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Dr Radcliffe (14)

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BY

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ON THE CHANNELS THROUGH WHICH CHOLERA IS COMMUNICABLE.

AMONG the greatest obstacles to the study of cholera are the dissimilarity of the symptoms in the various stages of the disease, and the difficulty of connecting the mild symptoms at its commencement, with those that are so excruciating and virulent in its later stages. The recognition of this connection is of recent date, and until it was established our knowledge of the nature of the poison progressed slowly. The acknowledgment of this fact has materially assisted our investigations, as an early diagnosis of the presence of cholera is of the utmost importance. When this connection is allowed, it gives valuable aid in effecting measures for restraining the dissemination of the disease. In its milder stages, treatment can be employed which will prevent its advance to those later stages in which medicine is often powerless, and sometimes injurious ; and in thus checking a simple case, the spread of the cholera poison is most effectually opposed. I consider cholera the most important medical question of the day, and it is to promote its elucidation, and in the hope of benefiting by the experience of the many celebrated and justly honoured members of our profession now assembled, that I submit my opinion on one branch of the inquiry, viz., the channels through which the disease can be communicated. I have selected this point as one of the greatest practical importance, leaving others for future investigation and more able observers.

The history of the views of the medical profession on the contagious nature of cholera is very interesting. I find in the accounts of the disease in India previously to 1817, that it was supposed to arise from a vitiated state of the humours and from putrid bile which had to be purged off. When the epidemic in 1817 commenced, it was considered an aggravated attack of an ordinary seasonable disease, which, like ague, prevailed during the rainy season in Bengal. The progress of the disease in the Upper Provinces, the severe attack in Lord Hastings's camp in Bundelcund in November, and its subsequent history when it attacked the troops on service in Central India and in Madras and Bombay in 1818-19, led some of the officers to consider it contagious. The official reports drawn up by the Medical Boards of Calcutta and Madras, in 1818, concluded that cholera was not contagious, though there were some dissentient voices to this view. The Medical Board in Bombay, on the other hand, considered that it was contagious. In Paris, where I first saw the disease, in 1832 it was declared by the leading physicians to be non-contagious. The same opinion prevailed in England in 1848 and 1854. There were always individual exceptions, but officially and by the profession generally cholera was considered non-contagious. The first departure from this view in any official report, occurs in one published in India in 1856, when the con-

tagious nature of the disease was assigned as a reason for incurring the expense of removing the prisoners from the jail at Agra during a very severe epidemic. Again, in 1860, 61, 62, and 63, the same reason was assigned for incurring the expense of removing the European troops into camp during severe epidemics in those years. Similar views were supported by the Sanitary Commission in 1862, and they have since that time guided the measures adopted by the Government of India in regulating the precautionary treatment of the disease.

The non-contagious nature of the disease was the prevailing opinion of the profession in Europe until the year 1865, when the severe epidemic which desolated many countries attracted general attention, and was followed by the International Sanitary Commission at Constantinople. Since then the change of opinion has been very decided.

There are few now who do not consider the disease transmissible, either directly or indirectly, from a cholera patient to a healthy subject; and this is one of the recognised definitions of a contagious disease. The objections to the contagious view of the question are now reduced to the remark that cholera is not so contagious as some other diseases; or that it is not communicated in the same manner, but through some special channels as the air, subsoil-water, etc. That the course of the disease is influenced by the state of the various media through which the poison passes is evident; but that any one of these in a normal state is essential to the transmission of the disease is not proved, and the existence of an abnormal state has no further foundation than conjecture required to supply a deficiency in some theory.

It is thought by some, whose opinions have great weight, that the locality in which the disease occurs offers the most important channel of communication. This is the popular belief of the natives of many parts of India, as they will sometimes desert their villages when the disease breaks out, and take refuge in the surrounding jungles, thus showing their idea that there is danger in the locality.

With these preliminary remarks, I will now proceed to my subject, the channels of communication; and in the first place will trace the course of the poison from the diseased body of a cholera patient, through external agents, or media, to the healthy person in whom it excites the characteristic symptoms of the disease. I take it for granted that the symptoms of cholera are caused by the presence of a poison in the system, and that it is only when that is removed that health is restored. The restoration of health implies the elimination of the poison, either in an active or an inactive form. The ordinary channels of elimination are the lungs, the skin, and the bowels, and through one or more of these it may be inferred that the poison leaves the body. As these are the channels through which foreign bodies find entrance, it may be presumed that through one or more of them the poison enters the system. That the bowels form one channel for exit, is evident from the characteristic profuse discharge from them; and for entrance also, from the fact of the disease having been induced in a healthy person by swallowing the evacuations from a cholera-patient when mixed with drinking water or food. The opinion that the cholera poison exists in a most dangerous state in the evacuations has gained ground rapidly since the remarkable case of the Broad Street pump, recorded by Dr. Snow in 1854, and it is now universally accepted by the profession. Some authors of note suppose that the bowels are the only channel of elimination, and that, by disinfecting the evacuations, they can arrest the communication and dissemination of the disease.

That the skin forms another channel of exit appears probable from

the profuse cold perspiration, which is a symptom of the disease, and which has the peculiar or characteristic odour. Many instances are on record of the disease being communicated to healthy people who have worn, handled, or washed the clothes belonging to cholera patients. It is probable that in these cases the poison also entered by the skin; but it is possible that it may be of so light or volatile a nature that it may rise into the air and be breathed, thus entering through the lungs; or it may even adhere to the saliva in the fauces and be swallowed, and so pass into the bowels.

That the lungs are a channel of entrance for the poison is rendered probable by the fact of the disease following attendance on patients suffering from the disease, as well as exposure to currents of air from places polluted by cholera evacuations, to peculiar fogs or miasms or fœtid sewage-gases. There are numerous illustrations of all these cases.

Having thus briefly alluded to the different channels through which the poison, or germ of cholera, may leave and enter the body, I will now consider the various channels or media through which it passes while outside the body.

In ancient times, it was considered that plagues and pestilences of all sorts depended on an *epidemic or abnormal state of the air*, and not on contagion; otherwise the earth would have been depopulated by the extension of these diseases. This theory of an epidemic atmosphere has been thought especially applicable to cholera, as it differs from other contagious diseases, as small-pox, etc., in the fact that recovery from one attack affords no immunity from a second. It would also explain the limited duration of these epidemics, and these simultaneously appearing or disappearing over a wide extent of country. But it has been satisfactorily proved by recent investigation that atmospheric influence alone will not account for the appearance of the disease. It is a curious coincidence, that in India almost the only believers in this atmospheric theory at present are the two statistical officers in Calcutta —Dr. Bryden, Statistical Officer to the Supreme Government, whose Tables of the Diseases of India are most valuable; and Dr. Smith, Statistical Officer to the British Medical Service, who has lately written a book to prove that ague, cholera, and sun-stroke are modifications of the same disease. Dr. Bryden's theory is, that cholera originates in Bengal, where it is endemic; that it is carried over the world by winds; and that it has a period of existence limited to three years, after which it disappears, and will not return without a fresh irruption from Bengal. The objection to this theory is, that *the disease* progresses against the wind as readily as with it, on the different lines of commerce. The observations recorded at the time of the Hurdwar epidemic show that the disease spread simultaneously with the returning pilgrims in all directions of the compass, progressing at the rate at which they travelled, whether on foot, on horseback, or by rail; and thus could in no way have depended on the wind. Again: the disease has in many cases accompanied steamers across the ocean, and appeared in the new countries simultaneously with their arrival. In reference to the supposed triennial character of the disease, this is not supported by the fact that, since it reached Persia in 1820, it has appeared there every year with very few exceptions. In Russia since 1830, and in Germany and America since 1832, I believe it has never been absent from some part of the country.

The *season* of the year has a very decided influence upon the disease in India. I have compiled tables showing the result of a careful examination of the statistical returns of the sickness and mortality among

the European troops in the Bengal Presidency, from the year 1814 up to the present date. The influence of season on cholera is here clearly demonstrated; and it cannot be considered accidental, as it includes a period of fifty-eight years, and a total strength of 1,095,549. The second line in the table shows the returns from the native troops since 1826, on a total strength of 3,930,546. The third line shows the returns from the native prisoners since 1854, on a total strength of 980,546; the fourth, the returns from the native population since 1867, on a total of 221,042,902. It will be observed that the season favourable to the spread of the disease differs with the locality. In Bengal, and on the coast, the season is March, April, and May; whilst in the North-West Provinces and the Punjaub it is July, August, and September. The influence of season is marked also in Madras and Bombay; the period coincides more with the season in Lower Bengal than with that of the Upper Provinces. The vicinity of the sea may exert some influence. These separate divisions of the country show variations in the season; but season has merely a modifying influence on the atmospheric channel. These tables are valuable, as showing its extent; but they also indicate that there are other powerful influences bearing on the diffusion of the disease, as some of the most severe epidemics in the Upper Provinces have occurred at the seasons which these tables indicate as almost exempt from cholera—viz., the great epidemics at Hurdwar in 1782 and 1867, which both broke out in April; and the attack in Lord Hastings's camp in Bundelcund, which commenced in November in 1817. I have also seen some sharp local attacks, and had reports of many others, during the cold season in the Upper Provinces—a time when these tables show an almost total absence of the disease. July, August, and September are the months in which cholera has raged most severely in London; but the attacks over the country are not so prescribed. As a general rule, the season for the disease in England and all temperate climates appears to be autumn, though instances of its spreading at other times are numerous. It is very probable that pure air has a disinfecting or purifying property. At any rate, articles that have been excluded from the air have retained their infecting power for weeks or months. This has been shown when people were attacked after examining boxes containing the clothes of those who had suffered from cholera some time before. The influence of certain impurities mixed with the air in increasing the multiplication and facilitating the dissemination of the poison is very marked, whilst others are supposed to restrain its action or destroy the poison. The admixture with the air of the gases produced by animal and vegetable decomposition, evidently favours the development of cholera as much as plague, typhus fever, and other epidemic diseases. Some even suppose that defective sanitary arrangements may induce cholera; but there is no proof of this, and I do not believe in the spontaneous production of specific disease. This is a point of great practical importance, as it shows the value of those precautionary means which may be employed to intercept the communication of the disease through those channels which we are now considering. It is supposed by some that even discussing the contagious nature of cholera, far more authoritatively sanctioning such a view, would act injuriously on the public; that the sick would be deserted, and panic increased. But this is far from my experience. Concealing the truth does no good; and it is already the popular idea that the disease comes from the sick person, and that there is danger in his vicinity. It creates confidence to be assured that, though the poison may be, and

most likely is, imbibed from contact with the sick, its effects may be rendered very harmless by early attention. In some cases, nature alone casts it out; while, if the *malaise* from the poison proceed to diarrhœa, this can easily be checked in its earliest stage by simple remedies. I have on more than one occasion seen a regiment in a state of extreme excitement when it was loudly asserted that the disease was not contagious; and I have seen confidence restored by measures carried out avowedly for the purpose of avoiding contagion.

That very impure air will not alone cause the disease, is evident from the fact that cholera has only of late years become known in Europe; and defective sanitary arrangements are certainly not more general now than in former years, though they may attract more attention. As in a richly manured field a luxuriant crop of wheat or barley is produced if wheat or barley be sown, so in a very contaminated air will the crop of disease be abundant if the germs of cholera be introduced. The most striking illustration of this that I have met with occurred at Chillony, a station in Assam, in 1869. The disease had been prevailing in a mild form for some weeks in the surrounding country; but the station remained free until, for sanitary purposes, it was resolved to clean out a dirty hollow which formed a natural cesspool near the jail. Clearing out the soil caused a most disagreeable smell, and was immediately followed by a severe outbreak of cholera amongst the prisoners employed in the work and the inhabitants of the vicinity. In this instance, the poison, being present, seems to have found a suitable soil in the disturbance of the cesspool, in which it multiplied excessively, and without which it might have disappeared. The laudable intention of the sanitary officers proved injurious, from being carried out at a wrong time.

There is no point on which the concurrence of professional opinion is more decided than on the danger of impure air. It is founded on observation of the fact that in cities where the air is most vitiated, the disease prevails to the most fatal extent. As there is generally a combination of other non-sanitary effects, in sewerage, drainage, and bad water, it is difficult to discriminate the individual share of each agent. Impure air has probably been the channel of communication in instances on record where an individual walking out in the open air has been sensible of a disagreeable smell previously to the commencement of symptoms of cholera; also when the disease has appeared in part of a range of barracks or buildings situated to leeward of the place where the body of a cholera patient lay, or of cesspools or privies used when cholera was raging. One side of a ward has sometimes been affected when the occupants of the opposite side have not suffered. I have records of numerous instances illustrating these points; but in no case did the range traversed by the poison extend beyond a few yards.

In the investigation of the various channels by which the poison may be transmitted from the diseased to the healthy, the first object that occurs for consideration is the body itself in which cholera has manifested its presence. When this has run its fatal course, may it be transmitted from the dead body? This point has been argued with much ability and plausibility by the best medical authorities since the appearance of the disease in 1817. With many, it is still an open question. The argument that the dead body is not a source of contagion, rests on the negative evidence that many or most of those who have performed *post mortem* examinations have not been attacked by the disease. Negative evidence of this nature is to be found without limit; and it is a fact, though not so universal as many suppose who

limit their acquaintance with the disease to the stage of collapse. For example, Dr. Jameson, one of the most influential non-contagionist writers in India, relates that the body of a surgeon who had died of cholera was examined by three medical officers, who all remarked a peculiar smell, and all suffered for the next two or three days from sickness and diarrhœa. With our present knowledge of the symptoms of the earlier stages of the disease, we should say they had imbibed the cholera-poison; and this would be an illustration of its being contracted from the dead body. There are many instances related of women employed in washing and dressing dead bodies being attacked on the following day. I may mention the case of a sepoy who in 1818 died of cholera at Goruckpore, and was carried to the grave by five of his companions. They all took the disease that night, and died. Dr. Townsend, Sanitary Commissioner Central Provinces, reports in 1869 that on May 25th three men were summoned by the police from the village of Dumwahi to bury the body of a man who had died of cholera near the police-station. The cholera broke out at Dumwahi on the next day, and lasted fifteen days. These three men died, and sixteen more, out of a population of 106. The policemen were not affected; they probably did not touch the body. I have read several reports of cholera having broken out among parties of coolies employed in road-making, after opening graves where cholera subjects had been buried some years previously. In America, where it is a common practice to transport the dead from a distance to their native towns for burial, instances of the disease having appeared after the arrival of the bodies of cholera cases are reported in the *Army Medical Reports* for 1867. The presumptive evidence from these cases is, that the dead body is a source of danger.

The living body is considered by nearly the whole profession, in the present day, to be the channel through which the poison of cholera is received, multiplied, and transmitted; and from the living body the evacuations are one of the chief channels of communication. On this point there is little divergence of opinion. It is in accordance with the history of the disease to infer that the human body has been the means by which it has been spread over the world, through the ordinary channels of commercial communication, the poison having probably been disseminated in the evacuations. The number of those who question the power of the poison to multiply when in the body is very limited.

I think Professor Pettenkofer stands alone in considering the subsoil-water essential to the reproduction of the poison in a state of activity. There is every probability that the poison is capable of passing through the various stages of its existence outside the body, in a watery medium; but it is clear that it may pass directly from the body of the sick, or from the evacuations which proceed from the body, to a healthy body, and there induce the disease without the intervention of any subsidiary aid, beyond the mechanical transmission by air or by water. In impure water the poison probably multiplies, but this is not essential to its activity. In the cases just alluded to, of infection from dead bodies, there is no indication of any intermediate state of development in the poison, in its passage to those who received it. Instances of healthy people being affected by the disease after intercourse with cholera patients, are beyond number. I may give in illustration a few instances from my own experience, as they materially influenced my opinions of the disease. In 1856, during an epidemic attack at Agra, I visited the Jail Hospital, where the disease was very severe, with Dr. F. On leaving the hospital, he complained of feeling sick, but we drove to the

Thomason Hospital, where I had several good surgical operations, at which he assisted. The excitement appeared to keep the attack in check till the operations were finished, but immediately afterwards he was seized with watery vomiting, and other symptoms of cholera. On another occasion, during the same epidemic in 1856, while passing through the cholera wards of the Jail Hospital, I visited the dead house, where I saw some fifteen bodies. On returning to the cholera wards, where the peculiar odour was very oppressive, I felt a shock in the præcordium, followed by a cold, deadly feeling, which gradually extended over the body. I immediately concluded that I was attacked by the disease, but thought, if I made it known, it might create panic amongst the attendants. I asked the native doctor if he had a good stock of quinine in store ; he said he had, and I desired him to let me see it, and continued my progress through the hospital—the cold, dead feeling now extending to the extremities. On arriving at the hospital door, the native doctor brought the quinine on a paper to show me. I put a large pinch into my mouth, jumped into the carriage, and told the coachman to drive home. At first the quinine had no taste ; but, as I chewed and swallowed it, I became warm, and it tasted bitter. On reaching home, I took two cholera pills, lay down and fell asleep. I awoke well. For two or three days there was want of appetite, and the bowels were torpid, but there were no active symptoms. A few days afterwards, an American missionary, to whom I had related this case, had a similar shock about two hours after attending a child who was suffering from cholera. About two hours after the shock, diarrhœa commenced ; after the second or third motion, he recollected my treatment with quinine, and commenced taking it ; the diarrhœa continued till morning, but collapse did not supervene. At Agra, in the epidemic of 1861, a clergyman, Mr. C., was attacked with watery vomiting while attending the bed side of a cholera patient in the Artillery Hospital ; he had that morning officiated at the funeral of a gunner who had died of cholera. The captain and three men of the funeral party were attacked the same day. The captain and, I think, one man died ; the clergyman, from the use of timely remedies, recovered. On that same morning, on visiting the hospital of the European Regiment, I found the officer on duty vomiting in the verandah, which was the commencement of the disease ; he died two days afterwards.

There is a remarkable case noted by Staff Surgeon Connell in Madras, in 1818, of the wife of a conductor, living in the Artillery Lines, being attacked with cholera. Her friend, Mrs. Gray, attended her for a couple of hours ; she was seized with the complaint, and died the next morning. Her son, a boy six years old, living in the same house, was attacked the day after the death of his mother.

It is also reported by Dr. Cardew, Deputy Inspector-General of Hospitals, that the first case of cholera that occurred at Lucknow in 1864, before the epidemic appeared in the city, was in an officer of the Royal Artillery, followed, within twenty-four hours, by the attack of two other officers who were residing in different parts of cantonments ; but both these officers had been in constant attendance on the first patient till he died.

I consider these illustrations of the direct communication from the sick to the healthy, by means of the air certainly, but to a limited extent, and not requiring a specific or epidemic state of the atmosphere, which shall extend continuously thousands of miles, as implied in Dr. Bryden's aërial theory.

We now come to the consideration of the solid or earthy media, to

which the poison may become attached, and so be made a source of danger. The dead body comes under this denomination, but it has already been discussed. The clothes and bedding used by the sick come next under notice, and that they are dangerous is very generally believed; and, if so, this goes far to establish the contagious nature of the disease. In India, in 1869, under the orders of Government, I collected the opinions of the medical officers in that country on the chief points in the history of cholera. The result is a valuable table, showing the views of 505 members of our profession, who have all had experience of the disease. By 492 of these, the clothes and bedding were recommended to be burnt, while only three opposed this view. That danger arises from merely washing these articles, is shown in many instances. It was reported from Besabat, in 1867, that the inhabitants were attacked by cholera two days after the clothes of some pilgrims had been, contrary to orders, washed in the village tank. It may have been from the clothes of the pilgrims that the inhabitants of Jough Kelan were infected the same year; but the sick pilgrim remained on the banks of the tank during the day, and he most probably bathed and used the water for other purposes. At Constantinople, in 1865, an instance occurred which proves that these articles become contaminated. The clothes and mattresses of the sick were washed in a fountain, and, the water-pipe being unfortunately broken, the foul water communicated with the clean. In a single day sixty people died in the suburb which is supplied by the affected stream. It is a common practice in India to wear the clothes of the deceased, and this may be one of the causes of the widespread mortality. There they wash their own clothes; but, in Europe, there are special people employed for the purpose. The Report of the College of Physicians in England, in 1849, shows many instances in which washerwomen were attacked, and it was amongst them that the disease first appeared in 1854, after the clothes of a cholera subject had been washed. In America, many similar cases are recorded. Instances are numerous of people being attacked by the disease after unpacking and handling clothes that have been worn by cholera patients. One of the most remarkable anecdotes I have met with, illustrating this, is related by Dr. Simpson, who states that a young lady, in 1832, was attacked with cholera after wearing a cap which had been worn by her aunt, who had died of cholera nearly a year before. The cap had been set aside in a drawer, which was not opened until that day. Similar cases are mentioned as occurring in England and in Germany, by Professor Pettenkofer, of Munich, 1854, by Dr. Sibert, of Frankfort, 1856, and Dr. Flauvel, in France, 1868.

That the cholera poison becomes attached to places, and, remaining there, must be a source of danger, is the next point for consideration. On this the opinion of the medical officers in India, given at the time to which I have alluded, is less decided than on some other points, though it is very clearly defined. Of 505 officers, 432 think the disease communicable from the place, whilst 19 say that it is not; but, as only 4 of these object to removal from the place as a desirable remedy, their practice does not agree with their theory. That the ground may become affected is proved by instances of troops or travellers being attacked after encamping on ground recently vacated by parties suffering from cholera. The period during which the open ground, exposed to the influence of the sun and air, may remain dangerous, is uncertain. I have seen no injurious effects arise from ground which had been occupied by cholera camps a year previously, when troops have again moved on to it. But I had reason to suppose that old buildings, in the vicinity of

Agra, which had been occupied by cholera patients the year before, were injurious to the new comers, as attacks in them were more numerous than they had been in the previous year, or than they were in the open camps in the neighbourhood. I may here allude to the danger which arises from latrines. I have noticed that they are a fertile source of the dissemination of the disease, particularly in the European barracks and native jails. The accompanying table, which I bring forward to show the influence of season, also demonstrates the effect of the use of latrines. There is a marked difference in the extent to which the European soldiers and native prisoners suffered, as compared with the native soldiers and civil population. The military duties of the European and native soldier are the same, and the native soldiers and civil population are of the same race as the native prisoners. The sanitary arrangements for the troops and prisoners are equally efficient, while those of the towns are known to be very defective. There must, therefore, be some powerful channel of communication in force, with the English troops and native prisoners, which is wanting with the native troops and civil population, and this, when discovered, should be guarded against in all countries. The circumstances common to the English troops and native prisoners are, that they reside in large rooms or barracks, and that they use public latrines, whilst the native troops and civil population live in separate houses, and have no common latrines.

In the Indian reports which have come under my notice, instances are innumerable of a first case of a severe epidemic appearing in a village in some resident who had returned from a visit to a distant town, or to another village, where the disease was raging. Similar cases are common also in European and American reports. I have myself observed attacks to follow visiting buildings, or other places, to which the poison may have been attached ; living patients were also present, and from them the poison may have been transmitted, and not from the building.

The question whether there was danger in admitting cholera patients into general hospitals was much discussed in India when the disease appeared in 1817. It was decided that there was not, and this opinion prevailed till very recently. It was promulgated in official reports in France, Russia, Germany, and England, and acted on up to 1865, since which time these views have generally changed. There are, however, a few who maintain that there is little or no risk, and such cases are still admitted into general hospitals in many of the cities of Europe wherever especial cholera hospitals are not yet established. If the contagious nature of cholera were once authoritatively admitted, this would not be permitted. Even when there are special cholera wards, the danger is brought very close to the other sick in any hospital. Large wards for the treatment of cholera patients are very unfavourable. In no case is it more important to keep up the spirits of the sick, and the depressing effect is very great of seeing their companions in agony sinking and dying rapidly around them. Small tents, or huts, form, in my opinion, the best cholera hospitals. They should be erected on open ground in the vicinity of trees, if practicable ; the sites for these hospitals should be selected, and all subsidiary arrangements settled, before the disease breaks out. By this means time is gained, confusion obviated, and panic averted, by the public seeing that the authorities have foreseen the danger, and know how to meet it. The arguments in favour of the non-contagionist views were very strong. It was reasoned that if the disease were contagious, the physicians, hospital attendants, and other patients present must suffer—

indeed, could scarcely escape attack; but that in many instances these people did not suffer more than others. Some went so far as to say that, from habit, being in the hospital created an immunity from attack. Many old Indians will assert that the disease cannot be contagious, because they have attended friends suffering from cholera without contracting it themselves.

My own experience furnishes many instances illustrating immunity from attack. The native hospital attendants rarely suffered. The class of *shampooers*—natives employed to rub or "shampoo" cramped European sufferers—were in no instance affected during four epidemic attacks at Agra, where seven hundred were employed. The reports from the General Hospital, Calcutta, show that none of the subordinates, or native attendants, and few of the sick, have been attacked in the hospital; and similar reports are numerous in reference to other European hospitals in India. I see no reason to doubt the accuracy of these reports. But, on the other hand, as a *general rule*, the number of patients in hospital, and orderlies attending on their comrades when in hospital, who are attacked, is above the average of the rest of the corps.

Dr. Brown, the present Inspector-General in Bengal, reported that, of the cases in the hospital of Her Majesty's 89th Regiment at Umballa in 1861, one-fourth occurred in patients in hospital for other diseases, and one-sixth in the orderly attendants. Dr. Poole, Civil Assistant-Surgeon, notes in a report in 1859 that it is worthy of record that every one of the regular attendants on the sick were severally attacked, and he considers that the further progress of the disease in the hospital was only checked by daily doses of quinine, taken by himself, and ordered for the native doctor and all the other attendants. Dr. Wilkie, Deputy Inspector-General, Meerut Circle, in his report of 1861, remarks that in the European hospital at Meerut, twenty-seven men and three women patients were attacked, and six orderlies and attendants. Surgeon J. MacGregor, of Her Majesty's 39th Regiment at Bellary, in the Madras Presidency, writes in 1839 that there were a great many attacks in the hospital, both in men who had been long under treatment, and in men recently admitted for fever, in whom blood-letting had been practised. In this weak state cholera invaded twelve patients, and proved fatal to eleven. The Cholera Commission in India in 1862 reported that the sick and attendants in hospital were attacked above the average proportion. This is the conclusion at which I myself have arrived, after thirty-eight years of careful observation of the disease. That it is the decided opinion of the profession in India, is shown by the table I have before quoted. The adverse opinions on the four leading questions bearing on this point—viz., removal from the locality, isolation of the infected, special hospitals, special attendants—only amount to sixteen; whilst the opinions in favour of these measures amount to 1,943, which is a proportion of more than 99 per cent. I do not deny, on the contrary, I am of opinion that the body gets accustomed to, and from habit tolerant of the poison; somewhat as it gets accustomed to the use of alcohol, opium, or arsenic, of which an *habitué* can with pleasure take a dose which would render insensible, or kill, one not accustomed to their use. This view is strengthened by the fact that visitors to an infected locality are peculiarly liable to attack, and suffer in a greater proportion than the residents. I and others have observed this in the Upper Provinces, and it is peculiarly remarked in Calcutta.

It follows as a natural inference, from the facts here stated, that removal from an infected locality is one of the best means of avoiding danger from the disease. In military life this is practicable, and in

India has been carried into effect with the greatest advantage, by removing the troops into tents on the first appearance of the disease in an epidemic form. This is not feasible with a civil population or a crowded city in the same efficient manner; but those who have the means of leaving the place should do so, as their departure would not only benefit themselves; but be of advantage to those who must remain.

On board ships at sea, the disease appears to be influenced by similar causes as in houses or barracks on land. There have been numerous instances of cholera appearing in emigrant ships and proving very fatal some days after sailing from England. I may mention two instances. The steamer *England* sailed from the Mersey on the 26th May, 1866, with 807 emigrants on board. Five days subsequently cholera appeared; there were 500 attacked, of whom 250 died. The *Virginian* sailed from the same port six days after, and on the eighth day cholera broke out, and there were 105 deaths. The disease was not prevalent in the Mersey when these vessels sailed, but some of the emigrants had lately come to England from foreign ports where cholera was raging. There have been many attacks on board the ships in Calcutta clearly traced to using river-water, especially when cholera was prevalent in the city. Those vessels lying opposite the public sewers were particularly liable to attack; but this anchorage has now been forbidden. In some instances the disease has appeared in the emigrant ships some days after leaving Calcutta, and caused considerable mortality among the coolie emigrants.

Water, as a channel of communication, was not alluded to in the numerous reports which I have perused written on the first appearance of the epidemic among the European troops in 1817-18; nor was it suspected as such in Paris, in 1832. In the report of the Board of Health in England, in 1848-49, water is not alluded to; it is there stated that the disease is not, in the common acceptance of the term, contagious, but spreads by atmospheric influence. Attention was drawn to water as a means of communication in 1854, and its agency was forcibly shown by Dr. Snow, in his remarkable account of the Broad Street well, when 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 this pump, and that very few who drank of it escaped the disease.

It is not now questioned, in the profession, that water is one channel through which the poison may be transmitted; some even go so far as to consider water as the only medium. Instances are very numerous which illustrate the communication of the disease through this channel. None are more convincing than those reported to me during the Hurdwar epidemic in 1867, two of which I will relate. Mr. Blyth, Deputy Commissioner Bengal Civil Service, reports that a pilgrim was taken ill of cholera at noon on the 28th April, 1867, at a well in the village of Joogh Kullan, and he died next day. His soiled clothes were washed in an adjoining pond. Other parties, who afterwards visited the well and the pond for water and ablution, caught the infection. The disease broke out two days after, on the 30th, and up to the 15th May 53 were attacked, of whom 27 died. There had been no cholera in this village for twenty years before. Assistant-Surgeon Gardner reports that, at the village of Besabat, two men, who had returned from the Hurdwar Fair, died of cholera on the 30th April, 1867, and their clothes were not burned, according to orders given, but were washed in a pond which was inside the village, the water of which was used

for domestic purposes. On the 1st and 2nd of May, sixteen attacks occurred in this village. There is an analogous instance in a report on the subject by Mr. Anthony of Madras. The part of the tank at Ramnad which is nearest the chuttea, and where the clothes of the first patient must have been washed, is the part from which nearly fifteen-sixteenths of the cholera patients had taken their drinking water. That there is a popular belief in water as a channel of communication, is shown by the disturbances which took place in America (in the South) from the rumour that Government had poisoned the rivers. In Europe, there have been some political demonstrations, under the idea that the wells had been poisoned during cholera epidemics. In India, the suspicions of the people have only been directed to the medicines issued by Government, which they thought were mixed with substances which would destroy their caste.

The influence of the admixture of animal or vegetable matter to water, in facilitating or retarding the propagation of the poison, is a point of great practical importance. It is generally supposed that the poison multiplies more readily in water which contains animal or vegetable matter; but water, in all states of impurity, has been used without inducing cholera, whilst pure water, in any way contaminated by the admixture of cholera evacuations, will almost surely induce the disease. This is proved beyond doubt by the case given by Dr. Macnamara, when water in a drinking jar was so infected, and imparted the disease to those who drank it, as well as by Dr. Snow's observations. A small quantity of cholera poison in ordinary drinking water, may soon render it capable of widely disseminating the disease in a most fatal manner. There is no evidence that this poison can be removed by filtration, or by the addition of any disinfectant which will leave the water fit for use; it is, therefore, of vital importance to prevent the poison gaining access to the water. The military cantonments which have suffered most severely from cholera in the Punjaub are supplied with water from open canals. That this was the channel of communication in Peshawur, in 1867, is highly probable, as a large party of Hurdwur pilgrims passed through Peshawur, on the 19th of May, on their way to Cabool. Their road, for some miles, lay near the canal. The disease broke out all over the military cantonment on the 20th, and in the city on the 22nd and 23rd. That the station of Peshawur was attacked on the 20th is a fact, and there is strong probability that the cause was through the canal water, as on no other occasion has the disease appeared at this season. This view is strengthened by the result of the removal of the troops. One-half of the 42nd Regiment was moved into camp on the 20th, and the remainder during the three following days. The whole regiment changed ground on the 24th, and moved on to Cheraat. Out of a strength of 674 men, 105 had been attacked up to the 25th, of whom 54 died; 23 were attacked in the five following days, and, on the 31st, the last case occurred, making a total of 129 cases, of which 72 died. The 77th Regiment was attacked on the 21st. On the 23rd, four companies were moved into camp, and the rest of the regiment were also sent into tents in the vicinity of the station, as soon as carriage could be procured. The last case in this regiment occurred on the 24th June; the disease, therefore, existed in it three weeks after it had ceased in the 42nd Regiment.

The subsoil water may often be connected with the diffusion of the disease, but it is in no way essential to it, as supposed by Professor Pettenkofer. This is clearly shown by the progress of the disease bearing no relation to the rise and fall of the subsoil level in India, more

especially in the Central Provinces, where it has been carefully observed by Dr. Townsend, and by the continuous course of the disease, which accompanied the stream of pilgrims from the Hurdwur Fair, in 1867. There can be no influence from subsoil water in cases where the disease appears in ships some days after sailing from a port, in which cholera did not rage, and amongst emigrants who had never even seen the country where it did prevail, and from which it must have been brought by those fellow-emigrants who had lately left it. That the dampness of the soil in connection with chemical or vital action on the surface may influence the course of the disease, is very probable. There are many instances of epidemics breaking out after sudden storms or heavy falls of rain. The Hurdwar epidemic of 1867 was preceded by a heavy fall of rain. Instances are not uncommon of epidemics subsiding after severe storms. The disease has occasionally been preceded by severe dust storms, as at Kurrachee in 1845. The influence of the season, which is so clearly shown in the tables I have referred to, I attribute to the natural action of the elements on the surface of the soil. I do not think there is anything specific in the atmosphere when the disease is spreading, but merely that the state of the air and water at that period is well suited to the growth and development of the poison which causes the disease. The tenacity of life of the poison under all circumstances, and its excessive fecundity in some, indicate the difficulties of restraining the course of the disease. The development of the poison outside the body may be checked by the use of certain agents, called disinfectants. The nearer to the focus of the disease, the more effectually can they be applied. The evacuations from the body being the greatest source of danger, every possible means should be employed to disinfect them, and prevent their entering the public sewers, or getting near the sources of water supply ; everything soiled by them is a source of danger. Every energy should be directed to the effort of restraining the multiplication and dissemination of the poison when it has appeared ; but our first care should be to ward off its entrance. There are difficulties in excluding so subtle an enemy, and the means are vexatious and expensive, but not always useless. When we witness the great mortality radiating from a single point, and when we see how one focus may be contaminated by the casual visit of a sick man, and consider that the exclusion of that individual would have averted the explosion that followed his arrival as surely as the explosion of a magazine follows the admission of a single spark of fire, we cannot but wish that that exclusion had been enforced.

Great benefit has arisen in all countries, and at all times, from attention to sanitation. It is a means of saving life from all epidemic disease, and in none is its aid more valuable than in cholera ; but it would not be safe to neglect other precautionary measures, and rely solely on this. In India, I have seen some of the most fatal attacks take place in cantonments and jails, where all practicable sanitary rules were in full force and most zealously carried out. The foul air from drains, cesspools, and dirt of all kinds, is the nurse, not the mother of cholera.

In Europe sanitation has received the most careful attention, and is most thoroughly studied, but the origin and source of cholera has not been so perseveringly investigated as in India, where the Government has enforced many valuable regulations for restraining the dissemination of the disease, and averting danger from its attacks by early treatment and precautionary measures. Our knowledge that the poison passes through certain channels and is transported by human intercourse indi-

cates the possibility of restricting its course, and experience has shown that by quarantine regulations many cantonments and jails in India have escaped when the disease raged in the surrounding country. The disease has been arrested in the quarantine station at Staten Island, in America, in nine out of thirteen instances in which cholera subjects were landed from ships. In England, during the last two years, there have been about twenty instances where the disease, having appeared in the crews of vessels which had left infected ports in the Baltic, has been prevented from spreading by quarantine regulations in English ports. Sanitary arrangements unquestionably form a valuable auxiliary and are the groundwork on which plans for the restriction and cure of the disease must be founded, and without which neither quarantine nor medical treatment could be successful, but they will neither prevent the transmission of the disease over the world, nor cure it when present. The subtlety of the enemy, and the rapidity with which he multiplies, indicate the difficulty of restraining his action, but that he should be occasionally arrested is a position gained, saving, perhaps, a wide-spread mortality. Whilst his occasionally eluding this arrest is matter for regret, and is occasioned only by the imperfection of the measures used, or neglect in carrying them into execution.