he certainly draws his conclusions by a similar process of reasoning, for, at page 74 of his work, Dr. Johnson remarks, that in 1849 he was called to see a case of cholera:—"She had not a symptom of collapse. The countenance was natural, the skin warm, the pulse good. I gave her five grains of Dover's powder every hour, until three doses had been taken. When I saw her again, in about three hours from the time of my first visit, the vomiting, purging, and cramps had ceased, and she was in full collapse, from which she never rallied. This case gave a terrible shock to my belief that collapse is a consequence of loss of fluid, and that it is to be prevented by arresting the vomiting and purging which usually precede and accompany the symptoms of collapse. I saw no escape from the painful conviction, that my patient's condition had been made fearfully worse by well-intentioned but mischievous interference." Most people who have seen much of this disease would probably be of opinion, that Dr. Johnson might certainly quiet his conscience with regard to having done any harm with his fifteen grains of Dover's powder in this particular case.

Lastly, Dr. Johnson asserts, that the poisoned blood in cholera irritates the muscular tissue, as shown by the cramps; in like manner it excites contraction of the muscular walls of the minute pulmonary arteries, the effect of which is to diminish, and in fatal cases entirely to arrest, the flow of blood through the lungs. In confirmation of this doctrine Dr. Johnson does not refer to details of post-mortems made by himself, but affirms that the right side of the heart is generally found full of blood after death from collapse, the lungs

being pale because the blood has not entered the capillaries, but been arrested in the smaller branches of the arteries; and further, that the left side of the heart, like the lungs beyond the branches of the smaller arteries, is found empty. I shall presently attempt to show it to be probable that this condition of the heart depends on the water of the tissues draining into the venous capillaries and right side of the heart after death in collapse, the whole venous system being more or less full of fluid blood from this cause.

As to the condition of the lungs again, Dr. Johnson does not give us the results of the post-mortem examination of his own cases, but refers to those of Dr. Parkes, who says that, in most cases, he found the lungs collapsed, and deficient in crepitation, "arising from the more or less complete absence of air and blood; in other cases there was more blood in the *minute structure*, and a corresponding dark colour of the lung." This latter description is in accordance with that of most recent observers (see page 349), and entirely confirms my own observations that, in nearly one half the cases, the lungs after death during cholera collapse are engorged with blood. So that really the evidence in favour of the capillaries of the lungs being empty, under these circumstances, is inconclusive, and as the case stands, Dr. Johnson must give us further proofs of the effects of the cholera poison upon the walls of the smaller arteries of the lungs, before he will persuade the majority of men of the truth of his theory, even admitting that the blood is poisoned.

We require, in fact, more definite knowledge as to the nature, or even the existence of a blood poison in

cholera; and if this be discovered, we affirm that the results of our own post-mortems, and those of others, tend very much to weaken Dr. Johnson's conjecture, as to the cholera poison causing contraction of the muscular fibres of the smaller arteries of the lungs, stopping the circulation of blood through them, thus preventing its oxidation, and inducing the symptoms of cholera.

2nd. The second theory as to the cause of cholera which I have to examine, was, I believe, propounded by M. Bayer in 1832. I have referred to it at length when discussing the history of the disease for that period. M. Bayer was of opinion, that among the inhabitants of mountainous countries, through which streams flow with some rapidity, where no stagnant or retarded waters are met with, and where the foundation is rocky and the soil sandy, cholera is less apt to make an impression than among people living on an alluvial soil. Professor Pettenkofer has added much original matter, and in fact many independent ideas, bearing a definite relation, however, to those propounded by M. Bayer. I have referred to Professor Pettenkofer's early works on the subject, when discussing the epidemic in Europe of 1854, and he still holds to the opinions he then published.

Pettenkofer considers, that certain conditions are necessary for the development of cholera. 1st. A stratum of earth inhabited by men, penetrable to a certain depth by water and air. 2nd. A considerable fluctuation, temporarily, in the degree of humidity of this stratum, which fluctuation shows itself in the simplest and surest manner by the difference in the level of the subterranean waters, the most dangerous moment being, when the level of the water sinks, after

having attained a considerable height. 3rd. The presence of organic, and chiefly excrementitious matters, spreading themselves in a susceptible soil. 4th. The specific germ spread by human communication (the specific cause of cholera), the principal vehicle for which is found in the evacuations from the alimentary canal of those affected by the disease; it is possible, however, that evacuations of men who are healthy, but who come from infected places, may produce the same result. 5th. Individual disposition towards cholera.

Pettenkofer considers that the propagating agent may be considered as a cellule, or as an organic ferment, and that two hypotheses may be suggested to explain the connection existing between human communication and the soil.

First hypothesis.—It may be supposed to be possible and probable, that the infecting germ, contained in choleraic excrementitious matter, requires a certain sort of soil for its development, propagation, and multiplication.

Second hypothesis.—The injurious agent which proceeds from the soil, and the agent proceeding from importation, combine with each other in the organisation itself, and the choleraic condition originates from this combination.*

It appears evident, therefore, that Professor Pettenkofer believes two elements indispensable for the production of cholera. 1st. The importation of the choleraic germ into the locality. 2nd. A peculiar constitution of the soil. Neither the first nor the second of these elements would suffice of itself; the simultaneous action of both is necessary; the choleraic

* 'Journal de Biologie,' 1865, p. 355.

patient furnishes the germ, and the soil provides certain emanations, and these, entering into combination with each other, whether in the atmosphere or in the human organisation itself, result in choleraic infection. Pettenkofer has always opposed the pure contagionist, who declares that the infecting matter is produced by multiplication within the bodies of those affected with the disease.

With regard to this theory, Dr. J. Macpherson observes, that it hardly helps us on very far; it attributes much to a porous soil and to certain geological formations; "porous soils we have in abundance in Bengal, and that is its general characteristic. The only non-alluvial soil we have in lower Bengal is on its western edges, where the curious formation of laterite, a porous rock, occurs. I have examined the jail returns in such districts, and compared them with those on alluvial ones, with this result: that cholera was, during ten years of which I have examined the jail returns, more prevalent on the laterite than on the alluvial soil, in the proportion of 2.64 to 1.13 per cent."*

Pettenkofer allows, what is generally conceded by all observers at the present day, that cholera cannot make its appearance unless the germ of the disease is imported into a locality, and thus far we are in entire accord. He will not give a positive opinion as to the nature of the germ, because he is unacquainted with its characteristics. Upon this question my ideas begin to diverge from those of Professor Pettenkofer. In the instance I have so frequently referred to, in connection with the cholera of 1861, a small quantity of the dejecta of a cholera patient was known to have

* 'Cholera in its Home,' p. 44. By Dr. J. Macpherson. London, 1866.

been accidentally washed into a vessel containing water; the mixture, after being exposed to the heat of the sun for one day, was swallowed by nineteen men on the following morning, and within three days five of these were affected with cholera. That this water had been contaminated with organic matter, was first discovered from the appearance of vibriones on its surface, and this ultimately led to the detection of the circumstances I have related. The matter contained in this water must have been very much diluted, and we can only suppose each man to have swallowed as much as a few drops of the alvine flux, which consisted of organic matter in a state of molecular change or decomposition; yet in the course of three days, we find five out of these nineteen men passing large quantities of decomposing organic matter from their intestinal canals, of precisely the same nature as that which they had swallowed. A single well authenticated instance of this kind seems to me to militate against the theory of Professor Pettenkofer, for he affirms that the infecting matter is not produced by a process of multiplication of the cholera stuff within the bodies of those affected by the disease.

But it may be argued that the above case simply goes to prove Pettenkofer's theory; these people living in India, were subject to certain emanations from the soil, which, as the Professor says, are necessary to the disease, and that the cholera germs were introduced in the drinking water. An argument of this kind is however not very convincing, for one naturally ignores the idea of any such special emanation from the soil unless we have some distinct evidence of its existence. And, what perhaps is more to the point, we are compelled to admit that those subjected to these emana-

present in
 water.
 the water is
 a in food

tions, if they exist, have swallowed the dejecta of cholera patients in a concentrated form, and yet no evil result has followed. That is to say, of a series of, say twenty-one people, divided into sets of threes, each set swallowing two drachms of choleraic dejecta from the first to the seventh day after being voided, not one of the series may show any symptoms of cholera. Here, the germ being introduced into the system, the patients living upon such a soil as Pettenkofer considers necessary to produce the disease, all the conditions are fulfilled, and yet no cholera results.

It remains of course for me to explain why, on my own theory, the material cause of the disease, though introduced into the body, may yet be inoperative; and I shall presently show, from researches I have instituted into this matter, that there is reason to believe that the acids of the healthy stomach destroy the molecular process going on in decomposing choleraic dejecta; so that when swallowed in a concentrated form, they may be so acted on by the gastric juice as to have their infecting power destroyed, but when swallowed diluted with water, a portion of the fluid probably passes at once through the stomach, and reaching the alkaline contents of the small intestines, begins its work of destruction upon the epithelium. I shall enter more fully into this matter subsequently, but may here remark, that this view of the action of the gastric juice on the cholera stuff may account for the immunity of fourteen out of the nineteen men who swallowed the contaminated water in the instance referred to above. The five affected may have drunk the water fasting, when the secretions of their stomachs were alkaline; or, from other causes, the acid may not have been sufficiently powerful to alter the action going on in the

choleraic organic matter, and thus it took effect, inducing an attack of cholera.

But further, it does not appear easy to explain, by Pettenkofer's theory, the facts connected with such outbreaks of the disease as that which occurred at Hurdwar in 1867, and its subsequent dissemination over the North-west, and right away into the sandy plains of Rajpootanah and Mooltan. We have here evidence of the extension of the disease from a common centre, Hurdwar, over the Himalaya, Afghanistan, the rocky soil of the Punjab, the sands of Western India, and down into the alluvial soil of the Gangetic valley. And this terrible outbreak of disease travelled with man, and took root among his fellow men inhabiting regions presenting every variety of soil, and situated on the most opposite geological formations, the epidemic spreading over the country within six weeks or two months of its sudden outburst at Hurdwar.

Facts such as these prevent me from fully accepting Professor Pettenkofer's theory of cholera; I feel, nevertheless, that it demands careful consideration and further study. His ideas after all may prove to be correct, and mine too simply materialistic to account for all the features of the disease.

I at once admit the fact Pettenkofer advances, as to cholera being most common on alluvial soils; but it seems to me very possible that this may be accounted for by the circumstance of our large towns, and in fact of by far the majority of the inhabitants of the world, being located on alluvial soils. And when congregated in cities, the lower classes especially suffer from diseases consequent on faulty hygienic conditions; the oxidation of their tissues being imperfect, and their food often unwholesome and scanty, the secretions of

their stomachs must frequently be far less healthy than they would be under better sanitary conditions; and hence such people, imbibing cholera-contaminated water, would be more subject to its deadly influence than their healthier brethren.

Nor can we pass over the consideration, that supposing man not only the medium, but the soil in which cholera grows, of course the more abundant the soil (*i.e.*, the greater the number of men) the more probable the extension of the disease. This must be taken into account in weighing the probabilities of those living on alluvial soils suffering from cholera to a greater extent than other people.

In considering Professor Pettenkofer's theory, due weight must also be given to the remarks made by Dr. Macpherson (p. 381) regarding the soil in this country where cholera is endemic, as, for instance, on the laterite beds of Lower Bengal, and over the Deccan. True, Pettenkofer may consider the cotton soil of the Deccan, consisting of the disintegrated trap rock, as equivalent to an alluvial soil in the production of cholera; nevertheless, no one will argue that the Deccan is an alluvial formation, and much less that its inhabitants are not more or less constantly under the influence of cholera. In fact I much doubt the direct influence of the soil in the production of this disease. No doubt geological formations of various kinds play their part in the phenomena of cholera, as I have endeavoured to explain. A rich alluvial soil attracts human beings, and water being abundant, cholera can spread and grow in such places; moreover, man in the battle for life in these localities, often destroys Nature's best safeguard against this terrible disease—a healthy stomach.

3rd. The third theory I propose considering, may be regarded as a modification of that propounded by Dr. Snow, in conjunction with the views of Drs. W. Farr and Pacini. From a consideration of the ideas of these authors, together with those I have elaborated, it seems to me that we may consider *cholera to depend upon a specific organic matter, derived from the fomes of a patient suffering from the disease. This organic matter, when in a certain stage of decomposition, is capable of imparting its action, by a conversion of force, to the epithelium lining the intestinal canal of a person swallowing it. The epithelium being thus destroyed, the serum of the blood is allowed to drain away from the capillary arteries of the intestines, and at the same time venous absorption is prevented from taking place through the mucous membrane. Hence the symptoms of cholera.*

The primary and essential element in the production of cholera is, according to this theory, the infecting organic matter of cholera, as it may be called, and which is discharged with the excreta of those suffering from the disease. We must now, therefore, endeavour to ascertain the nature and properties of this matter.

In the first place it will be observed, that I am careful not to apply the term *germ* to this cholera stuff; for although the word is unobjectionable if used in the sense of a first principle, or the origin of the disease, still it is so often employed to signify an ovum, embryo, or seed bud, something, in fact, from which life is generated, that we are apt to invest the term with a signification which is not applicable to the case of cholera, and so to wander off into the regions of speculation, connecting cholera with fungi, or, it may be, with other hypothetical forms of animal or vegetable life. As I have before remarked, I cannot accept the doctrine of

the existence of any such special growth in cholera; the cholera fungus and all similar notions appear to me "not proven," though having a certain approximation to the truth.

In connection, however, with the subject of the infecting organic matter of cholera, I must here briefly touch on the arguments brought forward from 1861 to 1864, in the French Academy, between Messrs. Pasteur and Pouchet, in support, respectively, of the doctrines of primary life by miracle, and by the operation of existing laws. I need only remark that M. Pouchet, the leader of the latter form of thought, is rapidly gaining disciples from among all ranks of scientific men.

M. Pasteur, by means of an ingeniously devised apparatus, examined the atmosphere from various places, and under different circumstances, and believes that on every occasion he discovered in it 'organised corpuscles,' 'globules,' or the 'germs of living things.*' And further, that by destroying these germs in a solution of organic matter by heat, and only allowing an atmosphere from which they were excluded to reach his solution, he prevented the development of the lower forms of life in the organic matter; while these were at once produced when an atmosphere, unprotected by suitable means, was allowed access to this fluid; thus, as he concluded, proving, that when the germs are excluded no infusoria are produced. On the other hand Pouchet states, that in these solutions of organic matter, said to be free from bacteria by Pasteur, these infusoria existed in prodigious numbers, and would have been at once apparent if only searched for with a sufficiently high power.

* 'Annales des Sciences Naturelles,' 4e sér., tome xvi, p. 25.

Pouchet describes the following simple experiment, which any one can repeat for himself, to prove that the infusoria of infusions of organic matter can hardly arise from pre-existing germs in the atmosphere. A glass tube, containing a filtered infusion of organic matter, is to be placed in the middle of a glass dish containing the same infusion; this stands in a wider dish of water, in which a bell-glass is placed, covering the vessel containing the infusion. At the end of a day, or, it may be, three or four days, depending on the temperature of the atmosphere, the tube-infusion has a thick film abounding with ciliated infusoria; the dish-infusion has a thin reticulate film, containing only bacteria and other small non-ciliated infusoria. It is difficult to see how the germs of the one kind of creature should have entered or become developed in the one vessel, and an entirely different kind in the other.*

Now, though I agree with the general conclusions arrived at from this and other experiments made by Pouchet, still I think that, in this instance, the difference of the infusorial forms noticed in the tube and dish, probably depended upon the different circumstances under which they were placed; the oxidation of the organic matter in the one being more rapid than in the other. Had the liquid in the glass tube been carefully examined in an earlier stage of decomposition, bacteria and vibrios would alone have been discovered in it; subsequently, they had given place to the ciliated infusoria found in the infusion.

Dr. Hughes Bennett has given us an admirable description of these changes in a paper on the "Atmo-

* 'On the Anatomy of Vertebrates,' vol. iii, p. 815. By R. Owen, F.R.S. London, 1868.

spheric Germ Theory" ('Edinburgh Medical Journal,' March, 1868). Describing the mode of development of infusoria, he says, that on making a cold or hot infusion of any vegetable or animal substance, and covering the vessel with a piece of paper so as to exclude the dust, or putting it under a bell-glass standing in a stratum of water, and exposing the whole to the sun, and then watching it every twelve hours, the first change visible to the eye is a slight opalescence of the infusion, and the formation of a thin scum or pellicle that floats upon its surface. This appears at times, varying from a few hours to several days, according to the temperature of the air or the nature of the infusion.

On examining the pellicle or film under a high magnifying power, it is seen to be composed of a mass of minute molecules, varying in size from the minutest visible point to that of one thirty-thousandth of an inch in diameter. These molecules are closely aggregated together, and must exist in incalculable numbers. They constitute the primordial mucous layer of Burdach, and the proligerous pellicle of Pouchet. Dr. Bennett describes these molecules as apparently melting together, so as to form a short staff or filament—bacterium. I am not convinced of this: it seems to me that the molecules enlarge at the expense of the organic matter around them, and in favorable and carefully examined specimens, in twelve or twenty-four hours, they gradually assume a honey-combed appearance, the dark spots representing the cells. These become elongated at the edges of the molecular mass, which then appears to crumble away at its margins, and to break down into the surrounding fluid, into which each little elongated cell starts off

with a rapid wriggling movement. It would appear that the force concerned in the production of these cells, upon their gaining their freedom becomes converted into motion, and continues in action until overpowered by other forces, which acting upon the organic matter of the cell induce further changes in it, and the production of ciliated infusoria. But to return to the vibriones, which, under favorable circumstances, increase rapidly in length.

In the first instance the vibriones move with a rapid wriggling motion, and it appears a matter of perfect indifference to the cell whether it rushes forwards or backwards; subsequently, as it grows larger, it becomes more stately in its passage across the field of the microscope, which it accomplishes with a serpentine movement. Dr. Bennett believes that vibriones join end to end and are thus elongated, but I have hitherto failed to confirm this observation. I think they may increase in number by a process of spontaneous fission; but the majority of them are directly formed from organic matter in a state of decomposition, and having been produced from it, they increase in size at its expense.

What we have specially to notice, however, is, that for the first two or three days (depending on the temperature, and other circumstances influencing the oxidation of the organic matter) bacteria and vibriones are alone found in the organic infusion, this being the vibrio stage of decomposition, as I have called it. Subsequently we shall discover, on examining the liquid, that all these infusoria have died, or at any rate ceased to move, and their remains may be found in heaps at the bottom of the vessel. Having thus become disintegrated, a second molecular pellicle forms

on the surface of the infusion, which again undergoes further changes, ending in the formation of numerous ciliated infusoria. These, in like manner, die in the course of a few days, and falling to the bottom of the fluid, gas is evolved from their remains, which rises in bubbles to the surface of the fluid. The water then begins to clear, and the sides of the vessel are seen covered with a confervoid growth; by this time the fluid has become clear and sparkling. In following out these observations I would have it distinctly understood that we are dealing with *a dilute infusion of organic matter in water, such as, if the water were slightly muddy, might be drunk by a person without his being aware, either by taste or smell, of its containing impurity at all.*

Dr. Hughes Bennett thus expresses himself on this matter: he says,—“M. Onimus maintains that vibriones and fungi in fluids are not the result of atmospheric germs, but of conditions necessary to the putrefaction of organic fluids.

“These conclusions are confirmed by the numerous facts which have long been recognised in pathology, and indicate that it is to a knowledge of these conditions that science must now apply itself. So long as the origin of infusoria was ascribed to atmospheric germs, we rested contented, and all inquiry was stopped.”*

Professor Owen, on the same subject, observes: “it seems to me more consistent with the present phase of dynamical science and the observed gradations of living things, to suppose that sarcode, or the ‘protogenal’ jelly-speck, should be formable through concurrence of conditions favouring such combination

* ‘Edinburgh Medical Journal,’ March, 1863, p. 833.

of their elements, and involving a change of force productive of their contractions and extensions, molecular attractions and repulsions, and that sarcode has so become, from the period when its irrelative repetitions resulted in the vast indefinite masses of 'eozoon,' exemplifying the earliest process of 'formification' or organic crystallisation—than that all existing sarcodes or 'protogenes' are the result of genetic descent from a germ or cell due to a primary act of miraculous interposition."*

The reader who has followed me through the previous sections of this work, will understand the bearing of this matter on my subject, and will be in a position to appreciate my remarks as to the power which the organic matter, from the intestinal canal of a patient suffering from cholera, possesses in the vibrio stage of decomposition. It will be obvious that the passage of decomposing organic matter through a stage of this kind is no fancy of my own, but is supported by the highest living English authorities on the subject. Baron Liebig, again, expresses himself in the following terms on the same subject in his work on Agricultural Chemistry: he says,—“ But if it is true, as we have just shown it to be, that mechanical motion is sufficient to cause a change of condition in many bodies, it cannot be doubted that a body in the act of combination or decomposition is capable of imparting the same condition of motion or activity in which its atoms are to certain other bodies; or, in other words, to enable other bodies with which it is in contact to enter into combinations or suffer decomposition.”

A remarkable instance of change in the form of matter occurs on mixing two parts of cane sugar with

* 'The Anatomy of the Vertebrates,' vol. iii, p. 817. By R. Owen.

one part of the dry solid German yeast. If these be stirred together in a mortar, "as if by magic, the sugar is transformed into syrup, the transformation of cane sugar into invert sugar is complete."*

Now, what has been the result of the combined investigations of the leading scientific men of Europe, for the last five-and-thirty years, into the cause of cholera; or, rather, what have they discovered in the bodies of those suffering or dead from the disease upon which to base any rational idea as to its etiology? Pathologists, chemists, physiologists, botanists, and men enjoying the highest reputation in other branches of science, have one and all failed to discover any direct evidence of blood-poisoning, or, in fact, of any single new element or pathological change in the body, beyond the destruction of the epithelial cells of the intestinal canal, and the consequent dehydration of the blood.

In the early stages of cholera, in fact in the very first watery stools passed, these epithelial cells are found in large numbers full of molecular matter, precisely as in the instances of decomposing organic matter just described; the epithelial cells, as they are passed by the cholera patients, are in a state of disintegration and change, so much so that it is often difficult to recognise them; the alvine fluid, if retained, also contains bacteria and vibriones in abundance. During the time that these changes in the rice-water dejecta are observed with the microscope, the chemist informs us that he discovers no new or peculiar elements in the fluid, beyond such as he would expect to meet with in organic matter and serum of

* 'On Chemical Identification of Disease.' By Dr. Thudichum. Mr. Simon's 'Tenth Report,' p. 284.

blood from the intestinal canal in a state of decomposition.

Surely with evidence of this kind before us, it seems rational to conclude that, from some cause or other, a process of decomposition has been established during the life of the patient in the epithelial lining of the intestinal canal. For I would insist most strongly on the fact, that, in cholera, we have no evidence of the existence of any new elements in the alvine flux; there is nothing akin to a new cell growth, no vestige of the so-called process of inflammation. We have proof only—solely—of decomposition of the epithelium and mucus lining of the walls of the canal, with its consequences.

There is, doubtless, a tendency in many men's minds to look for some mysterious or great cause at work in the production of such a terrible scourge as Asiatic cholera. We find ideas of this kind constantly expressed in works on the subject; for instance, one of our most acute observers writing on cholera says,—“we see the causes which produce earthquakes take the most irregular and unaccountable routes, and as for this morbid agent appearing at sea we can have no great difficulty in conceiving the possibility of such occurrences, after seeing, in our days, volcanic islands boiling up from the bottom of the ocean.”* From a consideration of these facts, Dr. James Johnson regards cholera as more probably depending upon terrestrial than atmospheric causes. And so, in the present day, although men can understand the influence which a little organic matter has in producing smallpox or syphilis, they can hardly be persuaded that cholera depends upon a no less definite organic infecting principle.

* ‘The Influence of Tropical Climates.’ By Dr. James Johnson.

We must not, however, hurry on to our conclusion, but rather retrace our steps, referring again to the case I have advanced in connection with the epidemic of 1861. In this instance certain men were known to have partaken of water contaminated with the fresh dejecta of a cholera patient, and soon afterwards some of them were seized with the disease. When relating these particulars I stated that, out of a community free from cholera, nineteen people partook of the contaminated water, and five of them were seized with symptoms of the disease. The circumstance which led to the investigation and detection of the cause of the outbreak was, that soon after the water was drunk, its surface was found covered with large vibriones (*Vibrio bacillus*), and small particles of organic matter in a state of molecular change were found in the fluid. What follows? In less than three days five of these nineteen men were passing large quantities of organic matter from their intestines, in a precisely similar state of change to that which they had swallowed; they had, in fact, drunk water containing epithelial cells and mucus, passed by a man suffering from cholera, and in the course of a day or two, their own intestines were affected in a precisely similar manner. This fact undoubtedly leads to the conclusion, that in their instance cholera was induced by a conversion of force between the decomposing cholera-infecting matter they had swallowed, and the epithelium lining their intestinal canals—a little leaven leavening the whole lump.

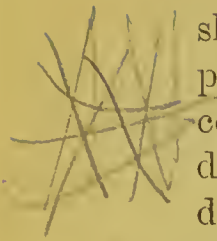
It may be asked, but why should this so-called cholera-infecting matter produce these changes in the intestines of otherwise healthy people? I can only reply I have not the remotest idea, nor can I explain

why vaccine or smallpox matter should induce peculiar effects on man, or even why man should generate man and not cats and dogs.

What I would insist upon, however, is, that we should cling firmly to the fact, that the organic matter passed by a patient suffering from cholera, will, under certain circumstances, when swallowed, induce the disease in another person in the course of two or three days. Having established this, we may, if so disposed, investigate further the specific properties of this cholera stuff; but the reason why it has a specific action is a secondary and very unimportant matter in comparison with the conclusions I am endeavouring to establish.

Supposing we mix a sufficient amount of cholera dejecta with a gallon of water, so as to make the infusion slightly opaline, and then place the mixture out in the sun in tall glass vessels. If this experiment be conducted under the heat of our Indian sun, we shall find, on examining the water at the end of twenty-four hours (especially in the early morning), that the vibrio stage of decomposition or change in the organic matter is in full force, the surface of the fluid being covered with large vibriones. On the following morning the same thing will be observed, but on the third day ciliated infusoria will have appeared in the fluid, and about the eighth day, or even sooner, bubbles of gas will be seen rising to the surface of the liquid, and the sides of the vessel will be lined with confervoid growths.

Now, I am prepared to state, that the contaminated water, which was certainly poisonous during the vibrio stage of decomposition of the cholera stuff, may be drunk with absolute impunity after the bubbles



yes but
series to
this we
must take
suppose that
it is possible
for the
germs to
grow in the
cool water
around us
and either
the infusoria
or the
be swallowed

1. 1/2
2. 1/2
3. 1/2

of air have begun to form in it, and the confervoid growth has taken the place of most of the ciliated infusoria. Beyond this, I have very strong grounds for believing, that immediately the organic matter has passed through its vibrio stage of decomposition, it becomes harmless; that is, water which had been contaminated with only sufficient cholera stuff to make it just opaline, would not produce cholera if swallowed by another person when the vibriones had disappeared, and ciliated infusoria had taken their place. This opinion of mine is based upon tolerably certain grounds; but I can assert it as a positive fact, that the contaminated water in the third stage of decomposition is harmless.

I don't know how I can bring stronger arguments forward, or give more direct proofs than I have done, that the organic matter, passed from a patient suffering from cholera, is capable of inducing the disease in an otherwise healthy person, if he happens to swallow water contaminated with it in a certain stage of decomposition. Since we cannot experimentise on our fellows at pleasure with cholera stuff, I can only add, that I am perfectly convinced it would be in my power, or in that of any one else, to induce an outburst of cholera among a number of people, in this, or in any other part of the world, in twenty-four hours, quite independently of soil, climate, or any other influence, by means of water contaminated by cholera dejecta as I have above described.

The ascertained properties of the organic infecting-cholera matter, however, are not yet completely told; I have endeavoured to secure one point before advancing to the next, which is, that if the freshly passed alvine dejecta of a cholera patient be allowed to

dry on the bed linen, clothes, furniture, soil, or, in fact, in any conceivable situation, it will retain its virulent properties, if the access of moisture be prevented, for any length of time. For instance, I have some of the dejecta of a cholera patient passed some seven years ago, and which I mixed at the time with sand, and allowed the mixture to dry rapidly under the heat of the sun. A small quantity of this earthy-looking stuff, if placed in water, and exposed to the sun, could not be distinguished from a fresh cholera stool, and I have little doubt it possesses all its deadly properties. In the same way the organic matter may be preserved on clothes.

In fact, in this respect, when preserved in a dry place, the properties of the organic matter of cholera seem to be retained, like those of the wheat germ or any other cereal, for years. On the other hand, if a large pot of earth, with a small hole through its bottom, be placed in a dish containing water, so as to keep the mould in the pot constantly moist, and if a quart or so of fresh cholera flux is poured over this earth, say once a week, we should find, at the end of a month, if the contents of the pot are emptied into a pail of water, that all vestiges of the cholera material have disappeared; it has, in fact, become oxidized, and the washings of this earth may be drunk with impunity. Dry earth, on the other hand, may deodorize the cholera stool, but it preserves the properties of the cholera-infecting stuff so long as it is kept dry; if moistened, decomposition goes on, and the organic matter is soon rendered harmless. This fact seems to me opposed to Professor Pettenkofer's theory.

Although it appears certain that water is the usual channel by which cholera matter enters the body, and

moisture is at all times required to call forth its active properties, this does not disprove the prevailing notion that cholera may at times enter the system by other means; and the properties just described may serve to explain those cases where there seems no reasonable doubt that the disease has been contracted by persons handling clothes stained with the dejecta of cholera patients, or by those attending on the sick.

Dr. Thomson and Mr. Rainey, as far back as 1854, found in the atmosphere of a ward filled with cholera patients, "particles distinctly having life, and showing growth and movement;" small flocculent masses, fungi, "bacteria" and "vibriones," and "so abundant were these as to cover some of the larger branching fibres of the mycelium." In the atmosphere of a ward only partially full of cholera patients, these organic particles were less abundant, and in the air external to the ward none of them were to be found. Now, it is not improbable that some of the "flocculent masses" were the organic cells and other materials passed by the cholera patients; these, together with the vibriones, had probably been spilt about the wards, and having dried were found floating in the atmosphere of the place. Under these circumstances they might of course be easily inhaled, and attaching themselves to the mucous membrane of the nose and mouth, would be swallowed with the alkaline saliva. We may readily suppose that it is in this manner washerwomen so frequently contract the disease, after being employed in pulling about the clothes of persons having had cholera.

It seems to me further probable, that if the room of the cholera patient is at all close, the organic matter in the atmosphere may be deposited in any vessel of water in or about the apartment, and this water, if

swallowed, becomes a medium of infection. I have little doubt that in hospitals in this country, the disease may thus spread, the water in the so-called chatty filters so frequently in use, becoming contaminated by the cholera matter in the atmosphere; this being afterwards drunk by the other patients, or attendants in the hospital, they become affected with the disease, especially if in indifferent health at the time, as most of the inmates of a hospital under such circumstances would be.

And this leads us to consider another feature connected with the organic matter passed in the dejecta of cholera patients. In the proceedings of the International Sanitary Conference of 1866 I find the following statement:—"In every instance when sulphate of iron was used for the disinfection of latrines and cesspools, no fresh cases of cholera were manifested after it was first applied. In those houses where chloride of lime was used in the manner above mentioned, fresh cases were afterwards seen. In every house where sulphate of iron was used as a prophylactic, not a single case of cholera occurred." Dr. W. Budd makes a precisely similar statement with regard to the use of sulphate of iron in the epidemic of 1866 at Bristol. It seems to me that we may account for this fact by noticing the action of these substances on the cholera dejecta. Supposing the cause of cholera to be the organic matter passed by a person suffering from the disease, the dejecta being in a certain stage of decomposition, which condition they are capable of imparting to the epithelium of the intestines of healthy persons, then, any chemical substance which will stop or alter the action going on in the cholera dejecta, should stop their injurious influence on man.

Dejecta.

Supposing we take a fresh cholera evacuation, dilute it with water, and allow it to stand in a warm place for a few hours; we shall, on examining it, find it to be alkaline, and under the microscope full of vibriones, the molecular particles of the organic material being in active movement. If we render this alkaline fluid acid, as by the addition of sulphate of iron, the infusoria and molecular action are instantly destroyed, and as long as the fluid remains acid the latter will not recommence. I maintain, not from conjecture, but observed facts, that cholera dejecta treated in this way are harmless, and may be swallowed with impunity, and probably digested and assimilated as any other equal quantity of iron and organic matter would be.

On the other hand, if we treat the dejecta with chloride of lime, although it may stop the action going on in the molecular matter for a time (and that not always), it is very soon resumed; and I should be very sorry to try its effects on any number of people, particularly if they were fasting at the time.

The truth is, that any substance which will render the alvine flux of cholera acid, destroys its specific powers, at any rate for the time being. Carbolic acid, creasote, and similar preparations, exercise a like influence, but unless in concentrated solutions I doubt if the effect is lasting; I mean to say, although carbolic acid will destroy the action going on in the organic matter for a time, still a very suspicious set of changes occur after a few days in contaminated water treated in this way. I shall have more to say about this when speaking of the preventive treatment of cholera.

The above considerations may enable us to explain the exemption of certain people subjected to the

supplement
of the facts
being
of cholera

influence of the cholera stuff when swallowed. If the organic matters of the dejecta are mixed with healthy gastric juice, either from a human being or from the stomach of carnivorous animals, we find the molecular changes in it are at once suspended, as on the addition of sulphate of iron; and still further, the organic matter appears to be digested by the gastric juice, the epithelial cells and other recognisable elements are evidently emulsified and rendered fit for absorption. Supposing, therefore, that water containing cholera matter reaches the stomach of a healthy man during the process of digestion, the chances are that the acid of his stomach destroys or modifies its deadly action, and thus the individual escapes the disease. But if he swallows the water some hours after taking food, when the stomach is empty and its reaction alkaline, then the cholera matter, being introduced into an appropriate soil, sets up destructive changes in the epithelium of the stomach, which action speedily extends to the intestines; so that a person, even in health, may contract the disease under these circumstances. Or it may be, when more water is swallowed than the stomach will hold, that the excess passes at once into the small intestines, and, their contents being alkaline, the specific action of the cholera matter is thereby favoured.

Again, we all admit that persons in bad health, whether suffering from actual disease or the less defined ill health which results from imperfect hygienic circumstances, are those most apt to be attacked by cholera. This is the case with the poor of our large towns, which are generally situated on alluvial soils. May not this be due to the want of a healthy acid secretion from the gastric walls, which their

country-dwelling brethren, or more healthy neighbours, are blessed with ?

It is in this way that I am also disposed to account for the fact, that persons suffering from depression of the nervous force, whether following fatigue or a debauch, are particularly apt to be attacked by cholera; the latter, moreover, increasing their risk by drinking quantities of water to quench their thirst. Here, in Calcutta, we all know how apt our sailors are to suffer from this terrible disease. They arrive in splendid health from sea, and, having been in port a day or two, get leave to go on shore; the man has his fling, probably takes far more alcohol than is good for him, and committing other excesses he goes back to his vessel feverish and depressed; he drinks a lot of the Hoogly water, which may be considered as always more or less contaminated with cholera dejecta, and is seized with the disease in twenty-four hours, or it may be sooner. In these cases some of the excess of water which the sailor drinks passes at once into his small intestines, and thus the cholera stuff is free to act. How many of these men, too, after a debauch of this kind, loathe food; the stomach no longer contains its healthy acid secretion, and the safeguard which Nature had provided them has been thus thoughtlessly thrown away; for I maintain that, so long as the organic matter of cholera is kept in an acid medium, it is harmless, and that there is no more perfect protection against its invasion than a healthy stomach, provided that organ is not overfull when the contaminated water is swallowed.

It has often been remarked that the first symptoms of cholera are frequently manifested in the early morning; this circumstance may perhaps be explained

by the fact, that the whole of the secretions of the alimentary tract are then alkaline. The choleraic action, which probably began in the intestine during the night, has crept upwards into the stomach; a sense of nausea is excited; the serum of the blood has been oozing into the intestines, and directly the patient assumes the erect posture it drains away by the anus, and that poured out into the stomach is discharged by vomiting.

The effect of heat and cold on the organic matter of cholera is no less evident than that of chemical agents. A temperature below 40° Fahr. seems to me to suspend its action, in the same way as the absence of moisture does. I am very much disposed to think that the infecting matter of cholera might be kept in water at or below 40° Fahr. for a considerable time, and on being subsequently exposed to the sun at 80° or 90° would be as dangerous as ever; on the other hand, I have little doubt that a temperature of 220° Fahr. will destroy the poisonous properties of the infecting principle; at any rate, I am quite certain it does so in weak solutions, if swallowed soon after the water has been boiled. I cannot speak so confidently of contaminated water which has been boiled and subsequently exposed to the air. Nor do I know practically what might be the result of exposing soiled linen or dry cholera stuff to a temperature beyond 220°, and then allowing it to remain in water for a time, the fluid being subsequently swallowed. I should doubt the power of dry air, unless at a very high temperature, to destroy the cholera principle.

Before proceeding to consider how far the ideas I have expressed regarding the etiology of cholera are consistent with the facts of its epidemic history, geo-

graphical distribution, and so on, it will be well to push our pathological inquiries a little further, and endeavour to understand how this choleraic matter, acting upon the epithelium of the intestines, induces the symptoms of cholera.

I have before described the state of the epithelium passed in the dejecta of cholera patients, and the abraded condition of the intestinal mucous membrane as a consequence of the disintegration of the epithelium. I have endeavoured to show that these changes are consequent on the presence of decomposing organic matter, in a precisely similar state of change to that which is introduced into the stomach.

Professor J. Müller and other physiologists have shown, that it is through the medium of the intestinal epithelium that the water swallowed is taken up into the venous capillaries of the mucous membrane.* These cells then being the primary organs in the process of absorption, when the epithelium is destroyed absorption is for the time being in abeyance. We find this idea to be in accordance with the experience of medical practitioners, for, in the stage of collapse, drachms and even ounces of calomel are swallowed with impunity, and have been found in the stomach after death; opium appears to take no effect; the patient swallows gallons of fluid, but cannot quench his thirst until reaction sets in. With reaction we find pus passing in the stools, and in post-mortem examinations we discover new epithelial cells forming over the mucous membrane. At the same time that absorption is suspended, there is an outpouring of the serum of the blood through the walls of the

* J. Müller, 'Manuel de Physiologie.' Traduit par A. T. L. Jourdan, tom. i, p. 209.

intestinal canal, constituting, with the disintegrated epithelium and mucus, the alvine dejecta of the cholera patient.

The quantity of blood in the body of a healthy adult is probably, at the most, from twelve to fifteen pounds, and Dr. Pacini asserts that, if one fourth of the serum of the blood is extracted from the body rapidly, the absorption of water through the mucous membrane of the intestines being at the same time suspended, the patient must inevitably die, unless the drain of serum be speedily stopped. The reason for this is, that the blood necessarily becomes viscid in proportion as its serum is withdrawn, and this viscid blood is unable to circulate with ease through the lungs; hence it does not absorb oxygen enough to render the attraction between it and the tissues sufficient to constitute an effective capillary force—the *vis a fronte* of the circulation, and when this ceases the patient must die. It appears, moreover, from Dr. Thudichum's researches, that "the serum of the blood, in consequence of the alvine flux, is changed in its constitution, and refuses to perform its functions. It extracts water and other matters from the blood-corpuscles, and the latter, therefore, cease to carry oxygen; oxidation does not take place any longer, hence the temperature falls, and the algide condition of cholera is produced."

Beyond this, the hydrostatic pressure of the blood on the walls of the vessels, and through them on the tissues, which is necessary for healthy nutrition and the dynamic evolution of the various structures of the body, is lessened, if not destroyed, in cholera.

So far, therefore, the intensity of the cholera process depends upon the extent of the epithelium involved. Thus, supposing the epithelium throughout

the entire canal to be affected, absorption cannot possibly take place through it, the outpouring of the serum at the same time is very rapid, and four or five pounds may thus speedily flow into the intestinal canal; the viscid blood can then no longer circulate, the corpuscles cease to carry oxygen, and the patient dies, although he has only passed, it may be, one or two motions, perhaps none at all, especially if he is suffering from a fatty heart, for the immediate loss of even three pounds of serum by the intestinal canal might then be sufficient to cause his death. On the other hand, if a part only of the intestinal canal is affected by the cholera process, the epithelium lining the remainder of the mucous membrane being capable of absorbing water, as the fluid swallowed by the thirsty patient is absorbed, it dilutes the blood and allows it to circulate. In this case, however, the drain from the system may continue, for the fluid which is swallowed and absorbed may flow away again from the intestinal canal; but still the circulation is maintained, and thus the patient is kept alive. In this way we may explain the fact noticed by Dr. Parkes and other observers, that there appears to be no direct relation between the severity of the disease and the amount of the alvine discharges; in other words, that the patient who is purged most is by no means always in the greatest danger, the fact of his being thus constantly purged showing that a considerable amount of healthy epithelium still exists in the intestinal canal, and by its aid he may recover.

Dr. Pacini, however, argues, that as the drain from the system continues through the intestinal canal, and the blood becomes more viscid, it forms plugs in the capillaries of those portions of the intestinal mucous

membrane from which the flow of serum has been the greatest; the solid particles of the blood clog, as it were, the pores of the filter, and thus the drain from the abraded surface is stopped. Dr. Thudichum expressly mentions that clots of the same kind form in the smaller vessels of the lungs and brain.

Another consequence of this plugging of the intestinal capillaries is, that the water of the tissues begins to pass into the empty blood-vessels, diluting the viscid blood, and enabling it to circulate; reaction may thus occur without any fluid being swallowed, the water of the tissues supplying the fluid necessary for the re-establishment of the circulation. If the patient remains at perfect rest, and the reaction is not too rapid, the vessels of the intestines remain occluded until new epithelial cells have formed in place of those which have been destroyed, and the individual recovers; but if, as we sometimes see, a quantity of blood is passed in the stools just as reaction is setting in, the smaller vessels of the intestines giving way before the pressure of the circulation on the plugs they contain, we find that the patient, as a general rule, sinks very rapidly.

Let us suppose that in a case of cholera the drain of fluid from the intestines has been very rapid, and death has speedily ensued, it is evident that much of the water of the tissues still remains in the body. Now, it is in these cases of rapid death from cholera, as I before remarked, that muscular contraction has been most frequently noticed after death, and the rise in the temperature of the corpse most obvious. It seems highly probable that these facts may be accounted for by supposing that, at death, the drain of serum into the intestinal canal ceases, at the same time the water of the tissues passes into the empty veins, thus supplying

fluid to the dehydrated blood-corpuscles, and re-establishing in this way, for the time being, organic life. This may be carried so far that the contractility of the muscles is restored, the corpse may open and shut its eyes, the flexor muscles fold the arms over the chest, and the temperature of the body rise considerably.

It seems to me also that it is the drain of water from the tissues of the body into the veins, which best accounts for the venous congestion noticed in various parts of the body after death in the collapse stage of cholera. I need hardly remark that, in the ordinary process of nutrition, it is the office of the venous capillaries to absorb the water and effete matters from the tissues, the arteries pouring in the substances appropriated by the tissues to supply the waste they undergo; this water of the tissues continues to drain into the empty veins during and after collapse, thus accounting for the fulness of the right side of the heart, and the veins of the kidneys, liver, and so on, after death. It has been observed by Griesinger, that the fulness of the right side of the heart does not exist during life, for, on percussion, there is no augmented dulness over this region, thus confirming the idea of this venous congestion depending upon the water of the tissues draining into the veins, immediately before and after death. The alvine flux having then ceased, the fluid collects in these vessels, and produces the appearances I have described. In rapid collapse and death, if the body is instantly opened, the venous congestion is less marked than it is twelve hours subsequently; I have seen several marked instances of this kind.

We have moreover evidence, both chemical and

physiological, to show that the organic infecting matter of cholera is absorbed into the patient's blood, at all events to some extent, during the deep collapse of cholera, for Dr. Thudichum found the blood at times to contain butyric acid; moreover, we can thus account for the changes noticed in the epithelium of the blood-vessels, and other organs of the body, and also for the fact of the foetus in utero being affected from the mother.

I think we may trace through the lacteals and mesenteric glands (which are always more or less involved) the course followed by the matter from the intestinal canal. The molecular action probably extends to the cell-contents of the villi, and thence through the open mouths of the lacteals they contain to the efferent vessels, and so through the mesenteric glands into the general circulation. The chemical action thus excited would tend to account for the rise in temperature of the body before and after death in cases of cholera.

Dr. Pacini's views regarding the process of reaction in cholera certainly explain much connected with the clinical history of the disease which was formerly a mystery to me, for although convalescence from cholera is by no means the rapid process which some authors seem to imagine, still one does at times see patients recover from collapse in a marvellously short period, and yet these are often the very cases which have appeared the most dangerous. They are characterised by slight purging and rapid collapse; nevertheless, a person thus affected may recover as speedily as he fell, because the drain of fluid from the intestines having taken place very rapidly, the balance between absorption and effusion has been speedily overcome, and

collapse immediately induced; at the same time the vessels of the abraded portion of the intestinal canal are rapidly plugged, and the tissues of the body, not having had time to yield up much of their water, can supply sufficient fluid to render the viscid blood once more capable of easy transit through their vessels. Under these circumstances the corpuscles quickly resume their functions, and oxidation is renewed, reaction sets in, and recovery is often most favorable, because no great accumulation of material from the disintegrated tissues has taken place in the blood, by which secondary fevers and such like complications are induced. On the other hand, if in cases such as I have above described, the circulation through the abraded mucous membrane is not arrested (as is too often the case), the drain of fluid from the intestines continues, and death must speedily ensue.

This account of the pathology of cholera also seems to afford a rational explanation of the fact insisted on by Drs. Parkes, Sutton, and other observers, that "in the worst cases of cholera the vomiting and purging begin suddenly and violently, go on rapidly, the algide symptoms set in very early, and there is very little and often no purging during collapse." Dr. Sutton remarks, "this fact appears to indicate that it is not simply that so much fluid is withdrawn from the blood, but further, that so much fluid is withdrawn comparatively quickly and suddenly, and we are therefore led to suspect that, besides the loss of fluid, there is another element in the causation of collapse;" and this Dr. Sutton believes to be shock of the nervous system.

Dr. G. Johnson, on the other hand, argues that, in these cases, the pent-up blood-poison acts with such deadly power upon the muscular fibres of the smaller

Same
Hence

arteries of the lungs, that the blood becomes impeded in its progress through them, and not being oxidized causes the symptoms of collapse, and the death of the patient.

Dr. Pacini believes that in these cases a vast epithelial tract in the intestines being involved, an outlet is afforded for the serum of the blood to rush from the body, and the supply of water necessary to keep up the discharge through the intestines being stopped, the flow rapidly ceases. A gush of four or five pounds of serum from the blood being sufficient to render the remainder too viscid to circulate freely, the corpuscles no longer carry oxygen, the *vis a fronte* ceases, and the patient must die.

Nor is cholera the only disease in which we see analogous effects induced by similar causes: Dr. Barlow, in his admirable paper on cholera, read before the Hunterian Society in 1866, points to the fact that, in cases of obstruction high up in the duodenum, "all the ingesta taken into the stomach are instantly rejected; no fluid can pass into the small intestines, or be absorbed thence by the mesenteric veins, the drain from the blood by the excretions cannot be repaired, and the fluidity of the blood is not maintained. The impaired fluidity of the blood prevents the access of that fluid to the air of the lungs, and one important moving power of the pulmonary circulation is suspended—I would rather say that the motor power of the capillary circulation of that system is so—and what is the consequence? the blood is arrested in the pulmonary arteries, there is pulmonary congestion; the systemic circulation languishes, organic function, or at all events animal heat, rapidly sinks; the patient is pulseless, he is organically dead or nearly so; he has

the cold and shrunken extremities of cholera, and its cold tongue and breath.”

Dr. Barlow gives instances of the above kind, and of other diseases producing similar results by impeding the ingress of water through the intestinal canal into the general circulation. On the other hand, Dr. Greenhow reports the details of a case of poisoning by croton oil, in which, two hours after the woman had swallowed this drug, he found her “with all the appearance of a person in the cold stage of cholera. There had been very profuse watery purging, exactly resembling the rice-water stools of cholera patients; the surface was cold, the features shrunken, the fingers shrivelled, the skin even more blue than is usual in cases of true cholera, and the pulse thready and almost imperceptible. The patient had had severe cramps; she was very restless, and her respiration gasping. Her intellect was unimpaired, and she died ten hours after taking the poison.”*

It is very remarkable how nearly these theories as to the cause of cholera approach one another. Dr. Sutton bases his views on the facts elicited in a post-mortem he made on the body of a man who fell down dead in the streets of London. There was no evidence as to his having had either vomiting or purging before his death, but on “opening the small intestines they were found *filled with fluid*, and the presence of a quantity of solid fæcal matter in the large intestines clearly showed that there had been no discharge of fluid from the bowels. There was no evidence of great obstruction through the lungs—there was not the least anæmic appearance.” Now, in a case of this kind, supposing the patient’s heart had been

* ‘Medical Times and Gazette,’ p. 142. August 11th, 1866.

fatty, or if his nervous system had been exhausted from any particular cause, I can quite imagine that the sudden drain of fluid, found after death in his intestinal canal, would not only have altered the condition of his blood, but the rapid withdrawal of this amount of fluid from his system might, by suddenly reducing the hydrostatic pressure on the walls of the vessels and the tissues, have rendered the contractions of the heart abortive, and thus caused fatal syncope.

How admirably, again, Dr. Johnson's theory would explain the circumstances of such a case! But, unfortunately, Dr. Sutton discovered no anæmic condition of the lungs, and no evidence of great obstruction through them.

On the whole, therefore, I must say that I strongly incline to the views of Dr. Pacini; they explain, to my mind, the phenomena of cholera, better than any others I am acquainted with, and the more I have worked at cases since I have become acquainted with his theory, the better I have been able to comprehend them.

I would not, however, disguise from myself or my readers that there are difficulties in the way of accepting the doctrines I have enunciated. They are not perhaps very formidable, but still I should wish to state them briefly. And first, with regard to the dejecta of cholera: if they are only decomposing organic matter, it does not appear why they should not implicate the epithelium of the intestinal canal of the lower animals in a similar way to that of man. I have repeatedly endeavoured to produce cholera in dogs, cats, and other animals, by injecting the material of cholera dejecta into their stomachs; but I have invariably failed to produce any effect. I have over and over

again introduced the same matter into the veins of these animals, but without any results. Thinking that the acid contained in their stomachs might have destroyed the influence of the infecting matter, I have opened the abdomen and small intestines, and testing the latter have always found their contents to be alkaline, and I have then injected the cholera matter into the intestinal canal, but with no apparent effect. The animals generally speedily recover from the operation, and the wound having been carefully closed with sutures, the creatures do not appear to suffer in the least from the injury. The series of experiments I have undertaken with this view have not been as complete as they should have been, but certainly in five or six dogs treated in this way no ill results have followed. I must leave it for some one having more time at his command than I have at present, to work out these matters; much remains to be done, although my experiments have only yielded negative results.

I have also endeavoured to destroy the epithelial lining of a portion of the intestines in the lower animals, by introducing a long probang through a wound in the intestines, and moving the instrument backwards and forwards, so as to rub off the epithelium. The result of this experiment has been so far satisfactory, that the animal's intestinal canal has, under these circumstances, evidently poured out a large quantity of fluid; nevertheless, the destruction of the epithelium in this way is so utterly unlike the cholera process, that I hesitate to accept results upon such grounds; the cases admit of no fair comparison.

Although there may be good reasons why the decomposing cholera stools should not affect the epithelium of the alkaline walls of the intestines in the

case of animals, still, if we believe the process to consist merely in a change of force from decomposing to living epithelium, it is not easy to form even a probable conjecture as to what these reasons may be.

I am aware that mice are said to be subject to cholera. Dr. Burdon Sanderson would seem to have proved this very conclusively; but I would caution those who may wish to substantiate his observations, in the first place to keep white mice for some time before beginning to try experiments on them, so as to study their habits, and then, in making the experiments, to take an equal number of these little creatures, feed one set on paper prepared as Dr. Sanderson describes, and let the other set feed on paper which has been dipped in decomposing organic matter—in fact, keep the two sets of white mice under precisely the same circumstances with regard to food, water, and so on, with the exception of one set having cholera dejecta mixed with their food, and the other decomposing organic matter other than cholera fomes. Experimenting under these conditions, I have failed to convince myself that white mice are capable of being affected by the alvine dejecta of cholera patients; I have in vain endeavoured thus to induce the disease in these little animals; it would have cleared up a vast deal of doubt and difficulty in my mind could I have done so, and I have, therefore, left no stone unturned in order, if possible, to bring about so satisfactory a result.

The results of my investigations on the lower animals as regards the experimental production of cholera being absolutely negative, I will not weary the reader by entering further on the subject; he will find the matter fully discussed in Dr. Burdon Sanderson's

admirable paper in Mr. Simon's 'Ninth Report' to the Privy Council.

Another feature which I find difficult to explain, is the profuse perspiration, which we often see in patients suffering from cholera. If the blood and tissues are without water, or nearly so, where does all this perspiration come from?

With regard to the supposed secretion of milk in cholera, I can only say, from my own experience, that the mother's milk ceases as collapse comes on. If, as some state, it increases, I cannot understand where its watery elements come from.

Lastly, how does opium act in the early stages of cholera, if the disease depends upon the causes to which I am inclined to attribute it? The action of acids I can understand, for in the early stages of the disease, no sooner do the stools come under the influence of acids swallowed by the mouth, than the cholera process ceases. The stools passed are dead, so far as the infecting principle of cholera is concerned. The changes in the intestinal canal under the influence of acids are precisely the same as those we watch under the microscope in the case of the dejecta rendered acid by sulphate of iron, or any similar agent. But the action of opium, so powerful and so sure, what is its nature? Perhaps the chemist may be able to tell us that it alters the secretions of the intestines, and thus arrests the action of the infecting principle of cholera..

It now only remains for us to inquire, if the views of the etiology of cholera which I have propounded are sufficient to explain the phenomena presented by the disease in its epidemic history, geographical distribution, and so on. In fact, are the general features

of cholera, as witnessed in the past and present, under varying circumstances, both in this country and other parts of the world, to be reasonably explained by the doctrines I have laid down as to its cause? If not, we have evidently not yet hit the mark, and must work on until we discover the true etiology of the disease.

First, let me briefly recapitulate my views.

I maintain that the cause of Asiatic cholera is invariably a portion of the fomes of a person suffering from the disease, but that this infecting matter must be in the vibrionic stage of decomposition, in order that it may induce its specific action on the walls of the intestinal canal. If swallowed in this stage, it excites, by conversion of force, changes in the epithelium of the intestinal canal, similar to those which it is itself undergoing, giving rise to the characteristic rice-water stools of cholera, which consist of serum of blood and the altered epithelium and mucus, together with gland cells, from the walls of the intestinal canal.

The result of these changes is a further outpouring of serum from the denuded walls of the intestines, while at the same time absorption of fluid through the mucous membrane is stopped. In proportion to the rapidity of this drain of fluid from the intestines, the patient's blood becomes viscid, and not being able to circulate freely through the lungs, the blood becomes imperfectly aerated, its corpuscles are incapable of carrying oxygen, and the *vis à fronte* of the capillaries is in consequence suspended. At the same time the circulation is further impaired by the hydrostatic pressure of the blood on the walls of the vessels being suddenly withdrawn, which tends to destroy the contractile power of the muscular fibre of the heart and other parts of the body, and the patient is speedily killed, unless the outpouring

of fluid from the intestines is suspended, by the vessels of the part becoming occluded with the viscid blood they contain ; in which case, the water remaining in the tissues of the body flows into the de-hydrated blood in the vessels, rendering it sufficiently fluid to circulate through the system, until absorption can take place by means of the newly-formed intestinal epithelium.

I believe this organic matter, the cause of cholera, may be preserved in a dry state for years ; and that whether fresh, or old, it undergoes rapid changes in water. The first change is what I have called the vibrionic stage of decomposition, lasting from two to five days in water *slightly* contaminated with cholera matter, and exposed to a high temperature ; the organic substance then becomes oxidised, and is no longer injurious. Furthermore the acids of the healthy stomach, and in fact all acids, are capable of destroying the action going on in the cholera-matter and so rendering it harmless. Certain degrees of temperature, both high and low, have a similar effect.

Water contaminated with cholera stuff, sufficient to render it poisonous, may, I believe, be purified by proper filtration ; and I know of no filter more capable of effecting this object than the earth. So that I hold that the water of a deep well cannot be polluted with cholera-infecting matter, unless from surface or other drainage contaminated by the cholera poison passing directly into it. I look upon water as the most common medium by which cholera is disseminated among mankind ; at the same time I admit it to be quite possible, and even very probable, that if a room or ward, in which cholera patients are kept, is allowed to become overcrowded, or is ill-ventilated, the organic matter from the sick may float about in the atmosphere,

and so find its way into the alimentary tracts of nurses and other attendants. In the same way washerwomen, or persons engaged with clothes of cholera patients, may contract the disease, either by the dry cholera stuff from the soiled clothes being disseminated in the atmosphere, or otherwise finding its way into the intestinal canals of these people.

Cholera may be carried from one place to another by means of stained clothing, but an epidemic outburst of the disease can only occur through the drinking-water of the place becoming contaminated with cholera matter.

With the exception of the specific cholera-infecting matter, I entirely ignore all other causes, or combinations of causes, as capable of producing this disease. The circumstances under which people live may predispose them to its action; but neither air, water, nor any other material agency can induce an attack of cholera, though many of these may serve as media by which the infecting matter is conveyed into the intestines.

Let us now test these ideas by the facts presented to us in the history of cholera; and I would first observe that it seems evident, from the quotations I have given from the works of Gaspar Correa and other Portuguese authorities, that in the very first expedition undertaken by these, the earliest European settlers in India, they met with cholera in its most virulent form among the natives of the country; and from that time (1503) up to the present, we have an unbroken chain of evidence as to the terrible ravages which cholera has committed, year after year, among the native population of the peninsula of India. It is true, English authors make but little mention of the disease prior to 1817, for the

majority of them seem to have been in error as to its nosology; nevertheless, there were exceptions to this rule, as in the case of Dr Paisley, who, in 1774, states that he had, for some years past, met with both endemic and epidemic cholera in Madras.

But in the communication on the epidemic of 1781-82, from the Supreme Government to the Court of Directors, the disease is not denominated cholera, and we have abundant evidence to the effect that it was known as "the spasms," rather than as cholera, by our medical officers in this country prior to 1817.

Further than this, the Bengal Medical Board in their first letter to the Government on the outbreak of the disease in Jessore in 1817, do not mention the word cholera, they describe it as the usual epidemic which breaks out every year among the natives of Lower Bengal; and it is remarkable that, in the earliest publications in India on the subject, namely, that of Dr. Tytler, dated Jessore, September 1817, and that of Dr. Corbyn, Saugor 1818, these officers write with the express purpose of proving that the epidemic was not of the nature of cholera morbus. We may, in fact, safely concur in Mr. Scott's opinion on this subject, expressed in 1820, that "though cholera very rarely appears in the sick returns of former times, it is by no means to be thence inferred that it did not then exist."

It has been argued, however, that admitting this fact, the disease evidently took a new and epidemic form in 1817. Yet we have evidence of a similar outbreak of the disease in 1782-83, and from the accounts of the early Portuguese writers, we know that cholera was as deadly in their day as at present. It is perfectly true that we have, in the account of the

epidemic of 1817-18, the first and only connected history of an outbreak of cholera over the whole of India, nor is it probable that we should ever have heard any thing of this epidemic, had it not attacked the Marquis of Hastings' camp, and very much frightened his lordship; so much so, that he called for reports from all the medical officers in India as to the history and phenomena of the disease. But it must be clearly understood, that this is the only report of the kind that has ever been compiled in India on cholera. Every four or five years since 1817, there have been equally severe outbreaks of the disease over India, but we look in vain for any government records regarding them. Up to the present day we have only one single connected account of the spread of epidemic cholera over this country, and that was in the case of the epidemic of 1817, when, as I have above stated, cholera struck the camp of the Governor-General and brought him face to face with its horrors, which had probably been repeated for years before, as they have been every year since, to a greater or less extent, among the unfortunate people of this country.

There seems to me ample evidence to show that cholera was no new disease in India prior to 1817. I do not of course pretend to say how, when, or from what quarter it originally came: the Portuguese found it endemic in the country and there it has remained ever since. Nor do I think, if we examine its symptoms and effects, either before the year 1817, or subsequently to that period, that we shall find it has altered in its characters, becoming, as some suppose, more deadly of late years. In 1503 Correa talks of 20,000 men being carried off in Zamoryn's army by cholera and smallpox. Fra Bartolomeo speaks of its destroying "thirty or

forty persons in a village during one night." Out of a force of 5000 men in 1781, Colonel Pearce says 500 were admitted into hospital in one day from cholera; he remarks, "death raged in his camp with horror not to be described." Dr. Corbyn uses much the same expression with regard to the Marquis of Hastings' camp in 1817. In 1824, Dr. Clarke reports from Mhow, that the European Artillery were "attacked with vomiting and purging of a whitish-coloured watery fluid, the most awful collapse of the system ensuing, leaving but little time for the employment of remedies. There was nothing like reaction; the vital powers seemed completely exhausted by the first stroke. There were only three cases where anything like spasms appeared." So again, if we refer to the table kindly placed at my disposal by Dr. Johnstone, regarding the circumstances of cholera in the Bombay Presidency, it does not favour the idea of any great increase in the mortality of those attacked by cholera of late years. Doubtless in some seasons the death-rate is higher from this disease than in others, but this feature is noticeable in other forms of zymotic disease, and, I conceive, depends upon a more active or vigorous store of potential power in the organic infecting matter, a force given it by the aid of other forces with which it is in relation.

And this leads us to consider why it is that in some years cholera is so much more virulent than in others. If we believe the disease to depend upon organic matter having peculiar properties when in a certain stage of decomposition, its action being checked by cold, it follows that the very existence of cholera must depend upon heat and moisture. It was in a year characterised by excessive heat and rain-fall, that the

great epidemic of 1817-18, broke out over India ; and, in fact, as I have shown, epidemic cholera in this country has always burst forth in seasons of this kind, and having first become intensely vigorous through favouring meteorological influences in Bengal, it has been disseminated over India in the same deadly form, being too often carried thence by man, to the Straits, China, Persia, Arabia, and Europe, and over all those parts of the world easily accessible from India.

It seems to me that we should not look to "epidemic influences" as governing the spread of cholera over the earth ; we now know what the real cause of the disease is, and may discard the use of a term which has been simply employed as a cloak for our ignorance. If those persons who write about "epidemic influences" would for an instant pause to consider the purport of their words, they would at once perceive how meaningless they are. That earth, air, and water influence the potential power of the infecting organic matter of cholera we can have no reasonable doubt ; if these be unfavorable the power of the organic matter for evil may be destroyed, but under the reverse circumstances they foster and give force to this deadly principle, as they did in 1817-18. Supposing that year had been a dry one, it would have been impossible for the epidemic outbreak of the disease to have occurred. Cholera was probably generated as usual over its endemic area in 1817, but the unusual amount of rain which fell in the early part of the year, together with the excessively high temperature, gave force to the disease in the following way :

I have before observed that the natives in this country invariably defecate, if practicable, on the soil immediately around their dwelling, or else in the fields

directly outside their village. If a man were seized with cholera, he would pass his evacuations, so long as he could crawl, on the ground outside his hut, or if attacked on the high road, would very probably stagger on till he got near some well or tank from which he could get water to quench his thirst. Under either circumstance, as he grew worse, his cotton garments, which he wears round his person, would become soiled. If the dejecta are cast upon a dry soil, as above described, a certain quantity of the organic matter clings to the surface soil, remaining quiescent and harmless so long as it adheres to the ground; but supposing a high wind arises, and clouds of dust are driven here and there, it is very possible that the organic matter may thus find its way into the mouths or noses of other people, and adhering to the mucous membrane, which from its alkaline reaction is favorable to its growth, may involve the epithelial cells in its action, and becoming multiplied, be swallowed with the saliva, or washed off by water taken into the mouth, and carried into the intestinal canal.

Or, supposing the dejecta remain on the soil, and that a shower of rain comes—perhaps an inch or two of rain falling in an hour or so—the organic matter is washed, perhaps, into some neighbouring tank or well, and, after the shower, out comes the sun with intense power, and the organic matter in the water is thus kindled into terrible activity. The water consumed when thus contaminated is deadly for three or four days; it may be that as many as five out of nineteen people who drink it are seized with cholera, and they in their turn scatter the disease in all directions, and so it rapidly spreads from village to village, and, in fact, in every direction followed by man. Now,

nothing of this kind could have occurred unless the organic infecting matter had been cast on the soil, and then disseminated either by the wind or by the water; in this sense only I can comprehend the meaning of the expression, "an epidemic influence."

It may happen that, in place of the organic matter finding its way into the intestinal canal of other people in the manner indicated above, the patients' clothes are washed in the village tank. Drinking-water, probably, more often becomes contaminated in this country by persons and clothes stained with cholera matter being washed in it, than in any other way. It may not be commonly known in Europe, that a native of this country, after an attack of cholera, will, as a general rule, crawl down to the nearest tank, and with the cotton cloth round his body—which, in all probability, he has had on during his illness—he wades into the tank up to his middle; he afterwards divests himself of his cotton garment, which he proceeds to wring out. Having washed it, he again coils it round his loins, and walks out of the water. Very probably, at the time this process is going on, a man or woman may be seen not far off filling an earthen pot, or a mussuckful of water, which is carried away and employed for drinking and other domestic purposes. River water may be contaminated in precisely the same way.

Lastly, supposing the cholera patient dies; if a poor man, his friends cannot afford fuel to burn the body; it is, therefore, for form's sake, just singed with fire, and then thrown into the nearest river, to contaminate its water for days as it floats down the stream.

I am sorry, however, to be obliged to add that it is not only the natives of the country who thus poison the waters; they do it ignorantly; not so such bodies

as the Justices of the town of Calcutta, who persist in casting the refuse of all the cholera wards in the place into the river Hoogly, day after day, and year after year, in spite of constant warning from the medical men, and notwithstanding that the dangers of the practice to our sailors were demonstrated by Dr. Hugh Macpherson, with great force, in his paper on 'The Mortality of Calcutta,' in 1860.

The above are some of the principal factors which, according to my idea, tend to create an epidemic outburst of cholera, and account for its being more virulent in one year than in another. And if we apply this theory to the circumstances of cholera in 1817, we shall find that it very faithfully explains its phenomena, as described by Mr. Jameson.

In Bengal the disease was endemic, because, from the nature of its moist, damp climate, the organic infecting principle of cholera there remains in perfect activity throughout the year, our showery and hot weather in March, April, and May, being very favorable to its dissemination; consequently, as Mr. Jameson remarks, the disease was continuous in these parts. On the other hand, there were none of those remarkable and localised outbursts of cholera which characterise its march through the upper provinces, and which I account for on the supposition that cholera is imported into certain localities by man or articles stained by him with cholera matter, that the drinking-water of the place becomes poisoned for a week or so, and then, if not further contaminated, regains its purity.

The severity and duration of such an outburst would depend much upon the nature of the soil, the sources from whence water was drawn, and the amount of

rainfall. And it will be now understood how an excessive fall of rain may tend to stop cholera, as it did in the case of the 1st Fusiliers at Cawnpore in 1848. The regiment had moved from one barrack to another, and still the disease stuck to them. Doubtless their wells and water sources were contaminated in one way or another by the excreta of the men, or of the regimental servants. It was then determined to move the sick, and every creature connected with the regiment, into camp. No sooner was this accomplished, than the whole of the men under canvas were exposed to one of those four days' continuous downpours of rain peculiar to the tropics. The consequence was that all the holes and corners about the barracks were well washed out, drains flushed, and, in fact, all the cholera stuff cleared away into the Ganges. The wells had time to purify themselves, and linen and clothes, and everything belonging to the men, must have been well drenched. After this purification the regiment returned to their barracks and remained free from cholera, although it existed around them.

In this case the overflow of wells, tanks, and drains, must have been most beneficial, and would naturally have been so according to my theory of the etiology of cholera, the men—that is, the source of contamination—being entirely removed; so that the excessive rain did as much good as showers would have done harm. And so with our rains in Bengal; they stop the cholera when they have fully set in, by keeping tanks and wells full to overflowing, flushing the whole country, and diluting and carrying away the cholera stuff through the aid of our large rivers to the sea; they thus effectually stay the progress of the disease, presenting to us a faithful type of the means we should

employ to oppose this great enemy of mankind. I would particularly notice that if, in Bengal, we get a break of dry weather during our rainy season, we are certain to have cases of cholera to treat.

Mr. Jameson comments on a fact, noticed also in the 'Madras Reports' for 1833-34, "that a regiment shall march over ground, from one station to another, in a perfectly healthy state, while in another body, on the same road, after an interval of only three days, cholera shall commence its ravages. Or a regiment on the march is attacked with cholera, and another, following the same road, after an interval of only two or three days, altogether escapes." No doubt these are very remarkable facts, but they may, I think, be accounted for upon the theory I advocate. In the first instance, a regiment marches along a road, and the men are free from cholera; immediately afterwards, from some source or other, a well or tank along the road becomes contaminated with cholera-stuff, and the soldiers of a second regiment get cholera in transit. The corps moves on, there is no further contamination of the water, the organic matter is oxidised, and a third regiment, passing along the road after a few days, may drink the water with impunity, and remain free from cholera.

No less remarkable have been the effects produced by changing the localities occupied by regiments, or even that of an army, as in the instance of the Marquis of Hastings' force, which marched from the river Scinde across the country to another encamping ground, after being attacked by cholera. In this case, the water, from repeated contamination, kept the disease in a state of constant activity, so long as the army remained on its first ground, but by moving

away from the infected locality, and encamping on the banks of another and more rapid river, the health of the troops rapidly improved, and cholera soon disappeared from among them.

It is unnecessary for me here to trace again the history of the disease, the details of which are to be found in the earlier part of this work. It will be sufficient to remind the reader of the famous Broad Street case; of the cholera at Newcastle in 1854; of the outbreak of the disease on board our Crimean fleet; of Mr. Radcliffe's admirable account of the East London District outbreak of cholera in 1866; and, later still, Dr. Murray's history of the Hurdwar cholera. I will not stop to analyse the facts connected with these remarkable outbursts of the disease, but simply ask all who are interested in the inquiry to read over the history with an unprejudiced mind, and examine the details by the light of the theory I have propounded, and I feel sure they must arrive at the same conclusions as I have done, that it does explain the history of cholera in an intelligible and satisfactory manner. And if this be so, then I submit that the etiology of Asiatic cholera which I have advanced must be the true one, or present a close approximation to the truth.

If, now, we turn from the history of cholera to its geographical distribution, we find the same principles of interpretation to be as applicable in the one case as in the other. Cholera spreads in all directions from its endemic area, not in the track of any particular wind, for while it may and does advance steadily *against* the monsoons, it travels *with* them as they carry man and his merchandise to the north-west from Bengal, along the course of the Ganges to Mirzapore and Cawnpore,

or up the Jumna to Agra and Delhi. But while extending in this direction it may stretch away far south, arriving in the Mauritius with coolies from Bengal, or to the east, *viá* the Straits, to China. In many cases, no doubt, the disease is propagated directly from man to man, either through contaminated water, or the foul atmosphere of a crowded vessel, holding the infecting organic matter in suspension until the crew arrive on shore, and then the far more potent influence of water is called into play, and an epidemic outbreak of the disease is generated. It is quite as easy to suppose, however, that soiled linen may carry the organic matter which induces the disease from place to place, till it is brought into active operation through the intervention of water.

The assembling of large bodies of people together from various quarters, as at Hurdwar and Mecca, and, in fact, pilgrimages in general, thus become one of the most influential agencies for the spread of cholera, scattering it in all directions, when once it has broken out among them.

On the other hand, I have shown, as in the instance of the convicts on the Andamans, and the Hill people of Bengal, that circumstances which prevent the importation of cholera matter among a set of people, even in the endemic area of the disease, effectually bar its outbreak among them. Facts of a similar nature have been recorded in Europe, as in the instance of Greece on several occasions, and Palermo in 1866. So, again, in the case of those parts of the world out of the course of direct communication with India, as Australia and the Cape of Good Hope; these have hitherto escaped the ravages of the disease. The Cape, especially, is protected in a great measure from the fact of

vessels simply touching there after a long voyage, and not going into dock or unloading cargo.

The Peninsular and Oriental steamers running from India to Suez furnish a somewhat similar instance; they have never been known to carry cholera into Europe, probably because it is only the better class of passengers that travel thither by them, the crew and the vessel returning from Suez to India. I should expect a very different story when small vessels pass through the Suez canal from India: without the greatest caution they will inevitably be constantly importing the disease into Europe, as they have done into Persia, and along the Persian Gulf. The great safeguard of Europe, as far as Egypt is concerned, up to the present time, has been the passage over the desert, obliging the steamers on this side to return with their crews to India. No doubt, in these magnificent vessels, means are taken to ensure proper ventilation, and, as a general rule, condensed sea water is employed for drinking purposes, which, although it may not be always very palatable, must obviously be free from all chance of choleraic contamination.

It seems to me that these are the principal causes, the last by no means the least, which have, up to the present time, saved England and France from contracting cholera frequently from India by way of Egypt. We have seen how different was the result in the epidemic of 1865, when cholera broke out among pilgrims at Mecca, and was carried by them through Egypt to Alexandria, and from this centre was disseminated over Europe; its advent in almost every instance being directly traced to persons from Alexandria, suffering from the disease.

I have also directed attention to the influence which

meteorological conditions exercise over the spread of cholera, particularly as witnessed in this country : how that in dry seasons its progress may be stayed, and has actually been stopped, by deficiency of rainfall. The infecting organic matter must doubtless have been carried into the famine districts from neighbouring places in 1860, but it never became epidemic there, although raging all round the barren, drought-stricken quarters. There was no rain to wash the organic matter into the scanty supplies of drinking-water, and thus man, although reduced by famine to disease and death, escaped the influence of cholera; and this immunity continued so long as the rains were delayed, but directly they came in full force the following year, the means for the dissemination of the cholera stuff were provided, and the disease burst out among the people.

So it is, again, with deserts : as I have before pointed out, cholera soon dies out from a caravan crossing such arid wastes. Necessity obliges those composing it to move on; their dead and sick must often be left behind; they experience no rain, meet with no streams or tanks, and wells are far distant from one another, and protected with religious care; and thus they get quit of cholera. There is nothing in the desert beyond this which stops the progress of cholera among those crossing it; a city in the midst of a desert, if supplied with tanks and wells, might become a centre of cholera; but, under existing circumstances, caravans leave their cholera behind them. Dr. Dickson says he could never trace it beyond three days' journey into the desert.

SECTION IX.—SYMPTOMS AND TREATMENT OF ASIATIC CHOLERA.

FOR convenience of description we may consider the symptoms of cholera as belonging to five stages: 1st, the incipient stage of diarrhœa (cholérine); 2nd, that of choleraic diarrhœa, the temperature of the body being decidedly lower than in health; 3rd, the stage of collapse; 4th, the tepid stage, and 5th, that of reaction. I need hardly remark, however, that one or more of these stages may be absent, and that, in reality, they run insensibly one into the other.

The first stage of Cholera, viz. that of diarrhœa, or cholérine as it is usually called, is by no means present in all cases of Asiatic cholera; in fact, in India, it is rather the exception than otherwise to meet with it; whereas, in Europe, the first stage of the disease is certainly well marked in at least one half the cases that occur.

The most prominent feature of this stage of the disease is a copious watery purging, attended with little or no pain, but followed by great exhaustion. The patient complains of an indescribable feeling of sinking or faintness at the pit of the stomach, which is relieved by a deep inspiration. Together with diarrhœa, languor, and lassitude, there is more or less nausea, but seldom any vomiting. The patient's tongue is whitish and clammy, and he is very thirsty, complaining more of uneasiness than of actual pain in the abdomen; he is troubled with constant bor-

borygmus. The temperature of the body varies only within the limits of the natural diurnal fluctuations of health (from 98° to 99° F.).

On examining the watery alvine dejecta, we shall find them of a brownish colour, containing feculent matter in solution and bile; they are alkaline, and frequently a considerable quantity of columnar epithelium in a state of molecular change may be found in them, constituting the true organic infecting matter of cholera.

In a vast proportion of these cases the patient rapidly recovers from this stage of cholera, especially if judiciously treated; but we cannot overlook the fact that its tendency is to run on into the second stage of the disease, and what is of quite as much importance, the organic matter passed from the intestines of a person suffering from this form of disease, is undoubtedly capable of inducing a similar affection in the intestinal canals of those who swallow it; in fact, if received into a favorable soil, other circumstances being propitious, it may cause an outbreak of cholera.

The duration of the first stage of cholera is very uncertain, it may continue for a day or two, or only last a few hours, depending on the one hand upon the amount of potential force contained in the infecting matter, and on the other hand upon the power the patient has of resisting its influence. However short this incipient stage of cholera may be, it is all important that it should be at once recognised, for we may then, as a general rule, stop the progress of the disease by a judicious plan of treatment; but after the epithelium of the intestinal canal has become extensively involved, the utmost we can do is to help the patient towards recovery; neither drugs nor anything

else we know of can cover his intestines with a new epithelium.

Second stage of Cholera.—The time of the invasion of this stage of the disease is most frequently the early morning, when the walls of the intestinal tract are alkaline throughout their length. The patient is seized with vomiting, first voiding the contents of his stomach, and subsequently almost all the water he drinks, mixed with serum, mucus, and disintegrated epithelial cells. This fluid is ejected with considerable force from the mouth, as if squirted out of a large syringe, and each effort of vomiting is followed by more or less exhaustion to the patient.

The purging, which is often the first symptom of the disease, is very frequent, the stools being passed without any effort or pain; they flow away from the patient with a sensation of relief rather than otherwise; he is seldom aware of the large quantity of fluid he loses in this way, for the calls may be frequent, only a few ounces passing each time, or as much as a quart may be discharged in the course of a few seconds. These alvine discharges are characteristic of Asiatic cholera, and have been aptly described as resembling the water in which rice has been boiled—"the rice-water stools of cholera;" they are always alkaline, but as I have already noticed their microscopical and chemical characters it will be unnecessary for me to enter more fully into the subject here.

The patient complains of terrible thirst, it is almost impossible to satisfy his craving for water. He also suffers excruciating pains from cramps in the muscles of his arms and legs; his toes and fingers become bent and stiff; the larger muscles contract into hard lumps; nor do those of the abdomen and thorax escape these

terrible spasms. These cramps are relieved by friction. Among the weak and poverty-stricken people of Lower Bengal, the contractility of their muscular fibres is at so low a standard, that they frequently escape the cramps from which their more lusty up-country brethren, or Europeans, suffer so fearfully.

Throughout this stage the patient is very restless, tossing about from one side of the bed to the other, utterly unable to sleep or rest for an instant in any one position; at times a feeling of deadly faintness comes over him; he complains bitterly of internal heat, especially in the stomach; and, although the temperature of his body is several degrees below its natural standard, he cannot bear to be covered with the bed-clothes, they feel hot and uncomfortable to him. His countenance is shrunken, and if not livid is pallid; the integument of the body is inelastic and doughy, the skin of the hands and feet wrinkled, and the tips of the fingers purplish. The surface of the body is covered with profuse perspiration, especially if the cramps are very severe. The pulse is feeble and rapid, from 100 to 110, and the respiration hurried. The external temperature of the body sinks rapidly, the thermometer standing in the axilla at 94° or 95° F. No urine is secreted, and less carbonic acid than usual is given off with the expired air from the lungs.

In the majority of cases of cholera which we meet with in India, the first stage, as I have already remarked, is wanting, especially at the commencement of an epidemic outbreak of the disease, and the attack begins with the characteristic symptoms of the second stage. The patient may have eaten his dinner and gone to bed apparently in good health, but is aroused from sleep with a feeling of sickness; vomiting and

purging set in, the temperature of the body falls, and all the symptoms of the second stage of cholera rapidly supervene.

The duration of the second stage of the disease is very uncertain; it may last for a few hours or for a day, and then gradually pass off, the patient returning to health. But in the majority of cases, if allowed to run its course, it is the precursor of collapse.

The third stage of Cholera; the Algide or Collapse stage of the disease, is characterised by a continuation of the vomiting and purging, though probably to a less degree than in the second stage. The lividity of the surface of the body increases, the integument having the doughy, inelastic feeling peculiar to cholera; the skin of the tips of the fingers and toes is blue and wrinkled. The eyes are surrounded with an areola, and the eyeballs deeply sunken in their sockets; the voice is low and husky; the breathing is rapid, from 35 to 45, the dyspnoea being often very distressing. The external temperature of the body is lower than in the previous stage of the disease, sinking, it may be, as low as 90° F., but rising after each violent attack of cramps, and being by no means proportionate to the intensity of the collapse. The temperature of the rectum and vagina are higher than in health by about 2° or 3° F., depending, probably, upon the violent chemical action going on in these parts, for beneath the tongue, or in deep fistulous openings in the body, the thermometer stands at a point below that of health. There is no pulse at the wrist. The urine is suppressed. The patient is still wakeful and very restless; he complains of intense thirst and of heat in the abdomen; the cramps are less violent, but nevertheless cause him intense suffering; he has often great pain

in the præcordial region, and also in the loins. His sight and hearing grow dim, and his intellectual faculties are blunted, although he may retain his reasoning powers up to the last.

The stage of collapse, as a general rule, lasts about twenty-four hours, although, of course, reaction may come on within a shorter period, or the patient may die within a few hours of the setting in of the collapse. I mean that, in cases where the symptoms of the algide stage of cholera have been well-marked, thorough reaction is seldom established within twenty-four hours of the first undoubted symptoms of collapse. The mortality, however, among patients who pass deeply into the algide stage of cholera, is very great, especially among persons beyond the prime of life: of these, probably, not less than 60 per cent. succumb to the disease in this stage; moreover, the fourth and fifth stages of cholera are severe in proportion as the algide condition has been deep and protracted. On the other hand, of those who suffer from cholera which does not pass beyond its second stage, probably not more than ten per cent. die.

The fourth, or Tepid stage of Cholera, is undoubtedly the most dangerous period of the disease; it seldom lasts for more than a few hours, and is fortunately not uncommonly absent; still, those conversant with the disease must be quite familiar with the characteristic symptoms of the tepid stage. The purging and vomiting cease, or, if the former exists, the patient passes his motions beneath him in bed. He lies in a comatose condition, with his eyelids half closed, and the eyes turned upwards and inwards; the pupils are contracted. We may generally feel the pulse, but hardly count it; the respiration is very laboured and

rapid, and the skin is covered with a cold, clammy perspiration, but the external temperature of the body rises to the standard of health. The lividity of the patient's face grows less, it becomes, in florid people, "a dusky red colour, and in pale persons it is a dusky grey or stone colour."* A patient cannot exist long in this state of extreme peril, he may pass on into that of reaction, but probably no less than 85 per cent. of these cases die.

The fifth stage of Cholera: Reaction. The patient having been in collapse for twenty-four hours (it may be a shorter or longer period) the external temperature of his body begins to rise slowly to 94°, and then to 95°, creeping up to its normal standard; that of the rectum falls to 98°. At the same time the respiration sinks in the same gradual manner, from 40 or thereabouts to 25; the pulse may be again counted, and the patient is able to sleep; his countenance assumes its natural appearance; the dejecta become greenish, or yellowish, and then have the pea-soup appearance of typhoid stools, containing a large number of pus-cells. Urine is again secreted; the processes of absorption, circulation and nutrition, are, in fact, slowly re-established, and in favorable cases, the patient, after a convalescence of ten or fifteen days, may generally be considered off the sick list. This desirable result, however, is too frequently thwarted by various complications which arise during the stage of reaction. Of these, the following are the most important:—Suppression of urine; hæmorrhage from the bowels; fever; gastritis; enteritis; pulmonary congestion; meningitis; extensive sloughing (including the cornea)

* F. M. Mackenzie's "Report on Cholera." 'Clinical Lectures and Reports, London Hospital,' vol. iii, 1866.

or abscesses; the formation of coagula in the right side of the heart or pulmonary arteries; roseola cholericæ, and various minor evils. It would evidently be going beyond my province to attempt to discuss the features of these various forms of disease, and by simply making a few remarks on their leading symptoms, I should certainly add nothing to the knowledge already possessed by medical practitioners. I shall, therefore, at once pass on to make a few general observations upon the symptoms of cholera above enumerated, and then, having considered the prognosis to be formed in cases of the kind, shall describe the treatment of the disease in its various stages.

I would insist upon the fact, which must be obvious to even a casual observer, that the stages of cholera above enumerated are more or less artificial, and simply drawn out in order to facilitate the description of the leading symptoms of the disease; that in reality one stage runs insensibly into another, so that it is frequently no easy matter to determine precisely the stage of the disease in which a patient may be when we first see him. Dr. Sutton's rules on this point are very satisfactory: he admits that, in at least one half the cases he saw in London in 1866, premonitory diarrhœa was present; and he considered no cases to have passed beyond this stage, unless he had evidence of rice-water stools having been passed, the temperature of the body being below 95.°* It is difficult to determine exactly when a patient is in collapse; the thermometer in the axilla may not stand much above 91°, the temperature of the rectum being 102°. If these conditions have existed, however short or long a time, and if the temperature of the body then begins to rise,

* Mr. Simon's 'Ninth Report.'

and reaches 95° or 96°, the pulse becoming distinctly perceptible and slower, and the respiration falling in frequency to 30 or 25, there can be no doubt that reaction has set in.

With regard to the vomiting in cases of cholera, this symptom is not invariably present, although we rarely meet with many cases of Asiatic cholera which run their course without vomiting; and, as I have before remarked, it is still more uncommon to see an instance of the disease in which the patient has died without either vomiting or purging. In all the recorded cases of this description the intestines, after death, have been found to contain large quantities of the "rice-water cholera dejecta."

The severity of a case of cholera evidently depends more upon the quantity of serum which flows away from the blood in a given time, than upon the absolute quantity thrown off from the stomach or bowels during the patient's illness. A remarkable instance is related by Dr. Barlow, showing the effects of this drain of fluid from the system in cholera. A man under his care, suffering from dropsy, was attacked with cholera, "and passed gallons of liquid by stool, had cramps, and became livid and clammy, but his pulse did not disappear as in profound collapse, and he eventually rallied and left the hospital apparently well. When he began to recover from cholera his appearance was almost ludicrous, from the manner in which the integument hung loosely about him. Now this patient, having an excess of serosity in his system, was enabled to bear a drain which would have been destructive to most men."*

The flow of the serum from the capillary arteries of

* 'Medical Times and Gazette,' p. 138, August, 1866.

the intestinal canal renders the blood not only too thick to circulate with freedom, but, as Dr. Thudichum has proved, it renders the blood-corpuscles incapable of carrying oxygen, and the temperature of the body is thus lowered to such an extent that even urea ceases to be formed. After death, in deep collapse, the tissues of the body have been carefully examined for urea, and it has been found to be absolutely wanting; no urea, in fact, exists either in the blood or the tissues, or in any part of the body, under these circumstances.

With evidence of this kind before us, as to the deoxidation of the blood-corpuscles and contractile tissue of muscle, we shall be better prepared to understand the origin of the severe cramps from which cholera patients suffer. We never meet with cases of cholera in which cramps are severe until after the vomiting and purging have set in, and a considerable quantity of serum has thus been drained away from the blood. And it is interesting to observe that, if the serum of the blood be withdrawn by other causes than Asiatic cholera, cramps are experienced by the patient. For instance, as Dr. Barlow remarks, these spasms are common in English cholera; and Dr. Greenhow, in a case I have before referred to of poisoning from croton oil, expressly states that the cramps were very severe. We may conclude, therefore, that causes which induce an inordinate and rapid drain of the serum of the blood through the walls of the intestinal canal, bring about the phenomena of irregular and painful contractions of the muscles. One of the results of this dehydration of the blood is the deoxidation of the tissues; and, as this condition will under other circumstances induce cramps, I conclude that the cramps in cholera

are mainly due to the deficient supply of oxygen to the tissues.

In confirmation of this opinion, I may refer the reader to Dr. Radcliffe's work 'On Epileptic and other convulsive affections of the Nervous System' (3rd ed., 1861), in which will be found some very interesting and, to my mind, conclusive observations, on this point. Dr. Radcliffe is of opinion that the contraction of the uterus and other muscles, when cut off from their due supply of oxygen, is not, as was generally supposed, consequent on the accumulation of carbonic acid in the blood, but is directly owing to the want of oxygen in the circulating fluid; for on admission of this principle into the blood, the contracted muscles at once become elongated. Dr. G. Harley confirms these views, believing the effects of strychnia and brucia in causing convulsions to arise from their preventing the blood from absorbing oxygen; their action, in fact, may be said to be equivalent to a copious loss of the serum of the blood.

As an additional factor in the causation of cramps in cases of cholera, we cannot overlook the influence of the loss of the water of the tissues by the venous capillaries. Dr. Richardson has lately demonstrated the fact, that by altering the molecular state of the water contained in a muscle, we may cause it to contract independently of any nervous influences; for if a fresh muscle be rapidly frozen and then allowed to thaw, it contracts very considerably during the latter process. It would seem very probable, therefore, that during the dehydrating action of cholera, the loss of their water, combined with the imperfect supply of oxygen to the tissues, induce the cramps from which the patient suffers. For as the cramps come on with the

loss of serum through the walls of the intestinal canal, so, also, they cease as this drain of liquid stops, and absorption or reaction progresses.

From the remarks I have made regarding cholérine, and the cases I have given in the history of the disease, especially that of André Guilbert, in 1849, it is evident that this stage is truly one of cholera, and the products are undoubtedly capable not only of generating cholérine in another, but also the more grave form of the disease; in short, I believe the dejecta of a person suffering from cholérine may induce an epidemic of Asiatic cholera. I do not, however, consider the fomes of those suffering from cholérine to be nearly so deadly as those of cholera patients. In cholérine the potential power inherent in the organic matter of the intestinal discharges is the same, but its efficiency is less than in the case of cholera. Nevertheless, we may lay it down as a fundamental principle, that it possesses an identical influence: the seeds of cholérine if sown on favorable soil, may be productive of a more vigorous growth, and in this way engender the most deadly form of cholera.

The organic infecting matter of cholera, as I have before endeavoured to explain, must die out in obedience to certain physical laws, unless these so combine as to keep the poison constantly at work, which occurs in its endemic area.

Prognosis.—Our prognosis in cases of cholera must depend, not only on the stage of the disease in which our patient may be, but on his age and previous state of health, and the circumstances by which he is surrounded.

I have avoided, as far as possible, all statistical statements in this work, principally because I distrust

my own ability to analyse and interpret them; and it seems to me that, unless used by those who are masters in the art, statistics are, of all weapons, the most treacherous to those who resort to them. I shall not, therefore, bring forth a mass of figures to prove the fact that the mortality from cholera increases pretty regularly with the age of those attacked, but will give the results of Dr. W. Farr's calculations on this point :—

<i>Ages.</i>	<i>Deaths. to one</i>	
	<i>Males.</i>	<i>Females.</i>
5 years	... ·611	... ·632
5—10 years	... ·542	... ·424
10—15 „	... ·437	... ·500
15—25 „	... ·328	... ·389
25—35 „	... ·356	... ·354
35—45 „	... ·441	... ·429
45—55 „	... ·513	... ·491
55—65 „	... ·562	... ·519
65—75 „	... ·589	... ·578
75—85 „	... ·741	... ·695

I have already referred to some statistics connected with the epidemic outbreak of cholera in Paris in 1832, showing the direct influence which hygienic circumstances exercised over the mortality from this disease, and from that time up to the present the same rule has been found to hold good in Europe.

I have attempted to explain the reason of the greater liability of the poor, especially of our large towns, to contract the disease; and why they offer less resistance to its fatal influences when attacked than their richer brethren. I believe it to be that the secretions of their intestinal canals are too often vitiated from want of pure air and proper food, and from various other circumstances over which they have no direct control; but more especially because, as Dr.

Woodman states in his report on the cholera of the East London District of 1866, "the water used for drinking and ordinary purposes by the poor of the neighbourhood (and probably of the East End generally) was extremely impure. This was due mainly to *the filthy and exposed condition of the receptacles*, and partly to a faulty supply," this supply having, as Mr. Radcliffe showed, been contaminated with cholera stuff. Not only, then, are the poor more subject to cholera than the wealthier classes, but when attacked our prognosis must also be less favorable.

In the first stage of cholera, although the patient requires careful watching, our prognosis will be a decidedly favorable one, for probably not more than 4 per cent. of those who are judiciously treated in this stage of the disease pass into collapse. But then we must bear in mind the fact that, in nearly one half the instances of cholera which occur in Europe, the first stage of the disease is wanting; and in India it *generally* begins with the second stage, especially in those terrible outbursts of cholera which we so frequently witness in this country.

In the second stage of the disease our prognosis will be less favorable, for we know how considerable must have been the damage done to the epithelium of the intestinal canal, in order to allow of the large transudation of serum through it which characterises this stage of cholera.

If, in the second stage of cholera, the external temperature of the body does not sink below 95° , the respiration not rising beyond 25° , or the pulse upwards of 100, we may safely conclude that our patient has a very good chance of recovery. Probably 85 per cent. of such cases get well. With regard to the

vomiting and purging as influencing our prognosis in the first and second stages of the disease, I may observe, that I have already given what I consider to be proof of the existence of a definite infecting principle in the evacuations of those suffering from cholera, and, at the same time, I have stated my firm conviction that by stopping the dejections in the early stages of the disease, we may often save our patients' lives. Now, if the eliminative theory be true, with opium and astringents we lock up the poison of cholera in the system, for we stop the vomiting and purging, and I do not think it is argued that the poison escapes from the system by any other means than that of the alvine flux; nevertheless, I do not hesitate to adhere to my position, and to state my firm belief that no more favorable symptom can occur, in the first and second stages of cholera, than a cessation of the vomiting and purging. In by far the majority of such instances, no sooner do the discharges cease than the patient begins to recover, and may be said to be out of danger.

Although we cannot place any absolute confidence in the indications afforded us by the thermometer, nevertheless, if the temperature of the patient's body rapidly falls to 93° or 94° and remains at that point, the respiration rising in proportion, and the pulse becoming imperceptible, our patient is in extreme danger, the more so, as these symptoms have been rapidly induced. The danger increases as the patient passes deeper into collapse, and the longer he remains in this stage the more severe will be the tepid stage and that of reaction. Our prognosis must be most unfavorable, therefore, under these circumstances; the chances of the patient's recovery, if he passes into deep collapse, not being more, probably, than one in three.

Our anxiety as to the issue of the case will increase rather than otherwise as the patient falls into the tepid stage; if this be prolonged he will hardly recover, and probably no worse symptoms can occur in this stage than the passage of bloody stools. This symptom indicates over-action in the part; the vessels of the mucous membrane become not only plugged, but intensely congested, and these engorged vessels are apt to give way as reaction comes on, and hæmorrhage is the result; the small quantity of serum left in the body drains away with the bloody stools, destroying the only chance the patient had of recovery. In this stage of the disease, therefore, the appearance of blood in the dejecta compels us to hold out but slender hopes of a favorable issue.

In the fifth stage of the disease, that of reaction, our prognosis will be based on the fact that it is usually severe in proportion as the collapse has been deep. If the algide stage has been rapidly passed, there can have been but little time for the contents of the intestinal canal to be absorbed by the lacteals, and to find their way into the blood-vessels. Moreover, if the collapse has not lasted long, the products of the disintegration of the tissues will have had less time to collect in the blood, than if the algide state had existed for many hours; and it seems very probable that these matters, collecting in the circulating fluid, are the cause of the secondary fever and other conditions which follow reaction. Certainly, hardly more than one half of those persons who struggle through a protracted state of collapse, outlive the tepid stage and that of reaction which follows.

Suppression of urine is a very common complication of reaction, and one which justly alarms us. I have

already remarked that during collapse no urea is formed in the body, but as reaction comes on we may discover urea in considerable quantities in the blood and tissues, especially in those of the brain and cerebro-spinal fluid. Unless this urea can escape through the kidneys the patient is evidently exposed to the dangers of uræmic poisoning. In cases of death from this cause the cortical substance of the kidneys has been found pale and turgid, the tubuli uriniferi full of granular cells, disintegrated epithelium, and fine hyaline casts; these absolutely fill and plug up the tubules, and appear to me to afford a mechanical impediment to the passage of the watery elements of blood through them. If we can only clear these passages by means of diuretics, that is to say, by increasing the flow of water from behind, and flushing out the tubules, we may, I think, overcome the dangers arising from the retention of the urea in the blood. I am convinced that I have seen this result induced in many cases by the judicious use of the tincture of cantharides. I may be over sanguine; but in my hands the use of this drug, combined probably with the advantages of a less harmful treatment in cholera than I formerly adopted, has led me to form a more favorable prognosis in cases of retention of urine after the collapse of cholera than I should have ventured upon three years ago.

Another complication incident to the stage of reaction, which seems to me more common among the natives of this country than among Europeans, is the formation of a clot in the right side of the heart, usually extending into the pulmonary arteries. The patient seems to be doing well, when, suddenly, difficulty of breathing comes on, followed by collapse and death.

I have seen more instances of this kind during the present season (1869) than I remember on any former occasion, and they render one extremely cautious in giving a prognosis, even in cases which to all appearance are doing remarkably well.

Treatment.

It would be beyond my power to attempt to discuss the numerous plans of treatment which have been advanced from time to time for the cure of cholera. It seems to me wiser, therefore, to confine my remarks to a simple statement of the conclusions I have arrived at on the subject.

In the first stage of cholera I have no hesitation in declaring my firm belief in the efficacy of opium; we may safely trust this drug to cure the premonitory diarrhoea of cholera (cholerine). Of the various preparations, the tincture of opium is the one I prefer. Thirty drops of laudanum in an ounce of water should be administered as soon as possible after the first watery motion has been voided, and this must be repeated if the purging does not stop after the first dose has been given. Supposing thirty drops of laudanum to have been administered, and that within half an hour the patient is again purged, I should not hesitate to repeat the draught at once; it is not advisable to wait until two or three motions have been passed.

The patient must also be made to keep quiet, if possible in bed, and should be allowed nothing but some arrowroot, broth, and other light foods, but he is not to be starved; we require to keep the stomach at work, but not to overload it. The patient will probably com-

plain much of thirst, and, if so, he can drink nothing better than some iced water, acidulated with dilute sulphuric or citric acid. A drachm of the former to a pint and a half of water will make a pleasant and very useful drink.

I am convinced that, in seasons when epidemic cholera is abroad, and consequently at all times in its endemic area, watery painless purging should be at once stopped in the way above described. It seems to me the duty of every medical man to warn all those he may be able to influence, as to the danger of allowing diarrhoea of this kind to run on unchecked, especially in this country; every family should have a bottle of laudanum in the house, and it must be resorted to at once after the very first watery motion. No more erroneous practice can possibly exist than that of allowing diarrhoea to go on in this part of the world, or indeed in any other place where cholera exists, upon the supposition that the attack is a bilious one, and that the purging is a salutary or a harmless process; more deaths from cholera have been occasioned, I believe, from this, than any other mistaken notion on this subject with which I am acquainted. The issue is simply this: supposing the attack to be a bilious one, we stop it with opium, and may subsequently have to administer a dose or two of blue pill and rhubarb; or, perhaps, a little judicious starving will answer the same purpose. But if, under the impression that the diarrhoea is bilious, we allow it to run on, it may become, in the course of a few hours, the second stage of cholera, and our opium may then be of little or no use.

The rule I usually follow, and endeavour to enforce upon all those I can influence, is, that in this part of

India a dose of tincture of opium should be taken after the first copious watery motion, more particularly if it is accompanied by a feeling of exhaustion and a faintish sensation at the præcordial region; under these circumstances the laudanum (thirty drops) should be taken at once, and followed by a stiff glass of brandy and water. After this the patient will probably feel inclined to lie down, and having had a long sleep will wake up quite well; but should the diarrhœa return another dose of laudanum is to be administered.

In the case of children, the quantity of opium must, of course, be proportioned to the age of the child. •

Whenever epidemic cholera is prevalent it is well to have a supply of "cholera pills" at hand; they are more easily distributed than laudanum, and are almost equally efficacious. Perhaps one of the most useful formulæ of the kind is—

℞ Pulv. Opii, gr. j;
Plumbi Acet., gr. ij. Ft. pil.

One to be taken every hour until the purging stops.

Pills of opium and calomel are equally efficacious, and, in fact, there are numerous other prescriptions of a similar kind, all having for their base opium, combined with various other drugs.

With regard to the employment of chlorodyne, 'cholera tincture,' and so on, unless we are certain as to the exact nature and proportion of the drugs they contain, their use must be clearly objectionable.

Supposing the means above indicated fail to stop the progress of the disease, or that the attack commences with the symptoms described as characteristic of the *Second stage of Cholera*, I would still recommend opium to be given cautiously. If when we first see the

patient we find he has taken one or two doses of laudanum, or chlorodyne, but in spite of these vomiting has come on, the stools also resembling rice-water, I would still attempt to stop the attack with opium and sulphuric acid.

My object in prescribing the sulphuric or any other acid would be the hope of destroying the specific cholera process going on in the intestinal canal. As I have before mentioned, the rice-water stools are invariably alkaline; we must endeavour, if possible, to render them acid, so as to redden litmus paper. Under these circumstances, when examined by the microscope, we find the molecular action has ceased; may we not, therefore, believe that we have destroyed the cholera process going on in the intestinal canal?

The difficulty, however, is to render the stools acid. In the second stage of cholera, as a means to this end, I usually order the patient the following draught every half hour, for four doses, and then to continue it every hour until the vomiting and purging have ceased:

℞ Acid. Sulph. dil.,
 Acid. Acetic. dil., āā ṁxv :
 Acid. Carbolic. gtt. ss ;
 Aquæ, ḡiss. Ft. haust.

With regard to opium, this drug had better be added to the first and second draughts as indicated by existing circumstances; in many cases, if the patient has taken several doses of laudanum before we see him, we may be disposed to withhold opium and trust to the acids. At any rate I would never leave a mixture, with even a small quantity of opium in it, to be taken by a patient every hour or half hour in the second stage of cholera. One or two doses of this drug

may be very useful, but most assuredly it is very dangerous to continue giving it in this stage of the disease; one or two full doses is all we may venture on; anything beyond that may be absolute poison to our patient. I rely much on the acids in this stage of cholera, but I do not for an instant say they will cure all or nearly all the cases we meet with. I think that, used judiciously, and upon the principles above indicated, they are very valuable adjuncts in the treatment of the disease; but if they have induced their desired effect and rendered the stools acid, or the vomiting and purging have been decidedly lessened by their use, they should be laid aside; their further employment would probably be detrimental, and certainly can do no good.

I am well aware that, in too many cases, we cannot render the stools acid; that is, we cannot stop the cholera process until the patient has passed on into collapse, when our acids, and in fact all other remedies are almost useless.

In the second stage of cholera the patient suffers terribly from thirst, and we may safely allow him a reasonable quantity of cold water to drink, and as much ice to eat as he likes. Our object should be, on the one hand, to try and prevent the patient from overfilling his stomach with fluid, in which case he will certainly vomit it all up again, and the effort will exhaust him more or less; on the other hand it is doubtless very advantageous to allow a considerable quantity of water to remain in the stomach and intestines, so as to supply as much fluid as can be absorbed into the blood. This principle being kept in view, our common sense will best teach us how to apply it to each particular case.

I would here enter an earnest protest against the use of brandy, or any alcoholic stimulant, in this stage of cholera. I believe these, both theoretically and practically, to be the cause of unmitigated evil. I simply, therefore, mention brandy, champagne, and the like, in order to condemn their use most emphatically in cholera; according to my ideas and experience, it is almost impossible to hit on a more detrimental plan of treatment than that usually known as "the stimulant" in this form of disease.

The cramps in the limbs are best relieved by friction, but beyond this, rubbing the body seems to me useless, that is to say, any attempt to restore or keep up the temperature of the body by this means is quite futile. And so again with hot bottles; if they are comfortable and soothing to the patient by all means let him use them, but they are not likely to affect the issue of the case. The same remark applies to mustard poultices and blisters; it is impossible to suppose they can in any way influence the changes going on in the intestinal canal; but one and all of these means may be sources of harm if they harass the patient and prevent him getting the little rest which he might otherwise obtain, and which it is of the greatest importance we should encourage by every means in our power.

In furtherance of this latter object, I know of no remedy more efficacious than chloroform. If the patient is in much pain and very restless, I strongly advise his being placed under the influence of this anæsthetic. The chloroform must be administered by inhalation, and its full effects may be safely induced; or at any rate we may put our patient into a sound and comfortable sleep, allowing him to wake up from time to time, and drink some of his acid draught in a large

tumbler full of iced water. We must be prepared to continue the action of the chloroform, perhaps for four or five hours, or even longer, according to circumstances. The patient will require very little of it to keep him at ease after the first half hour, but of course its administration cannot be entrusted to any but a professional person. The advantage of this system of treatment, which is by no means a new one (see Appendix : Dr. Ross' Report), seems to me to be very decided, for by keeping the patient at ease we save his strength, and what is of greater consequence, by rest of body we favour the occurrence of the blood stasis in the vessels of the intestinal canal—in fact, we promote the healing process which we so earnestly desire. At the same time we may hope that the acids will stop the further extension of the disease.

Let us not, however, expect too much or be disheartened if all our efforts fail, which they must frequently do in spite of our best endeavours. Cholera is so insidious a disease, that irreparable damage is often effected in the walls of the intestines, before either the patient or doctor is aware of the existence of any evil at all; it is this fact which should make us realise the importance of the preventive over the curative plan of treatment. We have it in our power to prevent cholera; we necessarily must often fail to cure it; for the mischief is all done, in many cases, and the patient really a dead man, before any urgent symptoms of this terrible malady have manifested themselves.

The Treatment of the third stage of Cholera (Collapse).
We shall best attempt to conduct our patient through the great perils of this stage of cholera by a knowledge of the causes of collapse, which I have endeavoured to explain in a former section of this work.

In collapse, opium must not be given; it will be necessary to be very guarded in using acids, unless the vomiting and purging are urgent symptoms, when we may with safety prescribe the acid draught which I have recommended in the second stage of the disease. The dejecta having become acid under its use, we must at once stop its employment.

I think we need not hesitate to give the patient as much water as he likes during collapse, hoping that some of it may be absorbed into the blood.

As a means to the same end, we may wrap the patient up in blankets wrung out in warm water; some of the moisture is probably absorbed by the skin, and tends to supply fluid to the viscid blood. Hot baths have the same effect.

If the patient is in pain and very restless, chloroform may with advantage be administered. I have given it in the very last stage of collapse, with the temperature of the body as low as 92° , and the respiration at 50° , and I cannot say I have ever seen it produce injurious consequences; on the contrary, even in this hopeless state of collapse, it has eased the pain and distress from which the patient was suffering.

With these simple means I fear my stock of knowledge, as regards the treatment of cholera collapse, is exhausted. I am persuaded, however, that from an over-anxiety to do something we are often led into grievous errors. In the hope of exciting the circulation, stimulants are resorted to, destroying the faint chance the patient might otherwise have had of recovery. Calomel and all manner of drugs are sometimes poured down his throat to the great peril of the patient; whereas, if he were left alone, it is possible that reaction might set in and his life be saved.

It may seem hard to do so little under such urgent necessity, but we must learn to stay our hands if we see no reasonable prospect of using them to advantage.

In the fifth stage of Cholera (Reaction) our main object will be to supply the most easily digestible materials to the patient. For the first two or three days after reaction has set in, we must give him nothing stronger than milk and arrowroot or sago; on the third day we may venture, perhaps, on a little soup, but we far more frequently err in giving too much than too little food in this stage of cholera. Still avoid alcohol, and, unless in very special cases, give the strictest injunctions as to the patient's food; relations and nurses will attempt to "feed up" the patient, as they call it, whereas his intestinal canal has to recover the damage done by the cholera process, before it can begin to perform its functions again.

I think it is often useful, about the third day after reaction has set in, to give the patient a small dose of castor oil, so as to clear out the intestines; beyond this he will require no medicine if reaction goes on favorably.

Should fever, or any of the other complications I have mentioned supervene, they must be treated upon the principles generally applicable to all such cases, as though they had not occurred after cholera.

Supposing, however, that the patient does not pass any urine within thirty-six hours of reaction coming on, I am in the habit of prescribing the tincture of cantharides as recommended by Dr. Francis. Ten minims of the tincture in an ounce of water should be given every half hour, until six doses have been taken, and the patient should be encouraged to drink freely of water.

If this treatment does not cause urine to pass, we must, after the sixth dose, discontinue the medicine for twelve hours, and then repeat it in precisely the same way, giving six doses more, ten minims each, of the tincture of cantharides. I have seen this treatment followed by the most satisfactory results in very many cases, more especially if the plan I have sketched out for the treatment of the previous stages of the disease has been enforced.

Before bringing this subject to a close, I must briefly refer to the calomel treatment of cholera. I have no doubt myself that this drug, given in twenty grain doses, does stop the vomiting and relieve the purging of cholera; but I think it is simply in virtue of its antiseptic properties that it does so. It matters little if the calomel is given in large or small doses, so long as it reaches the walls of the affected intestinal canal; it there acts in the same way as the acids do, and, in many cases, equally efficaciously, but is more dangerous in its subsequent effects on the system. While, therefore, I admit the efficacy of calomel, I prefer, in most cases, the use of acids.

With regard to castor oil, I was acting as House-Physician to King's College Hospital, in 1854, when Dr. G. Johnson was treating his cholera patients on eliminative principles; I caught some of his enthusiasm on the subject, and came out to India the same year full of confidence and hope in castor oil. These ideas were destined soon to pass through a severe ordeal, for in the following year I was left at Bhaugulpore in charge of a field hospital; I was the only medical man in the place, when cholera burst out among the Europeans and natives under my care. I went boldly to work with castor oil, but it absolutely

and completely failed; the mortality from the disease was fearful. I have since, on several occasions, tried castor oil in cholera, but I have now finally abandoned it, having never seen any benefit arise from its use. I can fancy that, in cases of cholera in Europe, it may do good, by clearing away the infecting organic matter from the intestinal canal. But in this country I fear those who give this drug a fair trial will arrive at the conclusion I have done regarding it. I conceive it to be better, in and after the second stage of cholera, to give castor oil, than stimulants or over doses of opium, because these are absolutely dangerous; whereas the oil is hardly likely to affect the issue of the case one way or the other; nevertheless, it may exclude the employment of a more appropriate, and what I believe to be a more rational plan of treatment, and is therefore calculated to do harm.

I have had very little experience of the treatment of cholera by injections into the veins, but the success of this plan in the hands of Mr. Little, in 1866, would certainly lead one to hope that, in certain cases of collapse, we might resort to this method of treatment, not only safely but with advantage.

Mr. Little used the following formula as his injection fluid:

Chloride of sodium	...	...	...	...	60 grains.
Chloride of potassium	...	...	...	...	6 "
Phosphate of soda	...	...	...	...	3 "
Carbonate of soda	...	...	...	...	20 "
Distilled water	...	...	...	...	20 ounces.
Alcohol	...	...	...	...	2 drachms.

He injects as much as 120 ounces of this fluid into the median basilic at the bend of the elbow, or into the saphena vein, the injection being slowly carried on, so

as to occupy, it may be, over three quarters of an hour. An instrument such as that described by Mr. Little answers best for injections of this kind, the force of gravity being sufficient to drive the fluid into the vein. Mr. Little does not approve of the injection being forced into the vessels with a syringe.*

The supply of fluid to the dehydrated blood seems to revive the patient at once; but, unfortunately, the liquid too often drains away through the walls of the intestinal canal, almost as fast as we pour it into the veins. But in desperate cases the plan merits a far more extensive trial than has yet been afforded it, especially in conjunction with the less heroic treatment of the disease in its early stages, which is adopted by most practitioners of the present day.

I cannot help feeling hopeful that, formidable as the collapse of cholera is, we may yet, by means of a judicious combination of the means at our command, lessen the existing rate of mortality in this stage of the disease. We look to those in charge of our large hospitals in this country to enlighten us on these matters; and I for one am convinced we may with safety leave the issue in their hands. I must say, however, that it appears to me the profession in India require a little gentle stimulation in this direction; it would seem as if we had almost abandoned ourselves to despair in this matter of the treatment of cholera; doubtless the task is beset with difficulties, but this should not depress but rather stimulate research, where the good of our fellows and the honour of our profession are so deeply concerned. The solution of the question, I repeat, is one which pre-eminently

* 'Clinical Lectures and Reports, London Hospital,' vol. iii, 1866, p. 464.

devolves upon men living in the endemic area of cholera; and it is to us, therefore, that the profession in Europe naturally turn for information on these matters.

Preventive Treatment of Cholera.—The importance attached to the science of hygiene of late years is beginning to bear fruit in many parts of the world, and in none more so than in Great Britain and her colonies. In most of the principal towns in England extensive and well-managed water-works have been instituted, the drainage in many places vastly improved, and even in Calcutta we hope soon to see the magnificent water and drainage works at present under construction in full working order.

Beyond this, throughout India, as in other parts of the world, the conviction of the communicability of cholera has gained a firm footing since the report of the International Sanitary Conference of 1866, and means are being taken by individual officers all over the country, upon a more or less sound basis, tending to a practical recognition of the doctrines so forcibly enunciated by the savants assembled at Constantinople two years ago. It is a mistake, however, to suppose, as the Sanitary Conference has done, that the communicability of cholera was not acknowledged in this country before the Punjab report of 1861. Dr. John Murray, the present head of the Indian Medical Service, clearly recognised this fact in 1856, and for the last thirteen years has been the most energetic and unflinching advocate of the communicability of the disease. He has met with much opposition, but, nevertheless, the fact remains the same, that during this period he has contended for this doctrine with as much clearness and decision as Dr. Fauvel, or any of

the other leading spirits engaged in the Constantinople Conference of 1866.

It is evident, in considering the subject of the preventive treatment of cholera, that the rules we lay down must be based upon a clear and unqualified faith in its communicability from man to man. Admitting this principle unreservedly, it becomes comparatively easy to lay down such laws on the subject as shall be applicable to every civilised country, but the ways and means of enforcing those laws must necessarily be left to the wisdom of the governments of the states or nations concerned, differing as these do so widely in their habits and customs.

The fundamental principle, then, upon which our preventive means must rest, is an acknowledgment of the fact that cholera extends itself by the instrumentality of the fomes of those affected by it, or through articles of clothing, or, in fact, anything which has been exposed to the choleraic dejecta, and to which the organic infecting matter can have attached itself. Once let this law, which has been abundantly illustrated in the foregoing pages, be fully recognised, and the preventive treatment of this fearful disease might be left to the common sense of mankind. It is because I feel so strongly the vast importance of this recognition that I have been at the pains to draw up a faithful history of the disease—a record which, if it led to no practical conclusions, would be extremely dry and uninteresting. I am convinced, however, that it is only by a careful study of such a history that we can fully realize the certainty of the communicability of cholera, and the great importance of the recognition of this law.

Cholera is not transmitted from man to man by

contact, but by an organic infecting matter, passed with the evacuations of those affected, which must gain access to the intestinal canal of another person before he can be attacked with cholera. In this lies the whole secret of an effectual preventive treatment, for evidently, if we can destroy the organic infecting matter the instant it has passed from the patient, cholera cannot spread; or, what amounts to the same thing, if we can prevent the infecting matter of the cholera dejecta from reaching the intestines of other persons, we prevent them from getting cholera. Our efforts in this direction will constitute the most truly scientific preventive treatment of this fearful disease.

I appeal with confidence to the history of cholera for confirmation of the fact, that the disease has never yet appeared beyond its endemic area unless imported there from India by man. Every outbreak of it in Europe has clearly commenced in Lower Bengal, and been carried directly by human agency to the four points of the compass: south with coolies to the Mauritius, eastward to the Straits and China, northward over the Himalayas, and westward right away to Europe and America.

It naturally, therefore, becomes a duty for all civilised countries to consider how they may best protect themselves from what we may call the *Indian Pestilence*: a question in which European states have naturally a far deeper interest than in anything aimed at the elimination of the disease from its endemic area. This latter work should be the special care of, and one would have thought must be a matter of some interest to, the British Government in India; but from 1817 to 1860, it has, to the best of my knowledge,

never occupied their attention, at any rate so far as their native subjects are concerned.

Now, to apply this law of the communicability of cholera to the prevention of the disease: we understand that, on every occasion on which it has reached Europe, the disease has travelled from Bengal, either by way of Bombay, that is, westward, or through the north-western passage to Afghanistan. In the former course it has invariably extended from Bombay to the coast of Arabia, and so along the seaport towns of the Red Sea; and having reached Jeddah, it has been conveyed by pilgrims to Mecca, and by them distributed over Egypt, and so to Europe. Or the disease has passed from Bombay to Muscat, and the various towns along the shores of the Persian Gulf, and having gained Bassora it has spread up the Euphrates, or the Tigris, to Turkey in Asia, or to the north of Persia.

In other years the disease has spread to the north of Persia *via* Afghanistan, Herat, Mushed, and Teheran, and then along the shores of the Caspian or Black Sea, or else over the Caucasus into Russia and Europe.

We may first consider the circumstances of the Red Sea route, and see how far it is possible to stop the importation of cholera into the Hadjiz and Egypt from India. It is evident that the Turkish Government are in earnest in their intention of protecting themselves, as far as possible, from the inroads of cholera; for last year the Annual Sanitary Commission to the Red Sea, appointed by the Sultan to carry out the measures adopted by the Turkish Board of Health during the season of the pilgrimages to Mecca, left Constantinople on the 4th of February. The commission consisted of nine members, four of whom, Drs. Bimsenstein, Lozzi, Malesian, and Pasque, were Christians, and the others

and Africa
→

*If the pilgrims had not been isolated at
El For that stream of infected matter would
have been imported.*

Mussulmen. The Christian doctors would be stationed at Jeddah and Suez, at which places the majority of pilgrims from India would arrive and embark, although the pilgrims are at liberty to embark whenever and wherever they please. All ships on which any cases of cholera had occurred would be subjected to a quarantine of fifteen days, and the ships, as well as the baggage and clothes of the passengers and crew, would undergo disinfection. Ships from the country, on board of which no cholera cases had broken out, would be subject to inspection for from one to three days before any one would be permitted to land.

During the year 1866-67, out of a total of 896 vessels that arrived at Jeddah, only thirty-six were Indian, which carried 4230 Indians. Three thousand nine hundred and seventy-nine Indians only re-embarked, so that the remainder must have either died or remained in the country for the next year's pilgrimage, as those who arrive too late have to wait in the Hadjiz for next year's ceremonies. The total number of pilgrims arriving by sea was 26,794, and it took about three months for them to leave the country, after the conclusion of the ceremonies. No actual return is given of the number of deaths; but as only 24,381 pilgrims re-embarked, the mortality was probably considerable. Pilgrims from India are generally delayed the longest in the country, owing to their having to wait for a favorable monsoon for the sailing of their vessels. Subsequently Dr. Dickson reported to the British Ambassador at Constantinople, that he had received a communication from Dr. Bimsenstein, Inspector of the Hadjiz Commission, dated February 27th, 1868, announcing the safe arrival there of all the members of the commission, and the nomination of

*See 3/4
4
11230
3979
-261*

sanitary agents and health-guards at the several ports along the coast of Hadjiz and Jeman; and stating that all vessels touching at those ports were required to show a bill of health, under penalty of the fine as established by the Ottoman sanitary regulations.

Dr. Bimsenstein described the manner in which the caravans of pilgrims would be superintended by medical officers on their return from Mecca, and stated that, thanks to the efforts of the Governor of Jeddah, the hygienic condition of that town had so greatly improved since his last visit there, that he hardly recognised the place again. The sea-board of Jeddah was now lined by a well-built quay; the swamps which formerly surrounded the city had been filled up; the streets and bazaars within the city had been widened, made straight, and covered over with planks to keep off the rays of the sun; an air of cleanliness totally unknown in other eastern towns pervaded the whole place, and an abundant stream now supplied the town with fresh water. This had been effected by repairing the water conduits which had been destroyed by the tank proprietors, as stated in the report of the commission of 1866, and the water was now gratuitously distributed to the town by means of fourteen fountains. Dr. Bimsenstein further stated that the health officers were well seconded in their work by the local authorities, and by the people in general, who began now to appreciate the advantages derived from their presence. But few pilgrims had gone there in 1868, viz., from Suez, 3456, and from India 3093, making the total number of arrivals by sea 6549. The Board of Health now proposed to add to the improvements a lazaretto established on the Island of Camaran, for ships that

have to be put in quarantine in consequence of their being contaminated with cholera.

It is very plain, therefore, that the Turkish Government have profited by the advice of the Sanitary Conference of 1866; and they have been no less vigilant at Suez, where their quarantine staff is both strong and effective. Nevertheless, it seems to me that the British Government might give material aid to that of Turkey, by insisting upon all commanders of ships, whether European or Native, before leaving Indian ports, satisfying competent authorities that they could recognise a case of cholera when they saw it, and that under heavy penalties they should be bound to report any cases of the kind occurring among their passengers or crew to the port authorities, before allowing a creature from land to have communication with their vessel. It would be necessary for them to report instances of diarrhœa as well as of cholera occurring on board their vessels. To persons in Europe any such rule might appear impracticable, on account of the ignorance of the commanders of most ships regarding the symptoms of cholera, and the selfish opposition of owners; but in this country no such excuse as the former could be pleaded, for men frequenting our ports see too many instances of cholera not to be able to recognise it at once, and the Government might make agents and owners here responsible for the neglect of their employées in these matters.

The vessels which carry pilgrims are, however, of all ships the most likely agents for the conveyance of cholera from India to the Hadjiz by way of Jeddah, or to Kerbellah through Bassora.

The Native Passengers' Act of 1858 gives the Government of this country considerable power over these

vessels, and no doubt its enforcement prevents much overcrowding and filth which would otherwise occur; nevertheless, it seems necessary to control to some extent the description of passengers travelling by these vessels. I cannot wonder at cholera, or any other communicable disease, extending from India to the Hadjiz or Persia with these pilgrims; no one can realise the extent of misery and filth exhibited in the persons of many of the pilgrims, unless he sees them on board. Poor old men, on the brink of the grave, clothed in rags covered with vermin, their long beards and hair swarming with similar parasites. If one were set to select a cargo of human creatures from the endemic area of cholera, likely to spread disease of this kind, it would hardly be possible to pick out more promising subjects than these pilgrims, although they may not be overcrowded, and the appearance of the vessel in which they embark may be all that is desirable.

It would be well, I think, to insist upon each of these vessels carrying a Mohammedan surgeon—a licentiate of one of our Presidency Colleges, who could give a clear and full account of all cases of cholera or diarrhœa that might occur on the voyage from India, and the means taken to extinguish the disease on board. A full and really useful statement would thus be laid before the quarantine officers at the various ports at which the vessel might touch.

Another most important duty of the medical officer of these pilgrim vessels would be, to see that their clothes, and any bundles of old rags they might have with them, were thoroughly disinfected before they started on their voyage. Above all things he should attend to the supply of water placed in the ships' tanks

for drinking purposes. Commanders of vessels from this port are too often guilty of filling their tanks from the polluted Hoogly water; the water settles, and its organic matter, undergoing decomposition, becomes a deadly poison in about three or four days, and affects those who drink it on or about the sixth or seventh day after leaving Calcutta; it may be as early as the third or fourth day.

The commanders of vessels should be punished most severely if they leave port thus ill provided; and it should be the duty of the surgeon on board to satisfy himself that the drinking water has been drawn from a pure source, and that the tanks of the vessel are clean and in good order. If these matters were attended to, it would, I believe, be very rare to meet with cases of cholera on board these pilgrim ships.

The measures lately adopted by the authorities of Bombay might be carried out in other Indian ports, obliging the Custom House officers to add to the port-clearance of every seagoing vessel a bill of health, showing whether or not there are any contagious diseases prevalent in the town at the time of the ship's departure. In Bombay the Custom House officials carry out this order in the case of the English mail steamers, by merely endorsing on the back of the port-clearance a copy of the health officers' mortality returns for the week, which is shown to the chief of the Quarantine Department at Suez. But it would probably be well for the medical officer on board to back these certificates, or, in case the vessel carries no medical officer, for the captain to declare if even a single case of cholera, or, so far as he can tell, of cholera, had existed among his passengers or crew. And it should be his bounden duty to institute inquiries into these

matters: cholera could not escape his notice, but diarrhoea might do so, especially among the native crew.

It certainly seems absurd that vessels should be placed in quarantine, as the "Pearl" has been during the present year at Jeddah, because deaths from cholera were reported in Bombay whence she started. The Duke of Argyll very justly observes in regard to this case, that sanitary officers in India should be careful in wording the bills of health issued by them; but His Grace is not probably aware, that there is no such person as a sanitary officer or even a port surgeon attached to the Port of Calcutta.

But then comes the question, which seems so unnecessarily to have vexed men's minds, as to what is to be done with the vessel, her passengers, her crew, and cargo, supposing cholera to have occurred on board during the voyage from India. Are we to enforce quarantine or not? Surely there cannot be a doubt on this point; quarantine must certainly be strictly enforced under these circumstances; countries and continents ought not to be exposed to the dangers of such a fearful malady as Asiatic Cholera, for the convenience of a few persons from India—pilgrims, perhaps, from Mecca, or individuals in search of rest or health in Europe. Under any circumstances, it is quite contrary to the instincts of self-preservation to suppose that we should be allowed to imperil the whole of Europe and America for the convenience of a few, especially when this minority seem absolutely determined not to help themselves or respect their neighbours' interests in the matter.

It is evident that the more rigidly we can enforce quarantine on India, the greater the chance of pre-

serving Europe and the surrounding countries from cholera. Once let infected persons or things slip into Egypt or Persia, and there is but little chance of stopping the advance of the disease to the west and north-west.

Although I am thus an advocate for quarantine, it seems to me that those in power often defeat their own ends by enforcing an unnecessary and non-discriminating quarantine, putting individuals and merchandise to vexatious detention, in place of simply guarding countries from the invasion of disease. It appears absurd to argue, because a vessel, manned and officered by a set of half-civilised Arabs, carrying pilgrims to Mecca, should be carefully watched, and if subject to cholera made to undergo a rigorous quarantine, that therefore, if cholera has occurred on board a Peninsular and Oriental Company's Steamer, her passengers and crew must be subjected to the same restrictions. We may readily ensure 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.

With regard to pilgrims the case is quite different : people pursuing antiquated propensities of this kind must be treated upon antiquated principles ; moreover, the filth and misery in which these poor creatures exist, with their dirty clothes, long hair, and so on, render them the most favorable agents for the dissemination of the infecting principle of cholera ; which they may carry about with them in a comparatively inactive state so long as it remains dry, but ready to burst forth into a blaze the instant it is moistened by rain, or washed off their persons into rivers, or other sources of drinking water. I would therefore insist upon a vessel carrying pilgrims, among whom cholera has occurred, remaining in quarantine for six days after her arrival in the port of disembarkation ; and each day every man, woman, and child on board should be well washed in sea water, the vessel at the same time being thoroughly disinfected with sulphurous acid. The persons and clothes of the pilgrims having been repeatedly and thoroughly washed, they might be allowed to land with safety ; but should be detained in a lazaretto for six days more, and if no cholera shows itself among them during that time, they might be permitted to go their ways. But if, after their washing, and

during the period of subsequent probation, cases of cholera break out among them, it would be wise to re-ship the whole party and send them back to India.

Supposing the disease, in spite of these measures, to gain a footing among the pilgrims at Mecca, the recommendation of the Sanitary Conference of 1866 should be strictly enforced. They advise that the sanitary physicians of the Hadjiz should inform the local authorities of the fact, and likewise the vessels of war stationed at Jeddah and Yembo. On receiving the declaration, the authorities should make it known to the pilgrims, that those who wished to embark for Egypt would be obliged, before landing there, to perform quarantine at El-Wedge; and they should further inform them that they would be at liberty to go by the land route if they should so choose.

The embarkation should take place under the superintendence of the sanitary authorities, according to their established rules, and in whatever ports they may elect. The vessels of war should give every assistance to ensure the proper observation of the rules laid down; they should perform the duties of naval police, and they should keep as strict a watch as possible in order to prevent any unauthorised departures.

On receipt of the intelligence that cholera raged among the pilgrims, the Egyptian authorities should close all the ports of Egypt to all arrivals from the coast of Arabia, and they should send back all ships arriving thence to some place on the coast of Arabia, as El-Wedge. There they should be kept in quarantine, and not be allowed to start for Egypt until fifteen full days after the disappearance of cholera from among them, and after the disinfection of their clothes and luggage. On leaving El-Wedge, those of the ships

bound for Suez should be obliged to touch at Tor, where they should be placed under observation for twenty-four hours, and be medically inspected with a view to ascertain their sanitary condition. A clean bill of health, and the permission to proceed on their voyage, should only be given to the ships after such time as the sanitary condition on board should be reported satisfactory.

With regard to the caravan from Egypt, it should stop, as before, at its usual halting-place near to El-Wedge; it should be medically inspected there, and it should not receive permission to proceed on its journey until clear of cholera for fifteen days. With regard to the pilgrims proceeding to India or other countries beyond the Red Sea, they should be allowed to embark for the purpose of proceeding homewards, but only in conformity with the above rules. Communication by sea between the Hadjiz and Egypt should not be re-established for at least fifteen days after the disappearance of every trace of cholera, and this should be officially reported by the authorities of Jeddah. But even then the ships having on board pilgrims bound to Suez should be always compelled to touch at Tor, and remain there for twenty-four hours, for the purpose of being medically inspected as directed above. A proper scale of penalties incurred for each breach of the prescribed rules should be published; the "Native Passengers' Act" would form an excellent model for the purpose.

The principles upon which these rules of the Sanitary Conference are based, with regard to cholera among pilgrims at Mecca, seem to me to be equally applicable to similar assemblages in other parts of the world.

The first and most fundamental question upon which all restrictive measures turn is, the length of time the organic infecting matter may remain latent in the system, or may be preserved on articles soiled by ejecta. But a second consideration is also involved—can we destroy the cholera matter so as to render it innocuous?

I think it will facilitate matters if I attempt to answer the latter of these inquiries first, the more so as I can reply from actual observations made by myself in reference to this subject. It is now many years since Dr. W. Budd, of Bristol, declared his belief, and acted on that belief, that it is possible to destroy the infecting principle of cholera by means of chemical reagents; and one has only to read his admirable report on "Asiatic Cholera in Bristol, in 1866," in the 'British Medical Journal,' April 13th, 1867, to be convinced that the means he has employed have been successful in destroying the poisonous elements of the discharges when first passed by the patient. He recommends some sulphate of iron to be mixed with the stools directly they have been passed; I have already given an explanation of the way in which it appears to me the sulphate of iron acts, destroying the molecular action going on in the organic matter, and have stated my belief that cholera stools rendered acid in this way are absolutely innocuous. If one or more persons are seized with cholera on board a vessel, they should at once be brought on deck, and laid on a thick piece of sail cloth, so that they may be surrounded by a free current of air, with which the organic matter emanating from their persons may be diluted as far as possible. The stools should be voided into a vessel containing sulphate of iron, and they must then and there be thrown into the sea. McDougall's and

Calvert's disinfecting powders should be freely sprinkled about the spot on which the patient lies, and layers of sulphate of iron should be placed between the folds of the sail cloth upon which he is laid. Subsequently, whatever the issue of the case may be, the patient's clothes, and anything about or near him to which the matter of the dejecta might have attached itself, should be burnt; if this cannot be done, they must be thrown overboard, and the deck on which the patient lay should be well washed with some acid agent.

In cases of this description I would limit the number of attendants on the sick; let one or two men be employed for the purpose, and keep them separated from the remainder of the crew. This precaution probably somewhat exceeds the requirements of the case, but still it is better to be on the safe side, and extra care in these matters renders quarantine the less necessary—an object we should keep steadily in view, placing as few impediments on commerce as possible, and leaving it, at first, very much in the hands of those in charge of the cholera-stricken ships, to take the necessary measures for preventing the communication of the disease to others, which if they refuse or neglect to do they must then expect to suffer the inconvenience of quarantine.

The measures I have indicated would stop the extension of cholera on board a vessel from an individual case; but very possibly others may be attacked within three days of the first case, supposing them to have imbibed the poison at the same time; or it may be that the water in the ship's tanks is contaminated, in which case the outburst of cholera may be prolonged until the oxidation of the organic matter in the water has been accomplished, and this may take some days

in the cool, dark hold of a vessel at sea. It is well, therefore, if a case of cholera occurs on board a ship at sea, particularly if more than one man is struck down with the disease, to have all the water served out to the crew or passengers properly filtered and boiled, before it is used for drinking purposes; if there are condensers on board, by all means let the water from them be drunk in place of that in the tanks, at any rate for eight or ten days, or until the water shall have purified itself by oxidation.

If precautions of this kind are taken, it very much alters the case of the vessel as regards the necessity for her performing quarantine. To subject a carefully ordered and well-managed ship to fifteen days' quarantine, because she may have had a few cases of cholera on board, would seem to be quite unnecessary, whereas, had none of these precautions been taken, and were her passengers pilgrims in place of civilised beings, it is as obvious that quarantine would be all-important. If the quarantine officer in charge of the port of disembarkation is not thoroughly satisfied that means such as I have described have been effectually employed to destroy the infecting matter on board a vessel, she should be kept under quarantine of observation for six days, supposing the last case of the disease on board has occurred within six days of the ship's entering the port.

I mention six days, because it seems to me impossible for the infecting matter of cholera to remain in a person's system longer than that time without inducing its proper effects. In the case of the nineteen men who swallowed the contaminated water, the first was attacked in twenty-four hours, the last cases at the end of seventy-six hours, after which there was not a

Glow.

24 -

48 -

72

symptom of the disease; and this is probably the longest period the organic matter would remain in the system without inducing ill effects; it must inevitably become altered and destroyed in a warm alkaline medium, like that supplied by the intestinal canal, in four or five days or so. I am, therefore, of opinion that a human being could only be the medium of cholera for a period of, say three days; but we may allow three days more for accidents. On the other hand, if he is to be kept in quarantine until the dried organic matter which may have clung to his hair or clothes becomes innocuous, he might remain in quarantine for years. Means should be taken within the six days of quarantine to wash and disinfect the persons and articles of clothing, or, in fact, anything that could possibly have come within the influence of the infecting matter: all chance of cholera spreading may thus be absolutely prevented. The vessel, during the time that cholera cases occur, and subsequently, should be thoroughly fumigated with sulphurous acid, and the goods and crew after these precautions might be landed with safety.

In these days of rapid transit and universal inter-communication it is quite necessary to avail ourselves of all the aids that science can afford, so as to leave mankind as little fettered as possible in their movements. We can, and must rely for the protection of Europe and America from cholera, after it has passed into Egypt or Turkey, upon a well regulated system of naval hygiene, rather than upon lazarettos and lengthened quarantine—usages useful and necessary in years gone by, but not applicable to the circumstances of the civilised portion of the world at the present day. As I have already pointed out, when

dealing with less enlightened people we may safely resort to institutions justified by the conditions under which they travel and exist, and which are as necessary in these cases as they are unnecessary, vexatious, and impracticable under other circumstances.

I have already expressed an opinion as to the general impossibility of enforcing an effectual land quarantine. In fact, it is simply useless to look to such measures with any confidence, unless we can at the same time prevent the rivers of a country from becoming contaminated. We must be prepared, therefore, to stop the progress of rivers as well as of men, if we would effectually control the extension of cholera when once introduced into a country. Nevertheless there are exceptions, and I conceive that Europe has a right to demand that the Indian Government should do all in its power to stay the progress of cholera from the Punjab and Sinde into Afghanistan, and so to Herat, or northward to Bokhara.

Some of the means to be employed will be such as may prevent returning bands of pilgrims, from Hurdwar and other places, carrying cholera with them from town to town, and so spreading the disease, as they did in the course of a few months in 1867, from the north-west to Jelalabad. Even land quarantine may be very useful in cases of this kind, as insisted upon so strongly by Dr. J. Murray; the pilgrims should be stopped on the line of march if cholera occurs among them, and kept in quarantine, they and all their belongings undergoing a thorough ablution and fumigation before being allowed to pass on.

When once the disease has reached our frontier there is less chance of staying its advance into Cabul; but we certainly should endeavour to the utmost to prevent

its ingress into Afghanistan, either through the Khyber, Goleri, or Bolan passes. The entrances of these three inlets into Cabul are in our hands, and it would require but very little administrative talent to detect the presence of cholera among persons entering these passes from India; the Goleri and Khyber passes especially should be watched when cholera is epidemic in the north-west or Punjab.

The disease having reached Cabul, it may travel northward to Bokhara, as it often has done before; and here it will now come directly into contact with the Russians, and may spread along the course of the Oxus to the Sea of Aral, and thence to the Caspian; or it may extend, and probably would do so, along the course of the Oxus as far as Charjooee, and following the route to Merv would pass up the Etrek, and strike the south-eastern corner of the Caspian. We may, however, leave the Russians to deal with cholera in this part of the world.

A greater danger by far to Europe is the importation of cholera from Cabul into Herat; and yet the latter, being protected by mountains on one side, and the desert on the other, might be made a stand-point for resisting the disease. Unfortunately, it suits our purpose to preserve the place to the Ameer of Cabul, and Persia cannot therefore plant a quarantine establishment there. Cholera having once passed from Herat westward to Mushed, there is but little hope of preventing it spreading to Teheran, and the north of Persia. The main chance for Europe, then, is in Russian influence, protecting the towns on the western shores of the Caspian, and the routes pursued from the north of Persia into Turkey-in-Asia, and the shores of the Black Sea to Astrachan. These matters have been so

fully discussed in the report of the International Sanitary Conference, that I will not enter further on the subject in this work. It is evident that, so far as India is concerned, her responsibility ends after she has done her best to guard the passes into Afghanistan, and further, has lent her powerful aid to the Egyptian, Turkish, and Persian Governments, in preventing vessels or their human freight from introducing the disease into Europe *viâ* Suez, Mecca, Bassora—in fact by the Red Sea or Persian Gulf, which are so much under the influence of the Government of India.

It really seems that, if England would only insist upon these measures being carried out, we need no quarantine stations at the mouths of these seas; but if she continues deaf and indifferent to the warnings of Europe, and to the dictates of common sense and international morality, she cannot be surprised if Europe should some day combine against her, and compel her vessels to perform quarantine in the Straits of Bab-el-mandeb, or the mouth of the Persian Gulf. If this were done, and Herat protected, or still better the passes into Cabul, it would be almost impossible for Europe and America to be again exposed to the ravages of Asiatic Cholera.

Supposing, however, that in spite of all our care cholera has extended to Europe, how are we then to deal with the disease? And the same question may be asked, and the same answer will apply, to cholera in its endemic area. Our first care must be with regard to the water supply; if we can only preserve the drinking-water from contamination, it is out of the question that cholera should become epidemic in either country or town. The leading principles upon which we must rely for effecting this object are, first, to destroy the organic

infecting matter as it passes away from the patient by means of sulphate of iron, or some acid re-agent, taking care that the evacuations thus treated are buried in the earth away from wells or sources of water supply; and secondly, to disinfect or destroy all articles of clothing, furniture, or in fact anything to which the cholera matter could have attached itself. If this system were thoroughly carried out, it would be hardly possible for water to become the medium of the propagation of cholera.

I have admitted, and in fact would strongly enforce the doctrine, that the organic infecting matter of the dejecta of cholera patients is very apt to be disseminated through the atmosphere of close and small rooms, by patients suffering from the disease; and it is in this way that nurses and relatives in attendance on the sick often take cholera. Much of this might be avoided, if all the vessels into which the discharges from the patient are received, contained sulphate of iron or some dilute sulphuric or other acid. I give the preference to the sulphate of iron, because in powder it is more portable and easily managed than sulphuric or nitric acid.

The emanations from the sick, however, may also be absorbed by water contained in butts or cisterns, in fact in any such receptacles for drinking-water within a certain range of the source of infection. Water contaminated in this way in close and crowded courts or houses, may be the means of inducing a local epidemic, the supply being made use of by several people in one neighbourhood; and here again, unless the water were repeatedly contaminated, a limited and local outbreak of disease only would be the result; but this in its turn might spread through similar influences to distant parts of the same or neighbouring towns, and a more general

epidemic result. We cannot, therefore, too strongly insist upon every room (and the poorer the people the greater the necessity) being supplied with a pipe and stop-cock, from which water could be drawn direct from the mains of our large water companies. I am alluding of course to England, and those parts of the world in which the towns are supplied from well organised and properly constructed water-works.

I am convinced that, in the case of the river Lea, which was supposed to have been contaminated with cholera fomes in 1866, if the water-works had been in good order the inhabitants of East London would yet have been saved from cholera. The organic infecting matter of cholera will most certainly become oxidised in passing through well-constructed filter-beds, such as protect the entrances to the mains of all perfect water-works. I have no hesitation in affirming, that water slightly contaminated by cholera stuff is rendered absolutely harmless if passed through an upwards filter, such, for instance, as that recommended by Dr. F. Macnamara (see Appendix X); much more therefore would the splendid filter-beds in use by all large companies effect the same object.

This, I maintain, is our grand means of self-preservation when once cholera has appeared amongst us; if we can only establish the principle that nothing but freshly and properly filtered water shall be consumed by the inhabitants of a town, barrack, or house, not only when at home but when at work, at all times in fact when cholera is abroad, we may, I believe, discard all and every other means of preservation; cholera cannot possibly gain a hold on any country, village, or home protected in this way.

Measures of hygiene beyond this are, of course, most

useful in many ways, but they will not stop cholera, or in fact control its extension one iota if the means above indicated be neglected.

If the water supply is a matter of importance in a country like England, what must it be in the case of the drinking-water in the endemic area of cholera! And yet what is the state of the case at the present time, among the British troops stationed in and about the metropolis of India? This question is answered in the subjoined quotation from Dr. Macnamara's report. But we may ask further, if the water supply to our European soldiers, for whom so much has been done, and upon whom such vast sums are being expended by the State, be such as appears from this report, what must be the condition of the drinking water used by the natives of the country for whom nothing has ever been done, and not a pice expended by Government for the improvement of their hygienic condition?

Dr. Macnamara, in his report to the Secretary of the Inspector-General of Hospitals, for 1868, observes with reference to the drinking water used by the soldiers stationed at Fort William:—"It thus appears that the water of the old tank in its natural state yields six times more albuminoid ammonia than the standard of purity; in fact, it yields almost as much albuminoid ammonia as the vile and stinking water of the Thames at London Bridge. The water of the new tank is slightly better, it yields about five times more albuminoid ammonia than the standard. When we come to examine the effects of filtration upon the water, we find that the quantity of albuminoid matter is reduced but slightly, for the water from the standpipe still yields nearly four times more albuminoid ammonia than the standard water. It is then plain, from these experi-

ments, that the system of filtration in use in the fort water-works is very ineffective, for we find that it reduces the organic matter in the water only in the proportion of nine to seven, while the London Water Companies, using the same material, namely, sand, in their filters, manage to reduce the organic matter in the water they operate on to one-fourth the amount present in the unfiltered water.

“ There are, indeed, glaring defects in the system employed in the fort, the existence of which may account for its failure. In the first place it is to be noticed that the stratum of fine sand in the filters is only one foot deep, while in the filters of the London Water Companies it is in every case two feet and upwards in depth; moreover, the fort filters are constructed to allow of the filtration of 1000 gallons per square yard of filtering surface per diem, while the filtration in the case of the London Water Companies' filters is never allowed to exceed the rate of 720 gallons per square yard per diem, or thirty gallons per square yard per hour. Indeed, from inquiries I have made, I believe the figures just given do not fairly represent the practical working of the two systems, for the combined area of both filters in the fort is 200 square yards, the water is sucked through them at the rate of 90,000 gallons, the quantity daily supplied to the fort, not in twenty-four, but in about eight hours, the time during which the engine on an average works each day; this would indicate filtration at the rate of fifty-six gallons per square yard per hour. Further, if I am rightly informed, it commonly happens that only one filter is in use for days together, when the rapidity of filtration must be such as to preclude all hope of the filters acting effectively.

“But too rapid filtration is not the only, nor the greatest, defect in the system adopted in the fort water-works, for there exists in it another and a still greater defect, one which renders it impossible to judge with any degree of accuracy of the extent to which the filters exert a purifying influence; this defect is, that after filtration the water is exposed to light and air in the reservoirs annexed to the filters, and again in the service reservoir on the ramparts, before distribution through the service pipes. With the London Water Companies it is an axiom that the water after filtration must not again be exposed to light or air till it is drawn by the consumers, for it is a well known fact that if the water be so exposed, decomposition of the remaining organic matter quickly occurs, while the water may again become alive with minute animal and vegetable growths. If such a precaution be necessary in a climate like that of England, and in the case of the Thames water, how infinitely more necessary must it be in such a climate as that of Calcutta, and in dealing with tank waters which contain three or four times more albuminoid matter than the water which the London Companies operate on.

“The system of filtration in the fort water-works should be so altered and improved as to render subsequent filtration in the barracks quite needless. At present it is an accepted fact that the water from the service pipes must be refiltered, and accordingly chatty filters are brought into play throughout the barracks, and under their influence the little benefit accruing from the use of the main filters is undone, and the water is so transformed, that it out-rivals the water of the dirtiest butt in the filthiest court of any of the worst districts of London.

“ On the 3rd of February a bottle of water from one of the ‘chatty filters’ was sent to me by the surgeon of Her Majesty’s 26th Regiment, who was anxious, as choleraic diarrhoea had appeared amongst the men, to have the purity of the water used by them tested. The water was to the eye very dirty, with a considerable quantity of fluffy stuff floating in it; viewed in a foot tube the colour was very strong, and may be described as a mixture of green, brown, and yellow. On standing, a large amount of sediment was deposited; this I examined with a microscope; it proved to be made up of low vegetable growths, human hairs, fibres of cotton, wool, and linen, fragments of woody tissue, starch-grains, &c., and, amongst these, innumerable animalcules of many shapes and all sizes disported themselves, while many minute white worms wriggled about through the mass. On analysis I found that the residue from one gallon of the water yielded 3·99 grains of combustible matter, while the water yielded per gallon free ammonia ·034 of a grain, albuminoid ammonia ·081 of a grain, just double the quantity yielded by the albuminoid matter of a gallon of Thames water taken at high tide from London Bridge. On the 23rd of February I again examined some water from a chatty filter from the Dalhousie barracks. My notes of it are, ‘not so dirty as the water previously sent, combustible matter per gallon two grains, free ammonia per gallon ·0194 of a grain, albuminoid ammonia per gallon ·045 of a grain.’

“ Such are the results of filtration as practised for the benefit of her Majesty’s European Troops stationed in Fort William. I shall not add anything further in this place regarding ‘the chatty filter,’ for a correspondence regarding it will be found in the Appendix,

but I may here state that, under orders from His Excellency the Commander-in-Chief, I lately placed a sand and animal charcoal filter of my own arrangement in the Dalhousie barracks. I analysed the water when the filter had been at work three weeks; it was then yielding upwards of a gallon of water per minute. On analysis, one gallon of the water yielded $\cdot 5$ of a grain of combustibile matter, free ammonia $\cdot 0014$ of a grain, albuminoid ammonia $\cdot 0045$ of a grain; the water in the tub in which the filter is placed yielded of albuminoid ammonia $\cdot 0231$ of a grain per gallon; the effect therefore of the filter was to diminish the albuminoid organic matter of the water to one fifth its original amount. The description and a lithograph of the filter will be found in the Appendix.

“The water of the tank in the compound of the General Hospital is very dirty, even more so than that of either of the tanks on the glacis. The impurities were allowed to subside during two hours prior to the analysis, yet the water so far purified yielded $\cdot 030$ of a grain of albuminoid ammonia to the gallon. This water was, at the time the analysis was made, being used in an unfiltered state in the hospital, for the tower filter by the side of the tank has been for some time past out of repair. One of the new filters is now in use on the civil side of the hospital, and is found to supply sufficient water for the whole of its inmates.

“The water of the Alipore tanks was also allowed to clear itself during two hours prior to analysis. The analyses corroborate the statements I made in my last report as to the extreme foulness of the water.

“The water of the Diglah Tank at Dum-Dum is upon a par with that of the old tank on the glacis. The water of the hospital well at Dum-Dum contains

less albuminoid matter than that of either of the tanks reported on, and this, though the well is a very badly constructed one, is very unfavorably placed, and is used by many natives as well as by the European Hospital. It will be observed that the water yields a larger amount of free ammonia than the tank water; these salts of ammonia are derived from the albuminoid matter, and their formation marks a stage in the natural purification of the water.

“The water of the Havildar’s Tank at Barrackpore was in a terribly dirty state when I examined it on the 25th of January. The water had a most disagreeable smell, was of a very deep colour, and yielded to the gallon $\cdot 075$ of a grain of albuminoid ammonia; the water was not allowed to settle prior to analysis. This tank is considered the best at the station, and is the one which is most largely used for the supply of the troops both European and Native. In striking contrast with the analysis of the water of this tank is that of the river, which was examined on the same day by the same method; it yielded only $\cdot 008$ of a grain of albuminoid ammonia to the gallon. This is the water which, after subsidence, and thorough sand filtration, is to be supplied to Calcutta by the municipal water-works. I take this opportunity of again urging that the filtered river water should be supplied for the use of the troops in the barracks now being erected at Barrackpore; doubtless some arrangement might be made to obtain the water from the municipal filters, if not from the main which runs close to the barracks.

“The Havildar’s Tank at Barrackpore affords an example of the little reliance that can be placed upon a continuance of a supply of good water from a tank fed to a great extent by surface drainage. For, when the

water in it falls low under the influence of a long drought, the amount of organic matter becomes greatly increased, and undergoing decomposition may at any time, and quite unexpectedly, give to the water the taste, smell, and colour which characterised that of the tank in question at the time when I lately analysed it. It is, indeed, a common belief amongst the natives, that the water of a tank may suddenly turn bad, and I remember witnessing a most disastrous instance of the kind in one of the cooly depôts, attached to the Assam and Cachar Emigration Service. A large number of coolies were in the depôt at the time, and no cholera had occurred amongst them, nor indeed in the depôt for some time previously: the coolies all drank from one tank, the water of which was usually of very fair quality. One morning, on going to the depôt, I noticed a change in the colour of the mass of the water in the tank, and on pointing this out to the native doctor attached to the depôt, he said—‘Yes, the water has gone putrid.’ I immediately stopped its use, but the precaution came too late. Cholera broke out that night, and during the next three days upwards of twenty cases occurred in the depôt. My assistant, Baboo Kanyclall Dey, tells me he has witnessed three instances of the water of a tank thus turning *suddenly* bad.

“No doubt such a change in the water of a tank is very liable to occur in hot weather, owing to putrefaction suddenly affecting the organic matter which is apt to be so largely present in the water. But I can conceive the mass of water in a tank suddenly turning putrid owing to another cause, one to which my attention was drawn by a fact which I mentioned in my last report as having happened under my own observation in the case

of the tank which supplies the Martiniere Schools. We found that the water in the lower stratum of the tank smelt most horribly of hydrosulphate of ammonia, while the water at the surface was perfectly sweet. Now, though under ordinary circumstances, the circulation in the tank and the processes of diffusion going on in the water may be unable to overcome this difference in the water of the upper and lower strata, yet it is easy to conceive that, owing to sudden lowering of the temperature of the water on the surface, a rapid convection may occur, which will suffice to mix up the whole mass of water, giving to it the noxious properties of that which has hitherto constituted the lower stratum.

“The Fort William tanks are in two respects far more advantageously circumstanced than those at Alipore, Dum-Dum, and Barrackpore, for they are railed in and carefully guarded, and their gathering ground is well washed by the first heavy falls of rain before the water is allowed to enter them. I have no doubt that, owing to this latter precaution, any dangerous matters that may have accumulated upon the surface of the ground during the dry months are denied access to the tanks; yet a very large quantity of organic matter is washed into them, and it must be remembered that during the two or three months in which the maidan serves as a gathering ground to the tanks, it is traversed daily by hundreds, one might perhaps say thousands, of the poorer class of natives, whose notions of decency and conservancy are upon an equally low level. The water is therefore, during that time at least, in constant danger of pollution, and looking to this fact, and to the fact that the water at all times contains a large amount of organic matter, I cannot but think that, should the

municipal water-works yield the abundant supply of good water that is expected of them, the water might with advantage to the garrison be introduced into the fort; in the mean time the present system of filtration and distribution should be remedied; or, if this cannot be done, the chatty filters at present in use in the barracks should be replaced by a filter worthy of the name.

“ I recommended in my last report that for the supply of the native troops at Alipore, Dum-Dum and Barrackpore, wells should be provided, which should be dug by the side of the tanks at present in use, care being taken that they are all in the first place properly constructed, and that subsequently they are guarded from pollution at the mouth.

“ For the supply of the European troops at Barrackpore, I recommended in my last report the introduction of the filtered river water, and I am satisfied, from further examination of the water supply of the station, that it will prove much purer than the water of the tanks, which are at present relied on.

“ As regards the supply for the European troops at Dum-Dum, in default of better, the tank water at present in use must, I suppose, be still employed; but it should be filtered through sand and animal charcoal in the barracks. The tank should be diligently guarded; its gathering ground should be carefully preserved; and attention should be directed to the origin and course of any drains which open into it.

“ Wells, as a rule, afford a more safe supply of drinking water than tanks, for they are so much more easily guarded than tanks, and all the water which reaches the interior of the well must previously, if the well is properly placed, constructed, and used, undergo

very effectual filtration while percolating the soil in the neighbourhood. With reference to this point I was much struck by the evidence of Mr. Rawlinson on the purifying effect of a soil on water which passes through it. Mr. Rawlinson writes,* ‘We have made efforts to obtain water not from the surface of land, but that which has passed through the soil, and is there collected by subsoil drains. Sand mixed with loam occupied with vegetation, but not highly manured, constitutes a filter of the highest order. Most filters (all filters of the common sort) are merely strainers, and remove little but the matter in suspension; but the drainage through such cultivation, not only removes the matter in suspension, but takes away to the greatest extent matter in solution. This land filter, if it may be so called, takes out much of what may have been brought down by the rain in passing through the atmosphere. The waters derived from subsoil drainage were of the highest order of purity and quality, clear, cool and well aërated, and in the best condition for storage in covered reservoirs direct, and without any subsiding tanks. Where water cannot be got direct from naked primitive rock, then subsoil drainage waters are the best of all.’

“Only let the drinking-water wells be properly placed as regards distance from buildings and evident sources of pollution; let them be provided as they should be with ridge, platform, and drain to lead away waste water; let them be provided with a flooring of perforated stones or tiles, which will allow of the accumulated mud at the bottom being thoroughly removed; let each

* Report by R. Rawlinson, Esq., C.B., Civil Engineer, Chief Inspector, Local Government Act Office, Whitehall, on the best method of keeping water sweet when stored in tanks.

well be placed under a dome-shaped roof supported by pillars; exclude from the well all pots, lotahs, and ropes; let the water be drawn by a windlass provided with a chain and metal bucket, or better still, let it be raised by a pump, and there will be no difficulty in providing for the troops, at almost every station in the Presidency, perfectly safe and good drinking water. If a pump is used, the well's mouth may be closed, and light altogether excluded; if the windlass is used, the mouth of the well should be shut as nearly as possible by the application of a dome-shaped iron or wooden cover, having an aperture in the centre just sufficient to allow of the passage of the bucket.

“Attached is an epitome in a tabular form of the work accomplished in the analysis of potable waters during the past two years and a half. The table does not notice the reports upon two or three stations, the water supply of which will be re-examined during the current season, nor does it include the results of an important report by Dr. Sheppard, still in preparation, upon the water supply of Meean Meer; it however comprises a brief account of the water supply of fifty stations. With reference to this epitome, I think, perhaps, it would have been well had I, when speaking of any water supply as good, added the qualifying word “naturally,” for the water of some of the wells at almost every station is affected either by the faulty position of the well, or by its defective construction; it may be wanting in ridge, or platform, or drain to carry off waste water, or it may want all of these, or it may need clearing out. Even though the well may be at a safe distance from all possible sources of pollution, and though its construction may be excellent, including that very rare appendage, a covering, yet still, in almost

every instance, the quality of the water is liable to become injured by the frequent use of the well by native servants, who are allowed to draw the water from it by means of a rope and lotah or other vessel, which each provides for himself. In the case of the wells used by the native troops, it is indeed rare to meet with one the water of which does not bear the plainest evidence to the fact of its pollution by the habits of those who use it. I think it cannot be too strongly urged, that the wells for the supply of drinking-water to the European troops should be used solely for that purpose.

“Of the fifty stations reported on, the water supply, taken as a whole, may be said to be bad or deficient at Peshawur, Attock, Umballa, Delhi, Agra, Nusseerabad, Dinapore, Berhampore, Fort William, Alipore, Dum-Dum, and Barrackpore. Good water can be obtained at Peshawur, Agra, and Dinapore from certain wells, and the multiplication of properly-constructed wells in fitting localities will render the supply at those stations abundant and wholesome. At Delhi, Attock, Berhampore, Fort William, and Barrackpore, a good supply of water may be afforded by making use, for the purpose, of the water of the neighbouring rivers. At Umballa and Nusseerabad the supply may be rendered abundant and good by the construction of impounding reservoirs in the Morni Hills at Umballa, and the Aravelli hills at Nusseerabad. At Dum-Dum the water must be purified, as I believe it can be, by thorough filtration; and at Alipore, where native troops only are stationed, the construction of wells near the present drinking-water tanks will afford the means of providing wholesome water for their consumption.”

I have given this lengthened extract from Dr. Macnamara's report, because it embodies my own

views on the water question, stamped by the authority of one who has made the subject his study for some years past; and I would again inquire, if this be the condition of the drinking-water supplied to the British troops in this part of India, for whom so much has been done, what must be the condition of the water consumed by the natives of the country for whom nothing has ever been done in these matters? I can speak from personal experience as to the existence of very large quantities of organic matter in many of the wells and tanks in those parts of India in which I have resided.

I quite agree with Dr. Macnamara in his conclusions regarding the importance of the microscope as an adjunct to chemical investigations in examining the condition of potable waters. I do not believe we shall ever be able to find any characteristic appearances in the choleraic infecting matter, but I do think we can determine if the organic matter, which a specimen of water may contain, is in a state of decomposition capable of inducing cholera. For instance, if the water from a certain well or tank is placed in a tall glass vessel, covered with a bell-glass, and exposed to the sun, and after twenty-four hours examined under the microscope, and we find its surface covered with a film, consisting of molecular matter and vibriones, we may be almost certain that the organic matter, from which these vibriones are formed, is capable of inducing cholera, supposing it, of course, to have been derived from choleraic ejecta. It is not in our power, however, and probably never will be, from an examination of the contents of a given specimen of water, to determine if the organic matter it contains is derived from cholera products.

With regard to the action of the soil as a filter, I believe it surpasses all others as a purifier of water, and that a well-kept and covered well is one of the best sources from which we can possibly draw our supply of drinking-water. A well should, of course, be protected from surface drainage, and from all chance of contamination from cesspools and leaking drains. Moreover, the water should be drawn from it by means of a pump. I feel convinced that if freshly drawn water from a well protected in this way were alone used for drinking purposes, it would be hardly possible for those consuming it to suffer from cholera, unless attending on the sick in crowded or ill-ventilated rooms, or handling their stained linen. It would be very advisable to have one or more pumps connected with wells of the kind in the verandah of every barrack in this part of India, from which the soldiers might procure their drinking-water for themselves, entirely doing away with Bheestees and their abominable mussucks.

All cholera camping grounds should be provided with wells and pumps of a similar kind, or, still better, with Norton's patent screw pile pumps, in those parts of the country where they will answer.* A tube of this kind, run down twenty or thirty feet into the earth, could supply none but a stream of water absolutely free from cholera-infecting matter. I have little doubt that, valuable as the removal of cholera-stricken regiments into camp now is, the disease is often carried from one place to another in the Bhee-

* In this recommendation I am supposing, of course, that the pumps act in accordance with the statement and intention of the patentee. I have never seen a pump of this description at work; in fact, they do not, I believe, answer in this part of India.

stee's mussuck; the camp followers, also, greatly tending to spread the disease by contaminating the drinking-water as the regiment moves from place to place. All this might be avoided by means of Norton's pumps, or by properly-kept wells and pumps on the sites of cholera camps. If neither Norton's nor hand pumps are to be had, the drinking-water should be passed through an upward filter, or, failing this, might be boiled before being drunk. In all cases when a regiment is removed into camp, we must expect cases of cholera to occur for some three days after the men have been taken from their barracks, as a result of the contamination of the drinking-water, in or about the cantonments; prior to the removal of the corps; after that period no cases can occur unless from freshly contaminated water.

Soldiers, under these circumstances, like the crews or passengers of vessels, cannot be too frequently washed from head to foot, if possible in a running stream, together with all their clothes and belongings.

As a means of further security, I cannot but think a certain quantity of dilute sulphuric acid, served out to the men twice a day as a prophylactic, could do no harm, and would be well worth trying, especially on the first outbreak of the disease; it should more particularly be taken the last thing at night, and early in the morning.

Whenever cholera appears in localities where house-to-house visitation can be carried out, by all means let the practice be enforced; and pills containing acetate of lead and opium should be distributed to the people, with instructions to take them directly they are affected with diarrhœa—after the very first watery motion, as I have before laid down.

If a person is attacked with cholera, he must, as far as practicable, be isolated from the rest of the community; but, above all things, let the dejecta be received into a vessel containing some sulphate of iron, or other substance which will render them acid; they should then be thrown into a hole in the ground, taking care to select a spot away from wells or other sources of drinking-water. As each quantity of fluid dejecta is poured into this hole, a little dry earth should be thrown over it, and ultimately the spot carefully covered in.

If the patient dies, the body, after being laid in its coffin, should be covered with chloride of lime, and buried as speedily as possible.

In countries where cremation is practised, the body should be entirely burnt. This is a matter which our government here might look to with advantage, in place of allowing our rivers to be contaminated by the bodies of those dying from cholera, which are frequently thrown into them.

Under any circumstances all the clothing and bedding, together with the apartment in which the patient was laid, should be thoroughly fumigated with sulphurous acid or chlorine; the floors and walls being subsequently whitewashed, and left exposed to the air for six or eight days before being again occupied.

But with all this care, or any other means to which we may resort, cholera will never be stayed unless the authorities insist upon the drinking-water being boiled or filtered, whether the family are working at home or abroad. When practicable it will, of course, be preferable, as I have before said, to draw the water directly from the mains for the use of the consumer.

The grand object and main principle, then, of all

preventive treatment may be thus summarily stated :— First, to insure the destruction of the organic infecting matter by acids as it is passed, and its burial afterwards away from sources of water supply; and, secondly, to provide that the drinking-water be absolutely pure before being consumed. If precautions of this kind are carried out, especially in our large and low-lying seaport towns, we may defy cholera.

But this preventive treatment must not be confined to the destruction of true cholera dejecta, for I have before stated my firm belief that cholérine is a mild form, but the same disease as cholera. The dejecta, therefore, of patients suffering from cholérine must be destroyed in the same way as those of cholera. Moreover, the contents of latrines and privies should be largely mixed with sulphate of iron, as described and practised by Dr. Budd at Bristol in 1866.

There can be no doubt that the organic matter passed into badly-kept cesspools contaminates the atmosphere, and those who enter such places are liable to absorb the poison and be attacked with cholera, or cholérine, as the case may be; in this way, also, the foul air from sewers, containing the organic infecting matter of cholera, may induce its effects on those exposed to its influence. All this evil might be counteracted by the judicious use of sulphate of iron or mineral acids, together with the employment of disinfectants as recommended by Dr. Angus Smith, to whose work I would refer the reader for a full account of the method and practical use of these valuable agents.* I would only caution those in authority not to trust to deodorising agents alone, such as dry

* 'Disinfectants and Disinfection.' By R. A. Smith. Edinburgh, 1869.

earth ; it is but sorry practice to destroy merely the odour of so dangerous a material as that of the cholera dejecta by means of dry earth, and yet preserve its dangerous properties, as is too often done, by mixing it with sand, and allowing the mixture to dry and be disseminated as dust ; or, still worse, causing it to be thrown into rivers or other sources of potable water, as is done in Calcutta at the present time.

To obviate these evils we cannot use too much sulphate of iron, which, as Dr. Budd tells us, was employed in Bristol in 1866 “in the larger operations ; for which, as, indeed, for disinfection generally, it is admirably suited, by its cheapness, by the absence of corrosive power, and by many other qualities. Often, in order to secure a more abiding disinfection, this agent was placed in bulk, in the convenient form of coarse powder, in the drains and sewers, a mode of employment which deserves to be widely imitated.

“In the infected house the disinfecting powders were found very convenient for many purposes. In almost every case a thick layer of one or other of them was placed under the breech of the patient. Dispersed by a common dredger, such as cooks use for dredging flour, they were found to be the readiest means of sweetening the foul air of a filthy and crowded house.” *

It would be foreign to my present purpose to consider more in detail the circumstances under which cholera prevails as an endemic disease in India, and it would, moreover, plunge us at once into matters of a personal nature which are better excluded from a treatise of this kind. I can only express my conviction that the time is past for playing at Sanitary

* ‘British Medical Journal,’ Saturday, April 13th, 1867, p. 418.

Commissioners in this country. The question for the consideration of the Government is nothing less than this: Shall cholera be allowed by our mismanagement or neglect to become permanently localised throughout the civilised world? We have every reason to believe that it is a preventable disease, and that at present the only permanent source of infection is confined within comparatively narrow limits. It is to the condition of the inhabitants of the Gangetic Valley that our attention and efforts must be primarily directed if Asiatic cholera is ever to be effectually controlled by human agency. The present is a period singularly favorable for energetic action in this matter. The Empire is at peace; the first officer for India under the Crown is a nobleman of undoubted ability as a statesman, and one who possesses the acquirement, rare among those of his class, of being thoroughly conversant with modern science, and therefore able fairly to appraise all the evidence which may be brought before him on this and kindred subjects. Our Governor-General, again, although but a short time among us, has given unequivocal proof that he will adhere to his expressed determination of enforcing action and discarding a system of Reports and Red-tapeism—too long the bane of this country. With men like the Duke of Argyll and Lord Mayo at the head of affairs, we may confidently look for well-directed and vigorous action in a matter which affects so deeply the welfare of mankind and the honour of our country.

APPENDIX A.

THE following report by Dr. J. MacRae from Chittagong, dated November 1st, 1818, cannot fail to be of interest in a work on cholera. It is one of the very few remaining records of the period under review, and is the earliest original MS. I have had the opportunity of consulting on the subject. Dr. MacRae writes—

“The disease in question has been long familiar to me, but before I proceed to make any observations upon it, I consider it proper first to reply to the several questions of the Board in as satisfactory a manner as I can, and accordingly, in answer to the first question,—

“I beg to state, that the Cholera Morbus first came under my observation as a prevalent disease, early in 1790, when, as Assistant-Surgeon of the British Bengal Battalion, I marched to the coast with the Detachment sent to Madras, under the command of Lieut. Col. Coekwell, by Lord Cornwallis, upon the breaking out of the war with Tippoo; and since my arrival in Chittagong in 1794, I have had constant opportunities of observing it, as it prevails in this district, more or less, every hot season.

“In the camp of Col. Cockwell’s Detachment in 1790, it prevailed from the end of March until about the middle of June, or during the march through Cuttaek and the more northern parts of the Circars. In the district of Chittagong it always prevails in the hot weather.

“For some time before the appearance of the disease in Col. Cockwell’s Detachment, the first division of which left Barraekpore on the 13th of February 1790, the weather was such as usually prevails throughout Bengal in the cold season, and, therefore,

requires no particular description. During its formation, the Detachment lay encamped on the south coast of the Soobaureeka River, where the men erected temporary huts to protect them from the weather, the sepoy's of the Bengal Army being allowed no tents by Government in those days. On the 22nd of March the Detachment commenced its march to the coast, and as it proceeded to the southward the weather became warmer; fresh southerly wind generally prevailed during the day, and increased in strength as the sun ascended to its meridian altitude, and again became gradually more moderate as the sun sank lower, until it died away towards evening. A calm night succeeded, but close and warm in the early part, while towards morning heavy dew fell, and the air was chilly with a gentle easterly wind. We were daily threatened with rain, from the heavy white clouds which the strong southerly wind drove along in constant succession during the day, and in the evening became stationary in dark masses over us; but from the 7th of April, when we had the first shower on the south bank of the Cossjoory River, near the town of Cuttaek, until we arrived at Ellore on the 2nd of June, we had rain six times only, and then so slight were the falls of it, that they never prevented our marching on the following morning, except once, while encamped on the north side of the Chilka Lake, where, on the 15th of April, there was so heavy a squall of wind and rain, that the two Battalions, under orders to cross the lake on the following morning, were unable to strike their tents until noon, when they went over. About this period, the cholera morbus, which had made its appearance some time before, became very prevalent in camp, and continued to be so during our march through the more northern parts of the Circars, where we found the heat very oppressive, the thermometer (Fahrenheit's) rising on some particular days as high as 124° ; and having to march over bad roads, with artillery, the troops were often very late in coming to the ground, and when they did so, they had little covering to shelter them, either from the heat in the day, or from the dew and cold air of the latter part of the night. As we approached the Carnatic about the middle of June, there were frequent falls of rain; the heat of the weather became in consequence con-

siderably more moderate, and the temperature of the night and day more equal; the disorder then began gradually to be less prevalent, and as the rain became more constant it disappeared by degrees.

“In the camp of the Bengal Detachment in 1790, the disease appeared to take no particular direction: it prevailed during the march of the troops through the more northern parts of the Circars in the hot season, and ceased when a change of weather had taken place. Neither does it appear to have taken any particular direction in the district of Chittagong; whereas, in the northern Circars, the state of the weather seems to regulate it.

“It affects all parts equally and indiscriminately throughout this district, during the period of the year in which it prevails, namely, the hot season.

“No particular village, or part of this district, from its locality, is more especially subject to its influence than another. The soil throughout the district of Chittagong is uniformly dry in the hot season, and when it prevailed in Col. Coekwell's Detachment in 1790, it was marching through a country where the soil was in general light and sandy, and so much dried up at the time that the troops were frequently distressed for water to drink. The miasmata from putrid vegetable exhalations do not, therefore, appear to be at all necessary to produce it; and those of putrid animal exhalations appear to be equally unnecessary, or rather to have equally little effect in doing so, as was exemplified in the army of Lord Cornwallis in 1791, and 1792, while it lay before Bangalor, and Seringapatam; here so many thousands of the cattle, both public and private, died, that the air in camp was most offensive, yet no cholera morbus made its appearance in consequence of such putrid animal exhalations.

“All parts of this district are subject to the disorder at the period of its annual prevalence, that is, in the hot weather.

“It never occurred in the camp of the Bengal Detachment as a prevalent disorder, after its first appearance, upon our leaving the Circars, and then a change of weather had taken place. But in the district of Chittagong it occurs regularly every hot

season, and sometimes there are several cases of it upon the breaking up of the rains in October, when the atmosphere is loaded with similar, heavy, white clouds, as in the hot season; an easterly wind prevails towards the dawn, and very early part of the day.

“The lower classes of the natives appear to be most subject to the disorder, because they are most exposed to the weather—that is, more to the influence of the sun in the day, and to the chill air of the night. And the male sex is more subject to the disorder than the female, for the same reason, and adults suffer more than the aged and children. The food of all the lower classes, whether mussulmen or Hindoos, and indeed of all the natives generally in Chittagong, consists so uniformly of rice that little distinction can be made with regard to diet. The proportion of mussulmen to Hindoos is as three to one, but whether the proportion of those affected of either caste be in the same ratio or not, I have not remarked.

“Having never kept any registry of the number of patients I have attended during so many years, I cannot say, with any precision, what the average mortality may have been amongst a given number seized with the disorder; but I can confidently state, that none of those died to whom medicine was given immediately upon being taken ill, or soon afterwards, as was always the case while I was attached to the 13th Battalion; and though the disorder was so prevalent in the northern Circars, not one man died of it belonging to the corps. But when the purging and vomiting had continued long before any remedy was given, the result was very different. Referring to my own particular observations, I cannot say that I noticed any difference in the violence of the disorder during the period of its continuance; but there was a great difference in the number of casualties in the early part of its progress and in the latter. This I ascribed to the natives not being at first aware of the very dangerous nature of the disease, and therefore, from the expectation that the pain in the bowels, the first symptom of the malady, would cease of itself, they often never made their situations known until the purging and vomiting had come on; and as that generally happened in the night when people were

in bed, those around the unfortunate sufferer, from the natural apathy of the natives, would be in no hurry to get up and apply for assistance; thus much time was lost before any relief was administered to the patient, who was frequently so exhausted as to be past recovery. But the deaths so occasioned created such an alarm in the camp, that upon all subsequent occasions, they were prompt in their application for medicine, and fewer died in consequence.

“ I can form no estimate, or probable conjecture, of the sum total of mortality produced in this district during the last season by the disorder, but I understand it to have been considerable. As the opinion I had formed of the disorder, on its first coming under my observation, led me to infer that there was no morbid affection of any part, I never opened the body of any one who had sunk under it, and the dissections that have since been made have fully confirmed the justness of my opinion, in supposing it to arise from a general affection of the system.

“ A greater number by far recovered of those who took medicine, than of those who did not.

“ The stimulating mode of cure was decidedly the most successful, and the only one that I ever practised. Upon laudanum I chiefly depended for a cure, combined with essential oil of peppermint, æther, and volatile alkali. Laudanum, however, upon which I so much relied as a stimulant, is by some called a sedative; but how a substance which raises the pulse, increases the heat of the body, and produces intoxication can be called a sedative, I am at a loss to determine.

“ I never opened the vein of a single patient, for where there were such manifest symptoms of the most positive debility, I should have considered it highly improper to have done so; and it would have been a most wanton experiment in me to have made, when the mode of cure I had originally adopted, and have followed for so many years, has proved so very successful.

“ Calomel I never gave, in the first instance, to allay the irritable and spasmodic state of the bowels. Laudanum I found a certain remedy for the purpose; but after the disorder had

been relieved I have subsequently given calomel, and with the best effect, to induce a regular state of the bowels.

“The native practitioners have different prescriptions for the cholera morbus, but with the exception of two, in which opium is an ingredient, they appear to be of little use, and are not attended with much success. I consider their custom, however, of kindling a strong fire round their patient, a very judicious one, and it is said to be frequently useful. I have often ordered warm bricks to be applied to the soles of the feet, and to the chest on each side, while the abdomen was gently rubbed up and down with another, when the patient has been much sunk; and this has been done with the happiest effect, for the stimulus of heat, thus applied to the surface of the body, must greatly assist the remedies given internally, and tend much to restore the warmth of the skin and the circulation externally.

“The usual sequelæ of the disease in severe cases were great lassitude, and general weakness, want of appetite, and an irregular state of the bowels for some days, to relieve which, I have found the compound tincture of bark, with occasional doses of calomel, very useful.

“No instance of relapse has ever come under my notice, that I recollect, after recovery had been well established, and the bodily strength replaced; but I have frequently known the same person to be attacked in different seasons.

“No animals, that I have heard of, have been attacked by the disorder, though epidemic disorders frequently prevail among them.

“I have no reason whatever to suspect that the disease is contagious: on the contrary, I am decidedly of opinion that it is not so.

“It did not appear to me that the epidemic exerted any influence in lessening the frequency, or in modifying the symptoms, of fevers and other disorders common to this country; at the same time I am of opinion that the disposition to fever, in particular cases, must be lessened by the profuse evacuation that takes place in cholera morbus.

“Having thus answered the queries specified by the Board, I will now respectfully submit to their consideration such

further remarks as I have had an opportunity of making upon the cholera morbus; and though it will most probably ever elude our research to ascertain the causes which gave so wide a range to the disorder during the last year, we may, from the facts which have fallen under our more immediate and continued observation, be able to explain the cause of its prevailing under certain circumstances, and in certain situations, more than in others. By a reference to my answer to the second query, it will be seen that the disorder prevailed most in the camp of Colonel Coekwell's detachment proceeding to the coast in 1790, while passing through Cuttaek and the northern Circars during the hot season, when the troops were greatly exhausted by the fatigue of long marches, and were exposed to all the influence of the weather. The heat of the day, as formerly observed, was very great, the atmosphere was cloudy, and loaded with vapour, from the succession of white clouds, passing from south to north before the fresh southerly wind that usually prevailed in the day, and which clouds threatened us with rain morning and evening. But, from the end of March until we reached Ellore on the 2nd of June, we had rain six times only, and then so slight was the fall that, except once, on the 15th of April, as formerly mentioned in the answer to the third query, we never were prevented from marching on the following morning. The heat we found very oppressive in the day, but at night the air was cool, and towards morning became rather chilly from the easterly breeze, which then gently blew from the sea. The latter was close upon our left flank after we reached Jaggernath on the 11th of April, though we had had but occasional glimpses of it since we left Ganjam, as our road lay through a kind of valley, formed by the range of high hills which constitutes the western boundary of the Circars, and a chain of unconnected low hills near the sea. The Circars are a narrow tract of country, extending from north to south along the sea coast, and bounded, as stated, by high hills to the westward, and by the sea to the eastward. Towards Ellore these hills recede to the right, and the country becomes more open, the low chain of hills to the left, near the sea, disappearing.

“It has been already mentioned, that the Sepoys of the Bengal Army were not allowed huts by Government in those days; every man was obliged to shift for himself in the best manner he could, and the miserable covering which they formed to shelter themselves, by extending a blanket across a small bamboo as a ridge pole, with two erect ones at either end to support it, afforded but a slender protection against the weather; but, insufficient as it was, many of the men, and especially of the camp followers, had not even so much. Thus were they exposed to the alternate impressions of excessive heat in the day, and of the dew and chill of the easterly wind in the night; in consequence of which, the perspiration, which had been profuse in the day, received a sudden check during the night, in those who were exposed to the chill of the night air, or whose habits were most susceptible of the impression of sudden changes of temperature. A general chilliness, with violent pain and spasm in the bowels and stomach, then came on, which, if not speedily checked, soon deranged the whole system, but more particularly affected the alimentary canal, when severe vomiting ensued, attended with every symptom of extreme debility. The countenance assumed a ghastly appearance, the eyes sank in their sockets, the pulse became so feeble and low as to be hardly perceptible at times, a deadly coldness of the skin pervaded the whole body, and a complete collapse of all the blood-vessels externally seemed to have taken place, and the whole mass of blood to be accumulated internally, from a want of energy in the heart and arteries to propel it to the surface and the extremities.

“Such was my reasoning upon the causes, and such were the symptoms of the cholera morbus, on its first falling under my observation in 1790; and the observations I have had the opportunity of making upon it, since my arrival, in 1794, in Chittagong, where it appears every hot season, confirmed me in the opinion I originally formed of its cause—namely, the application of a chill air in the night, which gives a sudden check to the perspiration, after the body has been previously much exposed to a moist heat in the day. I call it moist heat because, when the disorder prevailed in Colonel Cockwell’s

camp in the northern Circars, the atmosphere was loaded with vapour and exhalations, blown upon us in heavy white clouds by the fresh southerly wind, which at that season blew daily along the coast. And when the disorder prevails at Chittagong every hot season, there is the same appearance of a cloudy atmosphere with a fresh southerly wind from the sea. That the disease thus arises from the alternate impressions of such heat, and a chill occasioning a sudden check to perspiration, simply and without reference to any noxious miasmata floating in the atmosphere, appears confirmed by what Colonel Cockwell's Detachment suffered during the three days it marched along the barren sands of the Chilka Lake, which hardly produced a blade of grass, with the sea within a few hundred yards on one flank, and the lake within a few paces on the other. So situated, it could not be exposed to the miasmata, either of putrid animal or vegetable exhalations; but it was exposed, under such an atmosphere as above described, to a hot sun, and its reflected rays from the sand in the day, and to the chill air of an easterly breeze from the sea in the night—when, in consequence, the men suffered much more severely than during any other equal period of the march.

“How far the easterly wind may have had any particular effect, (further than by the chill that accompanied it) in producing the disorder, I will not presume to say; but when it has fallen under my observation, the easterly was, invariably, the prevailing wind in the latter part of the night, the time when the disorder most generally comes on in the hot season. But whether it may not be produced in other places by the chill of the wind from any other direction, I cannot from experience determine. As being, however, so corroborative of the influence of the easterly wind in an inland situation far removed from Chittagong, I cannot omit bringing to the recollection of the Board the historical fact, stated by an anonymous author in one of the Caleutta papers some months ago, and said to be extracted from the records of a respectable native writer. He relates—‘that on a particular season during the Hurdwar fair, there happened to be a heavy fall of rain, followed by an easterly wind, that brought on a disease, of which thousands of those at the fair were taken ill, and died in a few hours,’ and from the descrip-

tion said to have been given of the disorder, it could have been no other than the cholera morbus.

“A fact of this nature, recorded by a person who cannot possibly be supposed to have been influenced by any motive to mislead, or by any bias to support a particular opinion, must be received as a strong proof of the influence of the easterly wind in producing that disorder, whether by some peculiar quality it possesses, or merely by the chill it brings along with it, in general, at a particular season at Chittagong. I have, in my own person, felt the effect of it; for having been unguardedly exposed to it towards morning in the hot season, I was seized with such a pain and spasm in my bowels, as would have been followed, I have no doubt, by every other symptom of the cholera morbus, if I had not had immediate recourse to laudanum for relief.

“In my answer to Query 14th, I said that the stimulating mode of cure was the only one which I ever followed, and had found it most successful, and that upon laudanum I chiefly depended for a cure. I then remarked, that I never found laudanum to fail if given early in the disorder, and in sufficient quantity, nor indeed after the purging and vomiting had come on, unless, from their long continuance before any relief had been administered, the patient had sunk so far as to be insensible to the effect of medicine.

“But the best remedy may fail, if not administered with judgment according to circumstances, and so get into discredit, as laudanum has often done in the cure of the cholera morbus. A fact so very illustrative of this fell under my observation during the late prevalence of the cholera morbus, that I trust the Board will pardon my relating it. Two of the bearers in a gentleman's family at this place, had been attacked, in the course of a few days, with the disorder; they were taken ill in the night, and some time consequently elapsed before their master was apprised of their situation, from an unwillingness to disturb him. Upon learning it, a dose of laudanum was given to each, and repeated, but without effect; both died. Their death so alarmed the rest of the set, that they were unwilling to remain in service; upon which their master sent them all to me

with a note informing me of what had happened, and requesting that I would prescribe for one or two of them, who complained of being unwell; and begging, at the same time, that I would mention what was proper to be done, in case any more of the servants were taken ill, as laudanum seemed to have no effect in relieving. At this I expressed my surprise, and desired to know what quantity of laudanum had been given to each of the men who died, when I was informed that forty drops had been given to each and repeated. This accounted to me at once for the failure of the medicine.

“Having prescribed some harmless thing to the men who complained, and who appeared to be more under the influence of alarm than of any disease, I said something to restore the confidence of them all, and sent them back to their master, with directions to give a teaspoonful of laudanum to the next man taken ill, instead of a few drops; and that this quantity should be repeated every twenty minutes, until the patient was relieved. An occasion soon occurred of following these directions: a man being taken ill, a teaspoonful of laudanum was immediately given to him, and repeated, when he was thrown into a profound sleep, and awoke perfectly well.

“The success of this case led to a continuance of the practice, and no servant has since died of the disorder in that family, though several have been taken ill, and thus the credit of the laudanum, and a confidence in it as a cure, were restored.

“A knowledge of the fatal consequences of taking opium, or laudanum, in any quantity, has excited an extreme caution in prescribing it, except in very small doses. But however judicious this may be on common occasions, this caution in giving it for the cholera morbus has often proved most injurious, as exemplified by the anecdote just related; for it would greatly surprise a person unaccustomed to the disease, to see what a quantity of laudanum a patient in the more severe cases can bear, before he is cured.

“Necessity originally induced me, while with Col. Coekwell's Detachment, to give laudanum in large doses; for as, after the first visit, I never could again see the patient, who had been taken ill about the hour of marching before dawn, until we

came to our ground, when the day was perhaps considerably advanced, I was led to act decidedly in the first instance, by giving as much as I possibly could with prudence of the medicine, and the success which attended that practice under me continues to the present day. A drachm of laudanum, with three or four drops of the essence of peppermint, seldom fail to relieve the first attack of pain and spasms in the bowels, if given immediately. If the purging and vomiting should have come on, and have become frequent, the medicine must be often repeated. We are not to be discouraged by the rejection of the medicine by vomiting, but instantly give another dose, and so on, over and over again, until the disease is overcome; for if the greater part of the medicine be rejected each time by the vomiting, yet still a certain small quantity so retained, accumulating at each repetition, never fails in the end to relieve, if it be duly persevered in. Æther I have successfully combined with laudanum: I have given a teaspoonful of each as a dose, and repeated this quantity several times before the disorder was overcome. It is not the quantity of medicine we may have given, but its effect, that is to direct our practice; in the state of the skin and the pulse we have an unerring criterion to guide us; until both are restored to their natural state it is evident that the disease is not overcome.

“In cholera there is a constant desire to drink, but until the vomiting be checked, this desire should on no account be gratified—the effort made to vomit tending to exhaust the patient.

“The malady more frequently comes on in the morning, or the night, particularly towards the morning, than during the heat of the day, though the symptoms may not be so severe at first and may, therefore, be neglected till the following day; the disease which had attacked the patient in the night is thus supposed to have begun during the day. I cannot say that I recollect a single instance of cholera morbus, in which purging and vomiting had come on all at once, without some previous uneasiness in the bowels, varying as to the length of time by which it has preceded the more violent symptoms.”

APPENDIX B.

THE following report, by Dr. H. W. Bruce, Surgeon to the 1st Bengal Fusiliers in 1848, is a good example of the material from which I have derived my information as to the circumstances of cholera in India; it is, moreover, an additional proof of the value of many of the records contained in the Proceedings of the Bengal Medical Board.

“Epidemic Cholera made its appearance in the regiment in the end of May, 1848, and almost simultancously, though in a much milder form, among the native inhabitants and native regiments of the place; and it continued to carry off its victims, by successive invasions of shorter or longer duration, up to the beginning of September. In May, easterly winds had prevailed from the 8th to the 22nd of the month, and between the 14th and 23rd there had been several very heavy falls of rain; on the latter date, the hot westerly wind began again to blow, and continued to do so during the remainder of the month, drying up rapidly the moisture that had fallen; the consequence was an aggravated type of diseases in general among us, succeeded by cholera, the appearance of which, at that time, is clearly to be ascribed to the above cause. The whole month of May had been very hot, the temperature taken at sunrise, noon, and sunset, within the hospital, gave a mean of 90° for the month; but the men had been healthy up to the time the rain fell.

“The first case of cholera was admitted on the 27th of May, and during that and four succeeding days thirty-one cases altogether were brought to the hospital; twenty-eight of these were cases of pure spasmodic, and three of bilious, cholera. I may here remark that none of the cases were allowed to be entered

as 'spasmodic' unless the spasms were distinctly marked, or the flocculent conjee stools were present; the rest were all entered as cases of bilious or incipient cholera. Among the latter, there were doubtless many cases of the spasmodic disease in its incipient state, which, being brought under treatment early, were checked, upon the spasms becoming apparent; but it was my wish to avoid that fertile source of error in the statistics of the disease, which arise from all cases of purging and vomiting, during the prevalence of an epidemic, being grouped together as spasmodic cholera cases. The term 'spasmodic' ought, in my opinion, to be confined to the disease in its fully developed state, for it is in that state that our remedies are found so utterly to fail, and it is most desirable that we should be able to gather from public returns what the proportion of recoveries from the matured disease generally is, and thence some indication of the value of the different medicines that have been used; this never can be done while the incipient cases, which are so much more amenable to treatment, are classed with the disease in its confirmed and intractable stage.

"The first cases admitted, as is usually the case at the commencement of an epidemic, were all very severe and rapid in their progress; the first seven all proved fatal, and it is a curious fact that six out of those seven were men belonging to No. 4 Company, and all brought from the same barraek. I carefully inspected that building twice over, without being able to find anything to account for the circumstance. In all the ranges the men were too much crowded for the purposes of health, but there was nothing in that particular one to render it more unhealthy than the rest. However, on the 30th of May, I recommended that the company should be removed into a large detached building on the plain, which had been the riding-school of the Dragoon regiments formerly stationed here, and that the barraek should be whitewashed and otherwise purified. The removal of the men had the immediate effect of checking the severity of the disease among them, and no fatal case occurred while they remained there. Various measures were adopted to prevent, if possible, the spread of the disease. Roll calls were instituted every hour during the day, which ensured

the presence of the men in the vicinity of their barracks, and prevented the injurious exposure and drinking which so often take place in the Bazaars and open air. The provisions were carefully inspected daily, and boxes of the common cholera pill were distributed to the pay and orderly sergeants of companies, with orders that one was to be given to any man who complained of sickness at the stomach or purging, and that he was forthwith to be sent to the hospital. Extra doolies were also allowed and kept near the barracks, that no delay might take place in transmitting the sick; and, at a later period of the season, I had the officers' guard-room bungalow made over to me, where I kept an efficient assistant. The men were admitted there, and treated during the day, and conveyed to hospital in the cool of the evening. I was induced to do this, not only that the cholera patients might receive immediate attention, but from the circumstance of one or two cases of apoplexy having occurred in the dooly, among men who were said to have left their barracks with fever, whilst being taken to hospital in the heat of the day.

“In June, twenty cases of cholera were admitted, but of these only twelve were spasmodic cases; in fact, during the first part of the month the malignant character of the disease had almost entirely disappeared, for, of those admitted between the 1st and 28th, only one case had proved fatal. Rain had fallen on six or seven days only, and not in quantity sufficient to have produced this change, and the mean temperature for the month was only half a degree lower than it was in May. On the 29th, however, it put on the same deadly type that had marked its first advent, and, strange to say, it fixed again in its worst form on No. 4 Company; on the 29th and 30th three cases were admitted from that company, two of whom died within twenty-four hours of their admission, and the third on the 1st of July. The men had been removed back to their own barracks when the lull took place, but they were restored to the riding-school on the 30th, and only one more fatal case took place in the company while we remained at that end of the station, and that one was admitted on the day after their removal.

“There is nothing more strange in the history of this strange disease, than the effect produced by removing a body of men among whom it is raging, even for a few hundred yards. In the present case, much might have been due to the increased quantity of air from the large size of the building, but they had the disadvantages of greater heat, from the want of their tatties, and were without punkas, which were pulled day and night in the barrack they had left.

“On the 1st of July I recommended, as a temporary measure, that the whole regiment should be removed from the Dragoon Lines on the east, to the Infantry Barracks at the west-end of the cantonments. I had a threefold object in this recommendation:

“1st. In the first place, we were then occupying buildings that were originally intended for only 600 men, and, although two of these ranges had been made over to us, the men were still too much crowded. The infantry barracks were calculated for the usual strength of an Infantry corps, 1000 men, and, in addition to these, there were two ranges of staff barracks available, in which all the married men of the regiment could be accommodated—a consideration of the greatest moment, as will be allowed by every one who has seen how the divisions and arrangements for married men fill up and obstruct the circulation of air in every barrack.

“2nd. We got rid, in some degree, of the great surface evaporation which must take place towards the east end of cantonments, and which is always detrimental to health; the ground is flat, none of the water, or at least a very small quantity of it, is carried off by drainage, and the nature of the soil admits of no percolation. When the surface is once moistened, in fact, the parade ground and the whole vicinity of the hospital are one extensive shallow jeal for days after each heavy fall of rain.

“3rd. We had in our favour all the chances of benefit which are known to arise simply from removal in cholera, and which was exemplified in a striking manner a little later in the season. Lastly, the men themselves desired the change.

“For four days after our removal to the west-end of the station we remained free from spasmodic cholera; but it broke out afresh after that time, and raged more violently than before.

Out of thirty-three spasmodic cases admitted in July, no fewer than twenty-one died. The rain continued to hold off, or rather to fall in such quantities as added to the evil instead of checking it, with intervals of very hot weather between the scanty showers, keeping up the temperature to a mean of 89° for the month.

“In August matters were very little improved, though the temperature had fallen so as to give a mean of $84\frac{1}{2}^{\circ}$; but as no abatement seemed to take place in the severity of the disease, I recommended that the regiment should be moved out into camp, and kept there away from cantonments altogether if the change prove beneficial. The safety of the measure was canvassed and much doubted by the military authorities of the division, and the question was referred to the decision of a medical committee which assembled with the superior surgeon as president; they gave me their full support, and strongly urged the necessity of the step as the only thing remaining undone which was likely to free us from the pestilence. On the strength of their report a divisional order was immediately issued for the move, and a camp was pitched about six miles from cantonments, on the highest ground that could be found, where there were trees to shelter us from the sun.

“But it so happened that, just as these arrangements were completed, one of those temporary lulls in the disease that had happened once or twice before during the season took place. We had no fatal case between the 23rd and 31st, and, as I was averse to exposing the men without urgent necessity, the commanding officer, on my own representation, took upon himself to postpone the move. On the 31st, however, one case was brought to hospital, as severe as any we had had, and as that was a sure prelude to a succession of others the whole regiment was marched out into camp on the following morning, viz. on the 1st of September. On that day three cases of the worst description occurred in camp, all of which proved fatal within twenty-four hours of their admission; and on the morning of the 2nd two others were seized, but they recovered. I ascertained that all these five men had been purged the night before we left cantonments, and two of the first three had had

slight spasms, which obliged them to fall out of the line of march to camp. I consider, therefore, that I am justified in saying that these were all entonment cases, and they were the last we had in the regiment.

“On the 6th and 7th we had continued heavy rain, so much so that the whole camp was flooded, and we were forced to return to entonments on the morning of the 8th; but the move had had the desired effect, for although we found the disease raging in the city and bazaar as severely as before we went out, not a single case occurred in the regiment from that time forth. This is a circumstance not easily accounted for: the rain certainly had fallen more freely, but we had still the same alternations of heat and moisture, which appeared to have generated and kept alive the disease during the former part of the season, and the increased quantity of rain had not freed the native population from the scourge.

“From the commencement of the epidemic excessive purging and vomiting had not been prominent features of the disease; even in the first admitted cases, all of which proved so rapidly fatal, the patients generally stated that they had vomited but once or twice, and had had three or four watery motions previous to admission. In many there were no spasms till after they were in a state of collapse, more or less complete, with a pulse sunk or gone; skin, tongue, and breath cold; hands and fingers shrivelled, blue, and clammy; countenance and eyes sunk, with deep areola round the latter; intense thirst, restlessness, and jaetitations. In three of these cases, however, the purging and vomiting were incessant, and neither could be checked by any medicines, blisters, &c., that were used, and they certainly proved fatal in a shorter period than the others—the collapse and sinking appearing to have a direct ratio to the amount of exudation and discharge.

“It is still a favorite opinion with many that this always holds good in cholera, viz. that the amount of discharge and the collapse stand in the direct relation of cause and effect. If it could be established that such is the case, a great step would be gained towards the successful treatment of the disease, and much of the anxiety and uncertainty that attends it removed;

but experience is opposed to such a conclusion, for who has not seen marked cases in every epidemic where there was neither purging nor vomiting sufficient to cause any degree of collapse, and yet those cases have sunk at least as rapidly as others where the discharges were profuse? Many of the cases treated last year, especially in August, were of this description; the subjects of two of them were among the best and steadiest men in the regiments, and whose account of themselves could be fully relied on. One of these men stated that he had one copious fluid motion, after which, feeling unwell, he came to hospital immediately; he vomited for the first time in my presence as he was taken out of the dooly. I found him in a state of collapse, and he was dead within six hours of that time, having been purged again only once; this last was a pure, floeculent, conjee motion, but it was only his second, and in the *post-mortem* examination an unusually small quantity of the conjee fluid was found in the intestines. The other was a case much of the same kind—he had three conjee stools and vomited three times in all. Had there been in these cases any remarkable degree of discharge from the skin it might have been supposed to compensate for the deficiency of the other, but such was not the case, the usual amount of cold clammy perspiration only being present. The following circumstance also bears on this point: I have said that the cases admitted on the first outbreak of the disease were of the most rapid and fatal description, but after a few days a considerable change took place, inasmuch as the heat of surface and the pulse did not sink at once and so hopelessly, though the purging and vomiting continued at least as great. It was in these cases, where the warmth of the extremities was in some degree persistent, and where the spasms were severe, that I found bloodletting, especially from the temporal artery, so decidedly beneficial.

“The first cases were treated with mercurials, opiates, vegetable astringents, and stimulants, and mustard cataplasms were universally applied to the epigastrium and to the extremities, if the spasms were severe. Some were allowed to take, on admission, Calomel gr. xx, washed down with a draught consisting of Tinet. Opii ʒj, Mist. Camph. ʒj; or a pill

composed of Cal. gr. xii, Opium gr. ii, was first given, and modified or repeated at longer or shorter intervals, according to the urgency of the symptoms, and the effect on the head and bowels. When vomiting was allayed by these medicines, stimulating draughts, composed of Turpentine, Tinet. Card. Comp., Spt. Lavand. Co., Spt. Æth. Sulph., Liq. Am., Brandy, &c. &c., were given, with or without opiates; and smaller doses of calomel were repeated every hour or half hour; bottles of hot water and bags of heated sand were placed in contact with the body and extremities for the purpose of preserving the animal heat as long as possible, and frictions with powdered ginger, brandy, or turpentine were assiduously applied to the arms, legs, and abdomen, without exposing those parts. The warm bath was tried with some, and, in short, everything was done which seemed to promise to sustain the circulation, while we waited for the effects of the calomel and astringents taken internally. But no success attended the practice; they were for the most part unfavorable cases from the first, where collapse had commenced and bleeding could not be resorted to, and, although in many of them the purging and vomiting were checked without difficulty, the collapse steadily increased.

“I next had recourse to the practice recommended by Dr. MacGregor, viz. croton oil combined with opium or hyoseyamus; but in my hands it was far from sustaining the high character with which he has invested it. In all the severe blue cases, as well as in those where collapse had commenced, it was as powerless as any of the other remedies administered; I found it succeed frequently in the milder cases where the pulse was good and bleeding had been resorted to before its use; but in that class of cases the mercurial and sedative treatment was equally, if not more, successful. It is astonishing the extent to which both opium and hyoseyamus can be pushed in the above combination without affecting the head, and the question must be left for future decision whether this tolerance of the narcotic is caused by any modification of its properties by the oil, or whether it is only in diseases like cholera, where the power of absorption in the stomach and bowels is entirely in abeyance, that such doses can be given. In one case, a hopeless one

certainly, I gave five drops of croton oil, combined with five grains of the Ext. Hyoscyam., every half hour for twelve consecutive hours; strange to say, the patient had only one scanty motion during the whole of that time, and up to the hour of his death the head remained as clear as it was before he commenced taking the medicine. It would appear in this case that no portion of the medicine had been taken into the system, as even the usual purgative effects of the oil were wanting; but I have seen several other cases which terminated favorably, and where very large quantities were administered before the proper effect of either medicine was apparent.

“I had recourse to the lancet only where the pulse was felt and the spasms severe; in those cases I found it eminently useful in checking the spasms, especially when the blood was drawn from the temporal artery; but other cases were not wanting where I had reason to regret having used it, though the symptoms promised a favorable result. It is a remedy which requires both caution and experience to be used with advantage; in the disease as it presented itself during the last two days in May, and in the beginning of June, I practised it freely, and for the most part with great benefit; but in July and August I was obliged to discontinue it altogether, for during the latter month the stage of invasion was so short that the disease might almost be said to have commenced with collapse, in which state I consider it inadmissible. A good pulse and warm extremities are conditions essential to its beneficial employment, and then, if the spasms are severe, it may be expected not only to check them, but in some cases the discharges also, as well as to restore the balance of the circulation.

“Upon the whole, the treatment I found most successful was that recommended by Dr. Graves, viz. acetate of lead and opium as an astringent, repeated every half hour, and the quantities increased or diminished according to the nature of the case; and as soon as the astringent effects of these medicines were apparent the intervals between the doses were increased, and a scruple or ten-grain doses of Ammonia Carb., either dissolved in an aromatic tincture or given in pill, were

alternated with each dose. As the purging ceased the acetate of lead was stopped, and small doses of calomel were given in its place, still keeping up the stimulants by the mouth. In some cases I found stimulating injections by the rectum of great service: the best was composed of turpentine, powdered mustard, and muelage or barley water, with the addition of Tinet. Opii if it could not be retained without it. I consider the acetate of lead the best astringent we have in cholera, and carbonate of ammonia and brandy are the best stimulants. The use of the acetate of lead, however, is not without its evils; in almost all the cases where recoveries from the first severity of the attack could be attributed to its effects, the secondary fever was more severe and intractable, and the head symptoms which accompanied that fever were for the most part alarming and frequently fatal, so much so, that I was obliged to apply ice to the head from the moment that reaction began to take place, and to leave a competent assistant to apply leeches to the temples and occiput whenever the slightest heat of head was discovered.

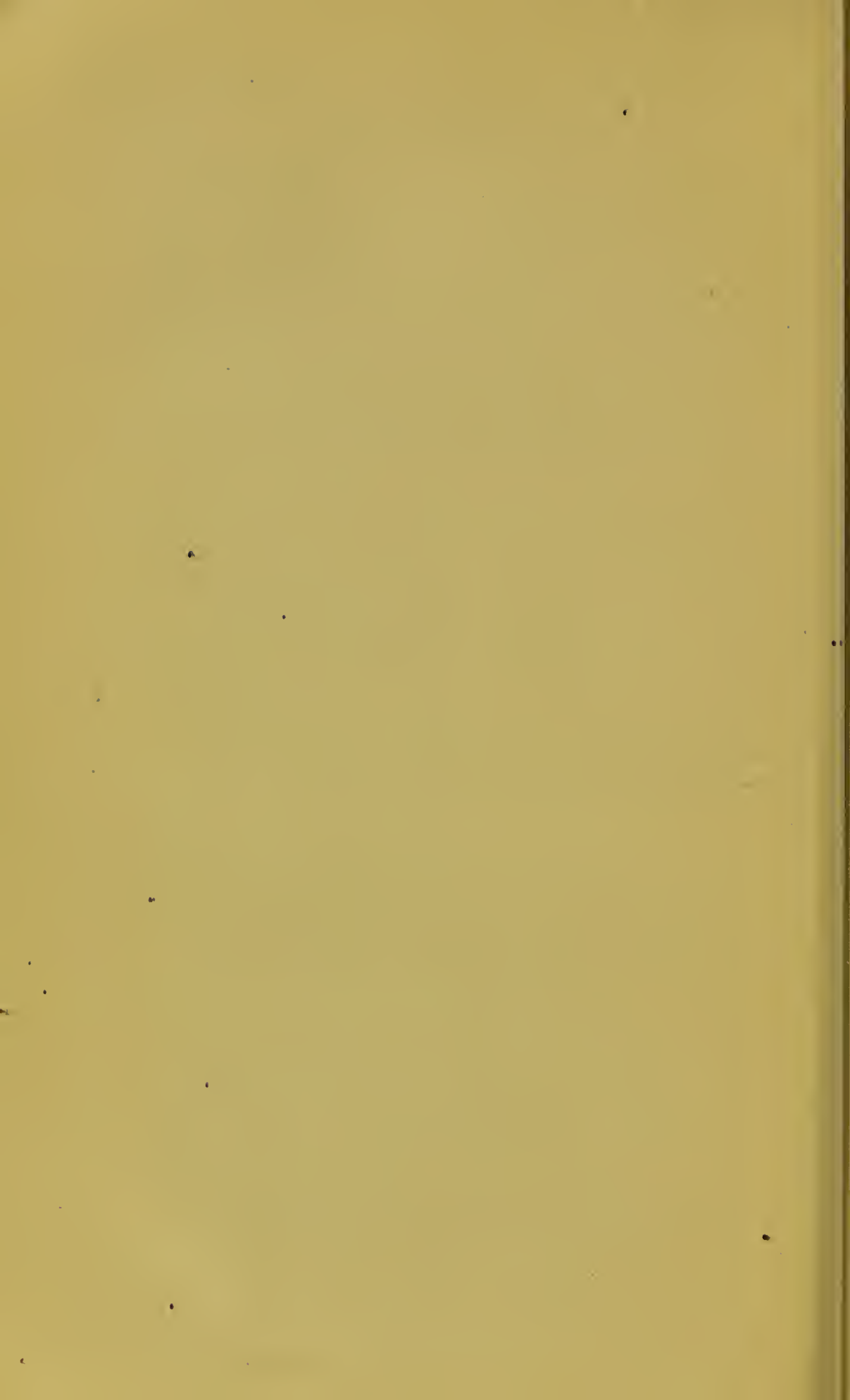
“I have seldom seen much benefit from the use of emetics; in a few of the cases, where there were no purging and vomiting, they seemed to rouse the circulation and sustain it in some degree by their action, but in the general run of cases they were useless.

“The *post-mortem* examinations led to nothing definite or satisfactory. In the head there was always venous congestion, greater in those who died in the first stages of the disease than in those who sank under the secondary fever; but in the latter there was more effusion, both in the ventricles and base of the brain, and sometimes opacity of the arachnoid.

“In the chest, the lungs were collapsed, and the large vessels at their roots distended with thick black blood, and the right cavities of the heart were generally filled with the same; sometimes both sides of the latter organ were so. Polypi were occasionally found in both auricles and ventricles, but more frequently on the left side.

“In the abdomen the mucous surface of the stomach was frequently found injected, especially in those who died from the

secondary fever, and its continuation in the intestines varied from vascular redness to a pale thickened and softened state. The contents of the intestines were always the same conjee fluid which constituted the dejections before death. The hepatic vessels were congested with black, grumous blood, and the gall bladder distended with bile. The urinary bladder was empty, and for the most part strongly contracted, and its inner surface was frequently found coated with thick glairy muens; on some occasions it was found of a bright red colour, as if it contained the only portion of dearbonised blood in the whole body.



APPENDIX C.

PROGRESS OF CHOLERA FROM HURDWAR FAIR, WHERE IT
APPEARED ON THE 12TH APRIL, 1867, AND WAS SPREAD
BY THE PILGRIMS OVER THE COUNTRY.

General distance from Hurdwar.	DIRECTION OR ROUTE.—No. 1. WEST TO MOOLTAN, <i>viâ</i> UMBALLA AND UMRITSUR. NORTH-WEST TO PESHAWUR FROM UMRITSUR.					
	NAMES OF DIS- TRICT OR TOWN.	Distance in miles from Hurdwar.	<i>Pilgrims.</i>		<i>Residents.</i>	
			Date of first case.	Duration of Epidemic.	Date of first case.	Duration of Epidemic.
<i>Miles over</i>		<i>Miles.</i>		<i>Days.</i>		<i>Days.</i>
1 {	Hurdwar ... ..	...	12th April	27		
	Kunkul	2	13th "	29		
	Jowalapore	4	13th "	13	...	30
10 {	Santal Serai	13	13th "	13	...	30
	Roorkee	19	13th "	12	17th April	41
20 {	Bugwanpore	23	13th "	15		
	Futtehpore	28	17th "	6		
30 {	Kylaspore	32	15th "	1		
	Saharunpore	38	14th "	13	17th "	31
	Deyrah	32	19th "	6		
40 {	Mussoore	46	...	...	27th "	24
	Chilkana	47	15th "	20	...	28
	Sirsawa	49	16th "	22		
50 {	Rampore	50	21st "	24		
	Nukore	51	18th "	14		
	Gungoo	55	18th "	12	...	18
60	Juggadree	63	15th "	29	15th "	45
70	.....	...	...	...	...	...
80	Chuppur	80	20th "	7	25th "	30
90	Narainghur	98	15th "	29	15th "	45
100	Umballa	100	15th "	29	15th "	45
120 {	Chorundghur	120	17th "	22	20th "	38
	Morunda	135	23rd "	13	25th "	35
	Kalka	137	...	...	3rd May	16
140 {	Roopur	146	25th "	9	26th April	34
	Kussowlie... ..	146	...	...	6th May	23
	Dugshai	153	...	...	17th "	1
	Marhuwara	157	22nd "	7	5th "	
	Soobathoo... ..	156	...	...	5th "	109
160 {	Khurma	169	19th "			
	Sunnawar	170				
	Simla... ..	179	...	...	4th "	108
180 {	Loodiana	182	18th "	22	24th April	33
	Sutlej... ..	188	19th "	...	24th "	33

General distance from Hurdwar.	DIRECTION OR ROUTE.—No. 1. WEST TO MOOLTAN, <i>viâ</i> UMBALLA AND UMRITSUR. NORTH-WEST TO PESHAWUR FROM UMRITSUR.					
	NAMES OF DISTRICT OR TOWN.	Distance in miles from Hurdwar.	<i>Pilgrims.</i>		<i>Residents.</i>	
			Date of first case.	Duration of Epidemic.	Date of first case.	Duration of Epidemic.
<i>Miles over</i>		<i>Miles.</i>		<i>Days.</i>		<i>Days.</i>
200	Jullunder	201	...	...	4th Sept.	17
	Jugraon	205	26th April	2	4th May	26
	Rackote	210	26th "	7	12th "	14
	Muhna	217	28th "	...	5th "	8
220	Moga	224	27th "	...		
	Issakhan	228	28th "	...		
	Dugroo	231	6th May	...		
240	Moodkee	240	4th "	...		
	Gull	245	24th April	...	24th April	
	Ferozshah... ..	248	13th May	...		
	Umritsur	255	21st April	...	23rd "	
	Ferozepore ...	258	24th "	...	24th "	95
280	Lunday Rora ...	280	12th May	...		
	Hajee Wattoo ...	286	19th "	...		
	Dooda	290	29th April	...		
	Lahore	291	24th "	...	27th May	120
	Sealkote	296	5th May	2	7th "	11
300	Jhoj Kulan	300	28th April	1	30th April	16
	Bukka Jhoj	308	...	...	12th May	
	Kangra Walla..	308	...	...	18th "	
350	Montgomery ...	387	25th "	6	30th April	16
	Jhelum	395				
400	Shapore	406				
	Jhung	410				
	Rawal Pindee ...	461	...	...	1st July	17
	Goozranwalla ...	480	5th May	1	7th May	11
500	Murree	500	...	...	29th June	25
	Mooltan	508	26th April	11	5th May	140
	Hazara	510	...	...	16th "	3
	Dera Ishmail Khan	515				
	Attock	522	...	...	21st July	9
	Nowshera	540	...	...	29th June	2
	Dera Ghazee Khan	548				
	Kohat	543				
	Peshawur	561	...	...	12th "	78
	700	Cabool	740	16th July	60

General distance from Hurdwar.	DIRECTION OR ROUTE.—No. 2. SOUTH-WEST TO HISSAR, <i>viâ</i> KURNAUL.					
	NAMES OF DISTRICT OR TOWN.	Distance in miles from Hurdwar.	<i>Pilgrims.</i>		<i>Residents.</i>	
			Date of first case.	Duration of Epidemic.	Date of first case.	Duration of Epidemic.
<i>Miles over</i>		<i>Miles.</i>		<i>Days.</i>		<i>Days.</i>
1	Hurdwar ... ..	...	12th April	27		
	Kunkul	2	13th "	29		
	Jowalapore	4	13th "	13	...	30
10	Santal Serai	13	13th "	13		30
	Roorkee	19	13th "	12	17th April	41
20	Bugwanpore	23	13th "	25		
	Munjloor	24	17th "			
30	Jubburkera	31	16th "	10		
	Deobund	37	14th "	27		
	Poor	35	15th "			
	Saharunpore	38	14th "	30	17th "	18
40	Budgown	48	26th "	1		
50	Mozuffernuggur	50	14th "	17		
	Nukow	51	18th "	23		
	Lucknowtee	55	16th "			
	Gungoo	55	18th "	18		
	Nanonla	56	24th "	17		
60	Gungoah	68	16th "			
70	Chajpore	70	16th "			
	Paneeput	78	21st "			
80	Kurnaul	84	18th "	21	21st "	62
	Daher	84	19th "			
90	Dharumghât	94	20th "			
100	Sursowtee... ..	108	18th "	...	23rd "	
	Sonput	108	22nd "	35	20th "	98
	Gôhana	110	18th "	10	23rd "	
120	Delhi'... ..	120	16th "	...	18th "	67
	Kytul... ..	120	21st "			
	Rhotuck	130	20th "	...	25th "	68
	Murnaghât	130	23rd "	22		
140	Goorgaon	142	22nd "	...	...	64
	Cheetra	145	25th "			
	Bussunt	148	29th "	1		
	Jhuggur	150	23rd "	...	29th "	
	Nujufghur... ..	154	23rd "			

General distance from Hurdwar.	DIRECTION OR ROUTE.—No. 2. SOUTH-WEST TO HISSAR, <i>via</i> KURNAUL.					
	NAMES OF DISTRICT OR TOWN.	Distance in miles from Hurdwar.	<i>Pilgrims.</i>		<i>Residents.</i>	
			Date of first case.	Duration of Epidemic.	Date of first case.	Duration of Epidemic.
<i>Miles over</i>		<i>Miles.</i>		<i>Days.</i>		<i>Days.</i>
160 {	Hansi... ..	164	20th April	23	25th April	91
	Furrucknuggur	165	22nd „	23		
180	.....	...	...	...	...	...
200 {	Hissar	180	21st „	17	25th „	84
	Rewaree	180	22nd „	...	...	70
	Ferozepore	195	25th „	...	...	67
	Rooree	197	...	...	23rd „	91
220 {	Futtiabad	208	22nd „	16	26th „	93
	Sirsa	210	22nd „	32	22nd „	93
240	Ranee	222	...	...	1st May	82
280 {	Dubwalla	246	22nd „	2	22nd April	84
	Mnloul	251	24th „	2	1st May	64
300	Jeypore	280	24th „	...	28th April	126
350	.....	...	...	...	...	...
400	Deolee	420	...	...	26th June	33
500	.....	...	...	...	...	...
700	.....	...	...	...	...	...

General distance from Hurdwar.	DIRECTION OR ROUTE.—No. 3. SOUTH TO ALLAHABAD, <i>viâ</i> MEERUT.					
	NAMES OF DISTRICT OR TOWN.	Distance in miles from Hurdwar.	<i>Pilgrims.</i>		<i>Residents.</i>	
			Date of first case.	Duration of Epidemic.	Date of first case.	Duration of Epidemic.
<i>Miles over</i>		<i>Miles.</i>		<i>Days.</i>		<i>Days.</i>
1	Hurdwar ... ..	...	12th April	27		
	Kunkul	2	13th "	29		
	Jowalapore	4	13th "	13	...	30
10	Santal Serai	13	13th "	13	...	30
	Sultanpore	15	19th "	24		
	Jawrassa	17	14th "	29		
	Roorkee	19	13th "	29	17th April	41
20	Munjloor	24	17th "	25		
30	Poor	35	15th "	3		
	Phutonda	37	15th "	3		
	Deobund	37	15th "	26		
40	Chupar	41	15th "	3		
50	Mozuffernuggur	50	14th "	17		
	Jullalabad... ..	50	14th "	21		
	Jhanna Bhow	52	14th "	24		
	Katowlee	55	14th "	23		
60	Shahpore	60	14th "	17		
	Shamlee	60	16th "	23		
	Gudurpore	69	19th "	11		
70	Kandhla	70	17th "	22		
	Boodhare	70	18th "	11		
	Dowraler	70	21st "	...	21st "	46
	Rooderpore	79	25th "	6		
80	Chuprowla	80	24th "	...	24th "	50
	Meerut	80	17th "	11		
	Binote	80	20th "	3	23rd "	53
90	Begumabad	92	20th "	7	22nd "	54
	Kurkoda	90	20th "	1	20th "	53
	Mooradnuggur...	90	19th "	4	22nd "	55
100	Haupper	105	19th "	8		
	Bagput	110	22nd "	35		
	Ghazecabad	115	18th "	10		
	Seeagana	112	25th "	18		
	Shadera... ..	115	19th "	6	21st "	48

DIRECTION OR ROUTE.—No. 3. SOUTH TO ALLAHABAD, <i>via</i> MEERUT.						
General distance from Hurdwar.	NAMES OF DISTRICT OR TOWN.	Distance in miles from Hurdwar.	<i>Pilgrims.</i>		<i>Residents.</i>	
			Date of first case.	Duration of Epidemic.	Date of first case.	Duration of Epidemic.
<i>Miles over</i>		<i>Miles.</i>		<i>Days.</i>		<i>Days.</i>
120	Delhi	120	16th April	...	...	67
	Boolundshuhur	124	19th "	9		
	Bhow	127	21st "	9		
140	Goorgaon	142	22nd "	...	...	64
	Koorjah	147	28th "	...	...	34
	Somnah	154	23rd "	...	...	27
160	Allygurh	163	20th "	...	...	30
180	.....	...	...	...	...	...
200	Akrabad	181	30th "	22		
	Hattrass	184	26th "	...	...	37
220	Muttra	205	...	...	26th April	10
	Saidabad	210	19th "	...		
	Agra	210	21st "	3		
	Secundra	216	...	...	28th May	8
240	.....	...	...	...	...	...
280	Mynpooree ...	243	24th "			
	Etawah	277				
	Futtyghur ...	278				
300	Cawnpore	348	25th "	...	...	100
350	Futtehpore ...	396	...	...	1st "	100
400	Hummeerpore ...	400	...	...	2nd July	30
	Banda	422	...	...	2nd April	100
	Allahabad... ..	472	20th "	...	24th "	96
500	Jounpore	538	2nd May	...	...	60
700	.....	...	...	...	...	...

General distance from Hurdwar.	DIRECTION OR ROUTE.—No. 4. SOUTH-EAST TO OUDH, <i>viâ</i> BIJNORE.					
	NAMES OF DISTRICT OR TOWN.	Distance in miles from Hurdwar.	<i>Pilgrims.</i>		<i>Residents.</i>	
			Date of first case.	Duration of Epidemic.	Date of first case.	Duration of Epidemic.
<i>Miles over</i> 1	Hurdwar	<i>Miles.</i> ...	12th April	<i>Days.</i> 27		<i>Days.</i>
10	Nujeeabad	14	13th "	...	...	49
20	Akbarabad	29	20th "	10		
30	Burrapore	30	14th "	...	...	48
	Keerukpore	30	17th "	...	...	48
	Nujeeana	35	13th "	...	...	48
	Mundauw	30	17th "	20		
40	Nethore	40	13th "	...	...	45
	Noorpore	41	18th "	...	...	40
	Afezulghur	42	16th "	...	...	53
	Bijnore	45	15th "	...	...	36
	Dhanpore	45	15th "	6		
50	Daranuggur	50	16th "	...	...	30
	Sherkote	50	17th "	...	...	35
	Seohara	52	16th "	...	...	35
60	Bazpore	60	3rd May	2	5th May	26
	Basla	64	19th "	17		
	Chandpore	68	17th "	...	...	39
70.	Kaut	74	23rd "	15		
80	Chuglyte	83	20th "			
	Mogulpore	88	20th "	17		
90	Moradabad	94	16th "	27	20th April	
100	Moondah	105	20th "	23		
	Guneshghât	109	25th "	4		
120	Baheera	125	19th "	...	...	34
	Meergung	128	22nd "	8	...	30
	Bisowlee	138	18th "	7	...	21
	Futtehgunge	139	19th "	11		
140	Kalepore	145	22nd "	5		
	Bilsee	150	19th "	4		
	Terrai village	151	18th "	25		
	Bareilly	151	18th "	37		

General distance from Hurdwar.	DIRECTION OR ROUTE.—No. 4. SOUTH-EAST TO OUDH, <i>via</i> BIJNORE.					
	NAMES OF DISTRICT OR TOWN.	Distance in miles from Hurdwar.	<i>Pilgrims.</i>		<i>Residents.</i>	
			Date of first case.	Duration of Epidemic.	Date of first case.	Duration of Epidemic.
<i>Miles over</i>		<i>Miles.</i>		<i>Days.</i>		<i>Days.</i>
160	Budaon	161	21st May	20		
	Banthra	163	24th "	6		
	Huldwanee	160	23rd "	...	...	19
	Nynce Tal	161	22nd "	...	...	20
	Kutra	174	25th "	5		
180	.....	...	...	...	...	...
200	Phillibeet	185	18th "	...	...	32
	Almorah	192	25th "	...	...	57
	Shahjehanpore...	198	24th "	...	...	95
220	.....	...	...	...	...	...
240	.....	...	...	...	...	...
280	.....	...	...	...	...	...
300	Lucknow	311				
350	.....	...	...	...	...	...
400	.....	...	...	...	...	...
500	.....	...	...	...	...	...
700	.....	...	...	...	...	...

JOHN MURRAY, M.D.,
Inspector-General of Hospitals, Upper Provinces.

SIMLA ;
 12th September, 1867.

APPENDIX D.

REPORT ON THE EPIDEMIC OF CHOLERA IN H.M. 21ST HUSSARS DURING THE MONTHS OF JULY AND AUGUST, 1862.

By Dr. J. Ross, Surgeon in Medical Charge 21st Hussars.

1. DURING the months of May and June the regiment suffered a good deal from ardent continued fever. Reeruits and men who joined from Barraekpore, in Mareh, suffering in the proportion of 24·5 per cent.

At the end of May, the general health and appearance of the men had not deteriorated; but, on my return from a month's absence on the 1st of July, I was much struck with the blanched and debilitated aspect of the troops.

The weather had been peculiarly favorable; two cooler months for the hot season had rarely been experienced.

2. There had been rumours of cholera at Rohat, and in the Derajat towards the end of May, and, about the middle of June, eases began to occur in the City of Peshawur.

During May and June there was almost an entire absence of bowel complaints in the regiment.

In May, with a strength of 594 men, fourteen eases of diarrhœa occurred.

In June, with a strength of 593, but fifteen eases occurred.

3. There were several points in the sanitary condition of the barraeks that I had long been endeavouring to get altered, and we were not in as good a state as we ought to have been, to have assisted us in escaping from the epidemic, should its atmosphere come near us.

A. *Overcrowding*.—The regiment had eight masonry (pucka) barracks for its occupation, two of them accommodating one troop. The space and ventilation in them were good.

Two barracks of unburnt bricks (cutcha) were occupied by the remaining four troops. These were built on a bad plan, badly ventilated, and only fit for the occupation of 160 men, while at least 260 men now occupied them.

B. *Impure Latrines*.—The buildings and seats had all been altered, on my recommendation, during the past year, to the pattern of the government standard plan improved on by me, and as reported by Dr. Hathaway, a special Sanitary Commissioner for the Punjab, at his visit in January, before the main body of the regiment arrived; these were all very clean and in excellent order, and managed by a system “that should be imitated as a correct model in every regiment;” but owing to the authorities neglecting to furnish us with the authorised government standard iron privy-pan, it had been impossible to keep the new latrines, now brought into use by our increase in numbers, entirely free from smell. They did not give out sufficient odour to be perceived on the outside, but inside there was sufficient, in a cholera season, to predispose men to attacks of diarrhœa.

The subsequent effects of A and B may be here noted. They may have been simple coincidences, but they are facts.

The crowded cutcha barraeks, holding four troops (half the regiment), gave only six of the thirty cases of cholera that occurred in quarters, two cases only of the nine of choleraic diarrhœa (that continued as such and did not turn into cholera), but gave twelve cases of the eighteen of simple diarrhœa (that continued so and did not go beyond in intensity).

The above is shown in Appendix B.

The two latrines used by these four troops were those in use during the preceding year, and so favorably reported on by Dr. Hathaway, and there was complete absence of all effluvium in them at the time also.

The above facts are remarkable, and might show that overcrowding, with, however, good interior arrangements and sanitation, combined with pure latrines, did not predispose to

attacks; while the impure latrines, used by the men inhabiting the good barraeks, with their good space, &c., did so. Bearing out, indeed, a remark in the report on the English Cholera Epidemic of 1854 by the general Board of Health, which states: "The fatality of large classes of disease has been found to increase in a given ratio to the density of the population; but no decisive results could be procured of this during the recent epidemic. The districts that suffered most were of intermediate density." Dr. Sutherland, in his report, adds, "that, even in low levels, in the most crowded and infected districts, where sanitary conditions were otherwise good, exemption was found to exist in particular groups of houses, from which certain definite sources of contamination (bad sewerage, &c.) had been removed."

c. *Drainage*.—For nearly one year I had been reporting on the defective drainage round four of the barraeks (pueka). Works had been carried out, and a good deal done, but much remained to be finished when cholera broke out. On a strong and urgent representation again, the works were completed in a few days.

It is a singular fact that these four barraeks, though the highest in the lines, and to all appearance the best, and occupied by two, generally very healthy, troops, gave ten out of the thirty cases of cholera that occurred in quarters.

4. No cases of diarrhoea occurred during the first four days of July; but, on the 4th, at 10 p.m., a weakly man, who had been admitted into hospital that morning with continued fever, was seized with cholera. From that date, until we left the station on the evening of the 15th July, diarrhoea, simple and choleraic, and cholera itself, were epidemic.

5. On my return on the 1st July I suggested to the commanding officer that an order should be issued for each man to wear his flannel belt, which was strictly carried out. The drinking-water of the men had been invariably filtered in barracks, but it was now proposed and carried out that all water should be boiled before being put into the filters. It was recommended also that the "filters" should be stopped; the moister weather, due to the commencement of rain in the hills, of which the influence

is always felt in the plains of the Punjaub, causing them to be of no value in cooling the air, and with the bad earthen floors of the Peshawur barracks, they only added to dirt and moisture. The filters were at once removed and their water tubs taken away. The sale of pop and fruit, &c., always under restrictions, was now prohibited; men were not allowed to be exposed to the sun. The drills and riding-school were much lessened of a morning, and amusements took their place of an evening.

6. On the appearance of the first case of cholera, therefore, but little remained to be done, except measures left undone intentionally to prevent any excitement in the Lines.

The first plan to be put in operation was to provide for the immediate treatment of all cases of diarrhœa. All non-commissioned officers were therefore ordered by words and written order to send any men to hospital who were noticed to go to the rear more than once, or taken ill in barracks in any way; and this was well responded to in all but one or two instances. Extra doolies were applied for, so that one could be placed at each troop barrack, and no delay occur in bringing a man to hospital. A sentry was stationed at night in each division of the barracks, under a non-commissioned officer, to report men who might be suddenly taken ill.

The men's beds were opened out as much as possible. All saddlery and horse appointments, usually kept at the bed's head, were removed into one of the verandahs, and the verandah on the opposite side of the building was taken up for a few more beds, so as to relieve the centre room.

The doors and upper windows of barracks were invariably kept open under old regimental regulations, but strict orders had to be given, and vigilance exercised on the married families in their barracks, and over the sergeants occupying the small rooms at the ends of the barracks.

The Regimental School was discontinued, as not being a matter of amusement, but looked on with distaste by the recruits, and it also added to their being crowded together.

Punkahs had hitherto ceased being pulled when men prepared for drill at 5 p.m., but were now continued until 6 p.m.; and

this generally being the closest and ealmest period of the day it was much appreeiated.

Extra rations of tea and wood were applied for, to give each man a cup of tea at gunfire every morning, and the system was well carried out through the regimental cooks.

Loads of firewood were indented for, and at the suggestion of Brigadier Haley, tar, also, for fumigating purposes in the lines and barracks; but the disease being spread over such a large space did not require their use.

Striet supervision was exercised over the bazaar and horse lines, and among the syces and grasscutters. The lines and huts had, however, always been under good sanitary regulations, so that nothing remained to be done under that head. The native head of the bazaar, and the gemedars of troop syces, were warned to bring any one taken ill immediately to hospital, where tents were pitched for their reception, and cholera pills were given to these head men, to be served out to any one who wished for physic, without being actually taken ill.

I made a rule of going through the barracks and chatting with the non-commissioned officers and men once a day at least. The men kept in good spirits, liked the little excitement of drills being left off, and fright, that frequent predisposer to many cases, may be said to have been absent from the regiment. The canteen, being in good hands, there was no fear of extra supplies of liquor being surreptitiously obtained, and there had been so very little drunkenness in the regiment previously, as proved that few facilities for procuring it existed in the station.

7. In the hospital no new rules had to be brought into play, or any new system adopted on the outbreak of the epidemic.

The ventilation was good. There was extra space at command, which enabled two large wards and several verandahs, to be taken into use, so as to separate entirely cholera cases from diarrhœa, and the latter from the main body of the patients.

Drinking-water had always been boiled before filtering, and patients had ever received a cup of tea or coffee in the early morning.

All the foul linen used by the patients attacked during the

epidemic was immersed in boiling water after use, and the usual system with the discharges of this class of patients being on the best principle, left nothing to be altered.

Volunteers were asked for from the men, to come as hospital orderlies, and give assistance to the sick. Four only were thus used, and their aid was energetic and valuable.

The whole Medical Subordinate Establishment were organized into watches of four or six hours each, and the assistant surgeon or myself were ever present in the wards. There were constant supervision and attention kept up night and day.

8. On the 2nd of July a letter was written reporting thirty-eight weakly and sick men as being fit subjects to be sent to the Murree Convalescent Hill Depôt, for the remainder of the hot weather. But delay took place in their starting, and when all was arranged, fears were mooted about their passing through other stations after cholera had broken out in the regiment; and it was not until the 11th that a batch of twenty-nine of them could be sent to the neighbouring Hill of Cherat, the remainder and others being sent up at subsequent dates. It was fortunate that only six men of this weakly number (thirty-eight) were attacked by any form of the disease, one dying of cholera.

9. The periods of three distinct outbursts of the disease are shown in Appendix C.

The first period was so mild as to give every hope that the attack would not be severe.

On the 7th, after the increase, up to the 6th, there was a complete lull. The weather, during the 4th, 5th, and 6th, had been favorable, but still cases occurred. The 7th, a moist, calm, hot day, had no admission, but on the 8th, a.m., a shower fell, and was succeeded by hot sun during the day. A ease of cholera had occurred at 6 p.m., after a remission of forty-six hours, and from that time, until 8 a.m. on the 10th, nine cases occurred—all more particularly between 1 and 3 a.m. The weather was close, with a moist and stagnant atmosphere, but a dust-storm and squall, with high wind all the day and night of the 10th, seemed to occasion a remission, and the second period was over.

On the 11th, one case of cholera occurred at 3.30 p.m., after

an interval of thirty-two and a half hours, and on this evening two troops, or 103 men, marched to the frontier outposts for change of air, and to diminish the numbers in barraeks.

On the morning of the 12th, at 1 a.m., there was an admission of choleraic diarrhœa. During that day seven cases under that head, and five of cholera occurred, chiefly towards evening and during the night and early morning of the 13th.

Seventeen cases of diarrhœa and nine cases of cholera having occurred in twenty-four hours, the epidemic was evidently becoming more intense, and I wrote on the morning of the 13th, recommending a move of the whole regiment into camp.

The weather, on the 12th and 13th, except for the heavy shower on the morning of the 12th, followed during the day by a hot sun, which, on the 8th, had also appeared to develop attacks, was fine, clear, cool, and windy.

During the day of the 13th, but one case occurred, at noon; and one at nearly the same time on the 14th. On the 15th, one case of those attacked on the 13th became collapsed (the two other admissions of that date being one in the squadron on the frontier, the other among the convalescents who had gone to Cherat Hill). At 11 p.m., on the 15th, the regiment marched to Zaloozai.

10. The march was a trying one of twenty miles, and the night was peculiarly hot and close. The doolie bearers all became knocked up as the sun rose, and many of the sick did not reach camp until 9 a.m. They all suffered, and one man had a relapse of choleraic diarrhœa which terminated in cholera.

There was this to be said of the march after its fatigues were over, that it took us entirely out of the influence of the disease at once, whereas, the only halting place on the road, being at six miles from the city, might not have had such a decided effect.

Diarrhœa, simple and choleraic, continued at about one case a day, until the 25th, when, at 2 p.m., a case of cholera occurred, and at 11 p.m. a second.

The weather, until the 23rd, had been very cool and pleasant, wind invariably being from the hills S.W.S. and S.E. On the 25th a hot wind blew strongly between 12 and 2 p.m. from the

N.W., or directly from the City of Peshawur, for the first time since we had been in camp. The cholera case occurred as it ceased.

The second case admitted that day, at 11 p.m., was the hospital corporal—the only attendant on the sick who suffered at all. He had been in attendance on the first case all the evening, and, going in late, I found the usual care had not been taken with the discharges, an hour after the corporal was attacked.

11. The camp was moved south to Shakkote at 7 a.m., on the morning of the 28th. No case occurred on the 26th and 27th, but, on the 29th and 30th, we having brought the disease with us probably, six cases of choleraic diarrhœa and one of cholera were admitted.

We returned to Zaloozai on the evening of the 1st August, and, at 10.30 a.m. on the 2nd, a weakly boy of the band was seized. That evening, at 9 p.m., we marched west to Shumshatoo, intended for our standing camp. Here, again, we probably brought the infected case with us, another of the band being seized at 10.30 a.m. on the 3rd. A third case out of the band occurred on the 7th, and this was the last that was attacked.

The band had hitherto entirely escaped, and it was a singular coincidence that three should have been attacked in succession. They inhabited different parts of the camp, and met together but twice a day for practice.

12. Appendix A gives full information of every individual case attacked with diarrhœa and cholera.

The strength of the regiment present on the 1st July was 593 men, 17 women, and 13 children.

Of the 105 cases that occurred from the 4th July to 15th August there were—

36	Cases of simple diarrhœa, of which turned into cholera	2
52	Of choleraic diarrhœa, of which ditto	20
—		
88	Total of Diarrhœa.	17
17		—
—		
		Total cases of cholera 39

105 Total of all.

Admissions of pure cholera to strength were 2·86.

Admissions of choleraic diarrhœa ditto 9·02. Of these 38·4 per cent. turned into cholera.

Admissions of simple diarrhœa per cent. to strength were 6·87. Of these 5·5 per cent. turned into cholera.

Total admissions during the epidemic per cent. to strength 18·75.

Of the thirty-nine cases of cholera:—Did not pass into collapse 7, or 17·9 per cent.; none died. Cases of complete collapse 32, or 82·05 per cent.; of whom 8 died, or 25 per cent. Consecutive fever supervened in 4, or 10·3 per cent.; of whom 3 died, or 75 per cent. Total of deaths to treated 28·8 per cent.

Twenty-two cases of cholera occurred in 336 men, aged from 20 to 25, or 6·5 per cent., of whom 6 died, or 27·2 per cent.

Twelve cases of cholera occurred in 207 men, aged from 25 to 30, or 5·7 per cent., of whom 2 died, or 16·6 per cent.

Four cases of cholera occurred in 36 men, aged from 30 to 35, or 11·1 per cent., of whom 2 died, or 5·0 per cent.

One case of cholera occurred in 20 men, aged from 35 to 40, or 5 per cent., and died.

Fifty-three cases of diarrhœa, simple and choleraic, occurred in 336 men, aged from 20 to 25, or 15 per cent.

Eleven cases of diarrhœa, simple and choleraic, occurred in 227 men, aged from 25 to 30, or 5·3 per cent.

The average duration of the 7 cases of cholera, without collapse, from the accession of the first characteristic symptoms (but not the actual recovery to health and duty) was 19·5 hours; longest 34 hours, shortest $3\frac{1}{2}$ hours.

Average duration of 28 cases of cholera with collapse, 23·8 hours; longest 83 hours, shortest $2\frac{1}{2}$ hours.

Average duration of 8 fatal cases was 26·2 hours; longest $70\frac{1}{2}$ hours, shortest $8\frac{1}{2}$ hours.

Average duration of the 3 cases of cholera collapse and consecutive fever, was 74 hours.

One case of the above dying twenty days after recovery, but still from its effects, is not taken into the calculation.

13. The inhabitants of the small rooms at the ends of the barraeks, occupied by six married families and thirty-nine single men, suffered in a nearly treble ratio to the remainder of the troops. These forty-five inhabitants (men) had cholera in the proportion of 11·1 per cent. The remainder of the regiment in quarters (548 men) supplied in the proportion of 4·5 per cent. None of the six women were attacked who lived in the small rooms, or any of their husbands. No cases occurred in the married barraek.

14. With respect to the treatment of the cases a general view will be given.

On admission with cholera, or its accession (without collapse), or with choleraic diarrhœa, a dose of calomel and opium, from grains x to v of the former, to grains iij to i of the latter, was given; and if depression was present, or came on, a draught of tr. opii, brandy, and aq. menth. pip., was administered. On the first accession of cramps chloroform was given in all cases, and proved of great relief to the patient. Much pain, with muscular fatigue and depression, were thus saved, and its ultimate effects may have been beneficial in restoring the man to health. The patient was allowed to recover gradually from its effects, but was again placed under its influence, however rapidly cramps returned. The general result was a long doze and interval of rest, with cessation of vomiting and purging. Shampooing and friction with stimulating liniments were also employed. The recumbent position was enjoined; free ventilation preserved round the bed; thirst was assuaged by soda-water with a small proportion of brandy or sal volatile in it, or, when preferred, an acid drink of dilute hydrochloric acid, ζi to ζxx of water. Counter-irritation by mustard poultices or turpentine stupes was employed over the epigastrium and abdomen, and a hot bandage or fomentation-cloth was kept constantly applied. If much vomiting was present, chloroform with tr. opii given in effervescing draughts, proved often successful, and tr. opii, in large quantities, with acetate of lead, was often an efficient enema in checking the diarrhœa. Sago with brandy, or soup, was given at intervals.

On the first symptoms of collapse, hot sand was applied to all

parts of the body; medicinal agents by the stomach were intermitted; chloroform was given in a minor degree, sufficient only to allow of its stimulant action being felt by the system, and reaction was assisted and encouraged by the cold douche over the face and chest. Respiratory movements and a quicker and stronger circulation were thus induced, and as long as consciousness remained these means were persevered in. The treatment was agreeable to the patient's sensations, and after one trial was often asked for.

Reaction was always carefully watched and individual symptoms attended to. We were fortunately so lightly visited that every case got its proper share of attention, and to that alone I consider is due the success of many of the cases.

Many remedies were used for the diarrhœa, simple and choleraic, but the most effectual proved to be the old chalk mixture with opium, bland nourishment with stimulants keeping up the strength, secretions being restored as the attack subsided by the pills of hydrarg., opium, ipecac., and camphor.

The main object of all the treatment was to prevent the diarrhœa passing into cholera and the cholera into collapse, and the reaction from terminating in the consecutive fever. It is unnecessary to detail its many varieties in individual cases.

15. It has been well proved that the chief causes of localization of cholera during epidemics are known and removable, and however beneficial temporary sanitary measures may be, they do not afford immunity. It must be by a more general and thorough system of sanitation in every process of barrack life that any real prevention of the disease can be hoped for.

Cholera can hardly be said to have been localised with us: our attacks were few, or of slighter intensity, compared with the other troops in the station. They probably would have been more dangerous had our sanitary conditions been worse. Our men were the weakest in health of any of the troops, but I have reason to believe the sanitary state of our barracks, of the latrines especially, was superior to that of the others; had it not been so we must have suffered in as severe a manner.

Cholera is a disease that certainly can be mitigated by "Pre-

vention;" the intensity of the poison and disposition to take on the disease being lessened according to the sanitary state of the places in which men live.

On reading Dr. Hathaway's recent report on the sanitary state of the military stations of the Punjab, one cannot but be struck with how much remains yet to be done before due sanitation, in all its force, is exercised in the barracks and stations of our European army, or even treat it lightly; and, indeed, the only wonder may be that, in the condition of all those portrayed, cholera should ever be absent from any station.

The greater prevalence of cholera in this presidency during the last few years, or since the larger number of European troops have been stationed in it, would seem to point to them or to their habits of life as connected in some way with the increase; and it is to be hoped that, ere long, something may be done for India, generally, to mitigate the intensity of all known and removable causes.

APPENDIX X.

DESCRIPTION OF A FILTER PROPOSED FOR THE USE OF EUROPEAN TROOPS IN BARRACKS AND HOSPITALS.

The "chatty filter," at present so largely used throughout India, is so well known that it is quite needless to describe it; it is to be found in many private houses, and it is at present the only filter in use in the European barracks and hospitals of this Presidency. Its defects are manifold; the chief of them are as follows:—

1. The filtering material employed is very ineffective. Wood charecoal in lumps of the size ordinarily employed is quite useless as a filtering medium, whilst the sand conjoined with it has only a mechanical action, removing in this manner, in proportion to its fineness and to the depth of it that is employed, more or less of the matter held in suspension in the water.

2. From the nature of its construction, the filter is necessarily very slow in its action, yielding only about twenty-seven ounces of water per hour. For the supply of a barrack therefore, or regimental hospital, a dozen or more of the filters are needed.

3. The impurities, mineral and organic, originally held in suspension in the water, collect in the upper vessel, and, becoming by decomposition more or less soluble, add to the impurity of the water which percolates through them.

4. The vessels being open become contaminated by dust and insects, while the water readily absorbs noxious gases, and in a hospital especially is liable to become poisoned by the emanations from the sick.

5. As the water is never completely emptied from either

the filtering vessels or the receptacle below, every fresh addition of water is polluted by the relics of that which has preceded it.

6. The water, when required, is obtained by dipping a pot into the storage vessel. This may be done by the bheestie, the ward cooly, or by any one in fact who wants a supply. Contact with so many hands, not always of the cleanest, or fresh from the most delicate of functions, must dirty, and may possibly poison, the water in the vessel.

During the past two years several assistant surgeons have been regularly engaged in analysing and reporting upon the potable waters of all military stations, including in their examinations the water actually in use in barracks and hospitals. These gentlemen in their reports unanimously condemn the present filter. They report that they have frequently found the water in the upper vessel of the filter of a dirty brown color, odoriferous, and swarming with mosquito larvæ and other animalculæ, while the water in the lower vessel is almost always described by them as being less pure than the fresh water from the original source of supply. I suppose that the filters in the Medical College Hospital are as carefully attended to as is possible, and yet the water in their storage vessels is generally clouded with a floating white flocculent matter, and contains numerous animalculæ, especially mosquito larvæ. Our Hospital Steward, Mr. James Bowser, who has had thirty-five years' experience of the management of these filters, tells me that he has never succeeded in obtaining perfectly clean water from them, and that unless they are most diligently watched, the water they yield may become horribly bad. On one occasion I noted that the water sent to me for examination from the filter of a regimental hospital, was not only of a dirty yellowish brown colour, and contained a great deal of suspended matter, but that it had a most horrible smell, such as would have been given to it had a musk-rat fallen into the receptacle. On another occasion I found a very large quantity of sediment in the water taken from a barrack filter, the sediment consisting of hairs, fibres of cotton, linen, and wool, woody tissue, starch grains, confervoid growths, myriads of animalculæ of various shapes and sizes, and many very minute white worms.

Such are the most prominent defects of the filter at present in use. I now wish to indicate what, judging from my own experience, and, as far as I can gather it from books, from the experience of others, are the requirements of a really good filter.

The filtering medium must, in the first place, be good; and I believe it is now pretty generally allowed that of all mediums well-burned animal charecoal is the one which exerts the greatest amount of chemical action on dissolved organic matter. As animal charecoal is used for the purpose in the form of coarse powder, it is not, however, so good a mechanical filter as fine sand, and I think, therefore, that in a well constructed filter the water should first be mechanically purified by traversing a layer of sand before it reaches the charecoal, so that the energy of the charecoal may be concentrated on the removal of the dissolved organic matters. Animal charecoal after a time, loses its purifying power, regaining it, however, after being well washed and exposed to the air; the construction of the filter should therefore be such that the animal charecoal can be removed, cleansed, and replaced with ease. I believe that if the animal charecoal be washed and aërated every second month, it will retain its energy for at least six months, when it would probably need to be reburnt.

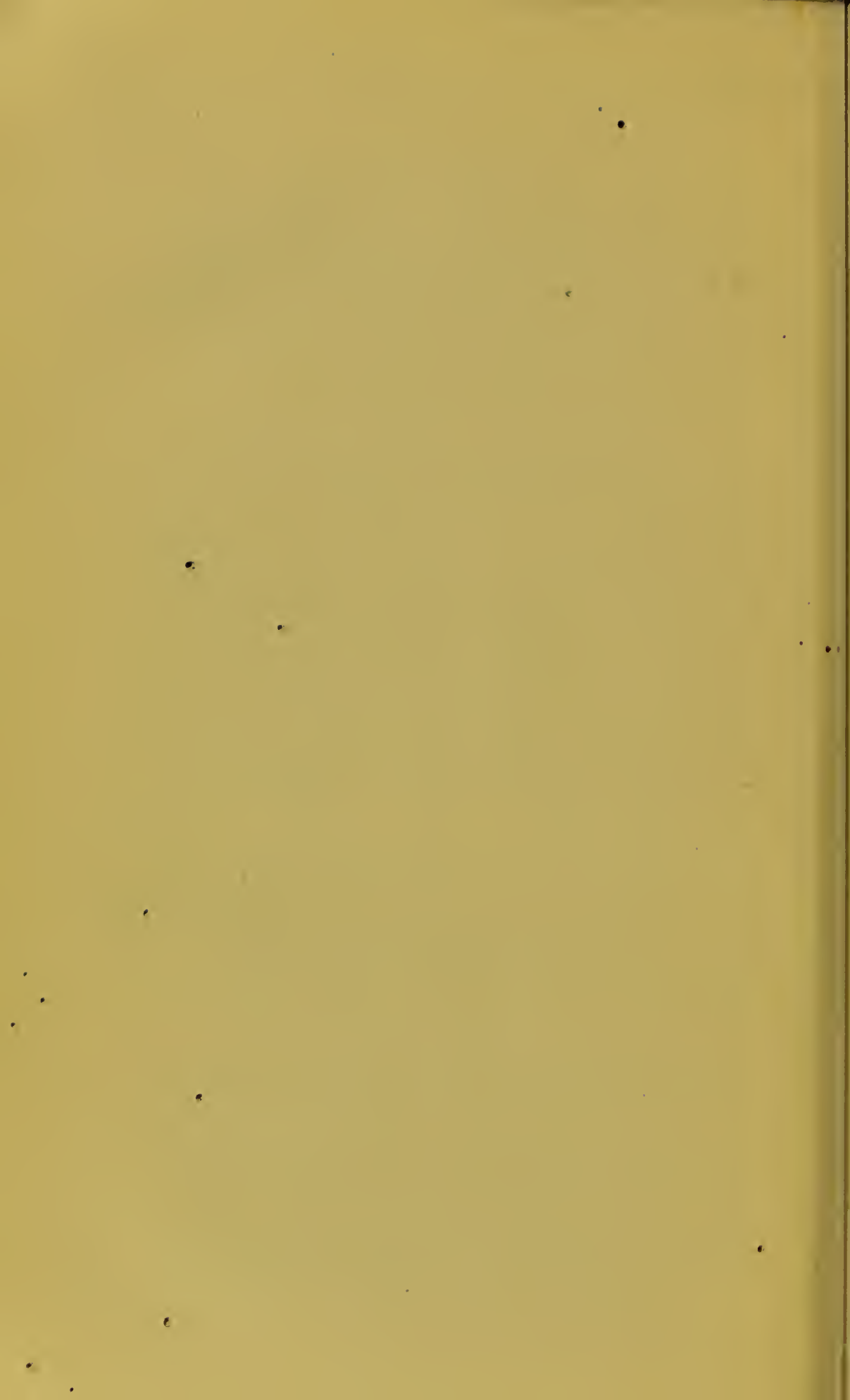
A good filter, moreover, should not get clogged, or if clogged, should permit of being readily set right without detriment to its purifying power. The ordinary household filters are objectionable, because they do become clogged, and because when clogged they cannot be renovated.

The arrangement of the filter should be such that the matters held in suspension in the water cannot possibly fall and collect upon the surface of the filtering medium.

The water should not be filtered into an open receptacle, in which it may become exposed to light or to contamination from the air.

Lastly, the filter should supply water quickly, and through a tap, and its construction should be simple, and not liable to get out of repair.

I have endeavoured to meet the above requirements in a filter



which I have had constructed, and which has been in use for the past six months in the Medical College Hospital; one of these filters has also been lately placed in the verandah of the Dalhousie Barrack in Fort William, and another of them is in use in the General Hospital.

The arrangement of the filter will be understood by reference to the diagram, which is drawn to a scale of one-ninth the real dimensions. The filter consists of a stout cylindrical zinc vessel (AAA) eighteen inches high by ten inches in diameter; the vessel is closed at the upper end, excepting where the delivery pipe E is attached. One inch from the upper end a zinc plate BB is soldered in; this plate is perforated centrally over a space six inches in diameter; over this perforated space fits a shallow cap made of perforated zinc, the cap is seven inches in diameter and one inch deep. Thirteen inches from the upper perforated plate, a wire of zinc is soldered into the interior of the vessel, this gives support to a tray (DDD) four inches deep, the bottom (when in place the top) of which is perforated to within one inch of its edge. Outside the main vessel fits another tray (HHH) also four inches deep, which, when in place, is fastened to the main cylinder by the hasps (MM). The bottom of this tray is also of perforated zinc, but the perforations are closed to the extent of an inch round the circumference by a band of non-perforated plate, which is soldered on externally. The perforated zinc which is used in the filter contains 400 holes to the square inch. The filter is placed in a tub or cistern,* and stands upon three half bricks. It is well to bevel off the surface of each brick towards one corner so as to give it somewhat of a wedge shape; with half bricks thus prepared it is easy to level the filter. The delivery pipe of the filter is of brass, five-eighths of an inch in diameter, it is sufficiently long to allow of the tap, which is of corresponding size, being inserted into the side of the cistern at a

* One half of a large water cask is very suitable for the purpose, or two rum or beer casks may be used. The casks should be connected by a pipe inserted three or four inches from their lower ends, and the filter is placed in either one of them. Each cask must have a mat or canvas cover.

level corresponding to the centre of the side of the external tray (IIII), that is, on a level two inches above that of the bottom of the main cylinder. The delivery pipe is connected to the filter and to the tap by what are called gas union joints, each provided with a leathern washer. An iron key is needed to screw on the nuts of the joints. In filling the filter a wooden rammer is required; this is made from a circular piece of board one inch thick, five inches in diameter, and provided with an upright handle, a foot in height.

The filter is charged with *dry*, well-burnt, animal charecoal, and *dry, well-washed*, sand. The charecoal must be sifted into two sizes; for this purpose I make use of a wire sieve having 100 holes to the square inch, but the ordinary cane sieve, which is used by the natives for sifting grain, answers very well; the holes should be of such a size as to retain all pieces of charecoal which are above the size of a small pea. Subsequently the fine charecoal should be winnowed, as the natives winnow the grain, in order to free it from the charecoal dust; or the fine charecoal may be placed upon the sieve which is used to separate the fine sand, and that portion of it which passes through should be rejected.

The sand must be *thoroughly washed* by stirring it up in a vessel with frequent additions of fresh water, till the water which comes off is *quite clean*; it should then be dried by exposure to the sun, and subsequently sifted into two sizes; the tray of the filter may be used for the purpose, or a fine cane sieve. I use a wire sieve which has 900 meshes to the square inch.

The coarse sand I use is that sifted from the Mugrah sand, which is ordinarily used in Calcutta for building purposes. I reject, however, all pieces above the size of a swan shot. The fine sand I use is that taken from the bed of the Hooghly at Barraekpore; it is a very fine white sand, and the grains are very uniform in size. I pass it through a sieve containing 900 holes to the square inch. Fine Mugrah sand answers almost equally well.

Before charging the filter it should be placed in a tub or cistern, and carefully adjusted by means of the three wedges.

shaped brick supports, so that the gas union joints at either extremity of the brass delivery pipe are in accurate apposition, the one with the tap and the other with the filter. It is most essential to the action of the filter that these joints should fit properly, and no force should on any account be applied in connecting them; the accuracy of the junctions should be insured solely by accurate adaptation.

Now to fill the filter: an assistant should hold the main cylinder in a convenient position with the open mouth downwards, the operator then fills the small tray of perforated zinc with some of the carefully sifted coarse sand, shaking the sand well into the tray, then supporting the tray in his right hand, he introduces it into the filter, and applies it so that it shall cover the perforated space in the diaphragm, he then places his left hand on the top of the filter, and keeping the tray firmly applied inverts the cylinder. If this operation be neatly done not a grain of sand will escape from the tray. The cylinder is next placed top downwards upon the ground, and the coarse charcoal is poured in till the space around the tray is filled, and more is added till the tray is covered to from half an inch to an inch in depth; by means of the rammer the charcoal is pressed firmly down. The finer charcoal is now poured in, the rammer being used, and the charcoal pressed firmly down as each successive inch of it is introduced, till the cylinder is filled up to within an inch of the wire ledge. The remaining space up to the level of the wire is then filled with coarse charcoal, which is pressed firmly down, its surface being slightly convex, so as to press tightly against the bottom of the interior tray (DDD), which is now introduced. Upon the perforated bottom of this tray coarse sand must be spread to the depth of half an inch, and must be pressed down with the rammer, and then three inches of fine sand added, with careful ramming on the addition of each half inch. The tray is finally filled to the level of its upper rim with coarse sand, the final surface being made slightly convex that it may fit tightly against the surface of the exterior tray. The exterior tray is fitted on and fastened by means of wooden wedges placed in the hasps. The filter is now inverted, the hasps opened and turned down, and the space between the rim

of the outer tray, and the surface of the main cylinder, filled up with soft wax, tightly pressed in by means of the finger. The use of the wax is to prevent water passing down between the tray and the cylinder. The hasps are again fastened, and the filter is placed in the tub, the bottom of the perforated tray downwards, resting by its edge upon the bricks in the position of accurate adaptation already ascertained. The delivery pipe is then connected with the cylinder, and with the tap, and the arrangement is completed. The time occupied in filling the filter, and fitting it into place, will be about fifteen minutes.

The delivery pipe in conjunction with the filter constitutes a syphon, and if air-tight will draw the water down to the level of the tap. The syphon is brought into action originally, simply by filling the tub with water above the level of the top of the filter, keeping the tap open to allow of the escape of air while the water is being poured into the tub. The suspended matters will gradually subside to the bottom, and any entering the filter will be stopped by the sand in the tray (DDD). The tub should be fitted with a hole and plug that it may be readily emptied and the accumulated sediment removed. It should also be furnished with a coarse canvass or mat top to prevent the entrance of mosquitoes, and to keep out dust, &c.

The water may not run freely for some hours after the filter has been set in action, and will continue to improve in quality for several days. The water which runs during the first few hours may have a slight taste derived from the charcoal, but this taste quickly ceases.

It is well not to fill the tub with water to a higher level than three or four inches above the top of the filter.

If, after the filter has been working some time, it begins to deliver water slowly, the reason will probably be that the pores of the sand have become choked; the old sand must therefore be removed, and replaced by new. But though the sand may require to be changed, it may not be necessary to change the charcoal, and chemical analysis of the water the filter yields can alone decide whether it is still continuing to exert a proper degree of purifying influence.

The colour of the water affords a rough, yet in practice, very

useful test of the presence of organic matter, but to detect minute traces of colour a column of water, at least a foot in depth, should be examined. A cylindrical glass tube placed upon a piece of white paper answers the purpose well, and the column of water should be examined by looking down through it upon the white surface below. If the filter is acting well not a trace of colour should be detected. In this experiment a tall glass, a water jug, or a decanter may be used if a cylindrical glass tube be not obtainable. Should the water at any time acquire an earthy taste, that is a sign that the sand must be changed.

The charcoal may be cleaned by washing it thoroughly first in warm, and afterwards in cold water; after it is well washed it should be dried in the sun, or in a degchee or sauce-pan, over a gentle fire. I would not advise the use of the same charcoal for more than six months, unless it be reburnt.

The filter of the size I have described is very suitable for ordinary well, or tank water, but if the water be very foul it may be necessary to use a filter in which the column of charcoal is eighteen inches or two feet in depth, the diameter of the filter and of the delivery tube remaining unchanged.



b- JZ

1870



F. 7260

