Instructions for conducting an enquiry into cholera in India / (prepared by the Army Sanitary Commission).

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Conducting an Enquiry into Cholera

IN

INDIA.

(PREPARED BY THE ARMY SANITARY COMMISSION.)

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IN

INDIA.

Cholera first appeared in an epidemic form in India, and it is to Medical Officers who had served there, that we owe the earliest investigations into its nature and treatment. For many years nearly all that was known of the disease was contributed by these officers, and only at a comparatively recent date have investigations in Europe been more than extensions of enquiries previously begun in the East.

Lately, however, the whole subject of epidemic cholera has obtained a new development from scientific investigations carried out in Europe; while the great losses recently sustained by troops serving in India have shown how little has been accomplished towards diminishing its fatality.

Under these circumstances it has been considered desirable that a special enquiry, in conformity with the following instructions, should be undertaken, with the view of ascertaining whether with improved methods of research any further information can be obtained regarding this disease.

An investigation, such as the one contemplated, is beset with difficulty, and trustworthy results can only be arrived at slowly; but the final object is so important to the public interests as to afford sufficient justification for undertaking the work.

§. I. Object of the Enquiry.

The object of this enquiry is to ascertain by an investigation, as complete as our present means may enable us to carry out, what cholera is? What are its laws of origin and extension? What is the real nature of the pathological changes which occur in persons suffering from it? What are the best methods of treating the disease, and by what proceedings the ravages of cholera may be mitigated, or its progress arrested?

The enquiry is a purely practical one, and as it may lead to legislative measures involving interference with freedom of intercourse, and to a large expenditure of public money, as well as to considerable private sacrifices, no results can be accepted for practical use unless these are fully sustained by obvious facts.

The enquiry is not to be undertaken with the view of establishing any particular doctrine or hypothesis in regard to cholera, neither is it to be carried out from any central doctrine or hypothesis, round which the facts are expected to range themselves.

If any beneficial result is to follow from it, the enquiry must be pursued without prepossession, and with the single object of ascertaining what is true.

It is necessary to give this caution, on account of a natural tendency which has shown itself in dealing with a subject of such

difficulty, to trace the manifold phenomena of epidemic cholera to some single cause,—such as epidemic influence, water contagion, cholera excreta, unhealthy subsoil, cholera germs, and the like; and to build on single causes, or on hypothetical considerations, not only epidemic doctrines and pathological systems, but also methods of treatment and measures for arresting the ravages of the disease, at the risk of overlooking the real evils to be dealt with, and of inflicting suffering and loss by the execution of measures not adapted to the ends they are intended to serve.

No opinion or hypothesis, and no evidence, except such as is sufficient to prove the existence of uniformly operating causes of disease, can ever justify legislative action in public health questions, or the expenditure of public funds.

The enquiry will probably not be completed when the present instructions are exhausted. These instructions are directed solely to ascertain facts, which, when arrived at, may indicate other points requiring examination. It is hoped that by following rigidly and experimentally this course of proceeding, the time may arrive when all the phenomena of cholera may arrange themselves naturally under some general expression indicating the measures required for saving human life, and when the various and apparently contradictory phenomena of the disease may become self-interpreting.

It is not, of course, intended that all Medical or other Officers should undertake every detail in the following instructions. This course would be unadvisable, even if it were practicable. Medical Officers will, no doubt, at once perceive the points in which they can render efficient aid, and it is scarcely necessary to state that any Officer who can communicate even a few carefully observed facts in his locality will do more to advance knowledge than if he were to transmit conclusions or opinions founded on imperfect observations made over a large area of country.

It is proposed to arrange the enquiry as follows :—

First. To obtain statistics of cholera as accurately as possible.

Those for the troops to be entered in detail by regimental surgeons at every station, whether for British or native troops.

Those for prisons and other public establishments by medical officers attached to them.

Those for the civil population by the most efficient statistical machinery available.

All Principal Medical Officers should be kept informed as to the statistics of cholera and other epidemic diseases among the civil population of towns, villages, bazars, &c., in order that they may know the movement of epidemic diseases in their districts. And all facts of this nature are to be carefully registered by the Principal Medical Officer for transmission with his reports.

Medical Officers of prisons and of other public establishments should be kept similarly informed.

Second. It is proposed that facts regarding the movement of cholera and the sanitary condition of troops and stations where there are British and native troops shall be given by the Principal Medical Officer of the station.

That similar facts regarding prisons and other public establishments shall be given by the Medical Officers attached to them.

That for cities, towns, and villages where enquiries of a special character are carried out, the sanitary reports should be drawn up by Officers of Health, or other Medical Officers selected for the duty, aided by Engineers or other persons having special knowledge, where necessary.

Meteorological observations should be supplied by existing observatories, and by the Officers at stations in charge of meteorological instruments.

Third. Special microscopic physiological and chemical enquiries into the nature and cause of cholera to be conducted—

(*a*) In localities where cholera is endemic,

(*b*) In localities always exempt from cholera,

By officers specially set apart for these enquiries.

Two Medical Officers specially trained for such investigations have already been sent to India.

Chemical analyses should be conducted by practised chemists.

Fourth. Although, for the sake of uniformity and comparison, it is deemed advisable that special local enquiries should be undertaken by qualified observers. Medical Officers at stations, prisons, &c., are invited to undertake independent enquiries of this class to the extent of the means at their disposal. But it is not intended that they should feel themselves called on to do so if they have not the time or means.

Fifth. The special enquiries should be carried out in concert with existing sanitary authorities in India under arrangements made on the spot, and all reports should be sent through the customary channels to the Government of India for transmission to the India Office.

§. II. Statistics of Cholera and Diarrhœa.

Little that is reliable regarding epidemic diseases can be ascertained without accurate statistical information.

There is no difficulty in obtaining information on this subject among British troops serving in India; but British troops constitute only a small part of the population attacked by cholera. Epidemics seize on all classes of population, and no trustworthy information can be obtained regarding the movement of epidemic cholera, except by including all classes in the same general statistical inquiry.

Much valuable statistical information regarding cholera has been already collected by Medical and other Officers in India, which will be reduced and made use of in due time. But as the present enquiry has a definite object, it has been considered desirable that it should be undertaken as far as practicable on one uniform plan, as follows:

Cholera chart for troops, &c.

The accompanying Statistical Chart or Register contains the data required for British troops.* A similar Chart or Register would answer for women and children.

We would strongly recommend that the same Register, so far as it may be applicable, should be employed for native troops.

It would also be applicable, with a slight alteration, to the population of prisons and other establishments where numbers of people live together.

The data on this Register, when reduced, will give most of the information required about the disease itself.

Civil statistics of cholera.

Any statistical enquiry among the civil population would have to be conducted on different principles, because it would be impossible to obtain all the points of comparison which might be attainable among distinct bodies of men under discipline. It would be necessary, therefore, to restrict the enquiry among the civil population to general facts showing the course of epidemics. But this general procedure would not interfere with special local statistical enquiries into cholera among the civil population where it was found to be possible to carry out any such enquiries.

* *Registers of different sizes for different strengths of Corps will be distributed together with these instructions.*

We would venture to propose the following statistical points for registration by the civil authorities in all parts of India affected by cholera, where it might be practicable to obtain the information.

In all statistical enquiries regarding cholera and other epidemic diseases, the dates and localities of events are of primary importance.

1. The date of any evident increase of any class of fevers, stating the nature of the diseases, and mortality generally.

2. The date of any evident increase of bowel diseases (diarrhœa and dysentery), stating the disease and mortality generally.

3. Should diarrhœa or dysentery break out suddenly, so as to present evidence of endemic attacks, the facts might be entered, wherever practicable, more in detail, as follows:—

(*a.*) Date of first endemic case.

(*b.*) Daily attacks and deaths. (This would include simply dates and numbers.)

4. A daily return of cholera attacks and deaths, wherever practicable.

A most important point in this record is the date of the first attack of cholera and of the first death. Both should be traced carefully.

A daily return should be prepared after the date of the first attack, unless it be impracticable to obtain the information.

If the disease has appeared among a group of population, an estimate of the population should be entered on the return.

Where a census has been taken, more numerous and accurate data would be available; such as—

The numbers and sexes alive at each age.

The daily number of attacks for each sex and each age.

The daily number of deaths for each sex and each age.

If it be impossible to obtain a daily record of cases and deaths, the return might be limited to the following points:—

a. Estimated population.

b. Date of first cholera case and of first death.

c. Date of last cholera case and of last death.

d. Total cholera cases and total deaths from cholera between these dates.

Statistics of station bazars.

In bazars and native towns, near stations of British troops, special arrangements might perhaps be practicable for obtaining daily statistical data regarding cholera and diarrhœa as accurately as possible, and also for recording all endemic outbreaks of fever, diarrhœa, or dysentery among their population.

In these circumscribed populations a special census might be made, and the data proposed above, as to daily attacks and deaths from cholera for each sex and age might be obtained.

The occurrence of cholera in the native population near British troops should be accurately registered, to admit of comparison with the course of the disease among the troops.

Cholera maps.

The dates of attack, and the localities, when transferred to station, town, or bazar plans, and to maps for the whole country, will afford information as to the laws of progress of cholera, such as can be obtained in no other way.

§. III. Meteorology.

If meteorological observations are accurately kept, according to the instructions, at stations which have been provided with instruments, a comparison of the data over a series of years, including epidemic years, will afford all the required information in this department of the subject.

In comparing the meteorological elements of epidemic and non-epidemic years, for reports, the elements of most importance are—

Barometric pressure above the average.

Unusual droughts, leading to diminution and contamination of the water supply.

Unusual rainfalls leading to development of local malaria, or other local causes of disease; or unexpected rainfalls resulting in wearing of wet clothing.

Rapid changes of temperature, especially at unaccustomed times, leading to diminished or checked cutaneous action.

Unusually high temperatures combined with rainfalls.

Direction and strength of winds. It has been stated that winds coming from particular points have been accompanied by increase of cholera attacks, or that cholera has progressed in the direction, or against the direction of prevailing winds. All these points should be carefully noted.

Stillness of atmosphere, indicating stagnation in cities, villages, or dwelling-houses, as well as diminution of oxygenating power of the air.

Amount of ozone. Prevalence, or otherwise, of fogs. Excess or diminution of hygrometric state of the air. Peculiarities in electric condition of the air.

Unusual atmospheric phenomena preceding the appearance or disappearance of cholera should be noted.

§. IV. Movement of Cholera.

Laws which determine the movement of cholera must be ascertained partly by careful observation of the phenomena of the disease itself, partly by scientific enquiry, the chief points of which are given in a subsequent section (§. VI).

Observations on the movement of cholera must necessarily be conducted by observers in numerous localities before the law of movement can be arrived at. But the scientific facts can be ascertained at a few selected stations.

It is proposed at present to enumerate the points in regard to which systematic observations on the movement of cholera are necessary among British and native troops, as well as among the population generally.

These are included in the following paragraphs:—

Premonitions of cholera.

1. When cholera is approaching a district, are there any indications of an altered state of health among the unaffected inhabitants, such as disturbance of the digestive organs, altered expression of countenance, or of colour of the conjunctivæ and other mucous membranes; or of the skin, in Europeans and light-skinned native races?

2. Are diarrhœal or dysenteric affections, or fevers, more than usually prevalent?

3. Are there any other premonitions of cholera observable?

Positive or negative replies on these points should be given.

Enquiry regarding the forms of cholera.

Cholera presents itself under three states or forms:—

1. The sporadic form.
2. The endemic form.
3. The epidemic form.

In regard to these three forms of the disease the following questions suggest themselves.

4. Are they precisely similar, or in what respects do they differ in their observed characters?

5. Do premonitory symptoms prevail among unaffected persons in localities where each of the three forms occur?

6. Are there any appreciable phenomena in the disease, in the locality, in the habits of the people, or in the nature of the seasons and atmospheric conditions, which would obviously account for the existence of one form rather than another, or for the passage of one form into another?

7. Are there any facts to show why a sporadic case of cholera is not followed by other cases? Or,

8. Why an endemic outbreak does not become epidemic?

Question of susceptibility.

During endemic outbreaks, as well as during epidemics of cholera, it is usually observed that of the population exposed apparently to precisely similar conditions, a portion only suffer from the developed form of the disease, while the majority usually escape, or suffer from comparatively trivial symptoms.

It has hence been the custom to divide a population exposed to the same causes of disease into two classes: "susceptible," those who have suffered; and "non-susceptible," those who have escaped. But it is obvious that such a division affords no explanation of the occurrence. It merely repeats in other words the obvious fact that some have suffered while others have escaped.

It is proposed that an attempt should be made towards an explanation of differences in susceptibility by obtaining replies to the following questions. But any other points calculated to throw light on the question of susceptibility should be stated.

Influence of sex and age.

9. Of persons living in a circumscribed endemic locality, the numbers of whom at each age and of each sex have been ascertained by census, what percentage of each sex and each age living is usually attacked by cholera?

Influence of temperament.

10. Does cholera take place equally in all temperaments, or do certain temperaments suffer more than others?

Influence of diet.

11. Is there any observed difference in the percentages of attacks among persons who live altogether on vegetable diet, as compared with the percentages among persons who live on mixed diet?

Influence of health and habit of body.

12. Has the occurrence of cholera among a population any marked relation to a state of general health or habit of body among those who suffer which does not exist amongst those who escape?

Influence of race.

13. Is there any appreciable difference in the liability to attacks, or in the proportionate mortality from cholera among different races in India?

Influence of occupation.

14. Are any trades or occupations observed to be more conducive to attacks of cholera than others?

15. Can it be shown by statistics whether mehters employed in collecting and removing excreta during times when cholera prevails suffer more from cholera, or only to the same extent as others living in similar localities?

16. Are occupations involving much fatigue, or, long marches and the like, more or less conducive to cholera?

Influence of intemperance.

17. Has the use of spirituous liquors any apparent influence on susceptibility to cholera.

18. Have regular temperate habits of life any apparent influence on susceptibility to cholera?

Influence of the element of number.

19. Can the exact influence of aggregations of persons, both as regards—

(*a.*) Actual numbers,
(*b.*) Crowding on a given area,

on susceptibility to cholera be proved statistically.

Communicability of cholera.

20. The fact whether or not cholera is communicable directly or indirectly from person to person should be positively ascertained.

Sources of evidence.

21. Evidence, either positive or negative, on this most important subject, may be derived from two sources, experiment and observation.

Experimental evidence.

22. The class of experiments most likely to prove or disprove communicability are stated under the special local enquiry (§. VI). It is proposed here simply to point out the kind of observations on the movement of cholera which would afford corresponding data.

Evidence from observations of sporadic cholera.

23. If a solitary indigenous case of sporadic cholera presents itself, the following questions will arise:—

(*a.*) What was the origin of the case?
(*b.*) Is there or is there not evidence to show that infection was imported from some distant place where cholera prevailed?
(*c.*) If there is evidence of importation, every step in the proof should be very carefully investigated and given in detail.
(*d.*) If the case had no communication with any other case, this fact should be stated.
(*e.*) The results, whatever they may be, of *every enquiry* made into the foreign origin of sporadic cases should be recorded.
(*f.*) Were there any local, personal, or atmospheric conditions to which the occurrence of the sporadic case might be reasonably attributed?
(*g.*) Was the communication which existed between the sporadic case and other inmates of the house, or between these inmates and those in other houses, followed by any appreciable effect on health?

Evidence from observations of endemic cholera.

24. When an endemic outbreak of cholera takes place similar questions would arise, as follow:—

(*a.*) Was there any communication between the seat of the outbreak and any other locality where cholera previously prevailed?
(*b.*) If so, the dates and other evidence should be carefully given, and the precise nature of the communication should be described.
(*c.*) Could the progress of the endemic attack be distinctly traced to communication between the first or earlier endemic cases in the same locality and persons subsequently attacked? If so, state in detail the nature of the communication with the dates.

25. To complete the evidence on the subject of communication it should be distinctly stated whether or not there was communication between affected and unaffected persons without extension of the disease.

Evidence from observation of cholera in prisons.

26. Prisons afford excellent opportunities of investigating questions regarding cholera, including development of the disease, its

relation to personal comunication, or to purely local causes, its relation to endemic outbreaks in districts where prisons are situated, and to any general epidemic movement of the disease.

27. By observations made in prisons and prison infirmaries, we might ascertain whether cholera is preceded by appreciable changes in the health of prisoners; whether the disease breaks out without visible communication of any kind with affected districts; the laws of its development and extension among prison populations. Instances in which it appeared in different parts of the prison, *without* communication with affected prisoners, should be noted. As also the number of instances in which it *did not* appear after communication between affected and unaffected prisoners. Care might be taken to prevent all communication, temporarily, between affected districts or parts of the prison, and unaffected prisoners, with the view of ascertaining whether the disease could be kept out of the prison, or confined to that part of the prison first affected.

28. It may be necessary to state that, as in all similar enquiries, a large number of observations of this class are required before conclusions can be drawn from them.

Evidence from observations of epidemic cholera.

29. When cholera takes on the epidemic form it will become necessary to investigate very carefully the relation of movements of the population to movements of cholera. With this view the following steps should be taken:—

(*a.*) A record of all groups of population, cities, villages, and the like, in the region of the epidemic, should be made.

(*b.*) On this record the localities successively attacked from the first appearance of the epidemic onwards to its termination, with dates of attack and other particulars, should be entered.

(*c.*) The localities and dates of unusual outbreaks of other diseases of the epidemic class, fevers, diarrhœa, dysentery, if there have been any such, should be recorded.

30. These data are necessary in order to show the exact number of groups of population which suffered or escaped within the epidemic region, and also to show whether cholera was or was not present before the arrival of persons, pilgrims, and others from affected districts.

Means of communication to be described.

31. In describing the movements of population between affected and unaffected districts, the means of communication, whether by walking, carriage, steamers, boats, railways, together with the rate of travelling, should be stated.

Importance of observing the influence of railway communication during epidemics.

32. Where the exact places, dates, and times of arrival can be ascertained, as in the case of railways, very important facts can be obtained with little difficulty.

Nature of data.

33. The following data for lines of railway would go far to show what is really the relation between movement of population and movement of cholera. Similar data might be obtained for main lines of highway and steam-boats:—

(*a.*) Names of stations and times of departure and arrival along the line of railway.

(*b.*) If practicable, the names of stations and dates at which passengers booked at the first affected locality were put down. The facts might possibly be ascertained from the railway tickets.

(*c.*) Names of stations and dates at which any passengers suffering from choleraic disease were left.
(*d.*) Name of station first attacked with cholera, and date of appearance of cholera there.
(*e.*) Dates of appearance of cholera in all attacked stations, and groups of population along the line.

Caution necessary in conducting these enquiries.

34. It is necessary, perhaps, to suggest a caution in carrying out enquiries into the relation between the movement of population and the movement of epidemic cholera, in order to avoid the disturbing influence of coincidences.

35. There are several known factors to be considered in all similar enquiries.
(*a.*) There is the obvious movement of the disease.
(*b.*) The obvious movement of the population.
(*c.*) The fact that cholera appears without apparent or known movement of the population between affected and unaffected districts.
(*d.*) The fact that cholera has appeared in unaffected districts after arrivals from affected localities; sometimes only in persons arriving; sometimes only in residents; sometimes among arrivals first, and residents afterwards; sometimes in residents first, and among arrivals afterwards.
(*e.*) The fact that arrivals take place from affected localities in unaffected localities without any appearance of cholera following on arrival.

Cholera appearing after intercourse. No proof per se of importation.

36. It would evidently be impossible to ascertain the truth by simply assuming that the arrival in unaffected districts of persons from affected districts was the cause of cholera appearing in these unaffected districts.

Negative facts as well as positive facts to be noted.

37. It would be equally impossible to arrive at truth by noting only those instances in which disease followed on the fact of intercourse without noting those instances in which intercourse was *not* followed by spread of disease.

Statistical data required.

38. In all statistical comparisons on this point, two facts are indispensable—
(*a.*) An estimate of the number of localities or groups of population which had communication with the affected centre, together with an estimate of their population.
(*b.*) The number and population of localities in which cholera appeared after communication, together with the dates of both events.

But other evidence altogether required.

39. But the fact to be reasonably shown by other evidence altogether is that the movement of population was the cause of the movement of cholera in those cases in which dates and localities are well known, and where there can be no doubt that the date of the appearance of cholera was subsequent to the date of communication with affected districts.

Recapitulation of nature of proof.

40. It may be repeated that the arrival of persons from affected in unaffected districts, and the subsequent appearance of cholera there, or the accidental passage of pilgrims near places or persons subsequently attacked with cholera, are nothing more than facts, in regard to the relations of which with each other, rigid enquiry is to be made, and the evidence itself must not be an opinion simply; for, as already stated, no opinion would warrant the adoption of legislative measures and the expenditure of public money. The evidence must be sufficient to satisfy every reasonable demand.

There is no doubt that this part of the enquiry is beset with great difficulties, as well as by many sources of error. But at all events a minute detail of such evidence as it may be possible to obtain should be given, in the hope that eventually the truth may be arrived at by improved methods of enquiry.

Coincidences to be stated.

41. If there is no satisfactory evidence, except the coincidence; or if the alleged fact be exceptional, this should be distinctly stated.

Observation of cholera among troops on march.

Much important information regarding the movement of cholera may be obtained by renewed observations on the appearance and course of the disease in troops on the march.

42. Besides the usual enquiries into the sanitary condition of camping grounds, water supplies, &c., it would be useful to record the following points.

(*a.*) The state of health of the place from which the troops started, and date of starting.
(*b.*) The strength.
(*c.*) The nature of the country, and length of marches, and dates.
(*d.*) The number of marches
(*e.*) The state of health of towns or villages through which troops passed, and dates of passing, daily state of weather.
(*f*). Date of appearance of cholera (if any) in the corps.
(*g.*) Names of places through which troops passed after cholera appeared, indicating those attacked if any.
(*h.*) Date of disappearance of cholera.
(*i.*) Daily cases and deaths to be entered on the register.

Among no class of population in India more than among troops could accurate enquiries be made into questions regarding the communication of cholera from man to man, from passing columns affected with cholera to unaffected villages, and *vice versa*.

Movement of epidemics on lines of movement of population.

Epidemics of cholera have generally, but not always, travelled in a north-western direction in India: it has been assumed that the movement of population is in this direction, and that the two movements stand to each other in the relation of cause and effect. We have already suggested a caution on this subject. But there is another very important element requiring investigation—namely, whether movements of population towards the north-west are not accompanied by corresponding movements in other directions; and if so, whether cholera does or does not follow the course of movement in these other directions.

43. In other words, it should be determined by observation whether, if the movement of population has been oscillatory, the movement of cholera has been in one direction only; or whether it has oscillated with the population.

44. Again, as there can be no epidemic without population, it is important to determine whether lines usually taken by epidemics of cholera are or are not the lines of maximum fixed population.

45. Instances should be carefully examined where communication has existed between affected districts, and localities which have at other times been seats of cholera, without being followed by outbreaks of cholera in the unaffected districts.

46. In localities which have never suffered from cholera it should be ascertained whether this immunity has existed, notwithstanding communication with affected districts.

Relation of "communicability" to epidemics.

The next question of importance is to ascertain what is the relation of communicability, if it exists, to the phenomena of endemic and epidemic cholera? The following points require careful examination before an answer to this question can be given.

47. Can it be shown by the conclusive evidence of facts that endemics and epidemics are made up solely of cases arising from well-ascertained communication of the disease, either directly or indirectly, from sick to healthy persons?

48. Are there facts to show conclusively that endemics and epidemics are due solely to communication of the disease, and to nothing else? If so, the facts should be very carefully detailed.

49. Is communicability, if it exists, only one of the elements of the movement of cholera? If so, what is its importance in comparison with that of other elements?

Relation of epidemics to great physical disturbances.

50. Are there facts to show that the phenomena of epidemics are coincident with great general causes, such as the following:—

(*a.*) General telluric disturbances affecting great areas of country, such as flooding of the country, dryness and cracking of the soil, excess of moisture in the subsoil, generally increased impurity of water-sources, unusual disengagement of malaria, and the like. Great droughts and famines.

(*b.*) A generally disturbed or contaminated state of the atmosphere, marked by unusual heats, colds, winds, calms, clouds, fogs, storms, rainfall.

(*c.*) General vital disturbances affecting animals as well as men, and probably also affecting vegetable life, such as unusual prevalence of febrile diseases, diarrhœas, dysenteries, influenzas, and the like. Epizootic diseases, blights in cereal crops, &c.

(*d.*) These phenomena existing not only in the epidemic region, but in distant parts of the earth (for instance, the epidemic cholera of 1867 in India co-existed with the great Mauritius epidemic of intemittent and remittent fever, and with epidemics of cholera and yellow fever among the West India Islands and round all the shores of the Gulf of Mexico).

Enquiry into causes why epidemics cease.

Enquiry should be made to ascertain why endemic or epidemic attacks of cholera come to an end.

51. If atmospheric conditions are causes of cholera, do the conditions undergo alteration when cholera declines and disappears?

52. If defective sanitary conditions are determining causes of outbreaks of cholera, why do they cease to act after a time?

53. If cholera is spread from person to person by contagion or cholera poison, how does it happen that the agent or poison communicated ceases to act after a time?

These questions require rigid scientific investigation; but light may be thrown on them by practical enquiries, such as the following:—

54. When cholera is in a district it might be observed to what extent the disease can be mitigated by better diet and regimen among troops and prisoners; and it might be further ascertained whether improvements in these particulars have been extending themselves among these classes of population during outbreaks of cholera for the express purpose of precaution.

55. It might be further ascertained whether, when the arrival of cholera is anticipated, the past known susceptibility of a well-marked endemic district can be diminished by sanitary measures, cleansing, improved water supply, and the like, to such an extent that it may escape the disease more or less: and further, whether in other cases the progress of sanitary improvements has been coincident with decline of the disease.

56. Questions regarding locality might be further elucidated, as follows:—

(*a.*) By observing and recording the effect produced on an epidemic or endemic attack among troops or prisoners by camping out on clean ground, as contrasted with the progress of cholera in barracks or prisons where this measure has not been adopted, or only partially adopted.

(*b.*) By removing small groups of population out of bad sanitary conditions from houses where cholera prevails, into healthy localities under good sanitary conditions, and by noting carefully the results to health.

State of public health after cholera.

57. After an endemic or epidemic attack of cholera has ceased in a well-marked locality, it would be important to examine into the general health of the people, and to compare it with the state of health before cholera appeared.

Observations of cholera on board ship.

58. An important class of facts might be obtained regarding outbreaks of cholera on board troop and emigrant ships by the following form of record:—

(*a.*) State of health of port and district from which troops or coolies have been embarked. Date of last cholera case. Date of departure of ship.

(*b.*) Sanitary state of ship and passengers at the time of departure, including questions of ventilation, crowding, quality of water, food, &c.

(*c.*) Whether cholera broke out on the passage, and if so, the dates, cases, deaths, state of weather, the then sanitary state of the ship, and other occurrences.

§. V. Sanitary Enquiries in Special Districts and Localities.

It is important that a special enquiry should be undertaken, not necessarily in all places affected with cholera, but in a few well-marked localities in different districts, including hill stations, with the view of determining what is the precise influence of bad local conditions on the origin and progress of cholera in India.

By whom to be undertaken.

This part of the enquiry should be carried out by Principal Medical Officers for stations of British and Native Troops, and by Sanitary Inspectors, Officers of Health, or other selected Medical Officers for cities, towns, villages, bazars, prisons, and pilgrimages.

Nature of localities.

With this view it would be advisable to select places—

(*a*) Where cholera never breaks out,

(*b*) Where cholera is endemic,

(*c*) Where cholera prevails epidemically,

And to obtain corresponding comparable data for each locality.

Comparative topographical details.

The topographical points specially calling for enquiry are :—

1. The approximate height of the station or locality above the sea level.

2. The approximate height or depression (if any) of the station or locality above or below the level of the surrounding country.

3. Whether the locality is near the sea, or near a river or any large collection of water, or near damp nullahs, marshes, or marshy wet ground; and if so, at what distance, and in what direction the water or marshy ground lies, with reference to the locality and to the prevailing winds.

4. Also whether the level of the locality be above or below water level in the adjacent river or lake.

5. A general account should be given of the surface of the country around the station or locality—whether it is flat or undulating, or hilly, or mountainous; and what effect (if any) the general configuration of the district is likely to have on the movement of air currents, and generally on the ventilation of the locality.

6. Whether the country around the station or locality is open or encumbered with vegetation, together with the nature of the vegetation, trees, jungle, and the like.

7. Whether there are damp or wooded ravines in the vicinity themselves productive of malaria, or leading directly from malarial districts of country.

8. The geological structure of the district should be described, including under this head:—

The general nature of underlying rocks.

But especially the nature of soils and subsoils, and the depth of these as far as it may be practicable to give them.

Prevailing malarial diseases.

9. Enquiry should be made as to whether marsh fevers are frequent among the population, and their sources.

10. Also whether cases of cholera or diarrhœa are influenced by malaria, and whether cases of marsh fever have passed into a choleraic state or into cholera.

State of agriculture.

11. An important element in this enquiry is the extent and condition of agriculture in the vicinity of towns and villages, nature of produce, condition of general drainage of the country, and whether irrigation is in use, and how it is carried out.

River banks and water level.

12. The state of river banks should also be examined, and it should be ascertained whether the subsoil of attacked as well as of exempted towns and villages situated on river banks is infiltrated by water from the river. The level of water surfaces of rivers, relatively to the level of surfaces of towns and villages, should be examined at periods when cholera prevails, and also at times when there is no cholera.

Position of inhabited buildings.

13. Intimately connected with this part of the subject is the position of inhabited buildings with reference to higher ground close to them, such for instance as buildings being erected close to slopes or sections of earth, or of rock rising more or less above the level of the inhabited floors. The distance at which buildings are placed from these sources of malaria, and also the height of the section above the floor should be stated.

14. Instances in which foundations of infected buildings are below

the general level of the country, or below the level of water surfaces in rivers, should be carefully noted.

State of subsoil drainage.

15. The next important point of the enquiry is into the subsoil drainage of stations, towns, and villages, subject to attacks of cholera, in comparison with the subsoil drainage of localities hitherto exempt from cholera.

16. This enquiry involves the depth of the water-line below the surface in dry and wet weather, at times when cholera is present and at times when there is no cholera; the slope of the ground in reference to facilities of outfall for subsoil drainage, the nature of subsoil; whether the buildings rest directly on rock; if so, its nature, especially whether it is porous or impervious to moisture.

17. It should be stated whether water lies on the surface of station, town, or village after rains, and if flooding from rains or rivers takes place; together with the nature of surface drainage works (if any) provided for carrying away flood and surface water.

Removal of foul water.

18. An enquiry should also be made as to the probable amount of water carried for consumption into the station, town, or village.

19. It should be stated distinctly whether foul water from barracks, hospitals, houses, baths, kitchens, lavatories, and the like, is drained away to a distance, or carried away by labour, or allowed to run away on the surface, until it sinks into the subsoil or evaporates. If there are surface-drains the fact should be stated; whether water thrown into them flows readily away to a distance, or sinks into the subsoil through the bottom of the drain; and whether foul water remains stagnant in the drains; and whether the drains give rise to nuisance.

The nature of the surface should also be examined, to ascertain :—

State of surface drainage.

20. Whether the surface in and around inhabited buildings in stations, towns, and villages, is equal and smooth, so as to allow of a free flow of rainfall.

21. All collections of stagnant surface water in tanks, jheels, holes, ditches, and the like, should be noted, together with their extent, the condition of the water in them, the uses to which the water is put, and whether any nuisance arises from such collections of water.

State of cleansing and nuisances.

22. The state of cleanliness of the surface of stations, towns, and villages selected for these enquiries, requires special attention. The vicinity of each should be examined, to see whether there are any heaps of foul matter, or whether the people resort to the outskirts for the purposes of nature; also the extent to which this source of nuisance exists: whether it is increased by rains or by close damp warm weather. If there be nuisance from the practice, the extent to which it was experienced before or during the outbreak of cholera should be stated.

23. An important part of the enquiry is into the condition of courtyards of dwelling-houses; whether there are accumulations of foul matter in them, or if the surface is kept clean.

24. The state of cleanliness of streets, lanes, roads, gutters, and the like, should be reported on.

25. It should be specially stated in what manner the excreta from barracks, hospitals, and native dwellings, are disposed of.

How often the excreta are removed, the manner of removal, and whether there is much nuisance in the process; to what distance from inhabited buildings the excreta are removed; how they are disposed of; whether afterwards there is any nuisance from the accumulations, especially in wet or in damp warm weather.

26. In cases where outbreaks of cholera have been coincident with the existence of nuisance from any source enumerated above, the facts should be carefully examined and described.

Enquiry into the water supply.

27. A very careful enquiry should be made into the condition of water supply of these selected stations, towns, and villages, including the points regarding water supply stated in §. VI.

A copy of any chemical analysis made of water used for drinking and cooking by troops or civil population when cholera is present, should be appended to the Medical Officer's report.

28. In cases where violent outbreaks of cholera have accompanied an impure state of the water supply, the facts both as regards the disease and the source and quality of the water should be carefully detailed.

General condition of dwellings.

Another important matter for observation is the general condition of barrack accommodation, and of houses of the native civil population liable to outbreaks of cholera.

Barrack-rooms.

29. As regards barrack-rooms, the most important statistical elements on which information is required are included in the cholera register.

It sometimes happens that at military stations, troops living in barracks suffer much more from cholera than officers living in quarters. Also, that troops quartered in certain barrack blocks, or in certain rooms, or even in particular parts of the same room, suffer more than others. These differential facts are of great importance in this enquiry. They should be carefully examined into, and the cause of the difference in susceptibility stated as far as practicable.

Native dwellings.

30. As regards native dwellings, the following points are of importance:—

(*a.*) To ascertain whether cholera was spread more or less equally over the area of the town or village, or whether it was chiefly confined to certain localities only, and if so to state any peculiarities in the sanitary condition of those affected districts or localities.

(*b.*) To give a very general account of affected native houses, including—

Construction and materials, usual dimensions, number of apartments, doors, windows, and the like.

Number of floors, and which floors are occupied for sleeping.

State of houses, courts, and compounds, as to cleanliness, keeping of animals, &c.

Nature, position and state of privy accommodation, and arrangements for cleansing.

Position of private wells in relation to privies, and state of the water.

Number of inhabitants generally, and whether crowded or not. Condition of the air and ventilation of affected houses.

31. Any appearance of fungi or lichens on walls of affected houses should be examined under the microscope, drawn and described.

32. It would be important to ascertain whether newly-constructed native houses are less liable to attacks of cholera, than old and long-inhabited houses among the same class of population.

Importance of differential enquiry.

33. Most important data might be obtained by selecting, say two stations, one notoriously subject to cholera, the other always exempt from cholera; by comparing all the elements presented by each, and by describing the differences.

Another important class of facts of the same kind might be obtained by selecting an endemic locality in which there are houses or portions always attached, and others always exempt, and comparing the differences in the two classes of dwellings.

Evidence from improvements.

34. A notoriously unhealthy locality might be thoroughly improved, and the results to health carefully given.

§. VI. Special Local Enquiry.

As already stated, this enquiry is intended to be conducted by specially appointed observers, now in India, but all medical officers are invited to contribute observations as far as it may be in their power to do so.

To be carried out in specially selected localities.

The enquiry should be carried out in specially selected localities where cholera is endemic, or where it breaks out occasionally.

It should also be carried out in localities always exempt from cholera.

And at different seasons.

The enquiry should be pursued at different seasons in both classes of localities, and the season and atmospheric conditions should be stated under which any observations of interest have been made.

Subjects of enquiry.

The enquiry will include a microscopic examination of air, water, soils, articles of food, organs and tissues, vital fluids, including secretions and especially diarrhœal and cholera discharges.

Microscopic constants to be obtained.

The object which should be kept in view in the enquiry is to obtain what may be called microscopic *constants* for each selected locality *when cholera is absent*, in order that these observations may be compared with another set of microscopic *constants* obtained *during the prevalence of cholera* in the same localities.

The results of all observations, as well as all similarities and differences in observed results, obtained in localities with and without the presence of cholera, should be carefully described and accurately measured and drawn by camera.

If the observer has arrived at what he considers to be a satisfactory opinion as to the nature of the objects figured and measured by him, he should state fully the reasons which have led him to his conclusions.

1. *Microscopic Examination of the External Atmosphere.*

Examination of air.

1. Samples of air should be taken at four or five feet from the ground (the height to be stated). This class of observations should be made under different atmospheric conditions, and besides the date or dates, and hours, between which observations have been made, the following meteorological elements, when obtainable, should be recorded.

Daily barometric height.
„ dry bulb temperature.
„ wet bulb „
„ maximum „
„ minimum „
„ winds, direction and force.
„ calms, &c., and whether wind blows over marshes, nuisances, and the like.
„ Rain.

Methods employed.

2. For examining the air an aspirator of known cubic contents should be provided. An ordinary chemical gasometer, or an air-tight vessel, to be filled with water from a cistern, and emptied by a stop-cock from below, should be used. Various methods have been adopted for straining the air in its passage from the atmosphere to the aspirator, so as to retain foreign bodies contained in it. Cotton, or asbestos, placed in a glass tube through which the air is to pass, have been used. If this method of straining the air were employed great care would have to be taken to ensure that the material is perfectly clean, and it should be microscopically examined before being used.

For the purpose of immediate microscopic observations, aspired air is made to impinge on a glass plate moistened with glycerine, which retains any foreign bodies in the air.

Another method has been to draw the air through distilled water contained in Wolfe's bottles; care having been previously taken to cleanse the bottles and tubes perfectly, and to boil the distilled water immediately before use.

This method yields results more or less reliable, but it has been found that foreign bodies, both organic and inorganic, pass through the water, and that only a part are retained.

A third method consists in drawing the air through a horizontally placed glass tube imbedded in a freezing mixture, so as to condense the moisture in the air; this condensed moisture being the vehicle for retaining any matters carried along by the air.

A modification of this plan is to expose a glass globe, containing a freezing mixture, to the atmosphere, and to collect and examine drops of moisture obtained in this way.

Objects to be attained.

3. It is desirable that any method adopted should combine two objects: 1st, to obtain the contents of the atmosphere for examination; 2nd, to estimate the amount of foreign bodies in the air in proportion to the volume of the air.

Precautions to be observed.

4. A very important precaution to follow is to complete the experiments as quickly as possible, so that the results may not be vitiated by the rapid development of organic life in the climate of India.

5. A few trials will soon determine which process is the best, and when this is done the process should be adhered to.

6. It would be important to carry out similar enquiries at times when fogs are prevalent, especially during night, and also with air taken over or close to marshes.

7. As already stated, these observations on air should be made in localities where cholera never appears, and also in cholera districts at times when cholera is present, and at times when it is absent.

Examination of rain-water.

8. It would be advisable to make careful microscopic examinations of newly-fallen rain-water from time to time, but more especially in districts and at times when cholera prevails, and any foreign bodies found in the rain should be carefully described and figured.

2. *Examination of Soils.*

Relation of soils to cholera.

The relation between the nature of soils and subsoils and cholera requires further elucidation.

For this purpose it would be desirable to select localities in which cholera is endemic, and localities in which it never appears, and to conduct comparative enquires at each locality on the following points:—

1. The general character and depth of the surface soil and subsoil occupied by the population.

2. If the surface consists of rock, its nature and general character should be stated.

3. Arrangements should be made for continuous observations on the water-level in the subsoil; its depth below the surface, and its temperature, should be registered at fixed periods when cholera is present as well as when there is no cholera. The fact of the presence or absence of cholera at the times of observation should be noted.

4. The upper layer of subsoil-water should be examined chemically and microscopically at times when cholera is present or absent, and the results recorded.

5. The temperature of the soil at different depths, as well as at the surface, should be ascertained and registered at the time observations are being made on the water-level.

6. The night surface-soil temperature and its relation to fogs should be noted.

7. Average specimens of soil, or of rock, as the case may be, at and near the surface should be taken from similar places among the houses in endemic and exempt localities, and submitted to the following examinations.

8. The proportionate amount of air in the interstices of a given weight of earth or rock should be determined.

9. The nature and constituents of this air should be carefully ascertained, especially with reference to the presence of microscopic organisms, and organic matter, animal or vegetable.

10. The proportion of water held in combination with the soil or rock should be determined. Also,

11. The amount of water which the soil or rock can absorb.

12. The chemical constituents of the soil should be examined particularly as regards the amount of organic matter of animal origin in relation to the amount of ammonia, nitrites, nitrates, and chlorides.

3. *Microscopic Examination of Water.*

Water to be examined at sources of supply.

1. This, like other comparative branches of the enquiry, should include the microscopic condition of water used for drinking and cooking purposes, in localities subject to cholera, and also in localities which enjoy an exemption from cholera.

2. In cholera localities, the examination should be made at times when there is no cholera, and it should be carried on into times when cholera breaks out among the people. It should be continued during the whole period of the epidemic, and onwards until it has ceased. In this way a microscopic picture of the water supply of affected populations will be obtained.

3. In localities which have hitherto escaped cholera, a sufficient

number of examinations should be made to enable the microscopic state of the water to be ascertained.

4. The points requiring notice and record are the following:—

(*a.*) The source of supply of drinking water, well, tank, river, &c.

(*b.*) The position and distance of the source, with reference to dwelling houses, or other causes of impurity.

(*c.*) The state of the surface and subsoil around the source, whether both are clean, or whether foul drainage or surface impurities are likely to find their way into the water.

(*d.*) Whether the people wash clothes, or wash or bathe themselves in the water, or near the mouth of the well.

(*e.*) The depth of the water level in the well, below the surface of the ground.

(*f.*) The sensible physical qualities of the water as to colour, taste, smell, and the like, and whether the water is alcaline or neutral.

Water from water vessels to be examined.

5. Microscopic examinations should be made not only of specimens drawn from the sources of supply, but of samples of water taken from vessels in which it is kept for use by the people, or by troops.

Points for examination.

Microscopic examinations of water should include the following elements:—

(*a.*) An account, illustrated with camera drawings and micrometric measurements, of all organic and inorganic bodies found in the water.

(*b.*) A comparative determination of the amount of microscopic organic and inorganic bodies in a given volume of water.

This determination should be made on some general principle, such as the following, which has been used in this country.

Half a gallon of water should be allowed to remain at rest in a scrupulously clean glass vessel, excluded from light and air, for a few hours, and the sediment examined under the microscope.

(*c.*) If the quantity of sediment be very small, the lower portion of the water should be transferred into a clean conical glass vessel, and excluded from light and air for such time as may allow of the subsidence of deposit into the narrow portion of the vessel. The deposit should then be examined.

(*d.*) Precaution should be taken that no development of organic bodies takes place in the water while being treated in this way.

(*e.*) After a few trials a rough estimate may be formed as to the number or proportion of microscopic bodies found in the quantity of water submitted to examination.

6. An account should be given of the larger non-microscopic forms of vegetable and animal life, if any, existing in the water source.

7. If the observer has arrived at an opinion as to the nature of the organic bodies discovered by the microscope, he should state it, (and give his reasons for arriving at his opinion, unless the objects are already well known).

8. It would be important to make microscopic observations on water drawn from marshes near districts attacked by cholera.

4. *Microscopic Examination of Articles of Food.*

1. This examination should include articles consumed by troops, and also articles of ordinary consumption among the civil population.

2. Like other branches of the enquiry it should be carried out both in localities where cholera is of frequent occurrence, and in localities not subject to outbreaks of cholera.

3. In cholera localities it should be followed up when cholera is present, and when cholera is absent.

Points for enquiry

4. The following would probably be a convenient mode of conducting the enquiry :—

(*a.*) To make a list of the alimentary substances made use of by troops and by civil population.
(*b.*) To examine these as to their apparent sensible qualities, goodness, inferiority, badness.
(*c.*) Then to examine them under the microscope, to become familiar with their normal characteristics when of good quality, with the view of ready detection of any departure from this condition.
(*d.*) To describe the microscopic changes observed, new bodies discovered, fungi and the like; noting any increase or decrease in amount when cholera is present or absent.
(*e.*) Any peculiarities observed, or any microscopic plants or animals in any articles of food should be measured, described, and drawn by the camera.

5. The dates of all examinations of this kind should be carefully kept, to be collated, with the dates of appearance or disappearance of cholera, or other epidemic diseases.

Diseases of Plants.

6. Careful enquiry should be made as to diseases occurring among plants, especially among cereals and other plants used as food, during the presence of, or preceding, an outbreak of cholera. Samples should be microscopically examined, and the results stated.

5. *Microscopic Enquiry into the Pathology of Cholera.*

Tissues to be examined.

1. This branch of enquiry should include a careful examination of organs and tissues of persons who have died of cholera in comparison with the healthy condition of the same organs and tissues in persons who have died by accident or by diseases not of the epidemic class.

2. These examinations might be made in localities where cholera has not hitherto appeared, and also in localities where cholera breaks out, and in such localities examinations should be made both during the presence and absence of cholera; the dates being recorded.

Differences observed to be described.

3. The object is to ascertain whether the microscope can detect differences, and, if so, what differences in organs and tissues of persons who have died of cholera, or whether the presence of an epidemic in a given locality produces any change in organs and tissues appreciable to the microscope in persons who have not died of cholera, or who have died of non-epidemic diseases in districts where cholera was prevalent at the time.

4. All observed differences, and all bodies foreign to the natural state of organs and tissues, fungi, animalcules, and the like, should be carefully described, measured and drawn, by the camera.

Caution.

5. Care should be exercised in discriminating between organisms which were present during life, and those which were manifestly developed after death.

Examination of fluids and excretions.

6. Another very important branch of the pathological enquiry is the microscopic characters of fluids in persons living in cholera localities, and in persons suffering from cholera, as compared with the characters of the same fluids in persons living in localities where there is no cholera at the time, or where cholera never appears.

7. The most important points of comparison will be afforded by the blood, the urine, and intestinal secretions.

8. The general physical characters of all fluids submitted to examination should be carefully described, with the view of determining whether they have special physical characters, and of examining into the real cause of any peculiarities they may present.

9. The observer should make himself acquainted with the normal healthy microscopic appearances presented by these fluids in non-cholera districts, and in cholera districts when there is no cholera present, and he will then be in a position to detect with ease any departure from normal appearances when cholera prevails.

Characters of choleraic discharges.

10. Special attention should be directed to the diarrhœal and choleraic discharges of cholera patients, and also to the diarrhœal discharges of patients not suffering from developed cholera.

Objects of enquiry.

11. The object of this enquiry is to ascertain whether, when cholera is present in a district, any organisms, animal or vegetable, can be detected by the microscope in the discharges, other than those organisms (if any) which may have been found in the secretions of persons living in districts never attacked by cholera, or in districts liable to, but not at the time attacked.

Constancy of results to be ascertained.

12. It is most important, in the event of any such organisms being discovered, to examine the discharges in a sufficient number of cases, and frequently in the same case, to show whether their appearance is constant, or only exceptional and accidental.

Caution.

13. Care should be taken to examine the discharges microscopically at different periods of the disease, and immediately they are passed, and also the microscopic characters of articles of nutriment used by the patient, to guard against error from the foreign introduction of microscopic bodies, or their development in the secretion either before or after it has left the system.

Effects of putrefaction.

14. Discharges should also be examined microscopically in various stages of putrefaction, and the results described and drawn.

Healthy excreta to be compared.

15. For purposes of comparison similar microscopic examinations should be made of healthy excreta of native population in various stages of decomposition.

Organisms to be described differentially.

16. If any microscopic organisms are detected, of which it can be said that they are peculiar to, and constantly present, either in diarrhœa or cholera cases, they should be compared with any microscopic organisms discovered in the atmosphere, in water, or in articles of food and drink, and their similarities or differences described.

17. Attempts might also be made at cultivating any fungoid bodies discovered, with the view of employing the product in experiments on animals.

Caution.

18. Experiments of this class are necessary steps in solving a very important question—viz., whether these minute organisms are specific causes of disease, or whether their function is simply to convert noxious dead organic matter into innocuous living forms.

19. All microscopic organisms or other bodies discovered in discharges by the microscope should be described, measured, and drawn by camera.

6. *Microscopic and Physiological Enquiry as to the Cause of Cholera.*

1. The next step in the enquiry is to ascertain what is the precise nature of cholera poison, if such there be; and the agency through which it is conveyed from affected to unaffected persons and districts.

2. The nature of this poison can, perhaps, be best ascertained by enquiries conducted in hospitals set apart exclusively for the treatment of cholera cases, and the hospitals selected should be in open healthy situations, at some distance from affected localities.

Seat of cholera poison.

3. This poison, if such there be, must exist in matters proceeding from the patient; in his expired air, cutaneous exhalation, matters ejected from the stomach, the urine, or intestinal flux; and it is in these that the cholera poison must be sought for if it exists.

Physiological experiment necessary as well as microscopic observation.

4. The main dependence for discovering the poison must be placed on the microscope; but the result of microscopic observations would be inconclusive, unless there were some means of proving that microscopic objects discovered actually reproduced the phenomena of cholera. Physiological observation and experiment must, therefore, accompany microscopic enquiry.

Investigations to be comparative.

5. Microscopic investigations should be comparative—*i.e.*, they should show that objects discovered in the excretions of persons suffering from cholera do not exist in the excreta of healthy persons, or in those of persons suffering from other diseases. Again, the excretions of patients suffering from various classes of diarrhœa and from dysentery should be examined in order to ascertain whether any objects which may be discovered in them are similar to, or differ from, those discovered in the excretions of cholera patients.

6. The condensed moisture of the breath of cholera patients should be compared microscopically with the same object obtained from healthy persons, and with the same object obtained from persons suffering from diarrhœa.

7. The microscopic characters presented by condensed cutaneous transpiration in each class of persons should also be examined.

Examinations to be repeatedly made.

8. These examinations should be repeated a number of times in the same case, and also in a sufficient number of cases to ascertain whether the facts observed are constant; and if they are not, this should be distinctly stated.

It must be repeated that in this part of the enquiry two things are absolutely necessary for practical purposes.

(*a.*) That the facts should be ascertained.

(*b.*) That the constancy or otherwise of the facts should be determined .

Physiological enquiry on the poison of cholera.

9. A most important class of physiological data may be obtained from observing the movement of cholera in hospitals where the disease is under treatment, with reference to attacks among medical officers, attendants, and patients suffering from other diseases.

By observations in hospitals.

10. To avoid sources of error, hospitals selected for this enquiry should not themselves be situated in endemic localities, otherwise pure endemic cases, due to locality (if there be such), might be confounded with cases arising from communication (if there be such).

Statistical points for observation.

11. Suppose that the hospital is in a fairly healthy site, and that its sanitary condition is good, and the wards not crowded with sick; observations might be conducted as follows:—

(*a.*) The number of patients, with their diseases, should be recorded.

(*b.*) A record should also be kept of the number and duties of attendants in the hospital, and of the medical staff; and at the conclusion of the outbreak the number of cases of cholera, and of diarrhœa, which have taken place in medical officers, attendants, and patients, should be recorded.

(*c.*) Differential observations might also be made on the proportion of attacks among attendants in good hospitals and in bad hospitals.

Nature of observations.

12. This part of the enquiry would include the amount and degree of communication existing between the attendant and the sick, his distance or proximity. The kind of communication, whether by inhaling the breath of the sick, or exhalations from excreta, by accidental wetting of the skin or clothing by matters ejected from the stomach or bowels, the accidental wearing of articles of clothing fouled in this manner, using foul bedding and the like, washing linen fouled by cholera excreta.

Both positive and negative results to be stated.

13. All instances should be carefully noted in which occurrences of this kind have taken place. The particulars should be recorded, and the instances in which disease *has not* subsequently appeared, as well as the cases in which it *has*, should be noted.

14. Careful enquiry should be made as to whether any part of the excreta were likely to have entered the system by abraded surfaces, by the lungs, or by the mouth.

By experiments on animals.

15. Another class of physiological experiments might be made with various species of animals in sufficient numbers to enable percentages to be deduced. Possibly mice, pigs and monkeys would be the most likely animals available in India.

16. These experiments might be conducted so as to test not only the physiological effects of cholera poison, if such there be, but also to determine the vehicle or medium through which the poison reaches the system.

17. Animals might be confined in cholera wards under such conditions as would expose them only to poisons carried in the air from cholera patients, *e.g.*, they might be kept day and night in an undoubted cholera atmosphere, and the results, if any, noted at brief intervals.

18. Another set of experiments might be instituted in which animals are made to inhale an atmosphere containing emanations from cholera excreta, fresh or in advancing stages of decomposition.

19. In another similar set of experiments, emanations proceeding from clothes or linen saturated with fresh cholera evacuations of two kinds (vomiting and purging) might be tried.

20. And a similar set with saturated clothes in a dry state.

21. The experiments with excreta and clothes could be best made in a room at a distance from the cholera hospital. The room should be light, and of fair dimensions, and without sanitary defects, which might vitiate the results.

22. In this class of experiments some simple method could easily be adopted to ensure that the animals made use of are exposed only to matters diffused in the air. Such, for example, as confining them in the upper part of a box communicating with the lower part, in which is placed the material to be experimented with.

23. Animals might be made to drink water or to use articles of ordinary food containing various amounts of cholera excreta.

24. Another distinct class of experiments should be performed by giving *small* quantities of fresh cholera dejections by the mouth or rectum.

25. Also by injecting larger quantities in the subcutaneous tissue.

26. In these trials fresh and decomposing excreta should both be used.

27. And for the sake of comparison, cholera excreta disinfected with carbolic acid should be employed in other instances.

28. Animals might be made to drink moisture condensed from the air in the vicinity of sick, or drawn over cholera excreta.

Objects to be attained.

29. But in conducting these experiments for practical ends, it should be kept in mind that there are two objects in view—first, to ascertain whether there is a specific cholera poison; second, to ascertain whether it is capable of producing choleraic symptoms in minute quantities, such as may be supposed to pass from person to person in ordinary human intercourse; and also to determine the probable channel of entrance of these minute quantities into the system.

Caution.

30. Care should be taken that the excreta used in these experiments are not those of patients who have taken active medicines.

Data to be recorded.

31. Should distinct specific effects be produced on animals, the following data should be recorded:—

The dates.
Temperature and moisture of air.
The period after passing the excreta when the experiments were made, and condition of the excreta when used.
The number and species of animals submitted to experiment.
The number exhibiting specific symptoms.
A detail of the symptoms in each case.
The period after exposure when the symptoms showed themselves.
The duration of the symptoms.
The termination by death or recovery.
Some account of post-mortem appearances.
An account of any special microscopic objects discovered in the excreta or intestinal canal.

32. Care must be taken that the animals are not exposed to injury or to production of disease simply by the methods or manipulations employed, which would vitiate the results. *Animals not to be injured by processes.*

33. Healthy animals might be confined in the same place with animals which have been subjected to these experiments, and the results noted.

34. Any results from experiments on animals will be incomplete unless repeated with diarrhœal excreta not proceeding from cholera patients, and at times when cholera is absent. *Experiments with non-choleraic discharges.*

35. For the sake of comparison similar experiments should be made with dysenteric excreta. *Experiments with dysenteric excreta.*

36. Experiments to determine the vehicle of cholera poison, if such there be, may be made by examining the air in the immediate vicinity of the sick, by condensing the moisture, and submitting the result to microscopic examination in the manner elsewhere stated. *Vehicle of the cholera poison.*

37. This examination should be made, together with a corresponding examination of the outer air at a distance from the cholera hospital, and the results should be compared.

38. A similar set of experiments should be performed with moisture condensed from air taken from a vessel containing cholera excreta. The object of this is to ascertain whether any special organized bodies which may have been discovered in cholera excreta can be carried into the air, and afterwards deposited.

39. Similar experiments should be made by wetting articles of ordinary clothing in cholera excreta containing special microscopic objects, allowing them to dry, and then agitating them in an enclosed body of air, so that any dust from them may be condensed, and submitted to the microscope. The results should be carefully described and figured.

40. As already stated, condensed matters so obtained, found to contain appreciable organisms or not, might be used in experiments on animals.

41. Another class of facts, either positive or negative, might be obtained by examining objects found in the condensed breath, cutaneous exhalations, or excreta of persons who have been in close communication with cholera cases in hospitals, or who have lived in cholera localities. In this class of experiments the persons who have been so exposed should be removed from the hospital or locality before the microscopic examination is completed. *Examination of excreta of unaffected persons.*

§. VII. Chemical Enquiries.

1. These enquiries should be carried out at selected stations exempt from cholera, as well as at one or two stations where cholera is endemic. They should be undertaken during periods of health, and at epidemic seasons. *To be comparative.*

2. They should include enquiries as to the constituents of the atmosphere, with special reference to estimating the amount of organic matter in air taken four or five feet from the surface of the ground. *Examination of air.*

Examination of water.

3. The same experiments to be made with air in localities specially the seats of cholera. The constituents of air in cholera wards to be likewise examined chemically.

4. The rapid progress being made in water analyses throughout India will afford most of the information required about the water supply. But in order to have the requisite means of comparison, a chemical examination should be made of water in selected cholera localities at various periods, with the view of ascertaining whether any and what physical and chemical changes have taken place in the same waters during the prevalence of cholera.

5. Water used in selected localities exempt from cholera should also be examined.

6. The more important sanitary points of such an enquiry are :—

(*a.*) The amount of *rapidly oxydizable* organic matter in water.
(*b.*) The amount of ammonia, muriate of soda, nitrites, nitrates.
(*c.*) The amount and character of other salts.

7. A chemical re-examination should be made of the serum of the blood in healthy persons and in persons suffering from cholera, in comparison with rice water discharges in cholera. The comparative degree of opalescence of the two fluids, and the effect of dilution on this property in each, should be observed and described.

8. The influence of disinfectants on cholera excreta should be examined, and the results, microscopical and physical, stated. It is important to ascertain which disinfectants can best prevent decomposition of cholera excreta, and arrest the development in them of organic life.