# THE PROCEEDINGS

OF THE

# FIRST

# ALL-INDIA

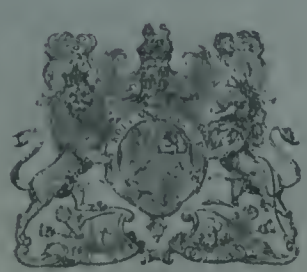
# SANITARY CONFERENCE

HELD AT

# BOMBAY

ON

**13TH AND 14TH NOVEMBER 1911.**



CALCUTTA
SUPERINTENDENT GOVERNMENT PRINTING, INDIA
1912

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PRESIDENT.

The Hon'ble Mr. S. H. BUTLER, C.S.I., C.I.E., I.C.S.

DELEGATES.

| | | |
|---|---|---|
| India . . | 5 | 1. The Hon'ble Mr. L. C. PORTER, I.C.S., *Secretary to the Government of India, Department of Education.* |
| | | 2. The Hon'ble Surgeon-General C. P. LUKIS, C.S.I., M.D., F.R.C.S., I.M.S., *Sanitary Commissioner with the Government of India.* |
| | | 3. *Lieutenant-Colonel Sir DAVID SEMPLE, Kt., M.D., R.A.M.C. (Retired), *Director of the Central Research Institute, Kasauli.* |
| | | 4. KUNWAR MAHARAJ SINGH, M.A., Bar.-at-Law, *Assistant Secretary to the Government of India, Department of Education.* |
| | | 5. Captain A. G. MCKENDRICK, M.B., I.M.S., *Officiating Statistical Officer to the Government of India in the Sanitary and Medical Departments.* |
| Ceylon . . | 1 | 6. Dr. G. J. RUTHERFORD, *Assistant Principal Civil Medical Officer, Ceylon.* |
| Madras . . | 5 | 7. Surgeon-General W. B. BANNERMAN, M.D., D.Sc.(P.H.). I.M.S., *Surgeon-General, Madras.* |
| | | 8. Captain W. A. JUSTICE, M.B., D.P.H., I.M.S., *Officiating Sanitary Commissioner, Madras.* |
| | | 9. Mr. W. HUTTON, A.M.I.C.E., *Sanitary Engineer, Madras.* |
| | | 10. Captain W. S. PATTON, I.M.S., *Officiating Director of the King Institute, Madras.* |
| | | 11. Major T. S. Ross, L.R.C.P., L.R.C.S., D.P.H., I.M.S., *Professor of Hygiene and Bacteriology, Medical College, Madras.* |
| Bombay . . | 7 | 12. *The Hon'ble Colonel R. W. S. LYONS, M.D., I.M.S., *Offg. Surgeon-General with the Government of Bombay.* |
| | | 13. The Hon'ble Mr. J. P. ORR, B.A., I.C.S., *Chairman, City of Bombay Improvement Trust.* |
| | | 14. Lieutenant-Colonel T. E. DYSON, M.B., C.M., D.P.H., I.M.S., *Sanitary Commissioner, Bombay.* |
| | | 15. Mr. E. G. TURNER, M.A., I.C.S., *Officer on special duty in connection with the development of Salsette.* |
| | | 16. Major W. G. LISTON, M.B., I.M.S., *Director, Bacteriological Laboratory, Bombay.* |
| | | 17. Mr. C. MANDY, C.E., *Sanitary Engineer, Bombay.* |
| | | 18. Mr. NANJUNDAYYA BELVADI, B.A., L.C.E., *Sanitary Engineer, Bombay.* |

* Attended on the 14th November only.

| | | |
|---|---|---|
| Bengal . . | 3 | 19. Major W. W. Clemesha, M.D., D.P.H., I.M.S., *Sanitary Commissioner, Bengal.* |
| | | 20. Mr. G. B. Williams, *Sanitary Engineer, Bengal.* |
| | | 21. Rai Kailas Chandra Bose Bahadur, C.I.E., L.M.S. |
| United Provinces | 1 | 22. *Major J. C. Robertson, I.M.S., *Sanitary Commissioner, United Provinces.* |
| Punjab . . | 2 | 23. Lieutenant-Colonel E. Wilkinson, F.R.C.S., D.P.H., I.M.S., *Sanitary Commissioner, Punjab.* |
| | | 24. Lieutenant-Colonel S. Browning-Smith, I.M.S., *Chief Plague Medical Officer, Punjab.* |
| Burma . . | 1 | 25. Major N. P. O'Gorman Lalor, I.M.S., *Deputy Sanitary Commissioner, Burma.* |
| Eastern Bengal and Assam . . | 2 | 26. Lieutenant-Colonel E. C. Hare, I.M.S., *Sanitary Commissioner, Eastern Bengal and Assam.* |
| | | 27. Mr. C. A. Bentley, M.B., D.P.H., D.T.M. & H., *Deputy Sanitary Commissioner, Eastern Bengal and Assam.* |
| Central Provinces | 2 | 28. Major T. G. N. Stokes, I.M.S., *Sanitary Commissioner, Central Provinces.* |
| | | 29. Major W. H. Kenrick, I.M.S., *Officiating Sanitary Commissioner, Central Provinces.* |

* Attended on the 14th November only.

# The Proceedings of the First All-India Sanitary Conference held at Bombay on the 13th and 14th November 1911.

## FIRST DAY'S PROCEEDINGS.

The proceedings which were held in the Council Chamber of the Bombay Secretariat opened with the following speech by the President :—

" GENTLEMEN,

" My first duty, and most agreeable I find it, is to welcome you all to this conference, and, in so doing, on behalf of the Government of India to thank the local Governments and Administrations and yourselves for your presence here. The utility of conferences of this kind is now, I think, generally appreciated, and that not only for any conclusions to which they may lead—though these must often be valuable—but also and especially for the opportunities which they present to zealous workers in different parts of India for comparing experience, exchanging ideas, and above all for setting up that energising friction of mind with mind the want of which most men toiling in isolation feel at times as a burden well-nigh intolerable. Nor can it be a disadvantage that we should get to know one another. Holding this opinion, I earnestly hope that this may be the first of a series of conferences to be held as occasion may suggest at convenient centres. I was anxious that our first meeting should be held in Bombay in order that we might perhaps catch some of the spirit of the place, the spirit which has made it the great and beautiful and progressive city that we see to-day.

" The agenda before us open up large questions of research work and hygiene, the two great and complementary divisions into which modern sanitation falls. By research I mean the acquisition of further knowledge of the specific agents of infective diseases and by hygiene the preservation of the public health and the remedy of known defects. You will discuss problems of urban sanitation, town-planning, water-supply, drainage and conservancy; rural sanitation; and special sanitation, more particularly epidemic diseases and food-supplies. You will also discuss vital statistics and improvement in their registration; and various scientific enquiries will be brought before you. I will not attempt to anticipate the course or the conclusions of your discussion, and I will not intervene with more than a few introductory observations.

" The basis of all sanitary achievement in India must be a knowledge of the people and the conditions under which they live, their prejudices, their ways of life, their social customs, their habits, surroundings and financial means. This was emphasised in the memorandum of Surgeon-General Lukis, to whose knowledge and rare ability my department is greatly indebted, which I laid upon the table at the last meeting of the Imperial Legislative Council. The proposition is really axiomatic. The ardent spirits who may think that sanitary measures possible and effective in the West must be possible and effective in India will flap their wings in vain and set back the cause which claims their laudable enthusiasm. I am far from saying that this must always be so. I believe with all my heart in the slow but sure results of education, the forerunner of sanitation. But we have to deal with facts as they are to-day. And to-day the forefront of a sanitary programme must be (1) a reasoned account of the conditions and circumstances which affect mortality and the increase and decrease of populations and (2) a study of the relative effects of various diseases, of personal environment and of the social and economic conditions in the different parts of the Indian Empire. We have to work out our own sanitary salvation. We have to study the epidemiology and endemiology of our communicable diseases, the so-called " tropical diseases "—plague, malaria, cholera and dysentery—in order that having ascertained the actual

sources and modes of conveyance we may determine scientifically the particular methods requisite for their avoidance, prevention and suppression; and that we may apply with precision those methods which it is possible and politic to adopt. And we cannot do this without the assistance and co-operation of Indians themselves.

" In this harnessing of the science of the West to the varying conditions and circumstances of India we must keep our standard high. For many years it has been the constant endeavour of the Government of India to build up a body of scientific workers whose whole duty is investigation. Laboratories have been provided; specialists have been appointed; and we now possess in the bacteriological department a band of workers who are second to none in Europe. The names of Sir Ronald Ross and Sir David Semple, not to mention others, are honoured throughout the world. We have as you know a highly skilled body of investigators engaged solely on research work in connection with plague and an even larger body engaged on research work in connection with malaria, in regard to which a conference will now be held over which Surgeon-General Lukis will preside. There still remain, however, numerous sanitary research problems in India, as yet almost untouched. Some of these problems will, I understand, be brought before us by the provincial Sanitary Commissioners and Deputy Sanitary Commissioners.

" In particular I may mention tuberculosis. Tuberculosis accounts for more than 75,000 deaths per annum in the United Kingdom and the interesting report recently published by Dr. Turner, Health Officer of Bombay, shows that the mortality from this disease in large Indian cities like Calcutta and Bombay is already considerably higher than in Glasgow, Birmingham or Manchester. One of the two chief sources of danger in this disease is milk and butter contaminated with tubercle bacilli. The question of milk-supply is therefore of urgent importance and I am glad to note that it is one of the subjects for discussion at the present conference. Then again we have to be forearmed against two diseases from which India has fortunately escaped up to the present, namely, sleeping sickness and yellow fever.

" Two officers of the Indian Medical Service, Captains Greig and Mackie, have at different times been deputed to Africa to work with the Commissions of the Royal Society sent from England to investigate sleeping sickness; and a monograph on the subject by Captain Mackie is now under preparation. With a view to prevent the importation of the disease into India regulations for the medical inspection of all immigrants from the endemic area have been enforced for several years at the different seaports, and so far as we know, no cases of the disease have escaped detection. These regulations, however, differ considerably in the different local administrations, and one set of rules is now being drawn up for discussion with local Governments. The danger of the introduction of yellow fever has recently engaged the serious attention of the Government of India and Major James, a specially qualified officer, has been deputed to visit the endemic area travelling by the route that will be followed by ships proceeding to India when the Panama Canal is opened. He will examine ports at which the ships may touch, ascertain the systems of inspection adopted in them, study the methods by which yellow fever is kept out of Panama and Havannah and the way in which the disease can be stamped out when it appears. He will attend any international conference that may be assembled hereafter to consider the subject and he will draw up a comprehensive report which will enable the Government of India to prepare a definite plan of campaign.

" A determined effort is, therefore, being made to combat disease in its origin. Great results may in time be expected from the recently constituted Indian Research Fund which, as you are aware, is to be devoted entirely to the prosecution of investigations in connection with sanitation. The first meeting of the governing body of the fund is fixed for the 15th instant, when it is proposed to elect the scientific advisory board, to constitute the different working committees, and to draw up a preliminary programme of work. The nucleus of the fund is a sum of 5 lakhs of rupees contributed by the Government of India and it is hoped that this sum will be supplemented later on by

the liberality of wealthy and public-spirited gentlemen and ladies in India, so that eventually a very extensive campaign of sanitary research may be carried on. I can imagine no more deserving object of charity than the endowment of research designed to relieve the sufferings of humanity.

" In general or prophylactic sanitation, which by improving the environment endeavours to protect the public from the attacks of all communicable diseases, the Sanitary Commissioners and Deputy Sanitary Commissioners will tell us of steady progress and substantial achievement. The Government of India were able to assist provincial revenues last year by a special grant of more than a crore of rupees of which 50 lakhs went in subvention of the Bombay Improvement Trust. I hope it will soon be possible to introduce schemes for the reorganisation of the sanitary services which will go far to meet modern sanitary requirements. I would like to bring specially to your notice the good results obtained in Fraser Town, Bangalore, which still continues plague-proof. And I would ask—Is it an impracticable dream to construct a model town or quarter of a town in each province, with good water-supply, efficient drainage, rat-proof and mosquito-proof houses and an adequate sanitary staff as a measure of demonstration and education?

" Gentlemen, you are the pioneers of a great and vitalising movement. Sanitation as now regarded covers the whole life of a people. The difficulties before you are many. The ignorance and even hostility of the masses of the people are still fundamental obstacles. But a thousand difficulties need not make a single doubt. The more enlightened minds in India have awakened to the importance of sanitation and the movement in its favour is steadily gaining ground. In India as elsewhere old ideas of politics are yielding to more modern conceptions of social duty. I doubt not that you will go forward with intrepid confidence in the ability of science to create that environment in which alone man's higher aspirations can be fulfilled. Though you may not yourselves see the fruits of them your labours will assuredly not be in vain."

On the termination of the speech the following resolution, which was proposed by the President and seconded by Surgeon-General Lukis, was unanimously passed by the conference, the members thereof standing in token of respect :—" The members of the All-India Sanitary Conference desire to place on record their deep sense of loss by the death of the late Lieutenant-Colonel Leslie and their appreciation of his services to the cause of sanitation and they desire that this resolution be communicated to his widow and family with an expression of their respectful sympathy."

The items on the agenda were then discussed in order.

## General Sanitation.

### (*a*) *Urban Sanitation.*

The President referred to the schemes of urban sanitation (Appendix 1) which had been submitted by local Governments in reply to a letter from the Government of India and stated that what the Government of India required was some definite information on which to allot grants for urgent schemes which were pending for want of funds, in the event of money being available as was the case last year. He asked the various provincial delegates to make any remarks in explanation of the information which had already been furnished by local Governments.

*Mr. Hutton* (Madras) stated that the works mentioned in the list sent by the Madras Government were ready for execution. The Madras City water-supply and drainage scheme would require a subvention of 77½ lakhs and would take about ten years to complete. The projects mentioned in lists I, II and III would take between one and three years.

*Messrs. Mandy* and *Belvadi* explained that in Bombay only 14 of the schemes detailed in the list were ready and had been approved by the Sanitary Board and 8 were in progress. The entire programme submitted could be executed in ten years. A supplementary note (Appendix 2) was submitted

owners in proportion to the individual benefits derived from the scheme. The benefit is ascertained by estimating the unearned increment accruing to each holding on completion of the scheme. In a large area a portion only of the tax need be required from owners until works materially benefiting their land are taken in hand. A man wishing to retain his agricultural holding intact could be left out of the scheme, unless the local authority considered that he should come in. Power should be taken to acquire compulsorily any land required for the scheme, but with redistribution it would be very rarely used.

He thought that with a redistribution scheme it would be necessary to take power to make owners come in. It would not be sufficient to bring in a scheme, only if the majority agreed. If they did not agree, the matter should be referred to the controlling authority, and if he thought it necessary they must come in. Questions of compensation should be kept out of the ordinary courts with an appeal however to the civil courts in cases over a fixed limit of value. Market value would be paid for acquisition, but no compensation for compulsory acquisition. The local authority would decide what land should form the subject of a scheme. *Mr. Turner* circulated three plans showing a section of the Santa Cruz plan, one with all the original holdings, another the original holdings with the proposed rates upon them, and a third the scheme as it will be when completed. A further note by *Mr. Turner* elaborating and explaining the principles of redistribution is printed as Appendix 5.

In the subsequent discussion on this and *Mr. Porter's* note on town-planning (Appendix 6) it appeared that no town-planning scheme properly speaking had been undertaken in any of the provinces.

### (c) *Water-supply, Conservancy and Drainage.*

*Major Clemesha* in introducing his paper (Appendix 7) on the uses and limitations of small models of septic tanks made the following remarks :—

" The essential point in the design of this little installation is the size of the grit chamber. Here I may mention a very interesting incident that happened in Bengal which absolutely proves the contention that a large and properly designed grit chamber is the fundamental point in the design of this latrine. A mill situated in Howrah constructed a latrine for 2,500 users. At first the coolies refused to make use of the latrine and clamoured for the old one. Eventually, as is usually the case, the latrine became very popular so that the mill hands from two separate adjoining mills used the latrines and as a result the number of users went up from 2,500 to 4,500. This was nearly double the number for which the latrine was designed. The Manager of the mill was in great distress because we were constantly reporting badly on the quality of his effluent. There was no available land in the neighbourhood to build a second latrine. As a way out of the difficulty it was decided to try the experiment of constructing another grit chamber only to accommodate the extra 2,000 users. This was carried out. One side of the latrine was led into the original grit chamber, and the other half into the new one. A very great improvement was at once noticed in the effluent. This simple incident shows that, as we have maintained, by far the greater part of the breaking down action in septic tank latrines goes on in the grit chamber."

*Major Lalor* referred to the difficulties of night conservancy disposal in Burma and illustrated his argument by reference to certain towns situated in the delta of the Irrawaddy.

He stated that the chief schemes formulated for the sanitary improvement of one of these towns were as follows :—

(1) In the year 1901 the removal of the mixed liquid and solid excreta in buckets by the aid of a small system of tramways and trucks was suggested, with disposal by trenching at a distance.

(2) In the year 1905 the same system of removal was suggested with disposal by septic tank treatment in place of trenching, at an estimated cost of ₹1,45,733.

(3) Later, the same system of removal was suggested with disposal by trenching in the dry season and mounding in the rains, at an estimated cost of ₹1,32,931.

(4) Later, the same system of removal was suggested with disposal by septic tank through the medium of a small sewerage system with three aligned " pail depôts " from the centre one of which the combined sewage was to be pumped to the tank. Pumping by electric power was suggested on the ground that such power would be more economical since it would be available also for the lighting of the town. It was further pointed out that for effective drainage of the area pumping would in any case have to be resorted to.

(5) Later, to meet financial exigencies, a system of removal of solid excreta only was suggested, liquid excreta to be dealt with by filtration *in loco* through ærobic filters, solid excreta to be removed by hand cart and disposed of by trenching in the dry season and mounding in the rains.

(6) Still later, scheme 3 was again put forward with the advice that experiments should be conducted locally with latrines on the separate system outlined in scheme 5, with a view to the gradual introduction of that scheme if found suitable, at an estimated cost of ₹1,38,210.

In his opinion, this question presented itself :—" Are septic tank latrines applicable in the circumstances given as the cheapest and most effective means of combined night conservancy removal and disposal, and if so, what would be the initial cost and annual recurring expenditure of the system approximately, for a town of this kind with a population of 10,000 inhabitants?"

*Major Clemesha* observed :—" The problem depends upon the nature of the town. If the houses are scattered many small septic tank latrines would be required. I suggest that a latrine for 200 users per diem would be suitable. Fifty such latrines at a cost of ₹1,500 each would suffice; total cost 75,000 rupees. The annual recurring expenditure would be the cost of providing water and this without more detailed knowledge of local circumstances it is impossible for me to calculate. If the town is compact a standard type latrine for 500 users would probably be satisfactory. The total cost of one installation of 20 such latrines at the rate of ₹4,000 to ₹5,000 each would be ₹80,000 to ₹1,00,000. The cost of providing water would probably be less than in the former case.

" Both schemes imply the existence, or the installation of a gravitation water-supply. Probably the cheapest method, though not the most sanitary, would be to remove the night-soil by hand, to centrally situated dumping tanks."

In connection with *Mr. Belvadi's* note (Appendix 2) on the progress of municipal water-supply and drainage works in the Bombay Presidency, it was pointed out by *Surgeon-General Lukis* that certain points had been raised (in paragraph 9* of the note) with regard to septic tanks at Poona.

In answer to the points here raised *Major Clemesha* said :—

" The first point (A) mentioned was ' to ascertain the *optimum* period of stay in a septic tank for sewages of various strength.' " Major Clemesha pointed out that " it was entirely erroneous to suppose, as was stated further on in the letter, that experiments of this kind had not been undertaken previously in other parts of India. It was now nearly five years since Dr. Fowler started experiments on precisely these lines, and from an enormous bulk of evidence both of models and working installations (of which there are nearly 100 in Bengal alone) it has been found that a 3 days' rest in the tank with a five-gallon dilution gives about the most economical result. It is never contended that a shorter period would not give very fairly satisfactory results but it has been clearly shown in the work published by him that the further the septic tank action goes the quicker is the nitrification action when dealing

* *Vide* page 62 below.

with a vegetarian sewage. There are so many points in sewage disposal which have been thoroughly investigated that it seems a great pity that practically identically the same work should be repeated in Bombay. I should also like to point out the difficulties of obtaining the various dilution of sewage. It is necessary to provide latrines with a self-registering turnstile in order to do this, and there are several other difficulties in the way which are not easily overcome.

"(B) 'To ascertain if this period can be shortened economically by the use of such means as hydrolytic chambers or macerating tanks or colloidors.' The septic tank designed in this country contains both the action of hydrolytic and macerating tanks. The constitution of the sewage is such that the solid particles always remain for a considerable length of time in a separate chamber much longer than is ever dreamt of in ordinary countries. As regards using colloidors we have never tested them in this country though it seems probable that these might possess several advantages in a sewage such as is observed in this country.

"(C) 'To find the maximum amount of suspended matter in the tank effluent which can be efficiently dealt with by different forms of filter material without clogging.' The reason why suspended matter has not been investigated very thoroughly in Bengal work is because the amount of matter in true suspension is comparatively small and very readily settles out as sludge. There is, however, a very large amount of true colloid material which interferes with the action of filters. We have found that the colloid figure is really of greater value in estimating the purity of a sewage for filtration purposes than the amount of suspended matter that it contains. This conclusion has been arrived at from many years' work and from a large number of analyses. An effluent which contains large quantities of colloids will give trouble on filters, if they are made of finely graded material. The same effluent might contain very little material in true suspension. Therefore the colloid figure is a better gauge of the suitability of the effluent than the amount of suspended matter.

"(D) 'To ascertain the proportion of nitrates in the filtered effluent and the methods of treatment which will give the maximum quantity of nitrates.' This is a subject which certainly might well be investigated because it is admitted that the nitrification process has not been studied in Bengal as thoroughly as the anærobic state. However there is a great deal of valuable work in Fowler's report which I am bound to say hardly need be repeated.

"(E) 'To ascertain how far supervision can be dispensed with in small installations.' Under this head we have made in Bengal small models of tanks in municipalities which are to be treated exactly in the same way as the ordinary latrine. This subject will be dealt with in the course of the next paper which has been written by myself. It may be briefly summed up by the fact that experience shows that, provided the latrines are designed simply of indestructible material, they give very satisfactory result even under very primitive supervision. A complicated latrine will always give trouble.

"There are so many phases of sewage disposal which have not yet been investigated, such as a careful study of the sewage from a town, that it seems a pity to work on the lines suggested. There can be no doubt whatever that in dealing with an artificially manufactured sewage, containing night-soil, urine and water only, a very good deal has been ascertained. We want to know the characteristics of an ordinary sewage as it passes from an Oriental town. It is perfectly obvious that this is a very different problem from those that it is proposed to study in this letter."

*Mr. Hutton* then put in a paper (Appendix 8) on water-supply and drainage works in the Madras Presidency.

In connection with the construction of galleries, *Major Lalor* and other delegates asked whether it would not be more efficacious to construct wells outside the river bed though near it which could be put down and taken up easily. A gallery once constructed could not be removed.

*Major Clemesha* thought that galleries were really the finest things for water-supply. The only drawback was that they did not give quite the same

quality of water as a lake or reservoir or filter and were liable to pollution in flood time. As a rule the water was quite pure, but differed considerably in bacteriological efficiency.

*Mr. Hutton* said they were prepared to put their galleries outside the river beds if they found a suitable ground layer of sand.

## Rural Sanitation.

*Captain Justice* in explaining his paper (Appendix 9) said that his object in writing it was to show the want of progress and lack of interest in rural as compared with urban sanitation. He thought that what the people required was an object lesson and that for this purpose model villages should be established in each district. He said that model types of wells and pumps, of which he produced three type designs, had also been designed by Mr. Hutton. These wells could be fitted with pumps and would cost between 1,600 and 1,800 rupees. In the design a leading feature was the provision of drainage. He concluded by asking for suggestions for improving village sanitation.

*Lieutenant-Colonel Wilkinson* explained the system of granting rewards in the Punjab to selected villagers in the Canal Colonies whose inhabitants had shown particular zeal in sanitation. This had stimulated interest though provisions limiting the total grant permissible to each village were not conducive to the permanency of the interest taken. Once the rewards were exhausted they reverted to their old standards. Village sanitation books containing rules for the guidance of inspecting officers were also in use. What he considered essential to any real progress was some form of legislation. He said that there was no Village Sanitation Act in force in the Punjab.

*Mr. Porter* mentioned that an Act of this description was in force in the United Provinces and provided for simple sanitation and improvement of water-supply. It could be extended to selected villages of over 2,000 inhabitants.

*Major Clemesha* considered that *Captain Justice's* proposals were at present impracticable. They must distinguish between the sanitation of the environment and the sanitation of the individual. For the first they should be 50 or 100 years ahead of the times of the people, *e.g.*, in putting in a good water-supply. Dealing with individual sanitation they came up against a very different proposition. The individual must first be educated to higher sanitary standards and that would take many years.

Legislation would be useless without getting the people to understand its *raison d'être*, and many of the suggestions for conservancy in the Madras paper were quite impracticable. He would concentrate on (1) improving water-supply, (2) educating the children in the simplest outlines of hygiene. He considered that the Punjab system of rewards was worth imitating elsewhere.

*Mr. Orr* entirely agreed. He complained that village sanitation books usually contained a mass of impracticable and unfulfilled suggestions. What was really necessary was to see that suggestions were carried out. He thought that the publication of particularly useful notes might be usefully made from time to time. Much had been done in Bombay to improve water-supply in villages.

*Colonel Hare* pointed to the different local conditions in Eastern Bengal and Assam where the villages covered enormous distances and where each house possessed its own water-supply. In these circumstances a practical scheme of rural sanitation was very difficult. The Sanitary Board last year received an allotment of funds from Government. These were distributed in different localities, the district board, the people and the Sanitary Board each contributing one-third, the people contributing either in the form of money or labour. Maps of districts indicating the nature of the water-supply, where improvements were necessary, were being drawn up.

*Major Stokes* mentioned that there was a Village Sanitation Act in the Central Provinces governing all villages with over 500 inhabitants. It was doubtful, however, whether the rules framed under the Act had any real effect.

*Colonel Dyson* laid stress on the necessity for a pure water-supply for villages and thought the Divisional Sanitary Commissioner and Divisional Medical Officer should be a member of the local board and have a voice in the allocation of funds for the improvement of water-supply, and in the selection of sites for wells.

The conference then rose for the day.

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## SECOND DAY'S PROCEEDINGS.

### Special Sanitation.

#### (*a*) *Food Supplies.*

*Colonel Wilkinson* in introducing his note (Appendix 10) on the milk supply of large towns in India explained that the salient points which he wished to emphasise were the necessity for excluding cattle from town areas, the exclusion to be enforced by imposing a tax, the provision of sanitary sheds at low rents outside, the direction of further efforts towards securing a purer milk supply, and providing for the examination of samples of milk and milk products, and the necessity for caution in any further restrictive legislative measures, which might cause a rise in prices. In reply to a question he stated that he was not in favour of Pasteurisation before issue by the Strauss method for India.

*Dr. Bose* said that measures taken in Calcutta had been rendered nugatory by the opposition of the *gwalas*. It was possible under the existing law for the vendor to escape prosecution by notifying that he sold mixed milk. In any case exclusion from municipalities would mean exclusion from supervision.

*Colonel Hare* advocated a system of licenses of vendors and dairies within municipal areas and thought that the larger towns should have model dairies. If cattle were excluded from town areas, as *Colonel Wilkinson* recommended, municipal control over them would be lost.

*Mr. Orr* cautioned the conference against excessive reliance on bye-laws which were in many cases too stringent for practical purposes. The Bombay Corporation's proposed bye-laws were so stringent that it was not possible for a man erecting a cattle stable in accordance with their provisions to make a reasonable profit. The existing bye-laws require a space at least 3½ feet wide to be provided for each animal and insist on a margin of 15 feet clear of buildings all round the stable, and it is proposed to raise the 3½ to 5 and the 15 to 50. At present in Bombay owners of milch cattle could only make things pay by disregarding bye-laws, *e.g.*, by keeping many more animals than the full number a stable is licensed for. One man made ₹1,200 in two months in this way and was then fined ₹75. Tests of specific gravity also were evaded without much difficulty. They were trying to get cattle under control by providing a big central area which the Improvement Trust was reclaiming. Exclusion of milch cattle from town limits was not possible in a town of the size of Bombay.

*Mr. Turner* said that much good was being done by private effort and mentioned a society which had been established for the preservation of cattle, the members of which pledged themselves to purchase milk from these cattle only. Mr. Tata had a scheme for planting Australian bush which is much relished by milch buffaloes and he hoped to run agricultural farms on these lines. Outside Bombay there were many stalls for milch cattle but little supervision and there were many complaints about the absence of train facilities for getting milk conveyed at an early hour to the city.

*Major Clemesha* thought that large cities such as Bombay and Calcutta, where the difficulties were enormous, should be differentiated in their treatment from smaller towns where the problem was capable of solution. He agreed with *Lieutenant-Colonel Wilkinson* in thinking that cattle could with advantage be excluded from the town area in very many smaller towns and that the levy of a tax was sound. But he was of opinion that real success was impossible without stringent legislation. The fight with the *gwala* had got to come.

*Colonel Wilkinson* in reply said that the difficulties as to loss of municipal control would be met by the provision by municipal agency of cattle sheds outside the area. Municipal supervision would of course continue. He considered that a system of licenses would probably be better than bye-laws, as matters could then be dealt with by executive authority. In Simla few bye-laws were literally observed though he had noticed a gradual improvement in the supply of milk. Milk cans were sold to cattle owners at less than cost price and other facilities afforded. He was opposed to any general or stringent legislation, both on grounds of policy and on the effect it would have in prices.

(*b*) *Adulteration of Food and Drugs.*

In reply to a question from the President as to the adequacy of existing municipal legislation on the subject of the adulteration of food and drugs and as to the desirability of its extension, the general opinion was that the question of the adulteration of food was an urgent one and that existing powers were generally inadequate. *Major Ross* considered that the Madras City Act was quite sufficient if enforced and *Major Robertson* said that the draft Bill before the United Provinces Council would meet all requirements. It was thought that no active steps could be taken till proper standards had been worked out and fixed. The members of the conference also thought that the question of the adulteration of drugs should be investigated. In regard to the form which legislation should take if found necessary, *Surgeon-General Bannerman* considered that an All-India Act might be preferable provided elasticity was permitted to local Governments to adapt it to local conditions. In any case standards should be worked out by Government officers and not local bodies. The existing staff of laboratories should not, however, be utilised for the purpose, but provision would of course have to be made for a body of competent analysts.

## Registration of Vital Statistics.

*Major Kenrick* introduced his paper (Appendix 11) on the subject of improvement in the agency for the registration of vital statistics. He pointed out that the employment of *dhais* as a reporting agency raised the important question of their registration.

*Colonel Wilkinson* who put in a note on the importance of vital statistics (Appendix 12) said that the question of the creation of a special organisation consisting of Assistant Surgeons or Sub-Assistant Surgeons as divisional inspectors of vaccination and vital statistics in place of promoted vaccinators was under consideration. Information for checking the registration of births was commonly obtained from *dhais*.

*Captain Justice* stated that in Madras Sanitary Assistants supervised the work but the local boards found it difficult with their present funds to maintain the staff. It was difficult too to give them a definite programme. Registration is usually attended to by the headman of the village and is not accurate.

*Colonel Dyson* said that there was no special supervising staff beyond the sanitary and vaccination staff. The difficulty in employing an improved staff was a question of money. He supported Major Kenrick's suggestion about employing *dhais*.

*Major Clemesha* explained that in Bengal registration was supervised by the vaccination staff in the hot weather but was admittedly performed perfunctorily. He was doubtful if inspection by low-paid and unqualified men was of any real value.

*Dr. Bose* referred to the reluctance of the people to register births. He was in favour of a Medical Registration Act to check the growth of unqualified medical practitioners.

*Colonel Hare* referred to a scheme which he had recently drawn up and which was now under the consideration of the local Government. The difficulties in the past had been lack of supervision by the sub-inspectors and the impossibility of getting Magistrates to take their reports seriously. The Bengal Registration Act gives ample powers if properly applied. Under the proposed scheme each vaccination inspector was to be held personally liable for the proper registration of such occurrences in every compulsory area within his circle. Each area is to be divided into circles of convenient size and the vaccination inspector is to inspect at least one monthly. He is to submit to the Magistrate periodical reports of default on the part of the people, and the Magistrate on his part is to fix a definite day each month for the hearing of cases. The trial will be summary and the result of the case will be at once noted on the sub-inspector's register. If the prosecution is successful the sub-inspector is entitled to a reward of four annas for each case. He thought that some such methods would speedily ensure better and prompter registration.

*Major Robertson* read a paper (Appendix 13) explaining the system of registration in the United Provinces and suggested an improved scheme for registration in municipalities. He advocated in particular the appointment of special medical officers of the grade of Sub-Assistant Surgeons in municipalities to which purpose a portion of the sanitary grant-in-aid might be devoted.

The general conclusion arrived at was that though on the whole vital statistics were accurately recorded, the subordinate registering staff should at least in towns be medically qualified. It was also agreed that incorrect registration of the cause of death by the present unqualified staff was the chief obstacle to sanitary science.

It was mentioned that the Census Commissioner to the Government of India had suggested in regard to vital statistics that a typical area with a population of about 40,000 should be selected in each province, a special staff employed for a particular period and the results tabulated. This would provide a normal standard to correct provincial figures.

*Major Clemesha* stated that this had already been done in the Burdwan district in Bengal.

*Colonel Hare* said that a whole area was being similarly dealt with in the Dacca division in connection with the anti-malarial enquiry.

*Major Robertson* mentioned that this had been done in 5 or 6 towns in the United Provinces.

*Major Clemesha* said that the results obtained in Bengal had been distinctly valuable.

## Scientific Enquiries.

### (*a*) *Standards for Water Analyses.*

In the discussion which followed the reading of *Major Clemesha's* paper on the necessity for a uniform method of water analysis in India or a uniform nomenclature of fæcal organisms (Appendix 14), *Captain Patton* referred to Gaertner's views on the value of the coli group as indicators of contamination. He considered that the dangerous character of a water-supply was in direct proportion to the numbers of such bacilli in so far as they were of human origin, for their presence pointed to a recent contamination with fæcal matter, and this fæcal matter might contain such organisms as those of typhoid and cholera. Gaertner emphasised the need of thorough investigation into the source and history of these organisms, whether they were of human or other origin. No one had yet been able to find a test of this, and until this was done it was useless to carry out elaborate methods of water analyses as a routine measure. *Major Clemesha's* standard was so high that few of the Madras water-supplies maintained its level. He

emphasised the necessity of further investigation made to discern some means of differentiating coli of human origin from that of other animals.

*Mr. Hutton* considered the question of what action should be taken in the case of a water-supply having received an adverse report. In his opinion MacConkey's method was too complex and lengthy, and the time which must elapse before a report could be received was so long, as to seriously diminish its value. He referred to difficulties which he had experienced from receiving variable reports on filtrates. In certain cases the filtered water was more adversely reported on than the unfiltered. The Government of Madras had sanctioned the erection of experimental filter beds. Very few filtrates attained the standard of perfection demanded by MacConkey's method, and he doubted whether large municipal expenditure in this direction was justified. He himself would give further trial to the simpler and shorter method of Houston.

*Major Clemesha*, in reply, said that analysis was only of use as a guide. If the analysis pointed to contamination, then the state of affairs should be investigated on the spot. There was no test of the source of coli contamination. It was impossible to say whether it was of human or other origin. This was one of the matters which must be left to direct investigation. He emphasised the importance of MacConkey's method as it was possible to differentiate between recent contamination and contamination of old standing.

(*b*) *Infantile Mortality.*

*Major Robertson* read a paper (Appendix 15) on infantile mortality embodying the results of special enquiries made by himself and Captain Graham in 4 different towns. He drew special attention to the fact that malaria was by far the most important direct cause of death, constituting 22·5 of the total mortality and that tetanus and accidents and diseases due to child-birth came fourth in order of importance.

*Colonel Wilkinson* referred to the havoc played by malaria and small-pox as causes of infantile mortality. As an attempt to combat it a few lady health visitors had been appointed in Lahore.

*Dr. Bose* pointed out the apathy of the public and mentioned many contributory causes of death, *e.g.*, injudicious feeding and deficient clothing. He also mentioned the increasing difficulty in procuring milk. The health record in and around Calcutta showed that death from malaria was not an important cause. Scurvy and rickets were very common causes of death.

*Colonel Dyson* outlined what was being done in Bombay City. They had trained midwives and nurses employed by the municipality and in the last year 60 per cent. of the total number of births had been verified by these midwives. This showed that they were getting at the poorer classes. The chief causes of infantile mortality were debility, diseases of the nervous system, and the spirits evil, the latter being the most common. A very high percentage occurred on the first 30 days after birth. In Bombay it was 34·36 per cent. and in Kanara, a malarious district, as high as 75 per cent. Attention should therefore be chiefly directed to helping mothers in their confinement and teaching them the proper treatment of the new born. The methods of treating confinements in villages were disastrous. All this showed the necessity for training midwives.

*Dr. Rutherford* stated that the training of midwives had been taken in hand in Ceylon, certificates being given at the end of one year, but much depended on the willingness of the people to pay for such nurses.

*Major Clemesha* said there were one or two very marked factors in Calcutta. One was that there was practically no malaria among children, another that tetanus, an entirely preventible disease, was very rife and accounted for 30 per cent. of the total mortality within the first 20 days of life. Another determining factor in Calcutta was the prevalence of premature marriages. Two visiting nurses had been appointed experimentally in Calcutta to assist confinements, while in Burma *Major Lalor* referred to a society for the prevention of infantile mortality having been established, which distributed pamphlets, held baby shows and awarded prizes.

### (c) *Plague.*

In introducing the discussion *Major Glen Liston* said :—

"I must presume that you have all read our pamphlet on recent researches in connection with plague in India (Appendix 16), for I have not time to read it now. I have tried to bring out certain points in the paper on which I think discussion could be developed profitably and I now propose to refer to these points.

"Taking up first our observations on the habits and breeding of rats I desire to draw your attention to the very rapid rate at which rats multiply. Our laboratory experiments show that a single pair of rats can multiply to fifty pairs in the course of a year, and although our field experience does not fully confirm this laboratory estimate we are none the less convinced that because of the very rapid rate at which rats multiply, rat destruction, to be successful, must be very thorough and very persistent. It is for you to consider whether, under these circumstances, a direct attack on the rat population of a place is practicable and likely to be successful. I am inclined to think that greater success will in the end attend measures which aim at the diminution of their food supply and at the removal of their breeding places.

"This line of attack on the rat population of a place, I think, has in this country generally been neglected, but some work which has been carried out in Burma by Captain Brayne must be mentioned as an exception. I understand that he endeavours to have houses kept in a proper state of repair and directs special attention to markets where rats are most plentiful and where they generally find ready access to food supplies. Grain godowns and markets in my opinion should be made rat-proof and should be kept clean by a special inspecting and scavenging staff. Markets as far as possible should be isolated from human dwellings.

"Passing on to our experiments with the breeding of rat fleas I think it is of interest and importance to note that, because of the favourable conditions for flea multiplication, a damp cold weather in this country is more likely to be associated with severe plague epidemics than a dry cold weather. It would be interesting to hear the experience of the members of this conference in this connection.

"I pass on now to refer to our immunity experiments which show that in the course of a series of epidemics of plague a race of rats is evolved which is naturally immune to the disease. These experiments have demonstrated that while at the present time in such plague-stricken cities as Bombay, Poona, Cawnpore and Lucknow a large proportion of the rats are immune to small doses of plague, say one one-hundredth thousand part of a grain of an infected rat's spleen, rats from such plague-free places as Madras, Madura and Raipur readily succumb to such doses. Moreover, the young born of the relatively immune rats caught in plague-stricken cities are almost as immune as their parents although it was possible to be sure that these young rats had never been exposed to infection.

"Young rats born in captivity of parents which were probably highly immune to plague, in that they had survived exposure to severe artificially produced epizootics, were even more resistant to plague than ordinary wild Bombay rats which, we have remarked, are at the present time comparatively immune to small doses of plague. It is thus evident that this immunity is transmitted from parent to offspring.

"This is a comforting discovery, for it assures us that if we wait long enough plague will ultimately disappear from India as it has done in the past. Let us hope, however, that this assurance will not lull us to sleep or cause us to curtail in any way our efforts to save the vast numbers of human lives which must otherwise be sacrificed. While we wait for the plague to disappear it may be very many years hence.

"I need only briefly refer to our observations on chronic or resolving plague which have shown that when a sufficient number of rats are used chronic or resolving lesions may be developed after experimental infection with plague virus.

"A more extended experience of these plague lesions has convinced us that they play little part in the annual recrudescence of the disease.

"I pass on now to our epidemiological enquiries which have shown that plague has been absent from the province of Eastern Bengal and Assam mainly because of the habits of the people inhabiting this province and the structure of their houses. The experience has shown us that plague is not likely to spread where the habits of the people and the structure and arrangement of their houses is such as not to favour rats.

"Our observations in Poona City which now have extended continuously over three years have shown that at the close of an epidemic the rat population of a place is greatly reduced and that thereafter if the conditions are favourable the rats rapidly multiply.

"They have shown also that the number of fleas found on rats has a very definite seasonal variation, a variation which is constant from year to year and corresponds with the climatic variations and with the seasonal variations in the intensity of plague epidemics.

"But the most important fact which has emerged from this enquiry is the part played by the people in introducing infection from infected to healthy areas. For a short period, September 6th to September 20th, arrangements were made to determine the number of persons arriving at Poona station from infected towns and villages. During this time 1,232 persons arrived from known infected places. As soon as it became known that Poona City was infected, the number of persons coming to the city from infected places practically ceased and an exodus from the town itself took place. Moreover, the presence of infection in certain places only came to our knowledge when cases of plague were brought to Poona from them, although arrangements had been made with the authorities for securing as early information as possible on this matter. Our information was often many weeks in advance of that supplied to us by the authorities. The importance of obtaining early information of the outbreak of plague has hardly been sufficiently realised by Government. A great problem will be solved when some means has been devised for obtaining early information of the outbreak of epidemic disease. This is a matter which, I think, specially deserves the attention of the conference.

"I need hardly add that this information of itself will not be of much value unless plans are well drawn up so that action may be taken at once on receipt of the information. In this connection I would particularly like to draw the attention of the conference to the Madras Plague Manual where the course of action of every administrative officer in a district is clearly laid down so soon as information of the outbreak of plague reaches him.

"What is required in the prevention of epidemic disease is (1) early information to be followed by (2) immediate and clearly defined action. So far as I am aware much requires to be done in this direction in India.

"Our work in the United Provinces has been mainly devised to explain, if possible, apparent anomalies in the distribution of plague. If the rat flea theory of the propagation of this disease is correct, as I believe it is, it should be possible to explain the anomalies of distribution. If with the aid of this theory we are unable to do so, there is something wanting in our knowledge. By making such investigations we are seeking to perfect our knowledge of this disease.

"The Madras Presidency has been peculiarly fortunate in having escaped plague and our enquiries here have been devised to find out whether this comparative freedom from the disease in the Madras Presidency has been due to good luck or good guidance or whether a little of each is responsible. Incidentally we hope to save the Madras Government a considerable sum of money if we are able to show that, after all, there are some compensations, *viz.*, a freedom from plague—associated with a somewhat hot and uncomfortable climate.

"We have carried out a very exhaustive enquiry into the usefulness or otherwise of anti-plague curative serum. Our results show that up to the

present no serum has been made which has any marked effect in curing the plague, but we still hope that better results will be obtained in the future.

"In conclusion I wish to draw your attention to the fact that I think the successful work of the Plague Commission has largely been due to the combination of laboratory work with epidemiological and clinical enquiries. I do not think that sanitary science or curative medicine or for that matter medical research will advance one iota unless there is a combination in the work of these several departments of our profession. I think that up to the present in India there has been too great a tendency for the sanitary, the bacteriological and the clinical departments of our profession to hold aloof from one another. Progress can only be made where we seek to help each other."

In the discussion that followed *Surgeon-General Bannerman* agreed cordially with *Major Glen Liston* that the work of the laboratories must be carried on in close connection with the work of the sanitary services and with hospital work. He mentioned the difficulty at Parel owing to the distance from hospitals of the laboratory.

*Captain Justice* thought that the passport system of Madras should be maintained pending the enquiries of the Commission in Madras. He stated that the Madras Plague Manual prescribed definite duties for every class of official on the occasion of an outbreak of plague, and that this had been of great assistance in ensuring early reporting.

*Colonel Dyson* mentioned that although in Poona rats became immune, as appeared from the course of the present epidemic, in Satara where epidemics occurred year after year, such was not the case.

*Dr. Bose* said that it was useless to attempt plague measures without the co-operation of the people, through whose inertia and indifference the measures adopted were often rendered nugatory.

*Major Stokes* drew attention to the inadequacy of the law in compelling reports of the outbreak of a case of plague.

*Lieutenant-Colonel Browning Smith* said that his experience in the Punjab as to the effect of humidity on plague entirely bore out *Major Liston's* conclusions. A weak monsoon was followed by a mild epidemic and *vice versâ*. He asked what was the longest period for development from the egg to the flea. He said that plague was present in London for 100 years before the epidemic of 1665, including four severe epidemics, and for 25 years subsequently, and feared there was no prospect of a cessation of plague of itself for a very lengthy period. Early information was essential, but was largely a matter of staff. Round Delhi now owing to the staff being sufficient it had reached such a pitch of perfection that when a field rat fell down a well, rat mortality was reported to the plague officer.

*Major Lalor* put forward Captain Brayne's views. They ran along two lines. In the first place he thought that plague in a place generally starts about the same time every year. It establishes a crisis among rats, but after a certain number have been destroyed it stops. His idea was to establish an artificial crisis among rats a month or so before it would ordinarily take place and to slaughter as many as possible; the rat population might thus be reduced to such a number that plague would not take place. This contention had not been finally proved. The second line of argument was that it is not possible to render dwelling houses rat-proof at reasonable cost, but *is* possible to render them "ratable," *i.e.*, constructed of such material that rats cannot find cover, and must be discovered if boxes and other movables are removed.

The unanimous view of the conference was in favour of the view put forward by *Major Glen Liston*, supported by *Surgeon-General Bannerman* and *Sir David Semple*, that it was essential that there should be close co-operation in the future between the laboratory worker, the sanitarian and the clinician.

*Major Glen Liston* said that he would experiment on the breeds of rats mentioned by *Colonel Dyson*.

*Captain Justice* in introducing his paper (Appendix 17) on the passporting of grain and grain gunny bags from localities infected with plague stated that the subject of the importance which grain bears in the dissemination of plague might perhaps be investigated by the Plague Commission, and that experiments on the transportation of fleas in gunny bags and grain might be carried out.

*Major Glen Liston* then read a paper (Appendix 18) written by *Captain Stevenson* on the action of hydrocyanic acid gas on grain and other food-stuffs. He himself considered that it would be extremely difficult to control the transports of gunny bags.

*Captain Patton* made the following remarks: While studying the life history of the cat flea *Ctenocephalus felis*, I was struck with the fact that the larvæ of this flea, even the smallest, when kept in proximity to the fleas always contain digested blood. It then occurred to me that larvæ may well ingest pathogenic organisms passed out by the flea, and that if they retain this infection in the mature flea on hatching out from such larvæ may constitute a factor in the transmission of the organisms. So little appears to be known regarding the feeding habits of flea larvæ that I venture to suggest that this is a possible method by which plague may be carried by infected larvæ in grain and gunny bags.

*Dr. Bose* urged caution in the use of hydrocyanic acid gas owing to the danger of men with dilated hearts or any derangement coming into contact with it.

*A member* here observed that a temperature of 112 degrees in the sun's rays for ¾ hour was sufficient to destroy fleas; and there should be no difficulty in disinfecting gunny bags by this means.

*General Lukis* pointed out that this could not be done in the case of cargoes.

*Major Lalor* was of opinion that action should be taken rather to adopt measures in *advance* of plague to prevent its *spread* than to attempt to prevent its importation, the latter being in the nature of things almost impossible. If large stores and barges were so constructed as to be easily ratable and if they were ratted regularly the danger of spread of plague by gunny bags would be minimised.

### (*d*) *Other Epidemic Diseases.*

A memorandum on the manufacture of glycerinated calf lymph and lanolinated vaccine was read by *Captain Justice* (Appendix 19), while *Captain Patton* explained the cultivation and preservation of cow-pox vaccine as practised at the King Institute, Guindy. A discussion ensued on the question of the supply and immunity of calves, of the advantages of glycerinated as opposed to lanolinated vaccine and of the possibility of the desiccation of vaccine.

*Major Clemesha* speaking from a knowledge of Madras assured Captain Patton that there would be no necessity for a reserve of calves outside Madras City.

Experience in Bengal showed that glycerinated vaccine retained its potency only up to a temperature of 60° Fahrenheit. Above that temperature it deteriorated rapidly. Lanolinated lymph was more robust, instances of decomposition being rare, and on the whole better, though glycerinated lymph might be more suitable for towns where a glycerinated lymph can be manufactured, and if not used, thrown away.

*Colonel Wilkinson* said that they were not troubled by climatic difficulties in the Punjab as their vaccination season was the cold weather. Epidemics occasionally occurred in the hot weather but they had not found their lymph manufactured in the hills to fail, if used within a week after preparation. Great care was taken in manufacturing a high standard of lymph. The strain was kept up by vaccinating from a cow into a buffalo calf. They kept

their own store of calves and did not depend on contractors. Generally speaking the results from glycerinated lymph had been excellent.

*Major Robertson* stated that in the United Provinces they had trouble over contractors for a good supply of calves. There was no cold storage on the ground of the expense it would entail. The glycerinated lymph was stored in the hills and sent weekly to the plains.

*Colonel Hare* said that a new depôt was required in Eastern Bengal and Assam, as at present there was no reserve of vaccine.

*Dr. Rutherford* stated that only glycerinated lymph was used in Ceylon. It was kept in cold storage and issued twice a week. There were consequently no failures.

*Major Stokes* mentioned that in the Central Provinces each Civil Surgeon made his own lymph and made his own arrangements for a supply of calves. No central depôt existed and the existing arrangements had the merit of cheapness.

*Major Lalor* stated that calves were purchased in Burma by the Superintendent, Vaccine Depôt, Meiktila, and were afterwards sold at a loss. The alternative of asking the Veterinary Department to purchase calves, lend them to the Depôt, and rear them subsequently on forest reserves for sale at a profit to Government, was unfortunately out of the question owing to the prevalence in Meiktila district of rinderpest amongst grazing cattle.

*Colonel Dyson* referred to a society of Jains which undertook to purchase cattle from Gujarat and to supply calves to the vaccine depôt. Glycerinated vaccine was in use and the results had been good. The lymph had gone to Aden and had been utilised after a lapse of 20 days. This was of course partially due to improved methods of packing and despatching.

*Captain Patton* who had written a note on the extraction or preservation of cow-pox vaccine as practised in the King Institute, Guindy, Madras (Appendix 20) dealt with the practical aspects of human vaccination. He said that the operation must be thoroughly performed. Small-pox seldom occurs in a child which has one large scar, and never in cases where two successful vaccinations have been performed. There is no evidence to show that the immunity conferred is less durable in the tropics than in temperate climates. The apparent difference in case incidence amongst the inoculated is due to the greater frequency with which sources of infection are encountered. No person is immune to primary vaccination and if a failure occurs it is due to improper application, or to deterioration of the virus.

*Dr. Bose* contributed a paper (Appendix 21) on the spread of tuberculosis in Calcutta, and initiated the discussion. It was agreed that there should be a separate hospital for phthisis wherever possible, and the conference endorsed the recommendations of Dr. Bose as to the hygienic measures desirable.

*Dr. Bose* also read a paper (Appendix 22) on epidemic dropsy or beriberi in Calcutta and *Major Ross* put in a note on education and public health (Appendix 23).

The conference then terminated.

# APPENDICES

TO

# THE REPORT

OF THE

# FIRST

# ALL-INDIA

# SANITARY CONFERENCE.

# APPENDIX I.

## SCHEMES OF URBAN SANITATION.

**No. 1538—1545, dated the 21st August 1911.**

From—The Hon'ble Mr. L. C. PORTER, Secretary to the Government of India, Department of Education,

To—
- The Chief Secretary to the Government of Madras.
- The Secretary to the Government of Bombay, General Department.
- The Secretary to the Government of Bengal, Municipal (Medical) Department.
- The Chief Secretary to the Government of the United Provinces.
- The Secretary to the Government of the Punjab, Home (Medical and Sanitary) Department.
- The Secretary to the Government of Burma, Medical Department.
- The Secretary to the Government of Eastern Bengal and Assam, General (Medical and Sanitary) Department.
- The Hon'ble the Chief Commissioner of the Central Provinces.

With reference to the correspondence ending with your letter* no. †, dated the , I am directed to say that the Government of India have recently had under their consideration the recommendation made by the Royal Commission upon Decentralization in India in paragraph 385 of their report regarding the occasional conferences of provincial Sanitary Commissioners with their Sanitary Commissioner.

* Addressed to the Secretary to the Government of India, Home Department.

† Madras, no. 417, dated the 27th May 1910.
Bombay, no. 229, dated the 13th January 1911.
Bengal, no. 1326-Medl., dated the 18th August 1910.
United Provinces, no. 3630, dated the 9th August 1910.
Punjab, no. 813 (M. & S.), dated the 8th November 1910.
Burma, no. 243-M.—5-X-11, dated the 29th April 1910.
Eastern Bengal and Assam, no. 4754-G., dated the 22nd July 1910.
Central Provinces, no. 1167 VI—14-10, dated the 13th August 1910.

2. After considering the opinions of the local Governments consulted on the subject they have decided that such conferences should be held regularly, at convenient centres, at which ideas can be exchanged and first-hand knowledge obtained of what is being done in the matter of sanitation in different places. Other important questions, such as the direct attack upon pathogenic microbes which are known to convey particular diseases, may conveniently be discussed at these conferences.

3. The Government of India will inform the Government of Madras / Bombay, etc. / you of the subjects to be discussed at each conference. In order to enable them to draw up definite agenda the delegates should be instructed with the permission of His Excellency the Governor in Council / the permission of His Honour the Lieutenant-Governor in Council / the permission of His Honour the Lieutenant-Governor to communicate to the Sanitary Commissioner with the Government of India the subjects which they propose for discussion, so far as possible, two months previous to the date fixed for the meeting. The discussions will be informal and the conclusions arrived at will in no way be binding on either the Imperial or Provincial Governments. No orders will be passed on the recommendations of these conferences without previously consulting the Provincial Governments concerned.

4. It has also been decided that the next conference, the precise date of which will be subsequently intimated, should be held at Bombay in continuation of the annual meeting of the General Committee for the study of Malaria probably in October or the beginning of November 1911. I am to request that delegates may be selected to attend both the meetings and to suggest that one of the delegates should be the provincial Sanitary Commissioner.

5. The Government of India think it particularly desirable that definite schemes of urban sanitation extending over a series of years indicating the degree of urgency and the amount of financial assistance required to carry them out within a reasonable period, should be prepared for the different provinces.

( ) omit in the letter to Central Provinces. I am to request that (with the permission of His Excellency the Governor in Council / His Honour the Lieutenant-Governor in Council / His Honour the Lieutenant-Governor) a report on the subject may, if possible, be submitted to them at an early date with a view to such schemes being discussed at the forthcoming conference.

6. The conclusions of the Government of India on the proposals contained in paragraphs 377 (*v*) and 384 of the Decentralization Commission's report regarding the appointment, etc., of provincial Sanitary Commissioners and Deputy Sanitary Commissioners will be communicated separately.

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No. 1546.

Copy forwarded to the Sanitary Commissioner with the Government of India for information.

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No. 1473-L., dated the 1st November 1911.

From—The Hon'ble Mr. L. DAVIDSON, I.C.S., Acting Secretary to the Government of Madars, Local and Municipal Department,

To—The Secretary to the Government of India, Department of Education.

In continuation of my letter no. 3646-1-L., dated 26th October 1911, and with advertence to paragraph 5 of your letter no. 1538, dated 21st August 1911, I am directed to enclose four lists of urban sanitary schemes which the local bodies concerned desire to take up for execution with the assistance of Imperial or Provincial grants.

These lists relate respectively to—

(*i*) local fund areas;

(*ii*) mufassal municipalities—water-supply and drainage projects;

(*iii*) mufassal municipalities—other sanitary schemes;

(*iv*) schemes in the City of Madras.

The local fund areas referred to in list no. (1) are small towns under the control of local boards and known in this Presidency as local fund unions. The first item relates to a scheme for which detailed plans and estimates are ready and which is now under the scrutiny of the Sanitary Board. It has been long in incubation and should receive preference to the other 15 items. It is not possible at this stage to indicate the relative order of preference according to which the latter should be dealt with. Other things being equal, it is proposed to give precedence to the items for which detailed plans and estimates have been sanctioned by competent authority before the actual distribution of subsidies takes place. It will also be necessary to examine the extent to which the local bodies concerned have already received assistance of this character and to regulate the distribution with reference to the total amount known to be available. It may be added that if circumstances permit His Excellency the Governor in Council would desire to consult the Finance Committee of the Legislative Council on this question. It is not possible to lay down any hard and fast rule for the determination of precedence in such matters and the rival claims of various local bodies form an appropriate subject for consultation with their elected representatives sitting on the Legislative Council. The relative position of the localities in the matter of urgency will also depend upon the extent to which they are liable to epidemics and the death rate resulting from the prevalence of insanitary conditions. The list, it may be added, has been compiled from applications for assistance put forward in connection with the distribution of the annual sanitary grant of 3½ lakhs and the items represent schemes for the execution of which local funds can make no immediate provision having regard to the other claims upon them.

2. The second list which appertains to water-supply and drainage schemes in mufassal municipalities consists of projects which have reached a comparatively advanced stage, the preliminary investigation being completed and the main outlines already approved by the Sanitary Board. In some cases also detailed plans and estimates are ready and in one or two instances a partial grant has already been promised by Government. The various items have been roughly arranged in order of preference by the Sanitary Commissioner who as a member of the conference at Bombay will be in a position to explain the reasons by which he was influenced. Columns 5 and 6 of the statement call for the following remarks. The local practice with regard to the distribution of Provincial grants-in-aid has been to give precedence to schemes which admit of being financed with a subsidy of one-half the estimated total cost, the balance being found from municipal funds whether by a direct allotment from surplus revenues or by means of a State loan. The figures entered in column 5 represent grants calculated on this basis, allowance being made for sums already promised and available without further assistance from the Government of India. The entries in column 6 represent the maximum subsidy permissible on the assumption that the half-grant rule is not enforced and that sufficient sums are available to meet the entire expenditure for which provision has not already been made. I am to say that the order of preference suggested by the Sanitary Commissioner is merely provisional and will undergo further

scrutiny as in the case of the items appearing in list no. (1) when the total grant available is known and the time for actual distribution has arrived. In this case also it is desired, if possible, to consult the Finance Committee of the Legislative Council.

3. The last remark applies to the third list which deals with other sanitary schemes in mufassal municipalities, notably projects for the improvement of congested areas and the extension of house site accommodation. No attempt has been made to detail the order of preference in these cases, but it may be stated that items 1 to 18 should take precedence of items 19 to 25. It has been the practice to give full grants in cases of this character, experience having shown that municipal bodies can seldom finance such projects without crippling their resources and undesirably restricting expenditure on other services.

4. It remains to refer to the fourth and last list which relates to the City of Madras. The three minor items aggregating 3·07 lakhs are applications for assistance towards the opening up of congested areas and the provision of house sites and model dwellings. The Corporation has already carried out a considerable amount of work of this description, but there is ample scope for development and assistance has recently been specifically requested to the extent indicated.

The major item of 77·5 lakhs represents the estimate framed by the Corporation of the amount of funds required in order to finance the extensive water-supply and drainage schemes now in progress and under investigation. The need for financial assistance of this character has already been brought to the notice of the Government of India in Mr. Cardew's letter no. 1598-M., dated 29th October 1903, when sanction was solicited for a loan of 25 lakhs in addition to a proposed grant of 17 lakhs. Since 1903 the drainage and water-supply work has grown in magnitude. Experience proved that the system of constructing drains was defective and that it would be necessary to supplement the contemplated improvements in the head-works of the water-supply by elaborate and costly distributary arrangements.

The programme of work under both these heads was placed under the control of a special engineer selected in England who has now been at work for nearly four years. This officer has recently devoted particular care to the investigation of the ultimate cost involved. His estimate is that an aggregate sum of approximately 184 lakhs is involved. Excluding work already paid for and funds available for expenditure in the current year there is a balance of some 145 lakhs for which provision must be made. The Corporation on examination of its resources, present and potential, estimates that without unduly starving other branches of the municipal service, it can afford to borrow 67 lakhs. It asks for the balance, *viz.*, 78, or to quote the exact figure, 77·5 lakhs as an outright grant.

According to present anticipations construction work will be spread over a period of at least ten and possibly fifteen years.

## LIST OF URBAN SANITATION SCHEMES WHICH REQUIRE GRANT-IN-AID FROM IMPERI FUNDS.

(I)

*Union Schemes.*

| Serial No. | Name of local body. | Name of the scheme. | Amount of estimate. | Amount of grant required from Government. | Whether detailed pl and estimates ar ready. |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |
| | | | R | R | |
| 1 | Chingleput District Board | Water-supply to Saidapet . . | 1,90,250 | 1,50,000 | Yes, under scrutiny the Sanitary Board |
| 2 | Nellore District Board . | Water-supply to Gudur . . | 1,30,000 | 1,14,000 | No, they are approac completion. |
| 3 | Ramnad District Board . | Water-supply to Ramesvaram . | 1,60,000 | 1,60,000 | No, they are approac completion. |
| 4 | Chingleput District Board | Drainage of Tiruvallur . . | 71,500 | 66,500 | No. |
| 5 | Ditto ditto . | Drainage of Saidapet . . . | 1,35,000 | 1,35,000 | No. |
| 6 | Godavari District Board . | Improvements to the drainage of Peddapur. | 42,000 | 42,000 | No. |
| 7 | Coimbatore District Board | Opening out congested areas in and extending the town of Kollegal. | 38,122 | 38,122 | Yes. |
| 8 | Tanjore District Board . | Provision of a pumping installation for the supply of water to a portion of Tiruvallur. | 28,000 | 28,000 | Yes. |
| 9 | Kistna District Board . | Improving a tank at Gudivada . | 18,790 | 18,790 | Yes. |
| 10 | Bellary District Board . | Opening out congested areas in the Kampli union. | 14,500 | 9,500 | Yes. |
| 11 | Kistna District Board . | Improving a drinking water tank at Gudivada. | 11,830 | 11,830 | Yes. |
| 12 | Salem District Board . | Extension of Dharmapuri union . | 11,500 | 11,500 | Yes. |
| 13 | South Arcot District Board | Improving a drinking water tank and its supply-channel in the Tindivaram union. | 11,000 | 11,000 | No. |
| 14 | Ramnad District Board . | Construction of an intercepting drain in the Sivakasi union. | 6,200 | 6,200 | Yes. |
| 15 | Bellary District Board . | Opening out congested areas in the Kamalapur union. | 5,500 | 5,500 | Yes. |
| 16 | South Arcot District Board | Construction of a reservoir at Panruti with a pumping installation for the supply of water to it from the Gadilam river. | Not known | 5,000 | No. |
| | TOTAL . | .... | .. | 8,12,942 | |

(II)

*District Municipalities—Water-supply and Drainage.*

| Serial No. | Name of local body. | Nature of the scheme. | Amount of estimate. | Amount of minimum grant required from Government. | Amount of maximum grant required from Government. | Whether detailed plans and estimates are ready. |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| | | | R | R | R | |
| 1 | Tinnevelly, Palamcottah and Tuticorin Municipalities. | Joint water-supply . | 17,08,000 | 8,54,000 | 17,08,000 | They are approaching completion. |
| 2 | Ellore Municipality . | Water-supply . | 3,16,570 | 89,870 | 1,69,870 | Yes, under scrutiny in Public Works Department. |
| 3 | Masulipatam Municipality. | Ditto . . | 4,50,800 | 2,25,400 | 4,50,800 | Yes, under scrutiny by the Chief Engineer, Public Works Department. |
| 4 | Vizagapatam Municipality. | Water-supply to Waltair. | 76,500 | 38,250 | 76,500 | Yes, under scrutiny in Public Works Department. |
| 5 | Chingleput Municipality. | Water-supply . | 1,35,000 | 67,500 | 1,35,000 | They are approaching completion. |
| 6 | Madura Municipality | Water-works improvements. | 3,00,000 | 1,50,000 | 3,00,000 | They are approaching completion. (Will be ready in December 1911.) |
| 7 | Ditto . | Drainage . . | 20,72,274 | 10,36,137 | 20,72,274 | Yes, under consideration by the Sanitary Board. |
| 8 | Trichinopoly Municipality. | Ditto . . | 6,50,000 | 3,25,000 | 6,50,000 | They are approaching completion. (Will be ready in December 1911.) |
| 9 | Negapatam Municipality. | Ditto . . | 2,30,000 | 1,15,000 | 2,30,000 | They are approaching completion. (Will be ready in December 1911.) |
| 10 | Vellore Municipality | Ditto . . | 3,70,800 | 1,85,400 | 3,70,800 | Yes, under scrutiny by the Chief Engineer, Public Works Department. |
| 11 | Conjeveram Municipality. | Water-works improvements. | 1,50,000 | 75,000 | 1,50,000 | They are approaching completion. (Will be ready in December 1911.) |
| 12 | Tirupati Municipality | Ditto . . | 1,50,000 | 75,000 | 1,50,000 | They are approaching completion. (Will be ready in December 1911.) |
| 13 | Adoni Municipality. | Water-works improvements (additional catchment areas). | 30,000 | 15,000 | 30,000 | They are approaching completion. (Will be ready in December 1911.) |
| 14 | Coonoor Municipality | Water-works improvements. | 1,00,000 | 50,000 | 1,00,000 | They are approaching completion. (Will be ready in December 1911.) |
| 15 | Kurnool Municipality | Ditto . | 36,000 | 18,000 | 36,000 | Yes. |
| 16 | Nellore Municipality | Drainage . . | 4,00,000 | 2,00,000 | 4,00,000 | They are approaching completion. |
| 17 | Ellore Municipality . | Ditto . . | 3,50,000 | 3,00,000 | 3,50,000 | They are approaching completion. |
| 18 | Dindigul Municipality | Water-works improvements. | 36,000 | 15,000 | 30,000 | They are under preparation. |
| | TOTAL . | .... | 75,55,944 | 38,34,557 | 74,09,244 | |

## LIST OF URBAN SANITATION SCHEMES WHICH REQUIRE GRANT-IN-AID FROM IMPERIAL FUNDS.

(I)

*Union Schemes.*

| Serial No. | Name of local body. | Name of the scheme. | Amount of estimate. | Amount of grant required from Government. | Whether detailed plan and estimates are ready. |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |
| | | | R | R | |
| 1 | Chingleput District Board | Water-supply to Saidapet . . | 1,90,250 | 1,50,000 | Yes, under scrutiny w the Sanitary Board. |
| 2 | Nellore District Board . | Water-supply to Gudur . . | 1,30,000 | 1,14,000 | No, they are approachi completion. |
| 3 | Ramnad District Board . | Water-supply to Rameśvaram . | 1,60,000 | 1,60,000 | No, they are approachi completion. |
| 4 | Chingleput District Board | Drainage of Tiruvallur . . | 71,500 | 66,500 | No. |
| 5 | Ditto ditto . | Drainage of Saidapet . . . | 1,35,000 | 1,35,000 | No. |
| 6 | Godavari District Board . | Improvements to the drainage of Peddapur. | 42,000 | 42,000 | No. |
| 7 | Coimbatore District Board | Opening out congested areas in and extending the town of Kollegal. | 38,122 | 38,122 | Yes. |
| 8 | Tanjore District Board . | Provision of a pumping installation for the supply of water to a portion of Tiruvallur. | 28,000 | 28,000 | Yes. |
| 9 | Kistna District Board . | Improving a tank at Gudivada . | 18,790 | 18,790 | Yes. |
| 10 | Bellary District Board . | Opening out congested areas in the Kampli union. | 14,500 | 9,500 | Yes. |
| 11 | Kistna District Board . | Improving a drinking water tank at Gudivada. | 11,830 | 11,830 | Yes. |
| 12 | Salem District Board . | Extension of Dharmapuri union . | 11,500 | 11,500 | Yes. |
| 13 | South Arcot District Board | Improving a drinking water tank and its supply-channel in the Tindivaram union. | 11,000 | 11,000 | No. |
| 14 | Ramnad District Board . | Construction of an intercepting drain in the Sivakasi union. . | 6,200 | 6,200 | Yes. |
| 15 | Bellary District Board . | Opening out congested areas in the Kamalapur union. | 5,500 | 5,500 | Yes. |
| 16 | South Arcot District Board | Construction of a reservoir at Panruti with a pumping installation for the supply of water to it from the Gadilam river. | Not known | 5,000 | No. |
| | TOTAL . | .... | .. | 8,12,942 | |

(II)

*District Municipalities—Water-supply and Drainage.*

| Serial No. | Name of local body. | Nature of the scheme. | Amount of estimate. | Amount of minimum grant required from Government. | Amount of maximum grant required from Government. | Whether detailed plans and estimates are ready. |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| | | | R | R | R | |
| 1 | Tinnevelly, Palamcottah and Tuticorin Municipalities. | Joint water-supply . | 17,08,000 | 8,54,000 | 17,08,000 | They are approaching completion. |
| 2 | Ellore Municipality . | Water-supply . | 3,16,570 | 89,870 | 1,69,870 | Yes, under scrutiny in Public Works Department. |
| 3 | Masulipatam Municipality. | Ditto . . | 4,50,800 | 2,25,400 | 4,50,800 | Yes, under scrutiny by the Chief Engineer, Public Works Department. |
| 4 | Vizagapatam Municipality. | Water-supply to Waltair. | 76,500 | 38,250 | 76,500 | Yes, under scrutiny in Public Works Department. |
| 5 | Chingleput Municipality. | Water-supply . | 1,35,000 | 67,500 | 1,35,000 | They are approaching completion. |
| 6 | Madura Municipality | Water-works improvements. | 3,00,000 | 1,50,000 | 3,00,000 | They are approaching completion. (Will be ready in December 1911.) |
| 7 | Ditto . | Drainage . . | 20,72,274 | 10,36,137 | 20,72,274 | Yes, under consideration by the Sanitary Board. |
| 8 | Trichinopoly Municipality. | Ditto . . | 6,50,000 | 3,25,000 | 6,50,000 | They are approaching completion. (Will be ready in December 1911.) |
| 9 | Negapatam Municipality. | Ditto . . | 2,30,000 | 1,15,000 | 2,30,000 | They are approaching completion. (Will be ready in December 1911.) |
| 10 | Vellore Municipality | Ditto . . | 3,70,800 | 1,85,400 | 3,70,800 | Yes, under scrutiny by the Chief Engineer, Public Works Department. |
| 11 | Conjeveram Municipality. | Water-works improvements. | 1,50,000 | 75,000 | 1,50,000 | They are approaching completion. (Will be ready in December 1911.) |
| 12 | Tirupati Municipality | Ditto . . | 1,50,000 | 75,000 | 1,50,000 | They are approaching completion. (Will be ready in December 1911.) |
| 13 | Adoni Municipality | Water-works improvements (additional catchment areas). | 30,000 | 15,000 | 30,000 | They are approaching completion. (Will be ready in December 1911.) |
| 14 | Coonoor Municipality | Water-works improvements. | 1,00,000 | 50,000 | 1,00,000 | They are approaching completion. (Will be ready in December 1911.) |
| 15 | Kurnool Municipality | . Ditto . | 36,000 | 18,000 | 36,000 | Yes. |
| 16 | Nellore Municipality | Drainage . . | 4,00,000 | 2,00,000 | 4,00,000 | They are approaching completion. |
| 17 | Ellore Municipality . | Ditto . . | 3,50,000 | 3,00,000 | 3,50,000 | They are approaching completion. |
| 18 | Dindigul Municipality | Water-works improvements. | 36,000 | 15,000 | 30,000 | They are under preparation. |
| | TOTAL . | . .... | 75,55,944 | 38,34,557 | 74,09,244 | |

(III)

*District Municipalities—Other Sanitary Schemes.*

| Serial No. | Name of local body. | Nature of the scheme. | Amount of estimate. | Amount of grant required from Government. | Whether detailed plans and estimates are ready. |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |
| | | | R | R | |
| 1 | Adoni Municipality . | Acquisition of houses and lands for a new road through Underpet and Bharpet. | 12,393 | 12,393 | Yes. |
| | | Cost of laying the road . . | 2,708 | 2,708 | Yes. |
| | | Widening existing roads . . | 6,964 | 6,964 | Yes. |
| 2 | Chidambaram Municipality | Construction of model huts for toties. | 10,120 | 10,120 | Yes. |
| 3 | Cocanada Municipality . | Laying out the site acquired for the accommodation of evicted people. | 45,345 | 41,345 | Yes. |
| 4 | Coimbatore Municipality . | Opening up of the Thorayar quarters and accommodation for the evicted people. | 70,000 | 70,000 | Yes. |
| | | Removal of congestion in Othachakkara Street and accommodation for the evicted people. | 33,000 | 33,000 | Yes. |
| | | Construction of 75 huts for municipal scavengers. | 16,200 | 16,200 | Yes. |
| | | Construction of 8 latrines . . | 12,000 | 12,000 | Yes. |
| 5 | Coonoor Municipality . | Construction of a Dhobikhana . | 16,000 | 11,030 | Yes. |
| | | Acquisition of insanitary houses in the native quarters of the town. | 15,000 | 15,000 | Yes. |
| 6 | Ellore Municipality . . | Opening of congested areas in Gajavallivaripeta. | 64,494 | 64,494 | Yes. |
| | | Opening of congested areas in Gollygudem. | 44,325 | 44,325 | Yes. |
| | | Opening of congested areas in Gollagudem near Ganganama's temple. | 21,230 | 21,230 | Yes. |
| 7 | Madura Municipality . | Extension of house sites in the locality known as Madichiyam block. | 1,00,000 | 1,00,000 | Yes. |
| 8 | Mangalore Municipality . | Opening up of congested areas . | 35,046 | 35,046 | Yes. |
| 9 | Masulipatam Municipality . | Filling up insanitary pits . . | 13,206 | 13,206 | Yes. |
| 10 | Negapatam Municipality . | Construction of 25 standard latrines. | 10,400 | 10,400 | Yes. |
| | | Construction of totie lines . . | 10,000 | 10,000 | Yes. |
| 11 | Nellore Municipality . | Seventeen schemes for opening up congested areas. | 4,00,000 | 4,00,000 | Detailed estimates have been ordered to be prepared. |
| 12 | Ootacamund Municipality | Acquisition of insanitary and overcrowded buildings in Mainbazaar. | 27,000 | 27,000 | Yes. |
| 13 | Palamcottah Municipality . | Completion of the scheme of opening milkmen's quarters in the cantonment ward. | 12,290 | 12,290 | Yes. |
| | | Carried over . | 9,77,721 | 9,68,751 | |

*District Municipalities—Other Sanitary Schemes.*

| Serial No. | Name of local body. | Nature of the scheme. | Amount of estimate. | Amount of grant required from Government. | Whether detailed plans and estimates are ready. |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |
| | | | R | R | |
| | | Brought forward . | 9,77,721 | 9,68,751 | |
| 14 | Palghat Municipality . | Construction of 50 totie huts . | 10,800 | 10,800 | Yes. |
| 15 | Tanjore Municipality . | Opening up congested areas in the third and fourth wards. | 20,000 | 20,000 | Will be ready shortly. |
| | | Acquisition of land for town extension in Nanjikotai Road. | 10,000 | 10,000 | |
| 16 | Tiruppattur Municipality . | Construction of 50 sheds for toties | 10,500 | 10,500 | Yes |
| 17 | Tiruvannamalai Municipality. | Opening up of private scavenging lanes. | 19,730 | 19,730 | Yes. |
| 18 | Vizianagram Municipality. | Removal of congestion in Relli Street in Santapeta ward and provision of accommodation for the evicted people. | 50,000 | 50,000 | Yes. |
| | | Widening the Venemmagari Street | 24,000 | 24,000 | Yes. |
| 19 | Adoni Municipality . | Construction of side drains for the new road through Underpet and Bharatpet. | 14,015 | 14,015 | Yes, but awaiting a general drainage survey of the town. |
| | | Construction of side drains in Bazaar Street. | 6,609 | 6,609 | Yes, but awaiting a general drainage survey of the town. |
| | | Construction of side drains in Kumbardiddy Road. | 13,317 | 13,317 | Yes, but awaiting a general drainage survey of the town. |
| 20 | Cocanada Municipality . | Opening up of congested areas in Old Cocanada and Jagannaickpur. | 76,241 | 76,241 | Rough estimates ready: will be taken up after the completion of the scheme of laying out new sites—item 3 above. |
| 21 | Ellore Municipality . . | Opening up of congested areas in Medaragudem. | 28,861 | 28,861 | Yes; will be taken up after the schemes noted as item 6 above. |
| | | Opening up of congested areas in Chakalagudem. | 14,186 | 14,186 | Yes; will be taken up after the schemes noted as item 6 above. |
| 22 | Madura Municipality . | Opening up of congested areas in Uppukkara block. | 60,000 | 60,000 | No. |
| 23 | Palamcottah Municipality. | Opening up of congested areas in the Fort ward. | 10,000 | 10,000 | They are under preparation. |
| 24 | Tellicherry Municipality . | Removal of congestion in the Konkani quarters and provision of house sites for the evicted people. | 22,500 | 22,500 | Under preparation. |
| 25 | Trichinopoly Municipality. | Relief of congestion in the Fort ward. | 40,000 | 40,000 | No. |
| | | Tennore extension schemes . | 24,000 | 15,000 | Rough estimates ready. |
| | | TOTAL . | 14,32,480 | 14,14,510 | |

(IV)

*Madras Corporation.*

| Serial No. | Name of local body. | Nature of the scheme. | Amount of estimate. | Amount of grant required from Government. | Whether detailed plans and estimates are ready. |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 |
| | | | Lakhs. | Lakhs. | |
| | Madras Corporation . . | Water-supply and drainage works | 183·88 | 77·5 | Detailed plans and estimates have been sanctioned for 51·35 lakhs. Approximate estimates have been prepared for 132·53 lakhs. The works are under execution by a special engineer. |
| | | | R | R | |
| | | (i) Opening up and improvement of paracheries. | 1,05,000 | 1,05,000 | |
| | | (ii) Construction of model paracheries. | 90,000 | 90,000 | |
| | | (iii) Provision of house sites for poor working classes. | 1,12,000 | 1,12,000 | |
| | TOTAL . | .... | 3,07,000 | 3,07,000 | |

No. 6022, dated the 11th October 1911.

From—L. ROBERTSON, Esq., I.C.S., Secretary to the Government of Bombay, General Department,

To—The Secretary to the Government of India, Department of Education.

With reference to the Educational Department communications noted on the margin, I am directed to state, for the information of the Government of India, that the Governor in Council has nominated the following officers as delegates from this Presidency to attend the forthcoming Sanitary and Malaria Conferences in Bombay:—

Paragraph 4 of letter no. 1539, dated the 21st August 1911.
Paragraph 1 of letter no. 1703, dated the 16th September 1911.
Memorandum no. 1820, dated the 29th September 1911.

*To the Sanitary Conference.*

The Sanitary Commissioner for the Government of Bombay (Lieutenant-Colonel T. E. Dyson, M.B., C.M., D.P.H., I.M.S.).

The Sanitary Engineer to Government (Mr. C. N. Mandy, C.E.).

*To the Malaria Conference.*

The Surgeon-General with the Government of Bombay (The Honourable Surgeon-General R. W. S. Lyons, M.D., I.M.S.).

The Sanitary Commissioner for the Government of Bombay (Lieutenant-Colonel T. E. Dyson, M.B., C.M., D.P.H., I.M.S.)

The Director, Bombay Bacteriological Laboratory (Major W. Glen-Liston, M.D., I.M.S.).

Major F. H. G. Hutchinson, M.B., I.M.S.

2. With reference to paragraph 5 of the Government of India's letter dated the 16th September 1911, I am directed to forward herewith a list of sanitary works in this Presidency and the amounts likely to be spent on them during the next ten years.

*List of sanitary works contemplated in the Bombay Presidency showing the amounts that are likely to be spent on them during the next ten years.*

| Serial No. | Name of project. | District. | Rough estimate of costs of contemplated projects. | Amounts of grants-in-aid. | | | | | | | | | | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1911-12. | 1912-13. | 1913-14. | 1914-15. | 1915-16. | 1916-17. | 1917-18. | 1918-19. | 1919-20. | 1920-21. | |
| 1 | Malegaon water-supply | Nasik | 2,00,000 | 20,000 | 30,000 | 50,000 | .. | .. | .. | .. | .. | .. | .. | |
| 2 | Yeola water-supply | Do. | 3,50,000 | 30,000 | 50,000 | 70,000 | 25,000 | .. | .. | .. | .. | .. | .. | |
| 3 | Dhulia water-supply improvements. | West Khandesh | 1,00,000 | 25,000 | 25,000 | .. | .. | .. | .. | .. | .. | .. | .. | |
| 4 | Do. town drainage | Do. | 2,00,000 | 20,000 | 30,000 | 50,000 | .. | .. | .. | .. | .. | .. | .. | |
| 5 | Parola water-supply | East Khandesh | 1,50,000 | 10,000 | 20,000 | 20,000 | 25,000 | .. | .. | .. | .. | .. | .. | |
| 6 | Jalgaon drainage | Do. | 2,50,000 | 10,000 | 15,000 | 20,000 | 25,000 | 30,000 | 25,000 | .. | .. | .. | .. | |
| 7 | Dholka water-supply | Ahmedabad | 50,000 | 5,000 | 5,000 | 10,000 | 5,000 | .. | .. | .. | .. | .. | .. | |
| 8 | Surat sewerage | Surat | 20,00,000 | 50,000 | 1,00,000 | 1,00,000 | 1,00,000 | 1,00,000 | 2,00,000 | 2,50,000 | 1,00,000 | .. | .. | |
| 9 | Dakor water-supply | Kaira | 2,00,000 | 5,000 | 45,000 | 50,000 | .. | .. | .. | .. | .. | .. | .. | |
| 10 | Jalgaon do. | East Khandesh | 30,000 | 30,000 | .. | .. | .. | .. | .. | .. | .. | .. | .. | |
| 11 | Faizpur sanitary improvements | Do. | 30,000 | 30,000 | .. | .. | .. | .. | .. | .. | .. | .. | .. | |
| 12 | Karad water-supply | Satara | 2,00,000 | 25,000 | 50,000 | 25,000 | .. | .. | .. | .. | .. | .. | .. | |
| 13 | Barsi do. | Sholapur | 4,75,000 | 25,000 | 50,000 | 50,000 | 62,500 | 50,000 | .. | .. | .. | .. | .. | |
| 14 | Sholapur do. | Do. | 3,25,000 | 45,000 | .. | .. | .. | .. | .. | .. | .. | .. | .. | |
| 15 | Alibag do. | Kolaba | 26,500 | 13,250 | .. | .. | .. | .. | .. | .. | .. | .. | .. | |
| 16 | Lonavla do. | Poona | 4,00,000 | 25,000 | 50,000 | 1,00,000 | 25,000 | .. | .. | .. | .. | .. | .. | |
| 17 | Poona drainage and water-supply | Do. | 17,50,000<br>5,50,000 | 2,75,000 | 3,00,000 | 1,75,000 | .. | .. | .. | .. | .. | .. | .. | |
| 18 | Pandharpur water-supply | Sholapur | .. | 2,475 | .. | .. | .. | .. | .. | .. | .. | .. | .. | |
| 19 | Nasik do. | Nasik | .. | 96,852 | .. | .. | .. | .. | .. | .. | .. | .. | .. | |
| 20 | Nandurbar do. | West Khandesh | 2,00,000 | .. | 20,000 | 30,000 | 50,000 | .. | .. | .. | .. | .. | .. | |
| 21 | Bhusawal do. | East Khandesh | 2,00,000 | .. | 10,000 | 20,000 | 20,000 | 20,000 | 30,000 | .. | .. | .. | .. | |

| Serial No. | Name of project. | District. | Rough estimate of costs of contemplated projects. | Amounts of grants-in-aid. | | | | | | | | | | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1911-12. | 1912-13. | 1913-14. | 1914-15. | 1915-16. | 1916-17. | 1917-18. | 1918-19. | 1919-20. | 1920-21. | |
| 22 | Rander town drainage . . . | Surat . . | 2,00,000 | .. | 25,000 | 25,000 | 25,000 | 25,000 | .. | .. | .. | .. | .. | |
| 23 | Broach water-supply . . . | Broach . . | 15,00,000 | .. | 25,000 | 50,000 | 1,00,000 | 1,00,000 | 1,00,000 | 3,00,000 | 75,000 | .. | .. | |
| 24 | Godhra do. . . . . | Panch Mahals . | 2,00,000 | .. | 10,000 | 20,000 | 20,000 | 50,000 | .. | .. | .. | .. | .. | |
| 25 | Dohad do. . . . . | Do. . | 1,00,000 | .. | 20,000 | 20,000 | 10,000 | .. | .. | .. | .. | .. | .. | |
| 26 | Uran do. . . . . | Kolaba . . | 4,00,000 | .. | 50,000 | 50,000 | 50,000 | 50,000 | .. | .. | .. | .. | .. | |
| 27 | Ahmednagar do. . . . . | Ahmednagar . | 6,00,000 | .. | 50,000 | 1,00,000 | 1,25,000 | 25,000 | .. | .. | .. | .. | .. | |
| 28 | Nadiad do. . . . . | Kaira . . | 3,00,000 | .. | .. | 20,000 | 30,000 | 30,000 | 30,000 | 40,000 | .. | .. | .. | |
| 29 | Matheran do. . . . . | Thana . . | 1,50,000 | .. | .. | 25,000 | 25,000 | 25,000 | .. | .. | .. | .. | .. | |
| 30 | Sukkur do. . . . . | Sukkur . . | 1,50,000 | .. | .. | 37,500 | 37,500 | .. | .. | .. | .. | .. | .. | |
| 31 | Malegaon town drainage. . . | Nasik . . | 2,00,000 | .. | .. | .. | 20,000 | 30,000 | 50,000 | .. | .. | .. | .. | |
| 32 | Yeola do. . . . | Do. . . | 2,50,000 | .. | .. | .. | 25,000 | 50,000 | 50,000 | .. | .. | .. | .. | |
| 33 | Nandurbar do. . . . | West Khandesh | 2,00,000 | .. | .. | .. | 25,000 | 25,000 | 50,000 | .. | .. | .. | .. | |
| 34 | Dakor do. . . . | Kaira . . | 1,50,000 | .. | .. | .. | 25,000 | 25,000 | 25,000 | .. | .. | .. | .. | |
| 35 | Godhra do. . . . | Panch Mahals . | 1,50,000 | .. | .. | .. | 25,000 | 25,000 | 25,000 | .. | .. | .. | .. | |
| 36 | Islampur water-supply . . . | Satara . . | 2,50,000 | .. | .. | .. | 25,500 | 50,000 | 50,000 | .. | .. | .. | .. | |
| 37 | Belgaum do. . . . | Belgaum . | 13,00,000 | .. | .. | .. | 50,000 | 1,00,000 | 2,00,000 | 2,00,000 | 1,00,000 | .. | .. | |
| 38 | Nipani do. . . . | Do. . . | 1,00,000 | .. | .. | .. | 25,000 | 25,000 | .. | .. | .. | .. | .. | |
| 39 | Parola town drainage . . . | East Khandesh | 50,000 | .. | .. | .. | .. | 10,000 | 15,000 | .. | .. | .. | .. | |
| 40 | Viramgaon water-supply . . | Ahmedabad . | 2,00,000 | .. | .. | .. | .. | 20,000 | 30,000 | 30,000 | 20,000 | .. | .. | |
| 41 | Broach town drainage . . . | Broach . . | 10,00,000 | .. | .. | .. | .. | 1,00,000 | 1,00,000 | 1,00,000 | 2,00,000 | .. | .. | |
| 42 | Dohad drainage . . . . | Panch Mahals . | 50,000 | .. | .. | .. | .. | 10,000 | 10,000 | 5,000 | .. | .. | .. | |
| 43 | Nasik do. . . . . | Nasik . . | 2,50,000 | .. | .. | .. | .. | 62,500 | 62,500 | .. | .. | .. | .. | |
| 44 | Amalner do. . . . . | East Khandesh | 50,000 | .. | .. | .. | .. | .. | 10,000 | 10,000 | 5,000 | .. | .. | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 46 | Nadiad town drainage . . . | Kaira . . | 2,00,000 | .. | .. | .. | .. | .. | | | | | |
| 47 | Thana water-supply . . . | Thana . . | 2,50,000 | .. | .. | .. | .. | .. | 50,000 | 50,000 | 25,000 | .. | .. |
| 48 | Dholka town drainage . . . | Ahmedabad . | 30,000 | .. | .. | .. | .. | .. | .. | 5,000 | 10,000 | .. | .. |
| 49 | Gogha water-supply . . . | Do. . | 10,000 | .. | .. | .. | .. | .. | .. | 5,000 | .. | .. | .. |
| 50 | Do. town drainage . . . | Do. . | 6,000 | .. | .. | .. | .. | .. | .. | 3,000 | .. | .. | .. |
| 51 | Barsi drainage . . . . | Sholapar . | 1,25,000 | .. | .. | .. | .. | .. | .. | 12,500 | 50,000 | .. | .. |
| 52 | Thana do. . . . . | Thana . . | 1,00,000 | .. | .. | .. | .. | .. | .. | 50,000 | .. | .. | .. |
| 53 | Kelwa-Mahim water-supply . . | Do. . . | 1,50,000 | .. | .. | .. | .. | .. | .. | 37,500 | 37,000 | .. | .. |
| 54 | Amalner do. . . | East Khandesh | 40,000 | .. | .. | .. | .. | .. | .. | .. | 10,000 | 10,000 | .. |
| 55 | Viramgaon town drainage . . | Ahmedabad . | 1,00,000 | .. | .. | .. | .. | .. | .. | .. | 20,000 | 30,000 | .. |
| 56 | Bulsar water-supply . . . | Surat . . | 3,50,000 | .. | .. | .. | .. | .. | .. | .. | 50,000 | 50,000 | 75,000 |
| 57 | Do. town drainage . . . | Do. . . | 1,50,000 | .. | .. | .. | .. | .. | .. | .. | 25,000 | 25,000 | 25,000 |
| 58 | Sholapur drainage . . . | Sholapur . | 10,00,000 | .. | .. | .. | .. | .. | .. | .. | 1,00,000 | 2,00,000 | 2,00,000 |
| 59 | Yellamma water-supply . . | Belgaum . . | 3,00,000 | .. | .. | .. | .. | .. | .. | .. | 50,000 | 50,000 | 50,000 |
| 60 | Belgaum drainage . . . | Do. . . | 8,00,000 | .. | .. | .. | .. | .. | .. | .. | 1,00,000 | 1,00,000 | 2,00,000 |
| 61 | Dhanduka town drainage . . | Ahmedabad . | 1,00,000 | .. | .. | .. | .. | .. | .. | .. | .. | 25,000 | 25,000 |
| 62 | Ankleshwar water-supply . . | Broach . . | 1,00,000 | .. | .. | .. | .. | .. | .. | .. | .. | 25,000 | 25,000 |
| 63 | Do. drainage . . . | Do. . . | 50,000 | .. | .. | .. | .. | .. | .. | .. | .. | 10,000 | 15,000 |
| 64 | Gokak water-supply . . . | Belgaum . . | 50,000 | .. | .. | .. | .. | .. | .. | .. | .. | 12,500 | 12,500 |
| 65 | Panvel drainage . . . . | Kolaba . . | 1,00,000 | .. | .. | .. | .. | .. | .. | .. | .. | 25,000 | 25,000 |
| 66 | Bandra sewerage . . . . | Thana . . | 4,75,000 | .. | .. | .. | .. | .. | .. | .. | .. | 1,37,500 | 1,00,000 |
| 67 | Borsad water-supply . . . | Kaira . . | 50,000 | .. | .. | .. | .. | .. | .. | .. | .. | .. | 25,000 |
| 68 | Do. town drainage . . . | Do. . . | 30,000 | .. | .. | .. | .. | .. | .. | .. | .. | .. | 15,000 |
| 69 | Sarsa water-supply . . . | Do. . . | 10,000 | .. | .. | .. | .. | .. | .. | .. | .. | .. | 5,000 |
| 70 | Do. town drainage . . . | Do. . . | 6,000 | .. | .. | .. | .. | .. | .. | .. | .. | .. | 3,000 |
| | | TOTAL . | 2,02,68,500 | 7,42,577 | 9,80,000 | 11,17,500 | 9,80,000 | 10,37,500 | 11,57,500 | 11,53,000 | 10,57,500 | 7,20,000 | 8,00,500 |

C. N. MANDY, C.E.,

*Acting Secretary, Sanitary Board, Bombay Presidency.*

No. 6096, dated the 14th October 1911.

From—L. ROBERTSON, Esq., I.C.S., Secretary to the Government of Bombay, General Department,

To—The Secretary to the Government of India, Department of Education.

In continuation of my letter no. 6022, dated the 11th instant, I am directed to forward herewith a supplementary list of schemes for town improvement and surface drainage in urban areas and the amounts that are likely to be spent on them in 1911-12 and subsequent years.

*List of schemes for town improvement, surface drainage in urban areas, etc., showing the amounts that are likely to be spent on them in 1911-12 and subsequent years.*

| Serial No. | Name of project. | District. | Rough estimate of costs of contemplated projects. | Amounts of grants-in-aid. | | Remarks. |
|---|---|---|---|---|---|---|
| | | | | (Sanctioned) 1911-12. | (Proposed) 1912-13 and subsequent years. | |
| | | | R | R | R | |
| 1 | Filling up an insanitary tank in Broach | Broach | 26,775 | 25,000 | .... | |
| 2 | Opening out congested areas in Ahmedabad City | Ahmedabad | 1,00,000 | 50,000 | .... | |
| 3 | Street improvement and surface drainage in the town of Bhingar | Ahmednagar | 20,900 | 20,900 | .... | |
| 4 | Street improvements in Nasik City | Nasik | 1,00,000 | 25,000 | .... | |
| 5 | Opening out the congested area near the Vithoba Temple at Pandharpur. | Sholapur | 36,000* | 27,000 | .... | *Of this R9,000 will be paid by the municipality. |
| 6 | Building a wall round Upliburuz Idga in Bijapur town to prevent people committing a nuisance there and thereby improving the present insanitary conditions. | Bijapur | 500 | 500 | .... | |
| 7 | Improvements to gutters in wards I, III, IV and VI in Bijapur town. | Do. | 5,000 | 5,000 | .... | |
| 8 | Improving drains behind the post office and Kal Peth in the town of Bagalkot. | Do. | 1,200 | 1,200 | .... | |
| 9 | Drainage channel to carry off storm water which at present floods the whole town of Guledgud. | Do. | 4,000 | 4,000 | .... | |
| 10 | Drainage of the Mussalman quarter of the town of Ranebennur | Dharwar | 6,800 | 6,800 | .... | |
| 11 | Drainage of the Koney nullah in Karwar town | Kanara | 11,000 | 11,000 | .... | |
| 12 | Filling in the Kafila serai tank in Larkana | Larkana | 10,000 | 10,000 | .... | |
| 13 | Opening out congested areas in Surat City | Surat | 1,50,000 | .. | 50,000 | |
| 14 | Opening out congested areas and surface drainage in Poona City | Poona | Not ascertained. | .. | 50,000 | |
| 15 | Opening out congested areas by the removal of Chambhar Wada near the Kumbhar Gate in Sholapur City. | Sholapur | 25,000 | .. | 25,000 | |
| 16 | Opening out congested areas and construction of surface drainage in Belgaum. | Belgaum | Not ascertained. | .. | 62,500 | |
| 17 | Construction of rat-proof godowns in Belgaum with the view of checking the dissemination of plague. | Do. | Do. | .. | Not ascertained. | |
| 18 | Widening of streets and improvement of surface drainage in Athni. | Do. | Do. | .. | 25,000 | |
| 19 | Widening of the street from Chandabavadi to municipal naka in Khodanpur Peth in Bijapur. | Bijapur | Do. | .. | 5,000 | |
| 20 | Opening up congested areas and surface drainage in Dharwar | Dharwar | Do. | .. | 30,000† | †Proposed to be held in reserve for allotment if a suitable scheme can be prepared. |
| 21 | Continuance of the work of driving streets through congested areas in Hubli. | Do. | Do. | .. | 50,000 | |
| 22 | Opening out insanitary areas in Pen | Kolaba | Do. | .. | Not ascertained. | |
| 23 | Sanitary improvements in Sind | Sind | .... | .. | 50,000‡ | ‡Set aside for distribution when approved schemes have been prepared. |
| 24 | Opening out congested areas in Ahmedabad | Ahmedabad | 20,00,000 | .. | .... | Certain questions regarding financial arrangements have been referred to the Government of India. |

No. 963-T. M., dated the 5th October 1911.

From—H. WHEELER, Esq., C.I.E., I.C.S., Secretary to the Government of Bengal, Municipal Department,

To—The Secretary to the Government of India, Education Department (Sanitary).

I am directed to acknowledge receipt of your letter no. 1538-1545, dated the 21st August 1911, in paragraph 5 of which it is requested that a definite programme should be submitted of schemes of urban sanitation extending over a series of years, indicating the degree of urgency of each and the amount of financial assistance required to carry them out within a reasonable period.

2. In my letter no. 173-M., dated the 26th January 1911, the procedure was outlined according to which projects of water-supply and drainage are ordinarily initiated. The original impetus may come from the efforts of the District officer, an inspection by an officer of the Sanitary Department, the generosity of some local resident, or similar cause and wish having been expressed that such a work should be undertaken, the assistance of the Sanitary Engineer is given in the preparation of a rough project. The question of finance then arises, and not infrequently presents various difficulties. The co-operation of the local authority has to be secured, and its willingness to take a loan or to raise additional revenue ascertained; private liberality has to be approached, and finally the amount of the grant to be given by Government is fixed in consideration of these different factors. These matters having been settled, the detailed plans and estimates are drawn up, the necessary funds are placed at the disposal of the local body and work is commenced.

3. Such being the actual practical working of all efforts towards the execution of sanitary improvements, it is not possible to frame a programme such as is apparently contemplated by the Government of India. Lists specifying the proposals for schemes of (*a*) water-supply and (*b*) drainage, which, for the moment are under discussion, are herewith submitted, and it will be seen that the total estimated cost under the first head amounts to ₹59,89,000 and under the second to ₹78,54,000. It is impossible to specify the exact order in which these works will be taken up, according as each can be pushed through, assistance will be given to it by Government in proportion to the sums realised from other sources and the Budget provision available, but anything in the nature of a programme is impracticable. All the improvements specified are desirable, and the sooner they can be carried through the better, but the rate of progress made with each will depend largely upon the local enthusiasm and energy evinced, over which Government can exercise little control. Apart from the fact that the schemes referred to are of sufficient magnitude to occupy the time of the sanitary staff which is at the disposal of the local Government, it will be obvious that it is still more impossible to frame a programme of the improvements necessary in other parts of the Province, from which no desire has as yet been expressed for the formulation of a scheme. Such requests will doubtless arise in time, and will then be dealt with, but a paper programme proposing to deal with different municipalities in a specified order would be of no real value; on the contrary, it would tend to throw a greater part of the expense on Government direct, while less was obtained from local bodies and from private sources. No attempt, therefore, has been made to prepare such a programme. There is room for the improvement of sanitation everywhere, but the different degrees of urgency of individual projects is not so much a point in issue as the provision of funds, and that depends mainly on local effort. According as each scheme matures, the local Government is prepared to help it to the utmost according to the state of its financial resources at the time, but it is not possible to say beforehand when each demand will occur and the amount of the expenditure which it will involve.

## STATEMENT A.

*Water-supply schemes which are at present under discussion.*

| No. | Locality. | Description of scheme. | Estimated total cost. |
|---|---|---|---|
| | | | R |
| 1 | Jherria coalfields . . . . . | Water-supply . . . . . (1) Pumping. (2) Gravitation scheme. | 25,00,000 |
| 2 | Khulna Municipality . . . . | Extension of existing water-supply . . | 19,000 |
| 3 | Kalna ,, . . . . . | Pumping water from the river and filtering | 86,000 |
| 4 | Bankura ,, . . . . . | Pumping water from wells . . . | 32,000 |
| 5 | Patna ,, . . . . . | Combined flushing and filtered water-supply | 12,00,000 |
| 6 | Howrah ,, . . . . . | Extension of existing water works . . | 15,00,000 |
| 7 | South Subarban Municipality . . . | Extension of pipe lines . . . . | 12,000 |
| 8 | Asansole Municipality . . . . | Water-supply (sketch project) . . . | 1,86,000 |
| 9 | Mazaffarpur Municipality . . . | Water-supply . . . . . | 4,54,000 |
| | | TOTAL . | 59,89,000 |

## STATEMENT B.

*Surface drainage schemes which are at present under discussion.*

| No. | Locality. | Description of scheme. | Estimated total cost. |
|---|---|---|---|
| | | | R |
| 1 | Katwa Municipality . . . . | Surface drainage . . . . . | 77,433 |
| 2 | Jessore ,, . . . . . | Ditto . . . . . | 4,10,368 |
| 3 | Kalna ,, . . . . . | Ditto . . . . . | 2,60,137 |
| 4 | Bettiah ,, . . . . . | Ditto . . . . . | 2,43,058 |
| 5 | Hooghly-Chinsurah Municipality . . | Ditto . . . . . | 8,79,368 |
| 6 | Suri Municipality. . . . . | Ditto . . . . . | 1,45,000 |
| 7 | Midnapur ,, . . . . . | Ditto . . . . . | 3,78,484 |
| 8 | Azimgunge ,, . . . . . | Ditto . . . . . | 1,46,052 |
| 9 | Ranaghat ,, . . . . . | Ditto . . . . . | 45,751 |
| 10 | Gaya ,, . . . . . | Surface drainage and partial sewerage . | 6,80,000 |
| 11 | Maniktolla ,, . . . . . | Ditto ditto . . | 19,80,000 |
| 12 | Sahebgunge ,, . . . . . | Surface drainage . . . . . | 51,297 |
| 13 | Kushtea ,, . . . . . | Ditto . . . . . | 23,688 |
| 14 | Ranchi ,, . . . . . | Ditto . . . . . | 2,06,454 |
| 15 | Cossipore-Chitpur Municipality . . | Ditto . . . . . | 12,40,515 |
| 16 | Purulia Municipality . . . . | Ditto . . . . . | 2,25,000 |
| 17 | North Barrackpur Municipality . . | Ditto . . . . . | 1,68,016 |
| 18 | Bhadreswar Municipality . . . | Ditto . . . . . | 79,000 |
| 19 | Motihari ,, . . . . . | Ditto . . . . . | 84,000 |
| 20 | Serampur ,, . . . . . | Ditto . . . . . | 5,30,600 |
| | | TOTAL . | 78,54,221 |

## Revised Statements furnished by the Sanitary Engineer, Bengal.

### STATEMENT A.

*Water-supply schemes which are at present under discussion in Bengal.*

| No. | Locality. | Description of Schemes. | Estimated total cost. |
|---|---|---|---|
| | | | R |
| 1 | Monghyr . . . | Unfiltered water pumping station . . . . . | 1,05,000 |
| 2 | Purl . . . | Water-supply from filtration gallery in sand hills . . | 3,00,000 |
| 3 | Jherria Coalfields . | Water-supply, Uplands Gravitation scheme . . . | 37,50,000 |
| 4 | Howrah . . . | Water-supply improvement scheme . . . . . | 15,00,000 |
| 5 | Patna . . . | Water-supply approximate estimate . . . . . | 20,00,000 |
| 6 | Asansole . . . | Water-supply from well in river bed (sketch project) . | 1,85,000 |
| 7 | Ranchi . . . | Water-supply approximate estimate . . . . . | 4,00,000 |
| 8 | Muzaffarpur . . | Filtered water-supply from river . . . . . | 4,54,000 |
| 9 | Bankura . . . | Water supply from wells in river bed . . . . . | 42,500 |
| 10 | Kalna . . . | Filtered water-supply from river . . . . . | 89,000 |
| 11 | Uttarpara . . . | Water-supply from Howrah water-works . . . | 1,00,000 |
| 12 | Burdwan . . . | Water-supply improvement scheme . . . . . | 2,00,000 |
| 13 | Balasore . . . | Water-supply for wells (rough project) . . . . | 1,20,000 |
| 14 | Midnapur . . . | Water-supply (rough project) . . . . . | 2,50,000 |
| 15 | Baranagore . . . | Water-supply from Calcutta waterworks . . . | 4,76,000 |
| 16 | Murshidabad . . | Filtered water-supply from river . . . . . | 1,06,000 |
| | | | 1,00,77,500 |

## STATEMENT B.

*Surface drainage and sewerage schemes which are at present under discussion in Bengal.*

| No. | Locality. | Description of scheme. | Estimated total cost. |
|---|---|---|---|
| | | | R |
| 1 | Gaya Municipality | Surface drainage and partial sewerage | 7,00,000 |
| 2 | Ranaghat „ | Surface drainage | 46,000 |
| 3 | North Barrackpur Municipality | Ditto | 1,68,000 |
| 4 | Purulia Municipality | Ditto | 1,46,000 |
| 5 | Kushtea „ | Ditto | 25,000 |
| 6 | Bhadreshwar „ | Ditto | 85,000 |
| 7 | Bettiah „ | Ditto | 1,50,000 |
| 8 | Cossipore-Chitpur Municipality | Ditto and sewerage (approximate estimate) | 20,00,000 |
| 9 | Sahebgunge Municipality | Ditto | 51,000 |
| 10 | Chapra „ | Ditto | 1,86,000 |
| 11 | Katwa „ | Ditto | 54,000 |
| 12 | Kalna „ | Ditto | 40,000 |
| 13 | Kissengunge „ | Ditto | 31,000 |
| 14 | Jessore „ | Ditto | 2,50,000 |
| 15 | Hooghly Chinsura Municipality | Ditto | 8,80,000 |
| 16 | Bankura Municipality | Ditto | 7,500 |
| 17 | Suri „ | Ditto | 39,000 |
| 18 | Howrah „ | Sewerage—approximate estimate | 25,00,000 |
| 19 | Asansole „ | Surface drainage | 58,000 |
| 20 | Muzaffarpur „ | Sewerage | 3,10,000 |
| 21 | Berhampur „ | Surface drainage | 2,00,000 |
| 22 | Bhagalpur „ | Ditto | 7,00,000 |
| 23 | Serampur „ | Ditto | 1,58,000 |
| 24 | Motihari „ | Ditto | 50,000 |
| 25 | Maniktolla „ | Surface drainage and partial sewerage | 19,80,000 |
| 26 | Ranchi „ | Surface drainage | 2,06,000 |
| 27 | Midnapur „ | Ditto | 1,50,000 |
| 28 | Azimgunge „ | Ditto | 1,46,000 |
| 29 | Murshidabad „ | Ditto | 3,00,000 |
| 30 | Utterpara „ | Ditto | 58,000 |
| 31 | Behar „ | Ditto | 88,000 |
| | | | 1,17,62,500 |

No. 1-L.K.O., dated the 28th October 1911.

From—The Hon'ble Mr. L. STUART, I.C.S., Secretary to the Government of the United Provinces, Sanitation Department,

To—The Secretary to the Government of India, Home Department.

With reference to the correspondence ending with the letter of the Government of India, no. 1541, dated the 24th August 1911, I am directed to forward the following schemes for improvement of urban sanitation in the United Provinces with a view to their being discussed at the forthcoming conference at Bombay.

2. These schemes are contained in the annexures to this letter.—

(1) Works to be undertaken.

(2) Projects to be prepared.

(3) Notes on the financial position of places mentioned in the programme.

Every endeavour has been made to bring these schemes up to date. But as the time for preparation has not been long, it is possible that there may be a few unimportant omissions in the figures of grants made towards the various projects.

3. All the schemes in question have been carefully considered by the Sanitary Board of this province, and the 26 schemes in the first list may be ranked as of real urgency and of public utility. Schemes nos. 1—8 and 12 and 13 in the second list are of urgency and of public utility. Nos. 9, 10 and 11 have not yet been thoroughly examined. In the case of all schemes that have been examined the only question remaining is that of the provision of funds. There can be no doubt as to the necessity of the improvements. There is considerable reluctance on the part of municipal boards to enter on such big schemes, as, in the majority of instances, the boards can see no prospect of providing funds. It appears that the best method of overcoming this reluctance is to give grants to start the work on condition that the board completes the work or a specified portion of it. In cases of drainage the best policy is often to make a grant for a main drainage and outfall system leaving over till later the final completion of subsidiary drains and the paving of lanes.

4. If the Government of India can supplement the generous assistance, which this province has already received from them for schemes of urban improvement, I am to suggest that the following grants will be of the greatest possible value:—

| | R |
|---|---|
| (1) A grant to the Fyzabad Municipality (list 1, no. 3) of | 1,00,000 |
| (2) A grant to the Saharanpur Municipality (list 1, no. 4) | 50,000 |
| (3) A grant to the Shahjahanpur Municipality (list 1, no. 5) | 1,00,000 |
| (4) A grant to the Etawah Municipality (list 1, no. 9) | 50,000 |
| (5) A grant to the Mainpuri Municipality (list 1, no. 10) | 1,00,000 |
| (6) A grant to the Dhampur Municipality (list 1, no. 11) | 70,000 |
| (7) A grant to the Meerut Municipality (list 1, no. 12) | 1,50,000 |
| (8) A grant to the Jhansi Municipality (list 1, no. 13) | 1,00,000 |
| (9) A grant to the Aligarh Municipality (list 1, no. 15) | 1,00,000 |
| (10) A grant to the Fatehpur Municipality (list 1, no. 16) | 50,000 |
| (11) A grant to the Cawnpore Municipality (list 1, no. 25) | 1,00,000 |

The case of the Agra Municipality may also be mentioned. No project from Agra appears on the programme. There is great need of sanitary improvement in the town but the finances of the municipality are in such a bad condition that the municipal authorities have not considered it worth while to put up proposals. The question of improvement of water-supply and drainage in Agra is now pressing, and a grant of 1 lakh of rupees for the first and 5 lakhs of rupees for the second object to this municipality would be of enormous value.

5. It will be seen that in many cases the municipalities suggest the enhancement of octroi duty as the only method of providing the requisite funds. As proposals have been made to abolish the levy of octroi, it is clear that this source of income may be left out of account. It is difficult to suggest any other method of enhancing municipal resources. The grants suggested form a modest portion of the amount which can be usefully expended at once, without incurring the danger of pauperising municipal boards. If more money be available, grants for the greater part of the funds required for the sanctioned schemes may be given with great advantage. Further grants to Lucknow, Cawnpore, Allahabad, Benares and Gorakhpur for the cost of town improvement schemes would also produce incalculable benefit. It has not been possible to work out such town improvement schemes in detail. It is, however, suggested that anything which the Government of India may choose to give for such purposes can be expended usefully.

## Programme of Sanitary Works, United Provinces, arranged in order of urgency.

### *I.—Works to be undertaken.*

PROGRAMME OF SANITARY WORKS, UNITED

*I.—Works to*

| Names of places. | Description of work and its estimate. | Remarks by Government. | REPLIES RECEIVED FROM THE MUNICIPALITY ON THE THREE POINTS RAISED BELOW. | | |
|---|---|---|---|---|---|
| | | | Funds available for the work. | Income with reference to the actuals of the preceding three years. | Method by which it is proposed to raise any additional income and method of repayment of loan, if taken. |
| 1. Khurja . | Drainage works, costing R1,37,840. | Part of the cost would be met from the cash balance which at the close of the year 1908-09 amounted to R42,364 and a loan of a lakh would probably be necessary, the Board should be able to afford this. | R 44,000 | R 54,973 | By taking a loan of 1 lakh of rupees which will be repaid without levying fresh tax. |
| 2. Hapur . . | Drainage works estimate, R2,08,893. | In 1908 the Board had a surplus income of R16,000 without allowing any sum for original works, but subsequently a decline in the octroi income disturbed the financial position. The Board should be able to finance the scheme, but enquiry will be necessary before the project is placed on the programme. | 41,000 | 1907—56,010<br>1908—45,189<br>1909—44,057 | By taking a loan to be repaid by 40 half yearly instalments of equal amount. |
| 3. Fyzabad . | Drainage works estimate, R3,79,533 —1,71,481. | Nothing can be done towards the execution of the scheme till either taxation is raised or the Government is in a position to give assistance. | No funds. Nothing can be said towards the execution of the scheme till either taxation is raised or Government gives assistance. | 1,12,574 | Enhancement of octroi duty. |
| 4. Saharanpur . | Drainage works estimate, R3,69,808. | The Board can finance the complete scheme. | 1,61,000 | 1,47,545 | Application made to Secretary, Sanitary Board, for a grant of R2,00,000. Will not take a loan but raise the octroi duty. |
| 5. Shahjahanpur | Drainage works estimate, R6,57,416. | Here also the octroi figures vary a great deal from year to year so that it will be necessary to ask the Board to work out a normal budget and to state clearly its financial position. | 6,000 | 1,39,000 | .. |
| 6. Rikhikesh . | Drainage works estimate, R1,01,571. | .. | .. | .. | .. |
| 7. Almora. . | Drainage works estimate, R27,948. | The Municipal Board has decided to defer taking up the project till it has revised its system of taxation. | .. | 21,500 | By taking loan and raising the income by additional taxation. |
| 8. Kanauj. . | Drainage works estimate, R29,885. | The committee of the notified area could probably afford to undertake the scheme. But to defray the loan charges it will be necessary to slightly raise the incidence of taxation and the committee should be asked for its views. | 5,000 a year . | 8,070 | No loan will be taken. Income has been increased by raising taxation. |

PROVINCES, ARRANGED IN ORDER OF URGENCY.

*be undertaken.*

| Remarks by Sanitary Engineer. | Remarks by Sanitary Board. |
|---|---|
| This project was prepared by Mr. Standley and sent in and sanctioned just after I took charge. I believe the municipality are thinking of starting on a portion of the work. | Classed as ready and urgent. |
| The Collector of Meerut (Mr. L. Porter) pressed urgently for this project and it got out in record time in March 1909 and was finally sanctioned by Sanitary Board and Government. They intended to finance 1 lakh's worth of it but nothing has been done. | Ditto. |
| The Board in letter no. 307, dated the 7th October 1910, said that they had applied for a 1 lakh loan in 1909. R12,000 for land and R7,735 for new station road has been made in the budget and the work is in progress. R19,735 should be exeluded from the total amount. | .. |
| This project has been finally passed by Government and Sanitary Board. But the Board so far have not been able to finance any part of it. I believe they intend to take up the Fatehganj nala portion which although forming part of the whole scheme is a separate piece by itself, but so far nothing has been started. | Classed as ready and urgent. |
| The final project is now before Government. The Board asked for R2,00,000 from the Sanitary Board to enable them to start. | .. |
| This scheme is now with the Municipal Board. They are awaiting the return of Mr. Tyler before doing anything further. | .. |
| This project has just been completed and submitted to Manager, Rikhikesh Improvement Fund. | Classed as ready and urgent. |
| This is a small scheme which the Board intend to carry out themselves. I am now preparing an accurate map for them which they asked for. | Ditto. |
| This work will probably be carried out slowly bit by bit by the Board's overseer. I am told the outfall advised and designed by me has been built. As the town itself possesses very steep gradients indeed, the project is really a simple one, and the smallest sort of drain carries away anything very quickly. If the outfall has been built, it is a step in the right direction. | Ditto. |

PROGRAMME OF SANITARY WORKS, UNITED

*I.—Works to be*

| Names of places. | Description of work and its estimate. | Remarks by Government. | REPLIES RECEIVED FROM THE MUNICIPALITY ON THE THREE POINTS RAISED BELOW. | | |
|---|---|---|---|---|---|
| | | | Funds available for the work. | Income with reference to the actuals of the preceding three years. | Method by which it is proposed to raise any additional income and method of repayment of loan, if taken. |
| | | | R | R | |
| 9. Etawah . | Drainage works estimate R3,69,095. | The Board can finance the complete scheme. | .. | .. | .. |
| 10. Mainpuri . | Drainage works estimate, R2,66,953. | The present income is only sufficient for the ordinary expenditure, and taxation must be enhanced if the project is to be taken up. The Municipal Board should be addressed. | .. | .. | By taking a loan which can be repaid by enhancing the octroi duty. |
| 11. Dhampur . | Drainage works estimate, R70,281. | The margin on the figure in the secretariat is only R1,000, and before anything is done it will be necessary to ask the Board to explain how funds can be provided. | 1,000 | The annual charges exceed the income. | It is proposed to take a loan or levy any additional taxes. |
| 12. Meerut . | Drainage works estimate, R6,50,000. | Without any provision for original works the income exceeds the expenditure by R15,000 or R16,000, but some money must be set aside annually for works and the real margin is considerably less. If however the scheme is to be undertaken piecemeal this will not matter. | 12,500 | 3,04,758 | The work will be undertaken piecemeal and paid for from revenue. |
| 13. Jhansi . | Drainage works R5,64,627. | The excess of income over expenditure is only sufficient to cover the charges on a loan of one lakh. The Municipal Board wanted drainage before water works. But it will be necessary to settle definitely what is to be done about water works scheme before the drainage project is taken up. | 50,000 | 86,166 | By loan and by additional taxation. |
| 14. Allahabad . | Drainage works, R18,32,628. | The Municipal Board has been asked to clear up the financial position and a further communication will be made when their report is received. | 20,000 | 5,67,341 | Will not take a loan, asks Sanitary Board to make a grant of five lakhs. |
| 15. Aligarh . | Drainage works, R5,50,000. | The Board can afford to take a loan of about 3½ lakhs and it has R28,200 invested. But if the whole scheme is taken up and further taxation is necessary, the Municipal Board must be addressed on the financial question. | 90,000 | 54,540 | It will probably be decided to take up the works by instalments and to finance it by small increases of taxation, but details cannot be given till the scheme is sent. |

PROVINCES, ARRANGED IN ORDER OF URGENCY—*contd.*

*undertaken*—contd.

| Remarks by Sanitary Engineer. | Remarks by Sanitary Board. |
|---|---|
| This project, I fancy, the Etawah Board are not very keen on. I had a conference with the collector a short time ago and they contemplate doing some portion of it and I do not think they wish to take a loan. | .. |
| This project takes in the whole of Mainpuri which makes the cost per head high. It can of course, like all the projects, be taken up in blocks, but so far they have not seen their way to financing any part of it. | Classed as ready and urgent. |
| This scheme has lately been completed. It is a small municipality and will require help. It is a place to which a grant might well be given by the Board. The Board say that the scheme is not necessary but that if Government press for it, it must be done through a Government grant. | Ditto. |
| The project is now being completed. It will be a big project, but if the municipality can build its mains, the rest can be done block by block. | Ditto. |
| The scheme is approaching completion. They would like to spend about R25,000 annually and do the work gradually. | Ditto. |
| The scheme has now been revised by Messrs. Lane Brown and Hewlett and is now with me. It is, I think, a considerable improvement on the original scheme and is some lakhs cheaper. But unless the municipality can finance a sum of about 5 lakhs not much can be done as the first works must be the pumping station and the sewage main across the Jumna. The Board have stated they are not in a position to finance further loans till 1912. They have asked Government to come to their assistance and make a special grant of 5 lakhs or some such sum as will enable them to make a start. | Ditto. |
| This scheme has lately been completed, and is now being considered by the board. | |

PROGRAMME OF SANITARY WORKS, UNITED

*I.—Works to be*

| Names of places. | Description of work and its estimate. | Remarks by Government. | REPLIES RECEIVED FROM THE MUNICIPALITY ON THE THREE POINTS RAISED BELOW. | | |
|---|---|---|---|---|---|
| | | | Funds available for the work. | Income with reference to the actuals of the preceding three years. | Method by which it is proposed to raise any additional income and method of repayment of loan, if taken. |
| 16. Fatehpur . | Drainage works, R1,80,000. | The surplus of income over the expenditure is about R3,500 a year, the Municipal Board reported that it would take up work on the scheme from time to time as funds were available, and in view of this fact it is for the Sanitary Board to consider if the scheme should be proceeded with. | R 10,000 | R 22,218 | It is not proposed to take a loan or raise any additional income. |
| 17. Hardwar . | Drainage works, R1,00,000. | The scheme should be explained to the Commissioner who will decide whether any part of its cost can be met from fair fund account. The balance in this account at the close of the year 1908-9 was R42,059 and the income exceeds the outlay by about R15,000 a normal budget of the ordinary income and expenditure indicates a surplus sufficient to cover the charges on a loan of a lakh, but this makes no allowance for original works. | Board can devote R10,000, during next year for the work. | 1907-8— 55,981<br>1908-9— 54,791<br>1909-10— 52,921 | The Board suggests the work to be done in three years and is prepared to pay R30,000 and proposes that the balance R20,000 be met from the fair fund ; it is not proposed to take a loan but to enhance the octroi duty on goods and the pilgrim tax. |
| 18. Atrauli . | Drainage works, R1,25,000. | On a normal budget, the marginal works work out to R2,000. The Board should be addressed. | 14,000 | 17,013 | It is not desired to take a loan or levy additional taxes. |
| 19. Amroha . | Drainage works, R2,67,543. | A normal budget indicates a possible surplus of only R3,000 and it seems necessary to ascertain from the Municipal Board in what stage it proposes to carry out the scheme and how provide funds. | .. | .. | Unable to carry out the scheme. |
| 20. Landour . | Drainage, R2,00,000. | .. | .. | .. | .. |
| 21. Lucknow . | Water-works, Gau ghat, R4,00,000. | .. | .. | .. | .. |
| 22. Naini Tal . | Latrines and pail depôts, R1,00,000. | .. | .. | .. | .. |
| 23. Mirzapur . | Water-works, R6,32,000. | .. | .. | .. | .. |
| 24. Benares . | Sewerage and surface drainage scheme, R2,00,000 | .. | .. | .. | .. |
| 25. Cawnpore . | Improving conservancy tramway, draining Collectorganj and Lachmanpurwa, R58,000. | .. | .. | .. | .. |
| 26. Lucknow . | Town improvement, R2,40,000. | .. | .. | .. | .. |

PROVINCES, ARRANGED IN ORDER OF URGENCY—*concld.*

*undertaken*—concld.

| Remarks by Sanitary Engineer. | Remarks by Sanitary Board. |
|---|---|
| This scheme is under preparation, and will be completed by the end of the year. The Board have R20,000. They propose to carry it out by their own agency piecemeal. | Classed as ready and urgent. |
| This scheme is still under preparation and will be submitted about January | Ditto. |
| The scheme is nearly ready. This is a small municipality, and one that the Sanitary Board might help. The Board say that they cannot finance it. | Ditto. |
| The Board have definitely decided that the project is altogether too ambitious a one for them to attempt, and I rather agree with them as it involves pumping. | |
| .. | Nos. 20 to 26 added by the Sanitary Board, as being of importance. The projects however are not yet ready. |
| .. | |
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| .. | |
| .. | |

W. G. WOOD, *Superintending Engineer,*
*Sanitary Engineer to Government, United Provinces*

PROGRAMME OF SANITARY WORKS, UNITED PROVINCES, ARRANGED IN ORDER OF URGENCY.

*II.—Projects to be prepared.*

PROGRAMME OF SANITARY WORKS, UNITED

*II.—Projects*

| Names of places. | Description of work and its estimate. | Remarks by Government. | Replies received from the Municipality on the three points raised below. | | |
|---|---|---|---|---|---|
| | | | Funds available for the work. | Income with reference to the actuals of the preceding three years. | Method by which it is proposed to raise any additional income and method of repayment of loan, if taken. |
| | | | R | R | |
| 1. Bahraich . | Drainage project, costing R4,14,372. | .. | .. | .. | .. |
| 2. Benares . | .. | .. | .. | .. | .. |
| 3. Muttra . | Drainage works . | .. | No funds . | 24,200 | Enhancement of octroi duty and raising a subscription. |
| 4. Brindaban . | Ditto . | .. | 30,000 which is the amount allotted by the Sanitary Board. | .. | Ditto . |
| 5. Etah . . | Ditto . | .. | .. | .. | The Board do not require a loan or any assistant in construction but propose to construct their own drains year by year out of current funds. |
| 6. Ghazipur . | Drainage works, costing R4,35,688. | .. | 25,000 | 51,000 | By further taxation and getting a loan of R75,000. |
| 7. Tilhar . . | Drainage works . | .. | 15,878 | 35,817 | It is proposed to raise the income by further taxation. |
| 8. Azamgarh . | Ditto . | .. | .. | .. | .. |
| 9. Shahganj . | Drainage works estimate, R60,000. | The statistics available here are insufficient to be the basis of a normal and the Committee of the notified area should be asked to explain its financial position. | .. | 9,144 | By further taxation. |
| 10. Shikohabad | Drainage works . | .. | .. | .. | .. |
| 11. Unao . . | Ditto . | .. | .. | .. | .. |
| 12. Gonda . | Drainage . . | .. | .. | .. | .. |
| 13. Gorakhpur improvement scheme. | .. | .. | .. | .. | .. |

PROVINCES, ARRANGED IN ORDER OF URGENCY.

*to be prepared.*

| Remarks by Sanitary Engineer. | Remarks by Sanitary Board. |
|---|---|
| The Board are now pressing to commence work on part of the scheme drawn up by Mr. Lane Brown. Up to now I have not seen the scheme, and have had no chance of going to Bahraich, so that I fear it must wait. But I will take an early opportunity of examining the scheme. I fear it will take some time to revise it in accordance with present instructions. | |
| I submitted two projects lately—one for the drainage of two areas in the pakka mahals, and one for the construction of a sewer to take the sullage of the Orderly bazar across the Burna river, and deliver it into the large main sewer. | |
| I have so far been unable to examine this project. It is an old one of Mr. Lane Brown's and will probably require to be revised in accordance with the present system. | |
| Ditto . ditto. | |
| I have lately completed a map of this municipality, but so far have not commenced drawing up a project. | |
| I have been over Mr. Lane Brown's project for this place; a good deal of it can I hope be utilized, but it will require a great deal of revision. | |
| The survey of this place has been made, but the mapping has been delayed owing to the surveyor having got ill, and he has not been able to do anything for 1½ months. | |
| I twice intended going to Azamgarh last cold weather, but the Collector was away on each occasion in camp, and told me the scheme was not urgent. | |
| A map exists, but I have not been able to take up any scheme yet. | |
| I have lately sent two surveyors to make a map of the place. | Nos. 12 and 13 added by the Sanitary Board as being of importance. |

W. G. WOOD, *Superintending Engineer,*
*Sanitary Engineer to Government, United Provinces.*

No. 693, dated the 11th November 1911.

From—The Hon'ble Mr. L. STUART, I.C.S., Secretary to the Government of the United Provinces, Sanitary Department,

To—The Secretary to the Government of India, Education Department.

In continuation of the correspondence ending with my letter no. 1-L.K.O., dated the 28th October 1911, I am directed to state that the programme of schemes for urban improvements was again considered by the Sanitary Board at its meeting on November 1st. In accordance with the recommendations made by it I am to add the following notes on schemes for which grants are required:—

(1) Hardwar water-works scheme. A scheme for this was prepared some years ago but was dropped owing to want of funds. A grant of 3½ lakhs is requested here.

(2) Muttra water-works and drainage. The scheme is under preparation. The water-supply is the worst in the province. Considering the importance of Muttra as a place of pilgrimage, it is essential that something should be done to improve the water-supply. A grant of 3 lakhs is requested here.

(3) Cawnpore. In addition to the minor sanitary schemes of an urgent nature for which a grant of a lakh was suggested in my former letter the municipal board has a comprehensive scheme for paving lines to facilitate drainage. The total cost is considerable and progress is very slow. A further grant of one lakh could be spent to great advantage.

(4) A drainage scheme for Ballia is in the course of preparation and as the town has recently been rebuilt on a new site owing to erosion of the old site by the Ganges, it is very important that a drainage system on sound lines should be undertaken. The estimated cost is 1¼ lakhs. A grant of ₹50,000 could be very usefully expended.

(5) A drainage system has been introduced into Dehra Dun. It requires extension, and a grant of ₹10,000 could be usefully spent.

(6) A scheme of flushing drains already constructed is under preparation for Muzaffarnagar, which is estimated to cost ₹50,000. A grant of ₹25,000 could be usefully expended.

(7) Improvements in the water-works at Benares are required to make the supply continuous, and a large sum could profitably be expended on extensions of drainage. A grant of a lakh of rupees is desired here.

(8) The drainage works in Jaunpur already undertaken have been stopped for lack of funds. Two and a half lakhs are required to complete them. A grant of ₹50,000 could be usefully expended at once.

(9) Drainage work in Kheri is at a standstill for want of funds, and the main drain put down is useless for want of subsidiary drains. This is a small place with very limited finances. The scheme could be completed for ₹27,000 and a grant of that amount would be of enormous advantage.

(10) The Sanitary Board has strongly recommeneded that the grant for Shahjahanpur should be raised to 1½ lakhs instead of one lakh as proposed in my former letter.

(11) It is also suggested that the grant for Fatehpur should be 1½ instead of a lakh as proposed in my former letter.

(12) Work on the drainage system at Budaun has been suspended for want of funds. The grant of a lakh of rupees to this municipality would be of great advantage.

(13) At present the sullage from Lucknow, which has been provided with an excellent drainage scheme, is discharged on two sullage farms. But this arrangement is not altogether satisfactory, and a scheme is under consideration to pump part of the sullage across the Gumti to a more suitable site. A sum of ₹41,000 will be required.

(14) A further grant of one lakh is requested to enable other sections of the Lucknow drainage system to be taken up.

(15) A project for the drainage of Brindaban, an important place of resort by Hindu pilgrims, was prepared, some years ago, and is now being revised by the Sanitary Engineer. The total cost will amount to several lakhs, and a grant of two lakhs is requested.

(16) The total cost of the water-supply scheme at Mirzapur, now under construction, is estimated at ₹5,98,000. Towards this grant ₹1,40,000 have already been made. The Lieutenant-Governor would be glad to be in a position to give further assistance to the amount of ₹50,000 as the board has increased taxation to finance the scheme and is faced with the possibility of a reduced income owing to the abolition of octroi.

(17) From the grants made by the Government of India last January a sum of one lakh was set aside for a drainage scheme at Atrauli, estimated to cost ₹1,88,000. Atrauli is a small place with little trade, and the municipal board has been unable to find the balance of the money required to complete the scheme though it was prepared to find ₹25,000. The Lieutenant-Governor has therefore transferred the grant to Aligarh where a large scheme has been prepared and where the need was more urgent. The Sanitary Board has however again recommended that a grant of a lakh should be made to Atrauli, without conditions as to completion of the scheme. This sum will enable the board to construct a substantial portion of the scheme. It may then be left to the board to complete it in time as funds become available.

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No. 871-M. and S., dated the 2nd November 1911.

From—The Hon'ble Mr. H. P. TOLLINTON, I.C.S., Revenue Secretary to the Government of the Punjab,

To—The Secretary to the Government of India, Education Department.

In continuation of my telegram no. 31-M., dated the 30th October 1911, I am directed to forward a list of schemes of urban sanitation in the Punjab arranged according to Divisions as the Sanitary Board have not been able to work out the order of urgency. As regards the financial assistance that will be required, the Lieutenant-Governor is of opinion that local bodies should be asked to contribute to the cost of the schemes according to the following scale:—

(*a*) one-fourth of their total annual income for not more than three years, or

(*b*) one-third of the total cost of the scheme spread over not more than three years whichever is less.

| Division. | District. | Municipality. | Population, Census 1901. | Income, 1909-10. | Incidence of taxation, 1909-10. | Nature of project. | Estimate of cost. | Remarks. *Note.*—All projects except those marked with an asterisk are included in Divisional Statements of Sanitary Projects to be carried out in 5 years from 1910. |
|---|---|---|---|---|---|---|---|---|
| | | | | R | R a. p. | | R | |
| Delhi. | Hissar | .. | .. | .. | .. | Drainage works at Hissar | 25,600 | Rough estimates including the cost of draining cattle farm at Hissar were prepared and approved by Sanitary Engineer. |
| | Hissar | .. | .. | .. | .. | Water-supply for Bhiwani | 1,00,000 | The project was abandoned for want of funds. |
| | Hissar | Hansi | 16,523 | 21,022 | 0 15 10 | Drainage and filling of tanks | 22,270 | Project in accordance with orders of Government. Rough plans and estimates prepared, an anti-malaria project. |
| | Rohtak | Rohtak* | 19,766 | 26,094 | 0 15 1 | .. | .. | Scheme under consideration. Plans and estimates not yet completed. |
| | Gurgaon | Rewari* | 27,295 | 48,800 | 1 6 11 | Water-works | .. | Wells have been sunk; estimate not yet quite complete. |
| | Gurgaon | Palwal* | 12,830 | 24,008 | 1 10 8 | Drainage of depressions | 35,000 | An anti-malaria project. Rough plans and estimates prepared. |
| | Delhi | Delhi* | 2,06,534 | 8,10,343 | 2 8 7 | Intra and extra-mural drainage. Improvements of Bela. | .. | An anti-malaria project. |
| | Delhi | Ballabgarh | 4,506 | 13,271 | 2 8 8 | Intra-mural drainage | 16,600 | "Quite beyond the means of Local Bodies." Note by Commissioner, Delhi Division. |
| | Delhi | Faridabad | 5,310 | 7,590 | 1 2 1 | Intra-mural drainage | 10,000 | |
| | Karnal | Karnal | 22,703 | 42,174 | 1 9 8 | Extra-mural drainage | 25,000 | Detailed plans and estimates approved. Grant of R6,156 made by Sanitary Board. |
| | Karnal | Karnal | .. | .. | .. | Intra-mural drainage | 2,000 | Rough plans and estimates prepared. |
| | Karnal | Kaithal | 14,408 | 21,194 | 1 1 4 | Drainage and filling of tanks | 12,000 | Under consideration. Plan and estimates not yet prepared. An anti-malaria project. |
| | Ambala | Ambala | 26,744 | 83,462 | 2 2 1 | Improvements of water-works | 23,000 | Plans and estimates under preparation. |
| | Ambala | Ambala | .. | .. | .. | Extension of drainage scheme in Ambala City | 10,000 | Fair estimate approved by Sanitary Engineer. |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Ambala | Ambala | .. | .. | .. | Improvement of Rupar drainage system | 20,000 | No proper estimate prepared yet. |
| | Ambala | Ambala | .. | .. | .. | Storm water and sullage drainage of Jagadhri town. | 14,000 | Estimate under preparation. |
| | Ambala | Sadhaura | 9,812 | 9,901 | 0 12 11 | Drainage | 17,000 | Under consideration. |
| | Simla | Simla | 14,130 | 5,60,693 | 13 3 2 | Hydro-electric scheme | .. | Under construction. |
| | Simla | .. | .. | .. | .. | Additional water-supply for Simla (a part of the Simla Improvement Scheme). | 3,61,000 | Fair estimates submitted to Local Government in the Public Works Department. |
| | Simla | .. | .. | .. | .. | Extension of sewage system for the disposal of sullage at Simla. | .. | Estimate under preparation by the Municipal Committee. |
| | Simla | .. | .. | .. | .. | Disposal of the Chhota, Chelsea and Sanjauli drainage. | 51,000 | Fair estimate approved by Sanitary Engineer. |
| Jullundur. | Jullundur | Jullundur | 54,455 | 83,485 | 1 3 0 | Outfall drainage | 10,700 | Under consideration. |
| | Ludhiana | Ludhiana | 48,211 | 1,26,748 | 1 14 4 | Improvement of extra-mural drainage | 15,765 | Ditto. |
| | Ferozepore | Ferozepore | 23,475 | 64,155 | 2 2 3 | Improvement of extra-mural drainage | 10,000 | Ditto. |
| | Ferozepore | Muktesar | 6,389 | 27,191 | 2 3 9 | Intra-mural drainage | 14,000 | Ditto. |
| | Ferozepore | Fazilka | 8,505 | 40,610 | 1 14 3 | Drainage | 65,000 | Under consideration. Partly anti-malarial. |
| | Kangra | .. | .. | .. | .. | Nurpur water-supply scheme | 21,000 | Preliminary estimate has been approved by Sanitary Engineer. |
| Lahore. | Lahore | Lahore | 1,86,884 | 9,21,351 | 3 2 9 | Sewerage scheme | 13,00,000 | Plans and estimates under preparation. |
| | Lahore | .. | .. | .. | .. | Conversion of Bach channel of Ravi into ornamental water with proper outfall and constructing proper Dhobi Ghat. | 20,000 | Under consideration. |
| | Lahore | .. | .. | .. | .. | Sharakpur drainage scheme | 15,000 | Rough estimate approved by Sanitary Engineer. |
| | Lahore | Kasur | 22,022 | 62,066 | 2 1 6 | Intra and extra-mural drainage | 32,500 | Under consideration. |
| | Amritsar | Amritsar | 1,61,039 | 6,58,243 | 2 0 11 | Sewage disposal works | 59,000 | Under consideration. R54,414 have been allotted by Sanitary Board. |
| | Amritsar | .. | .. | .. | .. | City sewage | 2,55,000 | Under preparation. |
| | Amritsar | .. | .. | .. | .. | Civil Lines drainage | 15,000 | Under consideration. |
| | Amritsar | .. | .. | .. | .. | Filling up of tanks | 95,000 | Plans and estimates prepared. |
| | Amritsar | .. | .. | .. | .. | Water-supply | 45,000 | Under consideration |

All anti-malarial. The Lieutenant-Governor has given R1,00,000 for buying tanks and R1,40,000 for filling them.

*List of urban sanitary projects in the Punjab—1911*—concld.

| Division. | District. | Municipality. | Population, Census 1901. | Income, 1909-10. | Incidence of taxation, 1909-10. | Nature of project. | Estimate of cost. | Remarks. *Note.*—All projects except those marked with an asterisk are included in Divisional Statements of Sanitary Projects to be carried out in 5 years from 1910. |
|---|---|---|---|---|---|---|---|---|
| | | | | R | R a. p. | | R | |
| Lahore. | Amritsar | Taran Taran | 4,428 | 11,454 | 2 0 11 | Drainage | 7,567 | Under preparation. |
| | Gurdaspur | Gurdaspur | 4,903 | 9,749 | 1 2 9 | Drainage | 8,045 | Under consideration. |
| | Gurdaspur | Batala | 27,365 | 57,047 | 1 4 6 | Drainage and filling of tanks | 11,124 | Under consideration. Partly an anti-malaria project. |
| | Gurdaspur | .. | .. | .. | .. | Drainage works for Khajini and Purian Gates area at Batala. | 5,000 | Estimate under preparation. |
| | Gurdaspur | Dalhousie | 808 | 25,781 | 8 13 0 | Improvements to water-supply | 7,000 | No information. |
| | Sialkot | Sialkot | 44,789 | 1,65,384 | 2 5 1 | Intra-mural drainage | 50,000 | Returned by Sanitary Board for revision. |
| | Sialkot | .. | .. | .. | .. | Water-works | 4,28,000 | Rough project approved by Sanitary Engineer. The wells sunk and estimates under consideration. |
| | Sialkot | .. | .. | .. | .. | Drainage scheme for the neighbourhood of railway station at Sialkot. | 21,000 | Rough project approved by Sanitary Engineer. |
| Lahore Division. | Gujranwala | Gujranwala | 28,356 | 81,781 | 2 1 2 | Intra-mural drainage | 15,000 | |
| | Gujranwala | Wazirabad | 18,069 | 32,641 | 1 6 4 | Water-works | .. | No information. |
| | Gujranwala | Wazirabad | .. | .. | .. | Intra and extra-mural drainage | | |
| | Gurat | Jalalpur Jattan | 10,640 | 14,865 | 1 3 2 | Drainage scheme (sullage) | 4,800 | Under consideration. |
| | Jhelum | Jhelum | 11,703 | 51,213 | 2 14 4 | Intra-mural drainage, northern section | 10,000 | Under preparation. |
| | Shahpur | Jhelum | .. | .. | .. | Khushab water-supply | .. | Experiment yet in hand. Trial wells being sunk. Estimate depends on result. |
| | Shahpur | Jhelum | .. | .. | .. | Extra-mural drainage works for Bhera | 18,000 | Project under preparation. |
| | Shahpur | Jhelum | .. | .. | .. | Drainage scheme for Miani | 10,000 | No proper estimate prepared as yet. |
| Rawalpindi. | Rawalpindi | Rawalpindi | 47,077 | 2,41,972 | 3 3 8 | Intra-mural drainage | 1,69,398 | Plans and estimate complete. Project pending owing to defect in extra-mural drainage. |
| | Rawalpindi | Rawalpindi | .. | .. | .. | Extension of water-supply at Rawalpindi | .. | No project prepared yet. |
| | Rawalpindi | Murree | 1,517 | 69,269 | 5 0 11 | Intra-mural drainage | 28,515 | Under consideration but project delayed for want of funds. Sanitary Board has allotted R7,000. |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Multan. | Attock | Hazro | 9,799 | 31,081 | 1 10 4 | Protection of bund | 6,000 | Under consideration. |
| | Attock | Hazro | .. | .. | .. | Sullage farm | 4,000 | Under consideration. This is part of a drainage (sullage scheme) costing R14,181, now under consideration, to which the Sanitary Board has made a grant of R8,000. |
| | Mianwali | Isakhel* | 7,630 | 8,044 | 1 13 1 | Water-works | 32,896 | Plans and estimates under preparation. |
| | Mianwali | Isakhel | .. | .. | .. | Drainage scheme for the town of Mianwali | 18,960 | Rough project approved by Sanitary Engineer. |
| | Lyallpur | Lyallpur* | 9,171 | 1,14,889 | 1 1 2 | Extension of drainage (sullage) | 30,378 | Scheme approved and forwarded to Government for sanction. |
| | Lyallpur | Lyallpur | .. | .. | .. | Extension of water-works | 24,384 | Detailed plans and estimates approved. |
| | Lyallpur | Lyallpur | .. | .. | .. | Provision of water tower | 13,910 | Plans and estimates forwarded to the Superintending Engineer, 1st Circle, for disposal. Board have no objection to scheme. |
| | Lyallpur | Lyallpur | .. | .. | .. | Water-supply for Chiniot Road town | .. | Estimate under preparation. |
| | Lyallpur | Lyallpur | .. | .. | .. | Improvement of water-supply at Gojra | 60,037 | Estimate approved by Sanitary Engineer and submitted for sanction. |
| | Jhang | Jhang | 23,198 | 56,363 | 1 15 2 | Outfall drainage | 7,000 | Under consideration. |
| | Jhang | Chiniot | 15,685 | 30,585 | 1 9 11 | Intra and extra-mural drainage | 59,783 | Fair project for the whole town prepared and approved by the Sanitary Engineer and sanctioned by the Local Government. It was abandoned for want of funds. |
| | Jhang | .. | .. | .. | .. | Provision of flushing arrangements at Maghiana. | 12,200 | No proper estimate prepared as yet. |
| | Multan* | Multan | 74,627 | 2,10,731 | 2 6 5 | Water-works | .. | Case sent to Sanitary Engineer on 14th December 1910 by Sanitary Board. |
| | Multan | Shujabad | 5,880 | 19,339 | 2 11 4 | Intra and extra-mural drainage | 5,117 | Plans and estimates sent to Executive Engineer for disposal. |
| | Muzaffargarh | Muzaffargarh | 3,737 | 13,404 | 2 2 1 | Drainage scheme | 6,385 | R4,000 allotted by Sanitary Board. |
| | Dera Ghazi Khan* | Dera Ghazi Khan | 21,697 | 63,284 | 2 9 3 | | | |
| | Dera Ghazi Khan* | Dera Ghazi Khan | .. | .. | .. | Chorutta water-supply | .. | Estimate under preparation. |
| | Dera Ghazi Khan* | Dera Ghazi Khan | .. | .. | .. | Chorutta drainage works | .. | No project prepared yet. |
| | Dera Ghazi Khan | Dajal .. | 6,213 | 12,473 | 1 13 8 | Water-works | 6,000 | Under consideration. |
| | Montgomery | Montgomery | .. | .. | .. | Drainage scheme for Pakpattan | 25,000 | No proper estimate prepared as yet. |

No. 508-M.—1-Medl., dated the 22nd September 1911.

From—G. B. H. Fell, Esq., C.I.E., I.C.S., Officiating Secretary to the Government of Burma, Municipal Department,

To—The Secretary to the Government of India, Department of Education.

I am directed to acknowledge the receipt of your letter no. 1543, dated the 21st August 1911, on the subject of a Conference of Sanitary Commissioners to be held at Bombay at the end of October or the beginning of November.

2. I am to explain that Major C. E. Williams, I.M.S., Sanitary Commissioner, Burma, is at present on leave, and will return in November too late to attend the Conference. On relief by Major Williams, the Officiating Sanitary Commissioner, Major S. A. Harriss, I.M.S., will revert to his substantive appointment of Deputy Sanitary Commissioner in the United Provinces. The Lieutenant-Governor does not consider that there would be any advantage in deputing him to attend the Conference, since any knowledge he might acquire from the discussions would not be at the disposal of this Government, whose service he would be leaving immediately after the Conference. His Honour has therefore deputed Major N. P. O'Gorman Lalor, I.M.S., Deputy Sanitary Commissioner, who is at present on special duty in connection with the study of malaria, and who will also attend the annual meeting of the General Committee for the study of Malaria. Major Lalor has been instructed to comply with the orders contained in paragraph 3 of your letter, and to communicate to the Sanitary Commissioner with the Government of India at the earliest possible date the subjects which he proposes for discussion.

3. With reference to paragraph 5 of your letter I am to submit that His Honour has considered the possibility of deputing the Sanitary Engineer, Burma, with such schemes of urban sanitation as have already been prepared; but as the present incumbent is retiring just before the date of the Conference, and his successor will not have had time to bring himself into touch with the requirements of the province, the idea has been abandoned. The preparation of a definite programme of urban sanitation extending over a series of years will be taken in hand without delay, but His Honour regrets that it is impossible to have the report ready in time for this year's Conference.

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*Extract from letter no. 6197-M., dated the 21st September 1911, from the Hon'ble Mr. W. J. Reid, I.C.S., Financial Secretary to the Government of Eastern Bengal and Assam, Shillong, to the Secretary to the Government of India, Department of Education, Simla.*

* * * * * * *

5. The Government of India have asked for the submission of a report on definite schemes of urban sanitation which will extend over a series of years indicating the degree of urgency and the amount of financial assistance required to carry them out within a reasonable period and steps are being taken to compile the necessary information. The number of such schemes in this province is very large, but the only two which need for the present be separately mentioned are the Dacca sewerage scheme which is estimated to cost 13 lakhs of rupees and the Dacca drainage scheme which is estimated roughly to cost something like 50 lakhs. For the former scheme a detailed project is being prepared. The time within which the former of these schemes can be carried out will depend on the possibility of takng it up in compartments.

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No. 6506-M., dated the 17th October 1911.

From—The Hon'ble Mr. W. J. Reid, I.C.S., Financial Secretary to the Government of Eastern Bengal and Assam, Municipal Department,

To—The Secretary to the Government of India, Department of Education.

I am directed to invite a reference to paragraph 5 of my letter no. 6197-M., dated the 21st September 1911, in which it was stated that steps were being taken to compile a report on definite schemes of urban sanitation which would extend over a series of years. I am further to invite a reference to Mr. Kershaw's telegram no. 32, dated the 23rd January 1911, which mentioned several urgent projects and to Mr. Porter's letter no. 353, dated the 3rd March 1911, sanctioning a special non-recurring grant of ₹9,00,000 for expenditure on urban sanitary works in Eastern Bengal and Assam.

2. As already observed the number of such schemes in the province is very large, and, while progress has of late been comparatively rapid owing to the generous financial assistance given by the Government of India, the Lieutenant-Governor could utilise to the full almost any amounts which might be available. Time does not permit of an exhaustive list of the sanitary requirements of the province being compiled before the

next Conference of Sanitary Commissioners, but a brief note is appended giving details of the most important schemes which His Honour would wish to undertake at the earliest possible moment but which must in default of assistance from the Government of India in some cases stand over indefinitely and in others be spread over a lengthy period of years. All these schemes are essentially necessary, but the Lieutenant-Governor regards the Dacca sewerage scheme, the Chittagong water-supply scheme and the Jorhat water-supply scheme as the most urgent.

3. As the Sanitary Commissioner in Eastern Bengal and Assam will attend the forthcoming Conference and is, as Secretary to the Sanitary Board, well acquainted with the various projects described in the note, Sir Charles Bayley trusts that the somewhat meagre information now given may suffice for the consideration of the Conference.

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## NOTE.

*Dacca sewerage scheme.*—This is a scheme for carrying off house sewage and sullage in underground sewers and treating it in septic tanks and percolating filters. A rough project has been prepared and two expert Engineers have been engaged to work out a detailed project. The estimated cost of the scheme is ₹13,00,000 and a beginning will be made with it next year if, as is hoped, it is found possible to undertake the work in compartments. It is improbable that the Dacca Municipality will be able to do more than meet the maintenance charges and it is proposed to finance the first instalment from the non-recurring grant of ₹9,00,000 made by the Government of India.

*Dacca drainage scheme.*—This is an ambitious but very necessary scheme for improving the *khals* in the town of Dacca and carrying storm water surface drainage and sub-soil drainage into them through surface drains. The channels will have to be cleared and deepened and the silt removed will be used to raise low-lying portions of the town. The result will be the reclamation of a considerable area of valuable land in Dacca, but, apart from the cost of the scheme which is roughly estimated at ₹50,00,000, the question of the ownership of these channels is by no means free from difficulty. Special enquiries into this question are being made by the Settlement Department, but it may be necessary before this scheme is actually undertaken to consider the advisability of the creation of a Dacca Improvement Trust somewhat on the lines of but on a much smaller scale than the Calcutta Improvement Trust.

*Chittagong water-supply.*—It has been estimated that the cost of a proper water-supply for Chittagong will be about ₹4,00,000 and ₹70,000 has already been expended by this Government in boring and maintaining three artesian wells. The water obtained is plentiful but is chalybeate, and special experiments are being made with a view to the removal of the taste. The Chittagong Municipality can contribute towards the cost of the scheme but the major portion will have to be found by the local Government. The scheme is one which His Honour would gladly see undertaken.

*Shillong drainage scheme.*—A scheme has been prepared for the removal of sewage and sullage by means of underground sewers and a detailed project is under preparation. The cost is estimated to be ₹11,00,000.

*Silchar water-supply.*—A project estimated to cost ₹1,00,000 is under preparation. The municipality proposes to borrow ₹40,000 and to ask Government for a grant of the balance.

*Jorhat water-supply.*—A detailed project for both a water-supply and the improvement of the drainage of the new civil station has been prepared, the estimated cost being ₹1,10,000. The municipality is a small one and can contribute very little towards the cost which must be borne almost entirely by the local Government.

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No. 1832-VI—14-36, dated the 20th October 1911.

From—Lieutenant-Colonel R. P. Colomb, I.A., Second Secretary to the Chief Commissioner, Central Provinces,

To—The Secretary to the Government of India, Education Department.

I am directed to refer to your letter No. 1545, dated the 21st August 1911, in connection with the ensuing Conference of Provincial Sanitary Commissioners to be held at Bombay, and, in reply to paragraph 5 thereof, to forward herewith for the information of the Government of India two statements showing drainage and water works schemes—

(*i*) which have been completed,

(*ii*) which are under construction,

(*iii*) which are under survey,

(*iv*) other works which are contemplated but not yet surveyed.

2. I am to say that Mr. Craddock considers that in order to combat disease, water works and drainage must go hand in hand. The former cannot be unduly protracted, but the latter can be spread out over a fair number of years. These works should also be accompanied by gradual demolition of existing site-crowded areas and by timely provision for the sanitary extension of towns which are growing or are expected to grow on account of the construction of new railways. The system being followed in the Central Provinces is one of preparation of really sound projects before any money is spent. The financing of the schemes by the Municipalities concerned has been arranged on the basis of half loan and half grants from Provincial revenues. At present the annual expenditure on sanitary works will be roughly 2 lakhs from loans and the same amount from Government grants or a total of 4 lakhs a year, but this amount might easily be doubled if the Government of India are pleased to increase the Imperial grant for sanitation. Some of the towns, however, will not be able to borrow even half the sum required to finance their schemes, and in their cases, provided the taxation is full, Government aid might be extended so as to cover $\frac{2}{3}$rds of the cost, but beyond this Mr. Craddock is not prepared to go.

3. Extensions for growing towns are among the most urgent requirements, and in these cases a good part, if not all the cost, is recovered from premia and rents on sites disposed of. Demolition of site-crowded areas has to proceed more slowly, but is a very useful and effective method of reducing disease. Improvement in general health from air and good drainage is, in Mr. Craddock's opinion, a very potent factor for combating the chief epidemic diseases.

4. The Chief Commissioner believes that the policy now being followed in the Central Provinces is thoroughly sound and will not, he hopes, be changed though the rate of progress is mainly a question of funds and supply of labour.

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*I.—Statement showing drainage schemes in Central Provinces.*

| Name of town. | Population according to Census of 1911. | Amount expended or required (total) to be expended for survey of schemes. | Probable cost of schemes. | Remarks. |
|---|---|---|---|---|
| (1) *Works completed.* | | R | R | |
| *Nil.* | | | | |
| (2) *Works under construction.* | | | | |
| Nagpur sewage scheme . . | 134,712 | 55,000 | 35,51,250 | Of this work to the extent of R16 lakhs has been sanctioned. Work is to be completed in 8 years ending 1917-18 having an allotment of two lakhs each year (one lakh from loan and one lakh by Government grant). Preliminary arrangements have been made for the manufacfacture of materials, and the manufacture is now in progress. Construction will be begun shortly. |
| Wardha surface drainage scheme | 12,540 | 1,000 (Revision only) | 2,04,670 | Estimate sanctioned. Work to the extent of R1,92,997 will be completed in three years ending 1913-14. Government grant one lakh and R92,997 from loan have been arranged. Arrangements will be made to start work shortly. |
| (3) *Schemes surveyed and under survey.* | | | | |
| Akola surface drainage scheme | 27,161 | 10,000 | 4,39,940 | A complete project has been prepared by Messrs. Lane Brown and Hewlett for the surface drainage of this town. The Municipality are considering the arrangements for financing the work. |
| Khamgaon surface drainage scheme. | 13,182 | 5,500 | 2,79,976 | A complete project for the surface drainage of this town has been prepared by Messrs. Lane Brown and Hewlett. The question of financing the scheme has not yet been considered. |

*I.—Statement showing drainage schemes in Central Provinces*—contd.

| Name of town. | Population according to Census of 1911. | Amount expended o required (total) to be expended for survey of schemes. | Probable cost of schemes. | Remarks. |
|---|---|---|---|---|
| | | R | R | |
| (3) *Schemes surveyed and under su vey*—contd. | | | | |
| Jubbulpore sewage scheme . | 100,651 | 25,000 subject to change in population. | 13,08,463 probable. | The preparation of the project is in the hands of Messrs. Lane Brown and Hewlett. A Government grant of R10,000 was made for the survey last year, and R15,000 from the same source this year. |
| Bhandara surface drainage scheme. | 7,414 | 3,700 | 96,382 | A Government grant of R3,700 has been made this year for preparing the project, which work has been entrusted to Messrs. Lane Brown and Hewlett. |
| Burhanpur surface drainage scheme. | 30,435 | 5,500 (Revision only). | 3,95,655 | The preparation of project sanctioned and its preparation is being carried out by Messrs. Lane Brown and Hewlett. A Government grant of R5,500 has been made for this work. |
| Khandwa surface drainage scheme. | 21,604 | 4,250 (Revision only). | 2,80,852 | The preparation of the project has been sanctioned and is being carried out by Messrs. Lane Brown and Hewlett. A Government grant of R4,250 has been made for the purpose. |
| Harda surface drainage scheme | 8,341 | 3,500 (Revision only). | 108,433 | The preparation of the project has been sanctioned ; it is carried out by Messrs. Lane Brown and Hewlett. A Government grant of R3,500 has been made for the work. |
| Itarsi surface drainage scheme | 4,430 | 1,750 (Revision only). | 57,590 | Preparation of project sanctioned. Messrs. Lane Brown and Hewlett carrying out survey. A Government grant of R1,750 has been made. |
| (4) *Schemes contemplated but not yet surveyed.* | | | | |
| Seoni surface drainage scheme | 13,839 | 3,460 | 1,79,907 | The Commissioner is considering whether it will be possible for the municipality to finance this scheme in the near future. His final reply is awaited before further steps are taken. |
| Raipur surface drainage scheme | 35,335 | 7,000 | 4,59,355 | The question as to the ability of the municipality to finance the work in the near future is under consideration by the Commissioner before surveys are begun. |
| Bilaspur surface drainage scheme. | 19,850 | 4,000 | 2,58,050 | |
| Amraoti , surface drainage scheme. | 40,610 | 10,153 probable. | 5,27,930 | The ability of the municipality to finance the work in the near future is being considered by the Commissioner before the preparation of the project is begun. |
| Saugor surface drainage scheme | 45,908 | 11,477 | 5,96,804 | The Commissioner is considering the question of the ability of the municipality to finance the project in the near future before the surveys are begun. |
| Arvi surface drainage scheme . | 11,902 | 2,976 | 1,54,726 | Estimate for the preparation of the project returned to the Superintending Engineer, I Circle, for record as the preparation of a sufficient number of projects has been undertaken in the Nagpur Civil Division for the present. |
| Hinganghat surface drainage scheme. | 14,943 | 3,736 | 1,94,259 | Estimate for the preparation of the project returned to the Superintending Engineer, I Circle, for record as the preparation of a sufficient number of projects has been undertaken in the Nagpur Civil Division for the present. |
| Umrer surface drainage scheme | 17,630 | 4,408 | 2,29,190 | Estimate for the preparation of the project returned to the Superintending Engineer, I Circle, for record as the preparation of a sufficient number of projects has been undertaken in the Nagpur Civil Division for the present. |
| Karanja surface drainage scheme. | 12,852 | 3,213 | 1,67,076 | Estimate for the preparation of the project returned to the Superintending Engineer, I Circle, for record as the preparation of a sufficient number of project has been undertaken in the Nagpur Civil Division for the present. |

*II.—Statement showing water-works scheme in Central Provinces.*

| Name of town. | Population according to Census of 1911. | Amount expended or required (total) to be expended for survey of schemes. | Probable cost of schemes. | Remarks. |
|---|---|---|---|---|
| | | R | R | |
| (1) *Works completed.* | | | | |
| Nagpur water-works . . | 134,712 | .. | .. | A gravitation scheme with a pumping high level extension exists. Another combined storage and pumping scheme has just been added, *vide* item I of 1911. |
| Bhandara water-works . | 7,414 | .. | .. | A pumping scheme from wells. |
| Jubbulpore water-works . | 100,651 | .. | .. | A gravitation scheme recently improved. |
| Seoni water-works . . | 13,839 | .. | .. | A gravitation scheme. A new iron main has just been laid. |
| Burhanpur water-works . | 30,435 | .. | .. | A gravitation scheme. |
| Raipur water-works . . | 35,355 | .. | .. | Pumping scheme from infiltration galleries and wells. |
| Rajnandgaon water-works | 11,979 | .. | .. | Ditto ditto ditto. |
| Buldana water-works . . | 3,820 | .. | .. | Pumping scheme from a storage tank. |
| Khamgaon water-works . | 13,182 | .. | .. | A gravitation scheme. |
| Wardha water-works . . | 12,540 | .. | .. | The question of improvement to this scheme is under consideration. |
| Khandwa water-works . | 21,604 | .. | .. | A proposal for increasing the supply by feeding the existing reservoir from the proposed Taimber irrigation tank, is being investigated. |
| Amraoti water-works . . | 40,610 | .. | .. | Extensions contemplated and project under investigation. |
| Akola water-works . . | 27,161 | .. | .. | Ditto ditto ditto. |
| (2) *Works under construction.* | | | | |
| Nagpur water-works . . | 134,712 | .. | 10,00,000 | A new storage reservoir at Gorewara with a pumping scheme from it is under construction and practically finished at a cost of R10 lakhs. The work is nearly completed. This is in addition to the existing water-works at Ambajheri. Government grant R2½ lakhs. |
| Hinganghat water-works . | 14,943 | .. | 22,887 estimated. | Estimate for improvements sanctioned from Municipal funds and work begun. |
| Harda water-works . . | 8,341 | .. | .. | Improvements at a cost of R1,20,000 from municipal funds practically finished. |
| (3) *New schemes contemplated and under survey.* | | | | |
| Arvi water-works . . | 11,902 | .. | .. | Sanction given for the preparation of a project and an amount of R1,378 as Government grant given to the Municipal Committee for its investigation. |
| (4) *New schemes under contemplation but no survey undertaken.* | | | | |
| Chanda water-works . . | 19,866 | .. | .. | |
| Saugor water-works . . | 45,908 | .. | .. | Schemes proposed. The possibility of the municipalities financing the schemes is being considered by the Commissioner before the investigations are carried further. The Commissioner's reports are awaited. |
| Damoh water-works . . | 17,042 | .. | .. | |
| Balaghat water-works . . | 7,400 | .. | .. | An estimate amounting to R197 for the preparation of a project was received but returned to Superintending Engineer, I Circle, for record as sufficient number of projects have been undertaken in the Nagpur Civil Division for the present. |

## APPENDIX 2.

### NOTE ON MUNICIPAL WATER-SUPPLY AND DRAINAGE SCHEMES IN THE BOMBAY PRESIDENCY INCLUDING SIND BUT EXCLUDING BOMBAY CITY AND ADEN.

The following is a brief review of the progress of water-supply and drainage works in municipal towns in this Presidency. The City of Bombay, Military Cantonments and all inhabited areas not enjoying municipal franchise are excluded from this review.

2. The total number of municipalities in the Presidency is 157 with a population of 2,351,829 out of a total of 19,618,687 for the whole of the Presidency. Out of these only 17 towns have a properly distributed piped supply and about 30 more have an imperfect supply capable of considerable improvement. The population of these towns is 1,671,000 and the capital outlay on water-works per head works out to R4·6.

3. Only two cities, Ahmedabad and Karachi, have drainage installations on modern lines and the sewerage of Poona City is in progress.

4. The Sanitary Board as at present constituted and consisting of—

| | |
|---|---|
| The Surgeon-General with the Government of Bombay | as President |
| The Commissioner, Central Division<br>The Chief Engineer, Public Works Department<br>The Sanitary Commissioner for the Government of Bombay | as Members |
| The Sanitary Engineer to Government, Bombay | as Member and Secretary |

was formed in 1902 to advise Government upon all general questions of policy and on large individual schemes of sanitary improvement. The functions of the Board have hitherto been advisory, but the time has come to consider if some of the powers of Government may not be delegated to it so that Government may be relieved of much work of minor importance.

5. Whatever progress was made in the past in regard to the provision or improvement of water-supply has been chiefly due to the initiative of Collectors assisted by Engineer officers and a few enthusiasts in the cause of sanitary reform. Very few municipalities were in a position to spend money on new schemes, and when they were willing to do so they had not the necessary establishment for the preparation of plans and estimates and very few had the means to undertake such works without substantial assistance from Government. The average capital expenditure on water-supply and drainage in mofussil municipalities during the six years ending 1896-97 was 6·38 lakhs of rupees annually. In the next seven years it fell to 2·18 lakhs and the total capital outlay on water-supply was as low as R3·26 per head of population in municipal areas. If large cities like Ahmedabad and Surat were excluded the capital outlay on sanitary works in municipal towns was merely nominal. This stagnation in municipal enterprise was brought to the notice of Government by the Sanitary Board in 1905, and Government were pleased in 1907 to pass liberal orders for securing greater progress in sanitary improvement in municipal and local board areas. Under these orders the execution of all surveys as well as the preparation of detailed plans and estimates was entrusted to the establishment working under the Sanitary Engineer, the cost of such establishment being considered as a Government grant-in-aid to the progress of sanitary improvement in the Presidency. Desirable schemes approved by the Sanitary Board, but which are beyond the financial powers of municipalities or other local bodies, will receive assistance both by loans and grants-in-aid subject to a limit in the latter case of 50 per cent. of the total estimated cost of the undertaking provided that Government is convinced that the local bodies concerned shew their willingness to make proper efforts to help themselves. This generous assistance from Government has given a great impetus to sanitary measures and there is no doubt that substantial progress may be looked for in future. There is already a great awakening and requests for the preparation of suitable sanitary schemes, particularly those in connection with water-supply and drainage, are coming in from several municipalities, and the Sanitary Engineer's establishment is fully engaged in maturing projects.

6. *Statement I* shews the water-supply and drainage works executed by municipalities previous to 1907 without any special grant-in-aid from Government.

*Statement II* shews the sanitary works sanctioned after 1907 and now in progress.

*Statement III* shews projects the estimates for which are ready for submission to Government.

*Statement IV* shews schemes that have been drawn up but which have not yet been approved by the Sanitary Board pending the settlement of the question of the manner in which they are to be financed.

*Statement V* shews the sanitary works that will probably be executed during the next ten years together with the grants-in-aid that are likely to be sanctioned by Government.

7. The daily rate of water-supply provided for varies from 15 to 30 gallons per head per day in the case of large towns and cities and in most of the smaller ones it is from 5 to 15 gallons only. The actual consumption in the case of large cities has already exceeded the provision made and as the population increases and new drainage schemes are introduced or old ones extended there will be more demand for water in a few years. In the case of smaller towns also the introduction of drainage systems of some sort will soon become necessary and the existing water-supplies will be found defective and unsatisfactory and schemes for their improvement will soon become an urgent necessity.

8. In Guzerat the question of water-supply in many places is difficult and urgent. The water available is scanty and brackish. Surface catchment is usually out of the question owing to contamination by salt in the surface soil. Shallow wells are also impracticable for the same reason and on account of contamination from sewage and cultivation. There is, however, every likelihood of a good underground supply being tapped. Almost everywhere in Guzerat there is a fairly good sub-artesian supply and there is a strong belief that if borings are made deep enough even artesian supplies may be met with. Corroboration of the existence of sub-artesian supplies is obtained from the result of a few moderately deep bores that have been already made. The presence of sub-artesian supplies at two places like Broach and Sanand 123 miles apart is sufficient to justify the sinking of numerous borings in Guzerat. The Bombay, Baroda and Central India Railway have recently made a successful boring in Viramgaon and it is reported that the Railway Company have now an abundant supply of good water. Details about this boring are now being collected.

Government have purchased six complete plants for making borings 3 to 12 inches in diameter and 250 to 2,000 feet deep at a cost of ₹1,15,000. Part of the plant has just been received and a special Boring Engineer has been engaged. Work will soon be commenced at Broach, Dakor, Nadiad, Nandurbar, Borsad, Sabarmati, Viramgaon and Kharaghoda. At Dholka a 5-inch bore 124 feet deep has been made and a good sub-artesian supply of sweet water has been tapped. Water is being pumped up but chemical analyses shew that it may have to be filtered. The annual expenditure on deep boring will be about ₹50,000, and in a couple of years it will be settled once for all if sub-artesian supplies will offer a satisfactory practicable solution of the water difficulty in Guzerat.

9. *Large drainage works.*—At Ahmedabad over half of the city has been properly sewered. The sewage flows by gravitation to a pumping station from which place it is pumped up into a sewage main and brick outfall sewer on to a sewage farm of 351 acres. The total population now served is 90,000 only and the cost of the works up to date has been about 14·9 lakhs of rupees. The complete scheme aims at sewering a population of 150,000 at the rate of 30 gallons per head per diem, but as the population of Ahmedabad is now 216,000 owing to increased activity in mill industry, and as the consumption of water is greater than the sewers were originally designed to carry, the sewerage scheme will probably have to be supplemented in the near future with an additional main sewer to accommodate the extra supply.

At Karachi the Shone system of drainage is in use and serves a population of 44,600 out of a total of 159,270. The total outlay to date is 11·5 lakhs of rupees. The rising main ends in a sewage farm of 115 acres of which 50 to 60 acres are under sewage irrigation.

At Poona the works are in progress and are somewhat similar to those at Ahmedabad. The sewage is proposed to be treated in a septic tank. Interesting experiments are being conducted by an officer specially deputed for the purpose and a sum of ₹27,000 will be allotted for the expenditure required. The experimental sewage installation is on a fairly large scale and the objects which it is hoped to attain from it are generally as follows:—

(*a*) to ascertain the optimum period of stay in a septic tank for sewages of various strengths,

(*b*) to ascertain if this period can be shortened economically by use of other means such as hydrolytic chambers or macerating tanks or colloidors,

(*c*) to find the maximum amount of suspended matter in the tank effluent which can be efficiently dealt with by different forms of filtering material without clogging,

(*d*) to ascertain the proportion of nitrates in the filter effluent and the methods of treatment which will give the maximum quantity of nitrates, and

(*e*) to ascertain how far skilled supervision can be dispensed with in small installations.

It is expected that the results of these experiments which is the first of its kind in India and which will give reliable data for the designing and efficient working of installations for the disposal of sewage by the bacterial method in this country in future will become available before December 1912.

10. The duties of the Sanitary Engineer have so far been that of a consulting officer; he has only two large sanitary works under his direct supervision. The Pandharpur water-works and the Poona drainage and water-supply (improvements).

In addition to inspections, responding to consultations and preparing plans and estimates for important sanitary projects it is scarcely possible for the Sanitary Engineer to undertake the *execution* of works also. As calls increase it will be necessary to adequately increase his establishment to enable him to get up projects quickly and judging from the present experience of the amount of work he has to get through it is likely that the Sanitary Engineer will ever remain as a consulting officer. Works are necessarily conducted by Executive Engineers in charge of districts. Ordinarily Executive Engineers may not experience much difficulty in carrying out small sanitary schemes from designs and specifications furnished by the Sanitary Engineer, but it is the execution of details in both water-supply and sewerage works that success of the schemes depends, and the necessity of having such works executed under special expert supervision may soon become apparent.

N. BELVADI,
*Sanitary Engineer to Government, Bombay.*

POONA;
*The 6th November 1911.*

## STATEMENT No. I.

*Sanitary Works executed.*

| No. | Name of works. | Total expenditure incurred. | Remarks. |
|---|---|---|---|
| | | R | |
| | NORTHERN DIVISION. | | |
| 1 | Ahmedabad water-supply . . . . . | 8,95,166 | |
| 2 | Surat do. . . . . | 9,97,229 | |
| 3 | Rander do. . . . . | 1,36,000 | |
| 4 | Thana do. . . . . | 85,165 | |
| 5 | Bhîvandî do. . . . . | 35,554 | |
| 6 | Ahmedabad drainage . . . . . | 14,20,000 | |
| | CENTRAL DIVISION. | | |
| 7 | Poona City pipe distribution . . . . . | 3,15,321 | |
| 8 | Sholapur water-supply . . . . . | 2,17,184 | |
| 9 | Ahmednagar do. . . . . | 1,19,381 | |
| 10 | Pandharpur do. . . . . | 2,35,000 | |
| 11 | Dhulia do. . . . . | 4,17,000 | |
| 12 | Jalgaon do. . . . . | 1,70,897 | |
| | SOUTHERN DIVISION. | | |
| 13 | Satara water-supply . . . . . | 3,69,000 | |
| 14 | Hubli do. . . . . | 4,88,666 | |
| 15 | Pen do. . . . . | 30,565 | |
| | SIND. | | |
| 16 | Karachi water-supply . . . . . | 17,29,677 | |
| 17 | Hyderabad do. . . . . | 4,50,000 | |
| 18 | Sukkur do. . . . . | 3,73,735 | |
| 19 | Karachî drainage including farm . . . . . | 11,50,000 | |

N. BELVADI,
*Sanitary Engineer to Government, Bombay.*

POONA;
*The 6th November 1911.*

STATEMENT No. II.

*Sanitary Works in progress.*

| No. | Name of work. | Estimated amount. | Government grant-in-aid. |
|---|---|---|---|
| | | R | R |
| 1 | Sassoon Hospital sanitary improvements | 13,798 | 13,798 |
| 2 | Ahmedabad water-supply improvements | 1,75,113 | .. |
| 3 | Ahmedabad sanitary improvements | .. | 50,000 |
| 4 | Pandharpur water-supply works improvements | 4,28,042 | 4,27,745 |
| 5 | Pandharpur drainage | 2,00,659 | .. |
| 6 | Improvements to Hubli water-works | 5,48,189 | 1,99,357 |
| 7 | Dharwar water-works | 3,35,473 | 81,063 |
| 8 | Nasik water-works | 4,15,852 | 2,65,852 |
| 9 | Improvements to Sholapur water-works | 3,16,427 | 45,000 |
| 10 | Improvements to Hyderabad water-works | 2,95,888 | 58,000 |
| 11 | Bijapur water-works | 4,26,000 | 2,00,000 |
| 12 | Ratnagiri water-supply | 46,500 | 16,750<br>15,000 |
| 13 | Roha Ashtami water-supply | 15,750 | 6,167 |
| 14 | Aden water-works | .. | 50,000 |
| 15 | Poona water-supply and drainage | 17,42,023 | 3,25,000 |
| 16 | Bhusawal drainage | .. | 20,820 |
| 17 | Gogha water-supply | 3,535 | 1,767 |
| 18 | Kurla drainage | 48,000 | 24,000 |
| 19 | Sanitary improvements to Surat | .. | 50,000 |
| 20 | Sanitary improvements to Ahmedabad | .. | 50,000 |
| 21 | Sanitary improvements to Belgaum | .. | 53,022 |
| 22 | Sanitary improvements to Hubli | .. | 50,000 |

N. BELVADI,
*Sanitary Engineer to Government, Bombay.*

POONA;
*The 6th November 1911.*

## STATEMENT No. III.

*Sanitary Works Projects—estimates for which are ready for submission to Government.*

| No. | Name of work. | Proposed. | | | Remarks. |
|---|---|---|---|---|---|
| | | Amount of estimate. | Grant-in-aid recommended by the Sanitary Board. | Loan recommended by the Sanitary Board. | |
| | | R | R | R | |
| 1 | Igatpuri water-supply . . . | 1,14,894 | 40,000 | 75,000 | |
| 2 | Karad do. . . . . | 1,81,400 | 90,700 | 90,700 | |
| 3 | Lonavla do. . . . . | 3,72,401 | 1,60,000 | 2,00,000 | |
| 4 | Barsi do. . . . . | 4,72,788 | 2,30,000 | 2,30,000 | |
| 5 | Malegaon do. . . . . | 1,93,000 | 1,00,000 | 90,000 | |
| 6 | Improvements to Dhulia water-supply . | 69,000 | 30,000 | .. | |

POONA ;
*The 6th November 1911.*

N. BELVADI,
*Sanitary Engineer to Government, Bombay.*

## STATEMENT No. IV.

*Schemes drawn up but not yet approved by the Sanitary Board pending the question of the manner in which they are to be financed.*

| No. | Name of work. | Estimated amount. | Remarks. |
|---|---|---|---|
| | | R | |
| 1 | Thana water-supply . . . . . | 2,48,262 | |
| 2 | Matheran do. . . . . | 1,44,887 | |
| 3 | Bulsar do. . . . . | 3,50,000 | |
| 4 | Parola do. . . . . | 1,40,000 | |
| 5 | Yeola (Khirdisate) water-supply . . . . . | 4,78,000 | |
| 6 | Nandurbar water-supply . . . . . | 1,71,512 | |
| 7 | Godhra do. . . . . | 2,00,000 | |
| 8 | Sholapur sewerage . . . . . | 9,57,810 | |
| 9 | Nasik do. . . . . | 4,54,856 | |
| 10 | Thana do. . . . . | 84,548 | |
| 11 | Belgaum City and Cantonment sewerage . . . | 7,77,098 | |
| 12 | Surat sewerage . . . . . | 18,17,000 | |
| 13 | Dhulia do. . . . . | 1,63,000 | |
| 14 | Bandra do. . . . . | 4,63,000 | |

POONA ;
*The 6th November 1911.*

N. BELVADI,
*Sanitary Engineer to Government, Bombay.*

## STATEMENT No. V.

*List of sanitary works contemplated in the Bombay Presidency showing the amounts that are likely to be spent on them during the next ten years.*

| Serial No. | Name of project. | District. | Rough estimate of costs of contemplated projects. | Amounts of grants-in-aid. | | | | | | | | | | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1911-12. | 1912-13. | 1913-14. | 1914-15. | 1915-16. | 1916-17. | 1917-18. | 1918-19. | 1919-20. | 1920-21. | |
| | | | R | R | R | R | R | R | R | R | R | R | R | |
| 1 | Malegaon water-supply | Nasik | 2,00,000 | 20,000 | 30,000 | 50,000 | .. | .. | .. | .. | .. | .. | .. | |
| 2 | Yeola water-supply | Do. | 3,50,000 | 30,000 | 50,000 | 70,000 | 25,000 | .. | .. | .. | .. | .. | .. | |
| 3 | Dhulia water-supply improvements | West Khandesh | 1,00,000 | 25,000 | 25,000 | .. | .. | .. | .. | .. | .. | .. | .. | |
| 4 | Do. town drainage | Do. | 2,00,000 | 20,000 | 30,000 | 50,000 | .. | .. | .. | .. | .. | .. | .. | |
| 5 | Parola water-supply | East Khandesh | 1,50,000 | 10,000 | 20,000 | 20,000 | 25,000 | .. | .. | .. | .. | .. | .. | |
| 6 | Jalgaon drainage | Do. | 2,50,000 | 10,000 | 15,000 | 20,000 | 25,000 | 30,000 | 25,000 | .. | .. | .. | .. | |
| 7 | Dholka water-supply | Ahmedabad | 50,000 | 5,000 | 5,000 | 10,000 | 5,000 | .. | .. | .. | .. | .. | .. | |
| 8 | Surat sewerage | Surat | 20,00,000 | 50,000 | 1,00,000 | 1,00,000 | 1,00,000 | 1,00,000 | 2,00,000 | 2,50,000 | 1,00,000 | .. | .. | |
| 9 | Dakor water-supply | Kaira | 2,00,000 | 5,000 | 45,000 | 50,000 | .. | .. | .. | .. | .. | .. | .. | |
| 10 | Jalgaon do. | East Khandesh | 30,000 | 30,000 | .. | .. | .. | .. | .. | .. | .. | .. | .. | |
| 11 | Faizpur sanitary improvements | Do. | 30,000 | 30,000 | .. | .. | .. | .. | .. | .. | .. | .. | .. | |
| 12 | Karad water-supply | Satara | 2,00,000 | 25,000 | 50,000 | 25,000 | .. | .. | .. | .. | .. | .. | .. | |
| 13 | Barsi do. | Sholapur | 4,75,000 | 25,000 | 50,000 | 50,000 | 62,500 | 50,000 | .. | .. | .. | .. | .. | |
| 14 | Sholapur do. | Do. | 3,25,000 | 45,000 | .. | .. | .. | .. | .. | .. | .. | .. | .. | |
| 15 | Alibag do. | Kolaba | 26,500 | 13,250 | .. | .. | .. | .. | .. | .. | .. | .. | .. | |
| 16 | Lonavla do. | Poona | 4,00,000 | 25,000 | 50,000 | 50,000 | 25,000 | .. | .. | .. | .. | .. | .. | |
| 17 | Poona drainage and water-supply | Do. | 17,50,000<br>5,50,000 | 2,75,000 | 3,00,000 | 1,75,000 | .. | .. | .. | .. | .. | .. | .. | |
| 18 | Pandharpur water-supply | Sholapur. | .. | 2,475 | .. | .. | .. | .. | .. | .. | .. | .. | .. | |
| 19 | Nasik do. | Nasik | .. | 96,852 | .. | .. | .. | .. | .. | .. | .. | .. | .. | |
| 20 | Nandurbar do. | West Khandesh | 2,00,000 | .. | 20,000 | 30,000 | 50,000 | .. | .. | .. | .. | .. | .. | |

*List of sanitary works contemplated in the Bombay Presidency showing the amounts that are likely to be spent on them during the next ten years*—contd.

| Serial No. | Name of project. | District. | Rough estimate of costs of contemplated projects. | Amounts of grants-in-aid. | | | | | | | | | | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1911-12. | 1912-13. | 1913-14. | 1914-15. | 1915-16. | 1916-17. | 1917-18. | 1918-19. | 1919-20. | 1920-21. | |
| | | | R | R | R | R | R | R | R | R | R | R | R | |
| 21 | Bhusawal water-supply | East Khandesh | 2,00,000 | .. | 10,000 | 20,000 | 20,000 | 20,000 | 30,000 | .. | .. | .. | .. | |
| 22 | Rander town drainage | Surat | 2,00,000 | .. | 25,000 | 25,000 | 25,000 | 25,000 | .. | .. | .. | .. | .. | |
| 23 | Broach water-supply | Broach | 15,00,000 | .. | 25,000 | 50,000 | 1,00,000 | 1,00,000 | 1,00,000 | 3,00,000 | 75,000 | .. | .. | |
| 24 | Godhra do. | Panch Mahals | 2,00,000 | .. | 10,000 | 20,000 | 20,000 | 50,000 | .. | .. | .. | .. | .. | |
| 25 | Dohad do. | Do. | 1,00,000 | .. | 20,000 | 20,000 | 10,000 | .. | .. | .. | .. | .. | .. | |
| 26 | Uran do. | Kolaba | 4,00,000 | .. | 50,000 | 50,000 | 50,000 | 50,000 | .. | .. | .. | .. | .. | |
| 27 | Ahmednagar do. | Ahmednagar | 6,00,000 | .. | 50,000 | 1,00,000 | 1,25,000 | 25,000 | .. | .. | .. | .. | .. | |
| 28 | Nadiad do. | Kaira | 3,00,000 | .. | .. | 20,000 | 30,000 | 30,000 | 30,000 | 40,000 | .. | .. | .. | |
| 29 | Matheran do. | Thana | 1,50,000 | .. | .. | 25,000 | 25,000 | 25,000 | .. | .. | .. | .. | .. | |
| 30 | Sukkur do. | Sukkur | 1,50,000 | .. | .. | 37,500 | 37,500 | .. | .. | .. | .. | .. | .. | |
| 31 | Malegaon town drainage | Nasik | 2,00,000 | .. | .. | .. | 20,000 | 30,000 | 50,000 | .. | .. | .. | .. | |
| 32 | Yeola do. | Do. | 2,50,000 | .. | .. | .. | 25,000 | 50,000 | 50,000 | .. | .. | .. | .. | |
| 33 | Nandurbar do. | West Khandesh | 2,00,000 | .. | .. | .. | 25,000 | 25,000 | 50,000 | .. | .. | .. | .. | |
| 34 | Dakor do. | Kaira | 1,50,000 | .. | .. | .. | 25,000 | 25,000 | 25,000 | .. | .. | .. | .. | |
| 35 | Godhra do. | Panch Mahals | 1,50,000 | .. | .. | .. | 25,000 | 25,000 | 25,000 | .. | .. | .. | .. | |
| 36 | Islampur water-supply | Satara | 2,50,000 | .. | .. | .. | 25,000 | 50,000 | 50,000 | .. | .. | .. | .. | |
| 37 | Belgaum do. | Belgaum | 13,00,000 | .. | .. | .. | 50,000 | 1,00,000 | 2,00,000 | 2,00,000 | 1,00,000 | .. | .. | |
| 38 | Nipani do. | Do. | 1,00,000 | .. | .. | .. | 25,000 | 25,000 | .. | .. | .. | .. | .. | |
| 39 | Parola town drainage | East Khandesh | 50,000 | .. | .. | .. | .. | 10,000 | 15,000 | .. | .. | .. | .. | |
| 40 | Viramgaon water-supply | Ahmedabad | 2,00,000 | .. | .. | .. | .. | 20,000 | 30,000 | 30,000 | 20,000 | .. | .. | |
| 41 | Broach town drainage | Broach | 10,00,000 | .. | .. | .. | .. | 1,00,000 | 1,00,000 | 1,00,000 | 2,00,000 | .. | .. | |
| 42 | Dohad drainage | Panch Mahals | 50,000 | .. | .. | .. | .. | 10,000 | 10,000 | 5,000 | .. | .. | .. | |
| 43 | Nasik do. | Nasik | 2,50,000 | | | | | 62,500 | 62,500 | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 45 | Dhanduka water-supply . . | Ahmedabad . | 2,00,000 | .. | .. | .. | .. | .. | 20,000 | 30,000 | 30,000 | 20,000 | .. |
| 46 | Nadiad town drainage . . . | Kaira . . | 2,00,000 | .. | .. | .. | .. | .. | 25,000 | 25,000 | 50,000 | .. | .. |
| 47 | Thana water-supply . . . | Thana . . | 2,50,000 | .. | .. | .. | .. | .. | 50,000 | 50,000 | 25,000 | .. | .. |
| 48 | Dholka town drainage . . . | Ahmedabad . | 30,000 | .. | .. | .. | .. | .. | .. | 5,000 | 10,000 | .. | .. |
| 49 | Gogha water-supply . . . | Do. . | 10,000 | .. | .. | .. | .. | .. | .. | 5,000 | .. | .. | .. |
| 50 | Do. town drainage . . . | Do. . | 6,000 | .. | .. | .. | .. | .. | .. | 3,000 | .. | .. | .. |
| 51 | Barsi drainage . . . . | Sholapur . | 1,25,000 | .. | .. | .. | .. | .. | .. | 12,500 | 50,000 | .. | .. |
| 52 | Thana do. . . . . | Thana . . | 1,00,000 | .. | .. | .. | .. | .. | .. | 50,000 | .. | .. | .. |
| 53 | Kelwa-Mahim water-supply . . | Do. . . | 1,50,000 | .. | .. | .. | .. | .. | .. | 37,500 | 37,500 | .. | .. |
| 54 | Amalner do. . . | East Khandesh | 40,000 | .. | .. | .. | .. | .. | .. | .. | 10,000 | 10,000 | .. |
| 55 | Viramgaon town drainage . . | Ahmedabad . | 1,00,000 | .. | .. | .. | .. | .. | .. | .. | 20,000 | 30,000 | .. |
| 56 | Bulsar water-supply . . . | Surat . . | 3,50,000 | .. | .. | .. | .. | .. | .. | .. | 50,000 | 50,000 | 75,000 |
| 57 | Do. town drainage . . . | Do. . . | 1,50,000 | .. | .. | .. | .. | .. | .. | .. | 25,000 | 25,000 | 25,000 |
| 58 | Sholapur drainage . . . | Sholapur . | 10,00,000 | .. | .. | .. | .. | .. | .. | .. | 1,00,000 | 2,00,000 | 2,00,000 |
| 59 | Yellamma water-supply . . | Belgaum . | 3,00,000 | .. | .. | .. | .. | .. | .. | .. | 50,000 | 50,000 | 50,000 |
| 60 | Belgaum drainage . . . | Do. . | 8,00,000 | .. | .. | .. | .. | .. | .. | .. | 1,00,000 | 1,00,000 | 2,00,000 |
| 61 | Dhanduka town drainage . . | Ahmedabad . | 1,00,000 | .. | .. | .. | .. | .. | .. | .. | .. | 25,000 | 25,000 |
| 62 | Ankleshwar water-supply . . | Broach . . | 1,00,000 | .. | .. | .. | .. | .. | .. | .. | .. | 25,000 | 25,000 |
| 63 | Do. drainage . . . | Do. . . | 50,000 | .. | .. | .. | .. | .. | .. | .. | .. | 10,000 | 15,000 |
| 64 | Gokak water-supply . . . | Belgaum . | 50,000 | .. | .. | .. | .. | .. | .. | .. | .. | 12,500 | 12,500 |
| 65 | Panvel drainage . . . . | Kolaba . . | 1,00,000 | .. | .. | .. | .. | .. | .. | .. | .. | 25,000 | 25,000 |
| 66 | Bandra sewage . . . . | Thana . . | 4,75,000 | .. | .. | .. | .. | .. | .. | .. | .. | 1,37,500 | 1,00,000 |
| 67 | Borsad water-supply . . . | Kaira . . | 50,000 | .. | .. | .. | .. | .. | .. | .. | .. | .. | 25,000 |
| 68 | Do. town drainage . . . | Do. . . | 30,000 | .. | .. | .. | .. | .. | .. | .. | .. | .. | 15,000 |
| 69 | Sarsa water-supply . . . | Do. . . | 10,000 | .. | .. | .. | .. | .. | .. | .. | .. | .. | 5,000 |
| 70 | Do. town drainage . . . | Do. . . | 6,000 | .. | .. | .. | .. | .. | .. | .. | .. | .. | 3,000 |
| | TOTAL . | ... | 2,02,68,500 | 7,42,577 | 9,80,000 | 11,17,500 | 9,80,000 | 10,37,500 | 11,57,500 | 11,53,000 | 10,57,500 | 7,20,000 | 8,00,050 |

C. N. MANDY, C.E.,

N

## APPENDIX 3.

### OPENING UP OF CONGESTED AREAS.

*With Rules for new Town Extension Sites and Buildings.*

Under section 180 of the Madras District Municipalities Act every person wishing to construct a building must submit (*a*) a statement showing the dimensions of the building and the levels at which it is intended to lay the foundation and lowest floor, and (*b*) a statement shewing the means of ventilation and drainage and the privies which it is intended to provide.

No type design is insisted on and the result is that the owner builds the house according to his own plan which the Municipal Council, as long as it satisfies (*a*) and (*b*) of this section, approve of, or if after six weeks the license is not granted the applicant may proceed to construct the building. Under this Act the Municipal Council has no power to enforce its ruling.

This office has issued the attached rules for the guidance of Chairmen of Municipal Councils in laying out of new sites for buildings. These are now under the consideration of the local Government.

The Sanitary Engineer has drawn up a plan for a cheap native house (type design). A further improvement is under consideration to make the house rat proof. This I consider is very necessary especially in localities where congested areas are receiving attention on account of the outbreak of plague and where new town sites are being laid out to provide accommodation for the people who have been compelled to vacate their houses. The Sanitary Board has issued a type design for town extension.

No provision exists in the Act as it stands for improving already constructed houses, *e.g.*, if an entrance to a backyard for cleansing purposes is required there is no legal power to compel the owner to do this.

W. A. JUSTICE, *Captain, I.M.S.*

### POINTS TO BE OBSERVED IN LAYING OUT TOWN EXTENSION SITES AND THE PLOTTING AND CONSTRUCTION OF HOUSES.

*In laying out* a site into house plots the following points should receive attention :—

(1) Roads and streets should be marked out on the site and as far as possible they should be made to run straight crossing one another at right angles. The main roads should be 36′ in width exclusive of lateral drains which should be $2\frac{1}{2}' \times 2'$. The secondary streets should be 24′ in width exclusive of lateral drains which should be $2' \times 1\frac{1}{2}'$. The roads should be metalled all over from side to side not merely in the centre.

(2) Conservancy lanes 8′ to 10′ in width should be formed along the backs of houses to enable the conservancy carts and scavengers to enter for the purpose of cleansing backyards of houses and for laying of drainage pipes in the event of the town being ultimately provided with under-ground drainage.

(3) Impervious U shaped storm water drains without joints should be provided in streets. They should not on any account be rectangular. If built of Cuddapah slab their joints should be well cemented. The sides of the drain sloping to a U shaped bottom should be made of cement.

(4) Storm water drains along streets should be at a distance of 3′ from the outside front of house blocks.

(5) Open masonry U shaped drains $1\frac{1}{2}' \times 1'$ should be provided on both sides of the conservancy lanes.

(6) The formation of roads, streets and drains must form part of the scheme for laying out the site and should be taken in hand along with the execution of the scheme instead of deferring it to a future date until funds are available which may mean anything or nothing.

(7) Suitable places for the construction of public latrines should be selected and set apart for the purpose.

(8) Where there is no piped water-supply, places should be selected for the sinking of wells.

(9) The site should be plotted giving size for house sites to be sold by auction. The width of the house sites should be 45′ and the length 60′ as a rule subject to alteration in particular cases. These plots should be sold under certain conditions which shall be definitely stated on the sale deed binding the buyer to carry them out under penalty of the sale being cancelled if the conditions are infringed.

(10) The purchasers of the building sites shall build their houses within one year of their purchase, otherwise they will forfeit their right to property without any compensation unless the Municipal Council thinks of granting them a fresh period considering the circumstances of each case.

(11) The sub-division of plots and the erection of more than one house in each plot should be forbidden.

(12) Houses should be constructed with frontage facing the roads and streets.

(13) The construction of back to back houses should be strictly prohibited. The formation of conservancy lanes as stated in (2) will prevent this.

(14) No thatched houses or out-house shall, under any circumstances, be allowed to be built.

(15) The main walls of the house shall not be less than 10′ high. The eaves must not be less than 8′ above the plinth.

(16) The house shall be built on a basement of at least 2′ from the ground. Wherever possible the basement should be masonry or of some rat proof material.

(17) The backyards of houses shall be provided with a gateway for municipal officers to inspect the same and for the entry of the sweeper when necessary.

(18) The backyards should be provided with a suitable impervious bathing platform for the inmates of the house. Each house shall be provided with a latrine of a standard pattern supplied by the municipal office. A plan of a cheap house latrine can be obtained on application to the Sanitary Engineer. The nightsoil must be capable of removal by way of the lane at the back of the house.

(19) All the sullage and bath water of the house should be drained towards the backyard. It should pass through the wall into the municipal drain constructed in the lane behind the house. It should not be let into the storm water drain in front of the house.

(20) Before any house is built a plan of it must be submitted to the Council for scrutiny and sanction for each building and unless the Council's sanction is obtained for the plan no house is to be commenced.

(21) Each house must be sufficiently ventilated by providing suitable windows in each room.

(22) All cattle yards should be flagged and properly drained.

(23) The compound of houses should be enclosed with pucca walls.

(24) A stringent requirement should provide that no buyer shall remove soil from his plot for building or any other purpose.

(25) Parties wishing to purchase house sites should agree to these rules before possession of the land is given.

W. A. JUSTICE, *Captain, I.M.S.*

## APPENDIX 4.

### SHORT NOTE ON TOWN-PLANNING IN SALSETTE ISLAND.

The Bombay Government propose to introduce shortly a Town-Planning Act for developing the Bombay suburbs in Salsette Island which adjoins Bombay on the north. Details of town-planning schemes are being worked out by a special officer deputed for the purpose and the method being followed is similar to that contained in the German Act, the Lex Adikes, whose principal virtues lie in obviating as far as possible the necessity of raising capital and in providing for the redistribution of existing plots so as to render them more suitable for building purposes.

The method briefly described is as follows:—

All land within the area being planned is pooled and the local authority takes all land required for roads, markets and other public sites and the remaining land is divided into suitable building plots and allotted to the original holders. The allotted plots are distributed, as far as possible, in the same proportion as the original ownership. The main portions of the allotted plots are kept, as far as possible, in the same position as the original plots so as to reduce displacements of existing holdings to a minimum. All rights in the original plots are transferred, where possible, to the allotted plots and in other cases are extinguished by cash compensation or otherwise. All expenses incidental to re-distribution and all costs of constructing roads and other works included in a scheme are obtained by a loan. Interest and sinking fund charges are met by the levy of a development tax upon owners in proportion to the individual benefits derived from the operation of the scheme. The benefit derived is found by estimating the "unearned increment" accruing to each holding on completion of the scheme. The estimate is liable to a certain amount of error, but, where the price of land is not too high, a slight error will not affect very materially the pockets of the holders.

2. The method above described may be applied to large or small schemes and to large or small areas. It can be applied to the construction of a single road or even to the mere re-arrangement of plots neighbouring an existing road, and it may be applied to a large area for the purpose of acquiring all land required for public purposes. The method has been worked out on paper for an area of about one square mile at Santa Cruz, a suburb on the Bombay, Baroda and Central India Railway about 12 miles from the Fort, Bombay, and a scheme has been tentatively drawn up which provides for the re-distribution of plots, the construction of roads and provision of lands for a park, a dispensary, a municipal office, schools, a police station and a recreation ground. The individual cost in most cases in land and cash for all these benefits is estimated to be under 30 per cent. of the present undeveloped value of a holding. A small scheme, such as the construction of a single road, can be carried out, in a year and the whole development tax can be at once levied from all holders, but for a large scheme, where some years may elapse before all constructional works are completed, a portion of the tax need only be required from owners until those works which materially better their holdings are taken in hand.

E. G. TURNER, *I.C.S.*,
*Special Officer, Salsette Building Sites.*

## APPENDIX 5.

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### NOTE ON REDISTRIBUTION OF PLOTS AND CALCULATION OF DEVELOPMENT TAX IN TOWN-PLANNING SCHEMES.

"Redistribution" may be defined as the pooling of plots of land belonging to different owners and the allotment to them, after making provision for lands required by the local authority, of plots reconstituted in more convenient form for building sites.

The reconstituted or allotted plots will all be provided with access on roads, either existing or proposed. The area for allotment of plots will be the original area included in the scheme diminished by the land taken for roads and other public purposes, so that, in general, the allotted plots will be of smaller area than their corresponding original plots. When roads are actually constructed an allotted plot will increase in value, and the amount of such increase measures the 'unearned increment,' from which the costs of construction and other expenses of a scheme should be defrayed. The difference in value at any particular instant—such as at the date of a notification—between an original plot and its corresponding allotted plot, valued without reference to future improvements contemplated in a development scheme, represents a material contribution in land by the plot holder of which account must be taken in calculating the dues leviable. If the allotted plot as so valued is of less value than the corresponding original plot, the plot holder must be given credit for the difference, and if of greater value, then the plot holder must be debited with the difference. In this way, credit is given for the value of any land taken from an original plot; and debit is made for the value of any land added to it. No cash on this account passes between the holder and the local authority, but debit and credit are made against the holder's contribution for constructional and other expenses of the scheme. A holder's contribution share should be proportional to the amount of his 'unearned increment' *i.e.*, to the difference in values of his *allotted* plot, when valued without reference to future developments, and when valued on the assumption that the scheme has been completed. The former may be called the 'undeveloped' value and the latter the 'developed' value of the allotted plot. The developed value is only an estimate, it is true, but any slight error in the estimate will not affect a holder's pocket very materially unless the price of land is very high. The expenses of a scheme must include the nett total difference in value between all the original plots and the undeveloped values of all the allotted plots, for this difference represents an immediate and material contribution in land to the scheme by the holders and its value should be shared by all in proportion to their 'unearned' increments.

2. The above method of calculating the contribution share is *absolutely independent* of the system on which the reconstituted plots are allotted; for every holder is given full credit for the present value of the land taken from him.

The German Act (Lex Adikes) lays down that plots should be allotted *as far as possible* in proportion to original ownership.

If the proportion refers to relative *areas* there is necessarily a large displacement of plots, that is to say many of the allotted plots cannot be in the same position as the main portions of their corresponding original plots, and if the proportion refers to relative *values* it is often a hopeless puzzle to arrange so that the developed values of the majority of the allotted plots bear *inter se* anything like the same ratios as the values of the original plots bear to one another. Only in a homogeneous tract of undeveloped land is there a chance of successfully allotting plots bearing *inter se* as far as possible either given proportional areas or given proportional values.

For a successful redistribution the main portions of the allotted plots should be generally in the same positions as the main portions of their corresponding original plots or in other words plots should be displaced as little as possible. Whole plots included in land required for roads and other public purposes must be displaced, but other plots should keep their position as far as possible. No hard and fast rule need be laid down for the way in which the reconstituted plots should be allotted, but the allotment should be made in consultation with the holders and should be approved either by the holders of the major portion of the area considered or by a controlling authority or by both.

3. Simple *example* showing the above method for calculating the contribution share.

Three plots X, Y, Z are to be developed by the construction of a road costing 900 rupees, the costs of preparing the scheme being 100 rupees:

| Plot. | Value of original plot. | Value of allotted plot. | | Unearned increment 4—3. | Difference between columns 3 & 2. |
|---|---|---|---|---|---|
| | | Undeveloped. | Developed. | | |
| 1 | 2 | 3 | 4 | 5 | 6 |
| | ₹ | ₹ | ₹ | ₹ | ₹ |
| X | 100 | 80 | 200 | 120 | —20 |
| Y | 200 | 250 | 600 | 350 | 50 |
| Z | 300 | 250 | 350 | 100 | —50 |
| Total . | 600 | 580 | 1,150 | 570 | —20 |

To find the dues leviable upon X, credit must be given for ₹20 (column 2—column 3) and it must bear in proportion to its unearned increment (column 5) a share of the total expenses ₹1,000, and also a share of the nett difference between the values of the original and undeveloped allotted plots, *i.e.*, ₹20 (column 6). That is to say the contribution leviable on X is—

₹

$$-20 + \frac{120}{570}(1{,}000 + 20) \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad = 194{\cdot}74$$

In the same way Y's share is—

$$+50 + \frac{350}{570} \times 1{,}020 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad = 676{\cdot}32$$

and Z's share is—

$$-50 + \frac{100}{570} \times 1{,}020 \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad = 128{\cdot}95$$

Total . 1,000

4. *Development tax.*—Instead of levying the full contribution at once from each holder, the whole sum required for expenses can be borrowed and a percentage of each holder's contribution levied annually sufficient to pay interest and sinking fund charges on the loan. This percentage of contribution is the *development tax*. In small schemes where all constructional works are likely to be completed within a year, the full development tax can be levied simultaneously from all holders, but in larger schemes where constructional works are likely to take some time to complete, then it will only be necessary to meet in each year the sum required for works to be undertaken in that year. In this case a portion only of the development tax need be levied on those allotted plots which have not materially benefited by the works already constructed. *To take a concrete example:*—Suppose there are 100 plots and the total expenses are 50,000 rupees of which 10,000 rupees must be met at once and 40,000 rupees are for new roads. Then the full development tax is found by distributing the 50,000 rupees amongst all allotted plots in the proper proportion. But if it be only possible to construct roads each monsoon, to the extent of 10,000 rupees the scheme will take 4 years to complete and there is no need to raise more than 10,000 each year for new roads. The 10,000 rupees to be met at once can be obtained by levying $\frac{1}{5}$th full development tax on all allotted plots, and the 10,000 rupees required annually for new roads can be obtained by levying the full tax upon those allotted plots which front the roads constructed during the year. If the full tax levied upon such frontage plots is not sufficient to raise the 10,000 rupees required, the general tax of $\frac{1}{5}$th can be increased and if the full tax on frontage plots exceeds the 10,000 rupees required then the requisite proportion of the full tax need only be levied on the frontage plots, the levy of the difference being deferred until it is required. Even whilst paying the $\frac{1}{5}$th development tax the holders are distinctly benefited, for they will all possess saleable plots suitable for building and upon which building will be allowed and will all have proper access to their plots over public land.

5. *Compensation by debentures.*—It may happen that a holder's share of expenses is less than the difference in value between his original and undeveloped allotted plot or in other words is less than the value of his contribution in land. In such a case instead of paying a development tax to the local authority the holder will have to be compensated. He can either be paid cash down, or be given a debenture guaranteeing him interest and sinking fund charges on the amount to be paid to him. The issue of such a debenture will reduce the capital to be raised in the open market. Full security, however, is present whether compensation is paid to such a holder either in cash or by debenture.

*Example.*—The contribution leviable from A, B, C, D are as follows:—

| | ₹ |
|---|---|
| A | 500 |
| B | 600 |
| C | —300 |
| D | 200 |
| | 1,000 nett. |

If C is compensated at once, a capital of ₹1,300 will have to be raised on the security of the amounts due from A, B, D. If C is compensated by debenture only 1,000 rupees capital would have to be raised in the open market, and interest and sinking fund charges would be collected from A, B, D as before on ₹1,300 by means of a development tax.

The system of payment by debentures is capable of extension, and some persons would possibly prefer being paid by a saleable debenture ensuring steady interest, instead of being paid cash down.

6. *Incidence of taxation.*—The development tax should be fixed for each allotted plot, so that when a plot is sold a purchaser will know exactly with what taxes the plot is burdened. Some holders may have several separate original plots and it may not be possible to allot a separate plot for each original plot. In such a case the total contribution of the holder can be calculated and distributed over his allotted plots in proportion to their unearned increments.

*Example.*—A holder has plots of the following value:—

| Value of original plot. | Undeveloped value of allotted plot. | Developed value of allotted plot. | Unearned increment, 3—2. |
|---|---|---|---|
| 1 | 2 | 3 | 4 |
| ₹ | ₹ | ₹ | ₹ |
| 1,000 | 2,000 | 3,000 | 1,000 |
| 2,000 | 4,000 | 7,000 | 3,000 |
| 3,000 | 2,000 | 5,000 | 3,000 |
| 4,000 | ..... | ..... | ..... |

If the holder's contribution is ₹700 then it will be divided amongst the allotted plots in the proportion of 1,000: 3,000: 3,000, *i.e.*, the burden on the plots will be ₹100, ₹300 and ₹300 respectively.

7. Formula for calculating contribution share:—

Let

$a_o$ = Value of original plot.

a = Undeveloped value of allotted plot.

A = Developed value of allotted plot.

X = Constructional and all expenses of the scheme debitable to holders other than the nett compensation to be credited to holders for land surrendered. (*Vide* para. 1.)

The holder's contribution share is equal to—

$$(a - a_o) + \frac{A - a}{EA - Ea}[X + E(a_o - a)]$$

where E is a symbol representing the sum total of the quantities of the type to which it is joined. The fraction $\frac{X + E(a_o - a)}{EA - Ea}$ forming a portion of the second member of the expression is easily calculated for any particular scheme, and remains constant in calculating the share of each and every holder. If we denote this fraction by K then the share is equal to $(a - a_o) + K(A - a)$ which simply means that a holder is given credit for the present value of the land he surrenders $(a - a_o)$, and pays the proportion K of his unearned increment (A— a) towards the expenses of the scheme. The nett total of all contributions is equal to X. If *A* and *a* are proportional to $a_o$, that is to say, if the developed and undeveloped values of an allotted plot are each proportional to the value of the original plot then the contribution share is proportional to the value of the original plot, and if these proportions obtain in respect of all the plots then there is no need to value the allotted plots as undeveloped. In a small scheme therefore, such as the construction of a small accommodation road where it may happen that all original plots are reduced at once in value in the same proportion, and when they all increase in value in the same proportion on completion of the scheme, the contribution shares can be found by dividing up expenses in proportion to the differences between the

developed values of the allotted plots and the values of their corresponding original plots.

8. *Practical application* of this method of allotting plots and calculating the development tax has been made tentatively on paper to a large partially developed area, about one square mile at Santa Cruz, a suburb of Bombay. This scheme comprises the acquisition and construction of about 3 miles of roads of varying widths and 1 mile of sweepers passages 10 feet wide. The public sites for acquisition comprise those for—

a Park.
Municipal Office,
Dispensary,
Girls' and Boys' Schools,
Police station,
Market,
Lawn Tennis ground,
Dharmshalla,

and the existing roads are widened where necessary. After allowing for possible local fund and Government grants the nett total cost of the scheme to be met by holders is estimated at ₹1,50,000. The capital to be raised is calculated at ₹1,52,000, the extra ₹2,000 representing compensation to be paid to those holders whose contribution in land is greater than their share of expenses (*vide* para. 5 above). The construction of roads will probably take five years to complete, and the initial expenses can be met and road construction started by the levy of 12 per cent. only of the full development tax. A holder's full contribution in land and cash together is found to be about $\frac{1}{3}$rd or less of the present value of his original plot, and the ratio of such contribution to the increase in the value of his holding, *i.e.*, to the difference between the developed value of his allotted plot and the value of his original plot, is found not to exceed 60 per cent. In most cases it is much less.

9. In conclusion it must be stated that the method of calculation described in this note has not yet been sanctioned. A Town-planning Bill has not yet been brought forward in the Bombay Legislative Council. Many methods of calculation have been tried on paper, but the method above described is the one which in my humble opinion is practical, and provides *an absolutely equitable system* of distributing expenses.

E. G. TURNER, *I.C.S.*,
*Special Officer, Salsette Building Sites.*

## APPENDIX 6.

### TOWN-PLANNING.

Town-planning.

I may think that there is one direction in which the functions of municipalities might most usefully be extended, which has not been touched on by the Decentralisation Commission—and this is by giving them power to frame and carry out town-planning schemes for growing towns.

In no direction is there room for substantial advance in dealing with the problems of sanitation comparable with this. All large towns of which I have had experience are hemmed in by insanitary quarters which have been allowed to grow up with no attempt at control, and which are very often the starting grounds for plague. Cawnpore is an instance of what ought not to be done. There the land which should have been earmarked for the extension of the town has been cut up by endless brickfields, with the result that a huge population is crammed into an altogether inadequate space. Control of town development is essential alike in the interests of Government or the local authority, of the ordinary residents and of landowners. In the interests of Government or the local authority so that it may not be necessary in future to pay enormous sums for the main lines of communications and open spaces. And in the interests of landowners because the present want of system leads to an enormous divergence of values between land sites where the land may fetch almost any price, and land in the immediate neighbourhood which has only an agricultural value; whereas a well considered scheme of town-planning would distribute values, prevent the piling up of monopoly values in the centre and spread the population and rise of rents over a larger circle.

I would submit that what is required is a Town-planning Act applicable to any area in which it may be desirable to control and regulate the expansion of a growing town. A Town-planning Bill is already under consideration in Bombay and legislation on similar lines was advocated for the United Provinces by the Sanitary Conference which included among its members many representative Indian gentlemen. A great deal of experience has been gained lately in western countries which should guide the lines on which advance can be made, and particularly in Germany and Sweden and lately in England.

The general principle of a town-planning scheme is that a scheme is prepared for a given area, distributing the land with which it is concerned to such and such uses, that this scheme is notified and discussed and settled, and that after it is settled owners are bound to conform to it.

The following suggestions follow in the main the lines on which it is proposed to legislate in Bombay, and the proposals of the Sanitary Conference.

A local authority would be constituted for an area in which any land is, or is likely to be used for building purposes. This body might either be the Municipal Council (as is proposed in Bombay) or the council *plus* representatives of Government, the landowners and other persons interested. There are strong reasons for constituting a special body to deal with these schemes. A municipal body should be adequately represented, but this could be insured by the local Government. The commission themselves recommend in certain cases the co-operation of outside interests on sub-committees. Otherwise the co-operation of landowners and of all interested should be ensured by frequent conferences at every stage of the scheme. This is the plan adopted in England (under regulations prescribed by the local Government Board) and proposed in Bombay.

In Germany a period of 30 years ahead is taken for this.

The local authority would be subject to the controlling authority, which would presumably, at any rate until experience had been gained, be the local Government.

The local authority would frame a scheme for the area, either *ipso motu* or at the requisition of the inhabitants or of* the local authority. The fullest publicity should be given to the scheme at every stage; and in particular notice served on every owner. This again is secured in England by regulations framed by the Board. (In England landowners have power themselves to frame and propose a scheme, and if the local authority fail without due cause to adopt it, they may be compelled to do so after public enquiry by the Board.)

* Power to require a local body to frame or adopt a scheme is given in England to the local Government Board (*vide* Appendix A).

The scheme when completed would be submitted to the controlling authority which might approve, modify or reject it.

Full provision for hearing parties interested should be made at each stage. (In England before the scheme is finally approved by the local Government Board notice of intention to do so must be published; and on due objection by any person interested the scheme must be laid before both Houses of Parliament for 30 days, and may be rejected by an address of either House.)

After approval the scheme would be notified, and all subsequent buildings or works in contravention thereof absolutely prohibited.

Each scheme would provide for the construction of roads and communications, the construction and alteration of bridges, etc., the plotting out of land as building sites whether intended for building in the immediate future or not; the reservation of land for open spaces, gardens, recreation grounds, schools, markets and public buildings of all sorts; drainage, lighting and water-supply; the rates of assessment and the incidence of the development tax on building sites and other lands; redistribution of sites, and compensation payable to persons whose property is injuriously affected by the scheme and any contribution payable by owners on account of increase in value of their property caused by expenditure of public money in the operation of the scheme.

* In the first instance the work of development would be financed by loans secured by the proceeds of a development tax; this tax would be assessed on all lands included in the scheme, and be leviable at the expiration of a prescribed period after the notification of the scheme. The levy of the tax on any land included in the scheme might be deferred by the local authority, with the consent of the controlling authority. This would provide for the case of occupants wishing to preserve their agricultural holdings, as such, intact, and to avoid payment of increased charges, provided the exclusion of such land does not vitiate the general planning of an area which the majority of owners desire. The rates and incidence of the tax would be fixed by the local authority with reference to the total cost of the scheme and probable enhancement of value of properties included in each scheme. The local authority would be given power to borrow under the Local Authorities Loan Act, 1879.

These are the Bombay proposals.

After notification of the scheme power would be taken to absolutely prohibit building on any land within the area except in accordance with an approved plan and under such conditions as regards building as may be imposed by the local authority. If any person erects or proceeds with any building within a notified area after notification of the scheme, the local authority may demolish without compensation, recovering the cost from the person in fault.

Power would be given subject to the consent of the controlling authority to pool and redistribute after deducting lands for roads and open spaces all land of different owners who wish to develop and sell or build on their agricultural lands, but cannot sell the land as at present distributed in plots suitable for building on the approved plan. Such redistribution would be made if the owners of more than half the plots agreed. This is on the lines of the German *Lex adikes*, the object being to avoid compensation in cash by exchange of lands and to facilitate agreement between numerous small owners. The general principle followed is to plan large areas in close consultation with the parties concerned, and to take free up to a fixed limit the land required for future municipal purposes. The remaining land is redistributed in suitable building blocks to the original owners. The land which the owners receive, though smaller in area, has a greatly enhauced value, and the rates of the future municipality are saved a very heavy burden. If the loss by transfer of land to the municipality exceeded the profit from the enhanced value of the remaining property, compensation would be made by reduction or remission of the development tax leviable.

Planning building plots on land with diversified ownership (as particularly is the case in India) connotes some scheme for inducing agreements between owners. In England the power of the responsible authority to make agreements with owners and of owners to make agreements with one another is to be regulated under the fourth schedule of the Act by general provisions prescribed by the local Government Board. In Germany where town-planning has been an accomplished fact since 1875 it has been found necessary to take power to pool and redistribute such land, and nothing short of this would probably be effective in India. The provision that redistribution should only be possible if a majority of landowners so decide is incorporated in the proposed Bombay Act. Planning must be done with care so as to avoid unnecessary redistribution, but if the majority refuse, planning must be postponed, and with it all sales for building purposes and building until they change their minds. This may temporarily retard development, but obstacles should be overcome by the due publication of provisional schemes.

Compulsory powers of acquisition would be given for land required for main communications, open spaces or other objects or works of a public nature, and also for acquiring a reasonable amount of frontage on the lines of main communications. Power

* The suggestions as to a development tax and the power to be taken to redistribute properties, are taken from a note by Mr. Mead, who was deputed on special duty by the Bombay Government in connection with this subject.

should also be given to acquire compulsorily the land of recalcitrant owners refusing to build on, or to let or sell for building purposes land urgently required for the development scheme.

In England in the Bill as originally brought in it was proposed that if compensation were payable to any person on account of injury caused to his property by the operation of the scheme, the whole of this might be recovered if at the same time other property of the same owner had been increased in value (up to the amount of such increase). This was subsequently modified and extended, and under the Bill as passed the local authority is entitled within a limit of time to recover one half of the increase in value in any property caused by the operation of the scheme. The arguments against this somewhat stringent enactment will be found in Appendix A in which I have given the main proposals of the English Bill. This particular clause goes beyond the conclusion reached by the committee on Town Sites—that the local authority is entitled to a share in that portion of the increase in values which has clearly been caused by the expenditure of public money. Obviously the rise in value might be brought about mainly by private expenditure on sewers, roads and buildings, and the local authority by the mere automatic introduction of a scheme would benefit to the extent of one half. (The whole was originally proposed, but a compromise was reached on the lines indicated.)

The acquisition of frontages on the main roads would, on the other hand, afford a simple and automatic means of enabling the local authority to share in the rise of values caused clearly by the expenditure of public funds, and it would materially decrease the cost of a scheme and the consequent burden on the rates.

With regard to the proposed development tax, municipal bodies are already empowered to levy a tax on houses and lands. It is but just that the owner should be taxed for the development of areas, consequent on which his property will be largely increased in value. The rise in rates of agricultural rents within and immediately adjoining municipal areas has rendered the ownership of such land so profitable that it is becoming increasingly difficult and expensive to obtain sites for building purposes, and anything which tends to restrict the supply of building sites round great cities is in itself a serious evil. The great mass of the middle classes in Indian cities are everywhere showing a desire for improved dwelling houses and sanitary conditions, but under existing circumstances it is almost impossible for them to obtain the facilities they require.

L. C. PORTER, *I.C.S.*,
*Secretary to the Government of India,*
*Department of Education.*

*The 11th May 1911.*

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*The English Act.*

The town-planning part of the Housing and Town-planning Act is contained in sections 54—67 with schedules 3, 4 and 5.

The following is an outline of the main provisions:—

The *local authorities* who will administer the Act are for London the County Council, and for the provinces the various Town Councils, Urban Councils and Rural District Councils. [Section 65 (1).]*

* Schemes may be prepared either by the local authorities, or proposed by all or any of the landowners [64 (2)].

The Board may constitute a joint body to deal with land in the area of more than one local body. [Section 55 (3).]

Local authorities can do little or nothing at any stage without the consent of the local Government Board, and running through the whole of the town-planning clauses is the question as to how that Board will give effect to the various regulations, general provisions, special provisions and interpretations of the particular clauses.

Thus before a scheme can be prepared at all the local authority must satisfy the local Government Board that there is a *primâ facie* case for making such a scheme. [Section 54 (2).]

A scheme may be revoked by the local Government Board on the application of the responsible authority or of any other person appearing to them to be interested, if they think fit [54 (6)].

A town-planning scheme shall not have effect until approved by order of the local Government Board [section 54 (4)] which may impose any modifications and conditions.

The local Government Board will prescribe a set of general provisions for carrying out the general objects of town-planning schemes and in particular dealing with the matters set out in *Schedule IV*—and these shall, as a rule, take effect as part of any scheme unless provision is made for their variation. [Section 55 (1).]

See below.

The local Government Board will make general regulations regarding the procedure to be adopted in obtaining authority to prepare a scheme, the preparation of a scheme, notices required to be given in connection therewith, etc.

In particular, provision shall be made by those regulations to ensure the co-operation of landowners and others interested in the land at every stage of the proceedings, by means of conferences or other means provided by the regulations. [56 (1) and (2).]

If the local authority fails to prepare a town-planning scheme or to adopt one proposed by the local landowners, the local Government Board may order it to do so. [Section 61 (1) (2).] A local public enquiry is necessary before this order can be made, and it can be enforced by *mandamus*. Modifications in the scheme ordered by the local Government Board, and the effective execution of the scheme when approved, can be similarly enforced.

Gingering up the local authorities, as Mr. Churchill termed.

Finally the local authority is still further bound by the provision [section 54 (4)] that if any single owner or other person or authority interested objects in the prescribed manner to a town-plan after it has gone through all its stages, including approval by the local Government Board, the scheme must be laid before both Houses of Parliament, and may be rejected by a resolution of the House of Lords, or House of Commons.

*What land may be the subject of a town-plan.*—Section 54 (1) provides that a town-planning scheme may be made for:—

(1) Any land in course of development.
(2) Any land which appears likely to be used for building purposes.
(3) Any land likely to be used for open spaces, roads, streets, parks or recreation grounds.
(4) Any land likely to be used for any work incidental to a town-planning scheme, whether in the nature of a building work or not.

The scheme may be prepared by the local authority for land within or in the neighbourhood of their area.

In Germany the expression 'likely to be used for building purposes' covers land likely to be so used during the next 30 years.

Any question as to whether land comes within the foregoing categories will be decided by the local Government Board whose decision will be final.

The effect of section 54 (3) is also to enable a town-planning scheme to include pieces of land already built upon, or which are not likely to be used for building purposes, when in the opinion of the Board they ought to be so included.

*Objects of town-plan.*—These are defined by section 54 (1) as securing proper sanitary conditions, amenity and convenience in connection with the laying out and use of, the land and of any neighbouring lands.

*General provisions.*—The extent to which these objects may be dealt with will be defined in a set of general provisions to be prescribed by the local Government Board [section 55 (1)] in accordance with the fourth schedule, which mentions streets, buildings, open spaces, the preservation of objects of historical interest or natural beauty, sewerage, drainage, lighting, water-supply, rights of way, obstructive buildings and any consequential works to the foregoing as being within the scope of a town plan. These general provisions are to be laid before Parliament.

*Special provision.*—Section 55 (2) provides for the insertion in every plan of special provisions, defining the area, the authority to be responsible for the execution of the scheme, supplementing, excluding or varying the general provisions, and providing for special circumstances, and suspending so far as may be necessary any statutory enactments, bye-laws or other provisions in operation in the area.

*Procedure before and during the preparation of a scheme.*—Section 56 and Schedule. This is to be laid down by regulations issued by the local Government Board. In particular, before applying for authority to prepare a scheme, the local authority must prepare plans and estimates, and issue such notices as may be required by the regulations.

Schedule 5.

Before the proposed scheme is submitted to the local Government, similar notices are to be given, and the objections of persons affected (including archæological and other societies) heard; notice of intention to approve the scheme must also be published, and objections may be lodged thereto (section 54 (4) see above).

The local authority must also publish or deposit for inspection any scheme or proposed scheme and give information to persons affected. (Schedule V.)

*Power to enforce schemes.*—Section 57.

After giving such notice as may be provided by a town-planning scheme the responsible authority may pull down or alter any building in the area in contravention of the scheme, and execute any work which it is the duty of any person to execute under

the scheme, in any case in which it may appear that delay in the execution of the work will prejudice the scheme; recovering expenses in each case from the persons in default.

Any question as to whether such building is in contravention of the scheme will be determined finally by the local Government Board.

*Compensation.*—Section 58.

No compensation can be claimed by any person for a building erected on or contract made with respect to land in the area, after the time that application for authority was made; except as respects work done before final approval of a scheme to complete a building or to carry out a contract entered into before application was made.

Otherwise any person whose property is injuriously affected by a scheme, may obtain compensation if he makes his claim within the time limited by the scheme (not being less than three months after the date of notice of approval published by the local Government Board).

Any question as to whether property is injuriously affected, and as to the extent of compensation payable, will be determined by the arbitration of a single arbitrator appointed by the local Government Board (unless the parties agree on some other method).

Parliamentary warfare waged furiously round this provision (see below).

*Betterment.*—Section 58 (3).

Where *any* property is increased in value by the making of a town-planning scheme, the local authority is entitled (within the same time limit as prescribed in the case of persons claiming compensation) to recover from the person whose property is so increased in value one half of the amount of that increase.

Parliamentary warfare waged furiously round this provision (see below).

Disputes to be decided in the manner prescribed in the case of compensation.

*Exclusion and limitation of compensation in certain cases.*—No compensation can be claimed on account of provisions in the town-planning scheme if such provisions would have been enforceable by bye-laws made by the local authority.

In particular no compensation can be claimed on account of provisions prescribing space about buildings or the height or character of buildings, or limiting the number of buildings to be erected, and which the local Government Board considers necessary (section 59).

*Acquisition of land.*—The local authority may for the purpose of a town-planning scheme purchase *any* land comprised in such scheme by agreement, or may be authorised to purchase land compulsorily, by means of an order submitted to the local Government Board and confirmed by that Board in accordance with Schedule I of the Act. The schedule, *inter alia,* lays down that in determining the amount of any disputed compensation, no additional allowance shall be made on account of the purchase being compulsory (3). Any question of disputed compensation shall be determined by a single arbitrator, appointed by the Board, which will fix his remuneration. In urban areas, if an order is objected to, an impartial person not in the employment of a Government Department will hold an inquiry. The enquiry is limited to the question whether the particular land is suitable for the purpose for which it is to be acquired and whether its compulsory acquisition is unduly detrimental to the persons interested. The Board may confirm the order for compulsory acquisition notwithstanding the report of this person, but in such cases the order is provisional only and will not have effect unless confirmed by Parliament.

The opposition to the Bill centered round three main points:—

(*a*) The extensive powers given to the local Government Board to supervise, overrule and, if necessary, compel the local authorities to act.

(*b*) The tribunal set up by the Bill to determine finally questions as to what land was or was not to be construed as building land, of compensation and contributions of owners on account of betterment and of compulsory acquisition of land. In all these cases the deciding authority is the local Government Board or an arbitrator appointed by the Board.

(*c*) The vexed question of the share of betterment to be taken by the local authority.

On the first two questions the Government refused any concession, and in particular (on the score of expense and delay) the substitution of the courts or arbitrators appointed by the courts, for the tribunal set up by the Bill.

As regards betterment the clause originally drafted limited the recovery of betterment to the amount of compensation payable, and no amount was recoverable unless compensation was due under the scheme.

The standing committee extended the scope of the clause and as introduced it provided that when any property "is, or will be, increased in value by the operation of a town-planning scheme," the local authority would be entitled to recover the whole amount of the increase from any person whose property was so increased in value.

The vagueness of this clause as to future increment of value was partially remedied by the excision of the words 'or will be.'

It was pointed out that the increase in value might well be caused by private expenditure on the part of the owner; and that recovery should be limited to the amount by which the property had clearly been increased in value by the expenditure of public money. This proposal and a proposal to limit betterment recoverable to the extent to which compensation was payable to the *same* owner, were not accepted by the Government.

In the Lords a compromise was proposed by which one half the increased value went to the owner and one half to the local authority, and that compromise was eventually embodied in the Bill as passed.

## APPENDIX 7.

### USES AND LIMITATIONS OF SMALL MODELS OF SEPTIC TANKS.

The experience that has been gained from the use of septic tanks in India is now becoming very considerable and there is no doubt that when properly designed these appliances are a very decided success; in fact it may be said that they have absolutely solved the problem of the best method of disposal of excreta in large communities, such as the labour in mills, in railway workshops, and in institutions, such as lunatic asylums, jails. The problem that we are now asked to solve is as follows:—Can we do anything to make septic tank latrines form a suitable substitute for the stinking hand removal latrines that are so common in most municipalities in India? There is no necessity for me to say anything whatever on the subject of imperfections of the usual hand removal latrines. All sanitarians are perfectly well aware of these.

Experience has shown that septic tank latrine works best when they are designed for daily number of users varying from 1,000 to 4,000. Obviously, therefore, a large latrine to accommodate 2,000 users per diem is not a suitable type for a small town, because it would be underused and too expensive. If latrines are to be used they must be placed reasonably near habitations and in many of the Indian towns the population is not sufficiently dense to allow of building latrines for—say—1,000 users per day. In mill bustees this type has been constructed and they answer extremely well. They do not work as well as the latrine in the mill themselves, because the load is not as constant, but at the same time they are a decided success provided they are designed correctly. There can, however, be no doubt that a simple latrine for 100, 200 and 500 users per day would meet with much success in suitable localities. I herewith submit designs for latrines for 100 and 200 users per diem. They are designed to be extremely cheap and make use of no complicated mechanisms. The amount of water required is not very great, varying from 500 to 1,000 gallons per day. The dilution is 5 gallons per user per diem. The capacity of the tank gives a three days' rest; the cost of building the latrine is about a thousand rupees in the case of 100 and 1,400 rupees in the case of 200 users.

At present it is impossible to say whether a small latrine of this kind is going to be an entire success if it is situated in a thoroughfare to be made use of by the public. A model of this type is being constructed and is being experimented upon. The difficulty is, that in a latrine designed for 1,000 users per diem the chances of ever getting an overload of more than 5 or 6 per cent. are not great, but a latrine that is designed for 100 users per diem might very easily, under certain circumstances, be visited by 150 or even 200 people. Is it possible therefore to design latrine which will give a reasonably good result under these circumstances? At present I regret to say that our practical experience on this point has not yet gone very far, but from the work that has been carried out I think it is safe to say that as long as the first partition or grit chamber of the latrine is made of large dimension, a variable load can undoubtedly be accommodated without much falling off in the quality of the effluent. The majority of night-soil passes in in more or less solid masses and these remain in the grit chamber until they are broken up. As long as masses do not pass into the body of the tank, the effluent, though it may be very concentrated, is fairly free from odour and suspended matter and is generally satisfactory. But if fresh fæces get beyond the grit chamber, the amount of easily oxidisable matter goes up very rapidly. Consequently in building latrines for public use, especially if they are small, the grit chamber must be able to accommodate a large quantity of solid material without allowing it to pass into the body of the tank. This is by far the most important point in the design and must be carefully borne in mind.

Of course, the remarks that apply to septic tank in general must always be investigated even before a small installation is kept up. There must be an adequate supply of water and there must be a suitable way of disposing of the effluent. Water should as a rule be supplied from a pipe service and not be drawn out of wells for the purpose. Effluent may be passed down ordinary pukka drains, especially if it is sterilised, but cannot be allowed to flow into the usual kutcha drains. Personally, I am hopeful that a latrine somewhat of the type shown to accommodate about 200 users per diem will be a great benefit to sanitation of towns and will do away eventually with the stinking night-soil carts, and the expense of carrying away large quantities of night-soil and urine, a process which is fraught with large amount of nuisance and with large expenditure of public funds.

W. W. CLEMESHA, *M.D., D.P.H., Major, I.M.S.*

## APPENDIX 8.

### WATER-SUPPLY AND DRAINAGE WORKS IN THE MADRAS PRESIDENCY.

The number of inhabitants in the Madras Presidency, according to the latest census taken in 1911, is given as 41,401,839.

This number may for all practical purposes be divided into three principal parts or divisions:—

The North-east or Telugu part, population 16,000,000,

The South or Tamil part, population 21,000,000, and

The West or Malayalam and Canarese part, population 4,000,000.

Of these three divisions the most progressive in the way of sanitary reform and in the provision of water-supply and drainage works is the South or Tamil followed by the Telugu-speaking part in the north-east. The West or Malayalam and Canarese part is at present backward in the advancement of sanitary measures, the apparent reason being the heavy annual rainfall which ensures generally sufficient water-supply from wells while at the same time the roadside drains, backyards, and streets are periodically flushed and cleansed.

The area of the Presidency is given as 141,705 square miles, of which 78,000 square miles may be allotted to the North-east or Telugu part, 53,000 square miles to the South or Tamil part and 10,000 square miles to the West or Malayalam and Canarese part.

The number of municipalities in the Presidency is 61 excluding the Corporation of Madras and in addition there is a large number of unions or large villages subordinated to the Taluk and District Boards. These unions, with the help of the District Boards, are now coming forward with requests for water-supply and drainage works thus following the example of the municipalities.

2. Proposals for drawing up water-supply and drainage schemes are usually first suggested by the Sanitary Commissioner during his inspection of towns, and occasionally by the Sanitary Engineer or the local bodies themselves. Owing to the progress made in educating the local bodies to the necessity for water-supply and drainage works and to encouragement given to such proposals by the last two Governors of Madras, Lord Ampthill and Sir Arthur Lawley, and also to the generous financial assistance offered by the Madras Government, the number of such proposals has steadily increased until the Sanitary Engineer has now 53 schemes on his programme to be investigated and drawn up in detail as soon as possible.

3. The increase in the number of water-supply and drainage proposals has rendered necessary an increase in the Sanitary Engineer's staff which now consists of myself, four Assistant Sanitary Engineers, one personal assistant, twelve surveyors and twenty-seven members of the drawing office.

4. The investigation and drawing up of schemes for water-supply and drainage works is solely undertaken in the Madras Presidency by the Sanitary Engineer with the exception of those for the City of Madras which Corporation maintains its own engineering staff.

5. The introduction of water-supply and drainage works in the Presidency outside the City of Madras may be said to have started with the appointment of a Sanitary Engineer to Government in January 1890.

6. The first progress made was in the introduction of the earlier water-supply works. Drainage works were not carried out at first, the Sanitary Engineer's time and funds available being concentrated on the provision of water-supplies.

7. It was found that Municipal Councils were unable to arrange for the introduction of both water-supply and drainage works and consequently the latter works were deferred and the old earthen side drains and badly laid masonry ones were called on to serve the impossible duty of dealing with the spill water from public fountains and the increased sullage discharge from house drains due to the augmented supply brought by the water mains and house connections.

8. The result was stagnation of sullage water in these drains and encouragement to the propagation of mosquitoes. Various attempts were made to deal with the spill water from fountains and lately the provision of filter trenches of special design and what is called filter wells have been stated by one Council to have satisfactorily disposed of the nuisance.

Plans of these filter trenches and filter wells will be shown at this Conference.

9. Despite the disadvantage due to difficulties in disposal of, or want of disposal of, increased quantities of sullage, there is no intention to defer the introduction of piped

water-supplies in mofussil towns where the introduction of a drainage work simultaneously is still financially impossible.

10. It is considered that the resulting improvement in health to the inhabitants of a town by the introduction of a protected and piped water-supply far outweighs the disadvantages resulting therefrom by the absence of efficient drainage arrangements. Thanks mainly to the high average temperature and the absence of rain for the greater part of a year, the soil at the roadside drains is more porous than it would otherwise be and the makeshift arrangements for disposal of spill water at fountains and the provision of cesspools, more or less impervious, for house sullage, minimise the evil results from the absence of good drains.

11. In the Sanitary Commissioner's Administration Report for 1910 the health statistics, amongst others, of 12 towns possessing protected water-supplies were given, and Government in reviewing this report remarked as follows:—

> "The bearing which water-supply has on the prevalence of cholera is illustrated by the statistics embodied in statement XIII appended to the Sanitary Commissioner's report, from which it appears that, in the twelve towns where an improved system of water-supply has been in force for more than five years, the average mortality from this cause was 5·8 per cent. of the total mortality during the quinquennium ending with 1910 as against 9·8 per cent. for the five years immediately preceding the date of the introduction. It may be added that under fevers there was a simultaneous and not less marked improvement from 25 to 16·5 per cent."

As none of these towns possess modern drainage works the gain to the health of a town by the provision of a protected water-supply scheme, even when unaccompanied by a drainage scheme, is considerable and this fact should be remembered by those who think that, because a town cannot afford to construct simultaneously both water-supply and drainage works, the former should not be introduced in advance of the latter.

12. It may be taken as the accepted policy in the Madras Presidency that the provision of a piped water-supply in mofussil towns is approved prior to the introduction of a drainage scheme. While the necessity for the provision of a drainage scheme is recognised this drainage scheme is deferred owing solely to the want of funds.

13. It seems to me that with funds limited the provision of a piped water-supply is of first importance. Local supplies from wells, tanks and rivers in the vicinity of towns are without exception contaminated and the consumption of water from contaminated areas affects more directly and quickly the health of the people, than the stagnation of sullage, however bad it may be.

Under the Madras District Municipalities Act, the maximum tax that can be enforced for water-supply and drainage purposes is 8 per cent.

14. The income of an ordinary mofussil municipality of 30,000 inhabitants in the Madras Presidency from this 8 per cent. tax can be taken as ₹14,000 to ₹15,000 which represents an available provision of capital if borrowed at 4 per cent. repayable in 30 years, of $2\frac{1}{3}$ lakhs of rupees.

Assuming for simplicity that the working expenses of a suitable water-supply scheme are paid from the general revenues of the municipality this sum of $2\frac{1}{3}$ lakhs is all that is available from municipal funds for the provision of water-supply and drainage works.

15. As the cost of a water-supply scheme, involving pumping by suitable pumping plant, may be taken as from 3 to 4 lakhs of rupees for an average municipality of 30,000 inhabitants, it will be noted that without assistance from outside sources such a municipality is unable to carry out either water-supply or drainage schemes and certainly not both.

16. Owing to the generous encouragement and financial assistance of Government and in certain cases of private individuals, notably the Maharanee Appalakonda Yamba of Vizianagram, the Mahant of Tirupati and the Hon'ble Mr. S. R. M. Ramasawmi Chettiar of Chidambaram, a fair number of towns in the Madras Presidency now possess piped water-supplies.

Certain of these towns owing to rising revenue, an increasing interest in sanitary matters, and the desire to construct drains and thus remove the nuisance caused by the additional discharge of sullage into earthen side drains or cesspools, have now resolved to construct drainage works on modern lines.

17. The number of water-supply schemes carried out in mofussil towns in the last 21 years in the Madras Presidency, practically since the appointment of a Sanitary Engineer was sanctioned, is 19, and in addition 6 more are under construction making a total of 25 excluding the City of Madras. A list of these schemes is given in an appendix.

18. In addition to the 25 water-supply schemes constructed throughout the Presidency there is the important water-supply of the City of Madras which has a present population of 517,335 according to the 1911 census. Nearly forty years ago when the

population was nearly 400,000 distribution pipes were laid down throughout the city and a supply of water was brought from a large irrigation tank situated at the Red Hills, 9 miles beyond the city boundaries, by an open channel to a masonry well located on the western boundary of the city. From this well which serves as a stand pipe the distribution pipes begin. These works cost originally 14 lakhs of rupees.

In order to preserve the static level of the water as much as possible so as to make a gravitation scheme possible the outlet from the tank was constructed at such a high level that it was found necessary in years of deficient rainfall to supply the high level outlet to the channel with water pumped from the lower levels of the tank. For the same reason the channel as it approached the city was carried on a high embankment, which, it may be noticed, has stood wonderfully well.

Owing to the increased demand for water and the trouble experienced from the deposition of silt carried forward from the open channel into the cast-iron distribution pipes plans and estimates for improvements were drawn up by Mr. H. Nowroji, Assistant Sanitary Engineer to Government in 1905, and subsequently sanctioned by the Corporation and Government.

This scheme provides for the tapping of the Red Hills tank at a lower level than the present channel outlet, the provision of a roughing filter near the outlet and the construction of a masonry conduit, 9 miles long, in lieu of the existing open channel. On the arrival of the water at the western boundary of the city it will be filtered through slow sand filters and partly stored in underground reservoirs and then pumped by steam pumps to an elevated tank whence it will be distributed to the city.

The cost of these improvements was estimated at R24 lakhs and a considerable portion of the works has already been executed. It is also in contemplation to improve the distribution pipe arrangements in the city at a cost of many lakhs of rupees so as to meet the demand from the increased population. The supply per head is also to be increased from the original provision of 16 gallons to 25 gallons.

19. The 25 water-supply schemes constructed or under construction in the Madras Presidency may be divided into the following types:—

| | |
|---|---|
| Gallery scheme | 12 |
| Well scheme | 1 |
| Storage tanks with filters | 9 |
| Storage tanks without filtration | 3 |

This list shows that the water-supply schemes are practically of two classes, the gallery type and the storage tank type with or without subsequent filtration. A gallery scheme of water-supply is much in favour in Madras for two reasons. The first is the low cost of construction and maintenance and the second reason is the simplicity of working.

Both of these reasons are of first importance in Madras owing to the fact that the water works are in charge of Municipal Councils who are unwilling to spend comparatively large amounts in construction, maintenance, and superior supervision.

20. An infiltration gallery as finally developed in Madras consists of a trench or gallery in a river-bed and is usually from 20 to 30 feet deep. This gallery is excavated either across the bed or longitudinally in the direction of flow of the river according to the results obtained from preliminary investigation. This investigation consists first in the selection of a suitable site above the town and outlying villages to be as free as possible from contamination, and secondly by the putting down of 40 to 60 borings to a sufficient depth, say from 30 to 50 feet. These borings are put down in a longitudinal section up and down stream and at increasing distances apart, and on these results the further borings to determine the cross sectional conditions of the river-bed are put down. In the majority of cases these borings either show a depth of fine and coarse sand ranging from 20 to 30 feet thick or alternate layers of sand and clay.

In the former case the gallery depth would be determined by the available depth of water in the summer season with reference to the usual condition that there is no surface flow in the river during this season.

In the latter case of alternate layers of sand and clay the gallery would be located so as to draw its principal supply from the deepest sandy layer, if, of sufficient coarseness, and to rest on the underlying layer of clay.

21. Samples of sand from the borings and from different depths would be taken and mechanically analysed to determine the coarseness of the sand and especially to observe the percentage of fine sand and silt contained in the coarse layers. The continuity and extent of the sand layers would also be calculated to determine the water contents.

If the samples of sand were found to be satisfactory, that is to say, with an uniformity co-efficient not less than 3 as shown in the accompanying appendix, then it would be considered that the sand in the river-bed was suitable for the location of a gallery therein.

As many rivers in Madras have occupied in former times other positions, it is advisable to trace out by borings the old course of the river-bed which is now dry land and to locate on this land the gallery itself instead of in the present bed. While the latest form of gallery adopted is a trench, there are several cases in which the gallery takes the form of an underground filter bed protected by a barrage wall built across the river-bed and with the top of the wall submerged. The most successful galleries are those which have been located in a sandy river-bed.

22. In the case of one of our works not in a river-bed where the gallery or trench was excavated in decomposed syenitic rock overlying hard syenite it has been found that, as is usually found in the case of wells in such rock, where the draw off is considerable, the construction of the gallery or trench has permanently lowered the ordinary sub-soil water level. In this case the only solution for augmenting the supply is to extend the gallery, but this type is not one on which reliance can be confidently placed.

23. In the case of galleries in sandy river-beds, those rivers receive from time to time floods which recoup the supply of water in the sandy bed.

Diminution of supply in these galleries can be confidently met by the extension of the gallery preferably across the river-bed or if necessary in a longitudinal direction up stream.

In this connection it may be noted that the extension of the gallery is only possible in those cases where the scour due to flood water does not reach more than 10 feet or so below the normal bed level. Where the scouring action of flood water would reach below this level a gallery placed across stream must be protected by a masonry wall on the down stream side.

24. In those cases where the gallery is a longitudinal one and the river water in flood time exerts deep scouring action the site of the gallery would usually be on the bank of the river outside the scouring action of flood water.

25. The trench type of gallery is constructed as follows:—

An open excavation is made in the river-bed in the summer season down to water level, and below this level the trench is excavated with the aid of timbering and sufficient pumping power to the depth desired which as already stated is usually 20 to 30 feet below river-bed level.

The width of the trench will usually be 8 feet and at the bottom a layer of broken stone, 1½ inch size, is laid to a depth of 1 foot. On this layer one or two lines of open jointed stoneware pipes are laid with a slight fall towards a collecting well on the river bank. The trench is then filled in to a depth of 6 feet with broken stone, beginning with 1½ inch size and completing with ¾ inch size. The planking and shoring are removed as the filling proceeds and the construction pumps keep the water down to below the top of the filling.

Above the ¾ inch size of broken stone, coarse sand is laid to a depth of 3 feet and above this layer the ordinary river-bed sand.

The gallery is constructed in lengths of 100 or 200 feet according to the quantity of water to be pumped out, and this water is measured as the work proceeds so that data may be obtained of the available supply.

26. As a rule in those rivers of limited cross section and without perennial flow the gallery is the first work to be constructed and until a test has been made of the quantity of water available the remainder of the works including the supply of pipes is deferred. A question that is often asked is whether these galleries do not become rapidly choked.

This, it is thought, is almost entirely a question of the percentage of fine sand in the deep coarse sand layers of the river-bed at the site of a gallery. Provided the percentage of fine sand is small there is no reason why such galleries should not work for 20 years or even longer.

In the case of the gallery at Conjeeveram water-works no trouble has been experienced from any movement of fine sand into the broken stone layers and stoneware pipes of the gallery and this after 15 years' working. In addition to no diminution in quantity the quality of the water has maintained a high standard of bacteriological purity.

27. It is however recognised that in cases of supplies from sandy river-beds where the sand contains a comparatively large percentage of fine sand which will pass through a sieve of say 100 meshes to the lineal inch and where the reduction in water level or infiltration head exceeds, say, 4 feet, there is every likelihood of this fine sand being carried forward into the interior of a gallery.

In such cases it is considered that a gallery is unsuitable and the headworks should take the form of wells which can be easily disconnected and periodically cleaned of the fine sand which may have entered the wells.

28. In the case of the filter bed type of gallery with a protecting barrage wall which has had to be cleaned every five or six years, it is considered that the frequency of cleaning required is owing to the excessive head caused by the increased demand for water and the want of sufficient area of filter bed and also to the periodical floods depositing

mud on the surface of the river-bed this mud being carried into the interior of the filter bed by the powerful suction action of the pumping engines during the day's working.

29. *Storage tanks.*—It has already been stated that the number of water-supply schemes in Madras, of which a storage tank is a component part, is 12. These are usually provided where it is impossible to draw up a gallery scheme at a reasonable cost owing to the distance from the town of a suitable river with a sandy bed.

30. These tanks are constructed preferably of a capacity equal to three years' supply in localities where the rainfall is low or variable. The result of storage in open tanks or lakes has been found to be highly beneficial to the quality of the water.

The capacity of a tank requires to be enormously increased by provision for evaporation and absorption. This is usually taken in the case of water-works tanks in Madras at $\frac{1}{2}$ inch per day over the area at $\frac{2}{3}$ of the depth of the tank, less the usual recoupment during the period.

Although it is recognised that all cultivation should cease within the catchment of a storage tank yet for financial reasons it is found impossible as a rule to insist on this and we have to be content with the acquisition of land within 1,000 feet of the line of water spread at maximum water level.

31. In the case of a tank which had laterite earth on the surface within the catchment area, heavy rain in the monsoon months resulted in the water of this tank becoming red in colour, and with a large proportion of mud in suspension. This laterite mud, owing to its fineness, was found to be incapable of deposition even after several months and the sand filters which were in use gave great trouble owing to their frequent clogging. The introduction of mechanical filters for roughing purposes was therefore seriously considered when owing to the acquisition of certain cultivated dry land within the catchment area the presence of laterite earth in suspension in the tank water suddenly ceased thus obviating the necessity for mechanical filtration.

It is therefore suggested that in similar cases the prevention of cultivation of dry land of certain kinds within the catchment of a tank is advisable.

32. From the analyses of the waters of storage tanks in Madras it is considered that, provided there is no abnormal amount of silt in suspension, the provision of 1,000 feet margin around the maximum water level by the acquisition of land 1,000 feet in breadth is a sufficient protection against the contamination of the tank water by the run off, from the rest of the catchment even when cultivation is carried on in the remainder of the catchment area to a considerable extent.

This statement is however subject to the condition of sufficient storage in the tank and to the draw off of water 3 feet below the highest level available either by a floating pipe or by a draw off stand pipe with valves at different levels.

33. Our tanks are being constructed with embankments or bunds 9 feet wide at the top and with front slopes $1\frac{1}{2}$ to 1 and rear slopes 2 to 1. In the future it will however be better to adopt slopes of 2 to 1 and 3 to 1 respectively, so as to minimise leakage from the tanks and to obtain a stronger embankment.

The front slope is usually pitched with stone 18 inches thick over gravel 12 inches thick.

34. *Filter beds.*—The only filter beds in use in Madras at present are of the ordinary sand filter type and these have given very variable results in the past owing to want of superior supervision by the local bodies.

The type in use is the ordinary European type consisting of a masonry tank, rectangular in form, filled up with 2 feet of broken stone of size $1\frac{1}{2}$ inches to $\frac{3}{4}$ inch and sand of varying coarseness, the first layer above the $\frac{3}{4}$-inch stone being sand, retained on a sieve of 10 meshes to the lineal inch, to a depth of 4 inches, the sand above this layer being that which will pass through a sieve of 20 meshes and be rejected on one of 30 meshes. This layer is 2 feet 8 inches thick. Above the top sand layer the minimum depth of water is 3 feet.

35. Rules drawn up by me for the working of sand filters in Madras and for the scouring of pipe distribution lines are given as appendices to this paper.

Our experience of sand filters in the Madras Presidency has been disappointing. Shortly after the filtering material in a filter bed has been relaid the filtrate has given excellent results, but as a rule the bacteriological analyses of samples by the Maconkey system has shown variable results either from want of attention to the working, indifferent sampling, tropical conditions in Madras, or the system of analysis itself.

36. Accordingly, I recommended to the Madras Government, and they have since sanctioned, the installation at a cost of R34,000 of experimental filters, both ordinary sand filters and mechanical filters, to be erected at the King Institute, Guindy, in order that some practical conclusion could be arrived at as to the actual working of filters under Madras conditions.

It has been suggested that the broken stone layers of a sand filter should be reduced from 2 feet to 1 foot in thickness in order to reduce multiplication of bacteria in the post filtration passages. This proposal appears to be contrary to the practice in Europe,

but the experimental sand filters to be erected at the King Institute will show by actual results from samples taken at different depths what actually happens, out of sight, in a filter bed.

Another proposal to reduce the depth of water from 3 feet to 2 feet in order to reduce the total depth of a filter bed, we have already negatived by experience of working with such a depth in the Cocanada filters. Owing to the rapid growth of algæ in the shallow water, it is found necessary to revert to the provision of a minimum depth of 3 feet.

37. In connection with the position of sand filter beds in relation to the storage tank, our experience in Madras has shown the necessity for their construction at some distance from the storage tank or in some position where the normal sub-soil water level will be below the level of the floor of the filter bed in order to avoid the coming in, by diffusion through cracks, of sub-soil water into the bed below the sand layer.

Inlet valves are automatically regulated and the outlets are provided with Glenfield Jones' automatic filter outlet apparatus so as to ensure the steady draw off from each bed of a quantity of water not greater than 450 gallons per square yard per day. These outlet automatic valves are also so set as to limit the maximum head of draw off to 2 feet.

As the supply to the towns is usually only for 16 hours in the day-time at the rate of 15 gallons per head storage is provided in covered reservoirs of 8 hours' supply for the water filtered at night.

The provision of a continuous supply although highly desirable is not one which ordinary mofussil Councils require and if given under present conditions would result in the wastage of almost the whole of the night's supply.

Until lately the powers of regulation were so limited by the provisions of the District Municipalities Act that it was found impossible to safeguard consumption of water especially at night. Since then an Amendment Act has been passed which gives the Chairman of a Council necessary powers to fix meters and to enforce rules against wastage of water.

It is therefore hoped that there will be less wastage in the future than in the past which wastage was encouraged by the early introduction of certain water-supplies prior to adoption of rules and bye-laws for regulating consumption.

### Drainage Works in Madras.

38. Mofussil towns in the Madras Presidency are so hampered by want of funds for carrying out both water-supply and drainage works simultaneously that it has been the invariable policy to utilise available funds for the introduction of protected water-supplies. Drainage works have had to be deferred until finances improved. Numerous petty improvements have, from time to time, been carried out to roadside drains in towns pending the drawing up of complete drainage schemes. In many cases the expected improvements to roadside drains have only been locally successful in transferring the stagnating sullage from one street to the next in such a manner, owing to faulty levels, that it is found impossible to join up the petty improvements to a proper outfall.

Of late years the construction by local bodies of old lengths of open drains has been discouraged, where observed, and the local bodies have been strongly advised to await the preparation of a general scheme of drainage with the object of laying down the correct levels of drains in all streets so that improvement to the drainage by construction of street drains can proceed from year to year as funds become available thus ensuring that all money spent on drains is usefully expended.

39. In the whole of the Madras Presidency there are only two modern sewerage or drainage systems—that existing in the City of Madras and that constructed at Ootacamund.

40. The drainage system in Madras consists in the division of the city into a number of sections each with a pumping station, to the pump well of which sullage gravitates through stoneware pipe sewers.

The sullage is pumped out of the pump wells by steam plant in some cases and by oil engines and centrifugal pumps in others and is forced through a cast iron rising main of a total length of 9 miles to a sewage farm located on the sandy area north of the city and adjoining the seashore.

41. The most populous section of the town is drained by open drains and two intercepting sewers to a pumping station where the sullage is pumped through an independent rising main to the same sewage farm.

The pipe drainage of another section of the city is now under construction.

42. The soil of the sewage farm is almost pure sea sand, and the farm which extends to 150 acres has from the first been highly successful in disposing of the sullage pumped on to the farm.

The crop grown on the farm is hariali grass which is made into hay and sold as fodder for the feeding of horses.

The farm yields a revenue of ₹30,000 per annum or ₹200 per acre.

This large yield is due to the porous nature of the soil, the high average temperature of the atmosphere, and the fertilizing nature of the sullage. The quantity of sullage pumped on to the farm per acre appears to be 30,000 gallons, and this comparatively large quantity is satisfactorily disposed of as the sullage is comparatively weak and the sandy soil of the farm is capable of absorbing a large amount of liquid.

In the future the sullage will become stronger in composition and it may then be necessary to add septic tanks to the system.

43. The second drainage work carried out in Madras on modern lines is that at Ootacamund on the Nilgiri Hills. In this town a system of 6 and 9-inch stoneware branch sewers on the separate system was laid down connecting up all the important inhabited parts.

Owing to the steep location of the town it was necessary in many cases to introduce drop manholes on the lines of branch sewers and in other cases to use cast iron pipes instead of the usual stoneware pipes.

44. The following were the limiting gradients adopted for the stoneware pipe sewers:—

| | | Full and half full velocity. |
|---|---|---|
| *6-inch sewers.* | | |
| Minimum | 1 in 100 | 2½ feet per second. |
| Maximum | 1 in 40 | 4 „ |
| *9-inch sewers.* | | |
| Minimum | 1 in 190 | 2½ feet per second. |
| Maximum | 1 in 76 | 4 „ |

The beginning of each 6-inch branch sewer was provided with Field's flushing syphons of 90 gallons capacity and the system was ventilated with air inlets alternating with 4 inches ventilating shaft outlets 20 feet high at every manhole not more than 300 feet apart. The distance between ventilating shafts was therefore not more than 600 feet.

45. The branch sewers discharge into an old 12-inch cast iron main sewer laid along the margin of the Ootacamund lake. Owing to this location the main sewer was not found to be as satisfactory as it should have been. The gradient averages 1 in 903 and it is now contemplated to lay down a new 18-inch cast iron main sewer with a grade of 1 in 414.

The present 12-inch main sewer is flushed with stream water and also with sewage by means of three 5,000-gallon masonry flush tanks which are filled from high level branch sewers.

46. The public latrines have been rebuilt as water carriage flushing latrines and dumping pits are being provided as pail depôts.

A night-soil shoot has been built near the septic tank and is in daily use with satisfactory results to the conservancy of the town.

47. The sewage is disposed of by means of a septic tank of 24 hours' capacity, or 200,000 gallons, and a sewage farm of 14 acres.

The soil of this farm is more or less of a heavy nature and it has consequently been provided with sub-soil drains 33 feet apart discharging into an effluent channel which runs along one side of the farm.

The net revenue from the produce of the farm, principally grass and green oats, is nearly ₹100 per acre per annum and the disposal works have satisfactorily met the problem of turning the raw sewage into an inoffensive effluent.

48. There are altogether in the town 1,423 house connections most of which have been provided for the Indian houses at the cost of the scheme. It was intended that the owners of European houses, in proximity to the sewers, should put in house connections as soon as the system was laid down. This they have not done up to date apparently in the hope that Government or the Municipal Council would construct the connections and debit the cost to the estimate for the drainage works.

The works were practically completed three or four years ago and ever since they were projected they have been subjected to a large amount of public criticism so that the Council hesitated to become responsible for them. This criticism reacted on the house owners themselves who found that visitors, not understanding the real situation, preferred to go to other hill stations. The criticisms if not actually started were certainly fostered by newspapers which rarely lost a chance of deriding modern drainage works as carried out at Ootacamund.

If there was unusually heavy rain of say 2 inches in the hour and the old main sewer surplussed this was held up as conclusive proof of the failure of the works.

As the system was only intended to carry away rainfall up to 1 inch per day which means a dilution of sewage over six times the dry weather flow, the old main sewer necessarily surplussed.

Gradually as minor mistakes in construction were rectified the agitation subsided with the result that the Municipal Council after three years' experience of the working of the drainage system have voluntarily proposed to take over and have actually taken over charge of the works. This change of opinion has been assisted by the discovery that, while other hill stations were suffering from unhealthiness, the public health of Ootacamund had apparently improved of late years.

49. In this connection I should like to take this opportunity of quoting from the reported speech of His Excellency Sir Arthur Lawley in reply to a farewell address from the Ootacamund Municipal Council presented on the 24th October 1911 in which the drainage scheme was referred to:—

"Now Ootacamund resembles many other good things in that she is not exempt from criticism. And I am afraid that criticism is sometimes tempted in its desire for effect to dispense with the companionship of truth. I was reading the other day some essays on politics by a distinguished Canadian writer, and the opening words of one of his essays run: It requires about 33 years to remove a false impression from the public mind and about the same length of time to replace it by a correct one. Twice 33 is 66. Being of a sanguine temperament, I hope that it will be less than 66 years before the public mind will be disabused of the quite erroneous idea which has lately been assiduously promulgated in the Press, and is to me quite incomprehensible, that the sanitation and the drainage and the health of Ootacamund are in very parlous plight. I am no expert in sanitary matters, but I have made it my business to obtain the opinions of those who are, and who have carefully investigated the plans of the Ootacamund drainage scheme, and the manner in which the designs have been carried out, and they are unanimous in assuring me that the scheme as a whole is admirably conceived and has been so far most efficiently carried out. Defects of detail, of course, there will be, as there must be in every scheme of this nature, but these, as they come into evidence, are being corrected and I am confident that when complete you will have a most valuable asset conducing to the credit of those who introduced it and the great benefit of those whom it serves. Various works of sanitation have been completed, others are in progress and others here, as in every other town in the world, are waiting to be taken in hand. Meanwhile it is satisfactory to know that you can say and say with truth that public health is excellent."

50. Our most important mofussil town to be provided with an up-to-date drainage system is Madura with a present population of 136,000.

This town occupies a flat site principally on the right bank of the river Vaigai which enters the sea near the island of Rámeswaram after a course below Madura of about 80 miles. A complete drainage scheme of pipe sewers on the separate system has been drawn up for this town, the estimated cost being 21 lakhs of rupees.

This scheme will, when constructed, serve a population of 171,460 so that the cost per head of present population will be ₹18 and of future population ₹13. Owing to the flat location of the town the area to be drained, 931 acres, has been divided into six sections. Each section is provided with a pump well so as to provide sufficient gradient for the sewers. Five of the sections pump into the heads of main sewers through independent rising mains, and these main sewers connect with masonry conduits which finally discharge the sewage through a screening chamber into the pump well of the main pumping station.

Each of the five smaller pumping stations are provided with oil-engines and centrifugal pumps, but the main pumping station is provided with direct acting steam plant which will pump the whole sewage of the city through a 24-inch cast iron rising main 5 miles in length to a sewage farm of 186 acres.

The soil at the site of this farm is red earth to a depth of 3 or 4 feet overlying gravel. It is proposed to utilise the sewage, pumped on to the farm, for growing sugarcane and it is hoped to realise a net revenue of ₹250 per acre which amount is based on local opinion and on the Poona experiments.

51. The sewers are designed to carry ½ inch rainfall per day per house over an area of 1,000 square feet in addition to the sullage based on the population of each house which has been taken as composed of 6 people, and the water-supply which is 15 gallons per head per day.

In addition to this provision for rain water the limiting length of a 6-inch sewer has been made 300 feet and beyond this length for the 6-inch sewer a 9-inch sewer has been substituted but to be laid with the 6-inch sewer gradient. On similar principles a 12-inch sewer has been substituted for a 9-inch and a 15-inch for a 12-inch.

These increased sizes of sewers are designed to be laid at the gradient of the next smaller size.

The object of this proposal is to have increased provision for carrying off heavy rain which may fall within a short time. The result of increasing the size of sewers as mentioned above means a slight lowering of the velocity of the sewage, but this diminution is considered so small as not to practically affect the self-cleansing velocities in the sewers when half full.

52. The following are the gradients adopted in the scheme:—

| Size. | Minimum. | Sewage velocity when pipe is half full or full per second. | Maximum. | Sewage velocity when pipe is half full or full per second. |
|---|---|---|---|---|
| 4 inches . . . . . | 1 in 52 | 2½ feet. | 1 in 21 | 4 feet. |
| 6 „ . . . . . | 1 in 100 | Do. | 1 in 40 | Do. |
| 9 „ . . . . . | 1 in 190 | Do. | 1 in 76 | Do. |
| 12 „ . . . . . | 1 in 295 | Do. | 1 in 120 | Do. |
| 15 „ . . . . . | 1 in 415 | Do. | 1 in 165 | Do. |

The velocities have been calculated from Kutter's tables with a co-efficient of ·013. If other formulæ are used the velocities in the smaller sizes will be increased by 25 per cent. At least the minimum gradients are provided in the scheme except in the cases of some short lengths of unimportant sewers where it was found impossible to carry out rigidly the rules for gradients stated above. Such exceptions will occur in every practical scheme of drainage and if efficient flushing is provided the unimportant exceptions can be accepted.

53. The greatest depths of sewers generally except when a short length of ridge has to be passed through has been fixed at 13 feet, that being the lowest sub-soil summer water level in the sandy sub-soil of the city.

54. The main section of the system will be ventilated by air inlets at the head of branch sewers, the only outlet being an extracting fan at the main pumping station where the foul air will be purified in a coke tower. The other five independent sections will be ventilated by air inlets and ventilating shafts as in the Ootacamund scheme.

55. Masonry flush tanks of 500 gallons capacity and in some cases Field's automatic flush tanks are provided in the scheme at the heads of all branch sewers and wherever possible these tanks are filled with spill water from public fountains. Where piped water is not expected to be available 4 feet wells provided with a semi-rotary pump are proposed to be sunk in the sandy sub-soil of the streets so as to provide the necessary water for flushing purposes.

56. The latrines of the town will be converted into flushing latrines and with the 20 dumping pits or pail depôts proposed will improve the existing conservancy arrangements.

57. The main pumping station is designed to be capable of pumping three times the dry weather flow to the sewage farm, the remainder of the rain water and sullage being surplussed from the main conduit into an irrigation channel which will lead away the surplus sullage to paddy fields.

58. The estimated annual pumping charges up to 1,927 are estimated at ₹49,630 out of which amount ₹37,500 is expected to be recouped by net income from the growing of sugarcane on the sewage farm, so that the net working cost of the scheme is estimated at ₹12,130.

59. The scheme as described is now under the consideration of Government.

60. A scheme for the drainage of the town of Vellore, population 40,000, has also been drawn up and is awaiting sanction of Government.

This scheme provides for open oval shaped masonry drains, on each side of streets and conservancy lanes. These drains have been designed to be capable of discharging half an inch of rainfall per hour over the area draining into them.

The drains provided are intended to be constructed with a concrete floor and side walls of brick in lime mortar with cut-stone copings. The inside of the drains will be plastered with Portland cement to an oval shape. It is found cheaper in the end to use Portland cement for this plastering rather than use ordinary or kunkur lime mortar, the lasting properties of the latter not being good when used in sullage drains.

The scheme further provides for pumping the sullage up to three times the dry weather flow on to an underdrained sewage farm of 44 acres on which it is proposed to grow crops of sugarcane.

The estimated cost of the scheme is ₹3,67,764 which is at the rate of ₹9 per head of present population.

61. Drainage schemes for the towns of Trichinoply (population 120,000) and Negapatam (population 58,000), Nellore (population 33,000) and Ellore (population 38,000) are at present being drawn up by me, and are expected to be under execution in the next year.

62. In addition to these towns drainage schemes for six other towns have been investigated and plans and estimates will be drawn up in 1912.

63. All of these schemes are, principally for financial reasons, on the open drainage combined system. The cost of drainage works in Madras can be approximately stated to be as follows in terms of present population:—

| | Per head. R |
|---|---|
| Pipe sewerage schemes involving sectional pumping by oil and steam plant with cast iron rising mains, septic tanks and sewage farm . . . . . | 18 |
| Open drainage schemes with intercepting pipe sewers, oil or steam plant, cast iron rising mains, septic tanks and sewage farm . . . . . | 9 |
| Open drainage schemes without pumping and discharge of crude sewage into the sea or tidal river . . . . . | 6 |

64. *Sewage disposal works in Madras.*—In many towns small sewage farms for disposal of sullage from local areas have been laid out. The largest sewage farm in use in the whole Presidency is that belonging to the City of Madras.

At this farm no septic tanks are in use or required at present although their construction will probably be found necessary in the future.

The soil at this farm being sea sand it forms an ideal means for sewage disposal. At Ootacamund where there is a septic tank the sewage farm in use is composed of heavy soil which requires to be underdrained.

In such cases where light and open soil is absent excellent results from the growing of grass for fodder may be achieved by top dressing the site of a farm with one or two feet of street rubbish so as to form a porous soil in which roots may spread easily and not be stunted in growth as in the case of grass grown on heavy or loamy soil. In this connection it may be remarked that in the case of certain sewage farms in Madras City, but now abandoned, as they were located too near dwellings, the growth of grass was phenomenal. These farms were located on sites which were in former times swamps or low ground but subsequently reclaimed by the dumping of street rubbish which was carted to the sites in conservancy carts.

65. Our experience in Madras is in favour of sewage disposal by the use of septic tanks and a sewage farm.

The septic tank should be designed in such a way that sludge may be periodically removed on opening a valve, thus causing the minimum of interference with the working of the tanks. What appears to be a cheap and suitable form of septic tank is a tank of triangular wedge section constructed with apex downwards, a slotted pipe being placed at the point of the wedge so as to receive the sludge which will be mementarily deposited. This sludge can be removed by the opening of a valve placed on the pipe, the requisite discharge head being provided by the liquid in the tank.

Tanks of this type can be cheaply constructed as a simple excavation, the sides to be puddled with clay and pitched with stone.

They may be left either open, or closed by a light corrugated iron roof.

66. *Programme of water-supply and drainage schemes.*—At the beginning of this paper I referred to the fact that the number of water-supply and drainage schemes awaiting investigation and the preparation of plans and estimates was 53.

A tentative programme of preparation and construction of water-supply and drainage schemes for the five years ending in 1917 has been drawn up and shows an apparent possible expenditure in the next five years on these schemes of 221 lakhs of rupees.

Out of this amount of R221 lakhs there is already available or will shortly be available plans and estimates for water-supply and drainage schemes of an estimated total cost of R76 lakhs.

The schemes to be drawn up in the next two or three years will be for the difference between 221 lakhs and 76 lakhs or 145 lakhs.

67. Many of these schemes, especially those for protected water-supplies, are urgently required by the local bodies. The number of schemes which can be drawn up and constructed is limited by the capacity of the Sanitary Engineer's establishment and by that of the Public Works Department to carry out the construction.

68. There is also to be considered the even more important question as to whether the local bodies which cannot bear the entire cost of sanitary works should be assisted by grants from ordinary revenues or from special sanitary loans. If from the former, then the construction of sanitary works must necessarily be retarded and in lean years it might so happen that, when the greatest need was felt for certain sanitary works, the ordinary revenue was already car-marked for the resulting consequences of the lean year.

69. If sanitary works are to be advanced in mofussil towns at that rate which an inspection of these towns seems to show is desirable, it appears to be advisable that a programme of construction should be prepared for a period of five or ten years ahead and to arrange for the supply of the necessary funds by a large and special sanitary grant to be given by the Government of India.

70. The construction of any sanitary work the cost of which bears a reasonable comparison to similar works carried out elsewhere should, I think, be determined not by the amount of financial assistance which can be given without dislocation of other demands, but by the actually proved necessity for the sanitary work, from the point of view of the public health of the town in question.

W. HUTTON,

*Superintending Engineer,*
*Sanitary Engineer to Government.*

MADRAS;
*The 10th November 1911.*

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## ANNEXURES.

Circular no. 3443, dated the 5th November 1909.

From—W. HUTTON, Esq., A.M.I.C.E., Sanitary Engineer to the Government of Madras,
To—The Chairmen, Municipal Councils, Vizagapatam, Cocanada, Kurnool, Adóni and Vellore.

In connection with the printed rules for starting and working filters issued by this department for your guidance I have the honour to request that the following instructions may be carefully observed:—

(1) *About starting filters after cleaning.*—Filtered water should invariably be admitted from the bottom upwards until the water rises 6 inches above the surface of the sand. The rate of admission should be the same as the safe rate of filtration for the filter. Then unfiltered water should be admitted through the ordinary inlet to the filter until the water rises to the full height in filter. The water should then be allowed to remain undisturbed for a period of 24 hours at the end of which period the scour valve should be slowly opened to let out all the water thus allowed to settle until the water level in the filter stands 6 inches over the sand layer. While the scour is kept open, care should be taken that the slimy layer formed on the top of the sand layer is in no way disturbed. As this slimy layer is found to play an important part in the efficient working of sand filters the process of admitting water into the filter, allowing it to settle itself quickly for 24 hours, then withdrawing by the scour valve without disturbing the slimy layer even very slightly, should be repeated as often as necessary until the slimy layer formed on top of the sand is about $\frac{1}{4}$ inch thick. The filter is then ready for working for the town supply.

(2) *About sand for filters.*—The sand used should neither be very fine nor very coarse. Its uniformity co-efficient should be somewhere between 2 and 3. The sample proposed for use should first be sent to the Sanitary Engineer to Government for examination and advice as to what treatment it should receive before using. If it is found necessary to screen the sand the Council may request the Sanitary Engineer to indent for such screens as he may decide is necessary for the purpose.

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No. 3676, dated the 29th November 1909.

From—W. HUTTON, Esq., A.M.I.C.E., Sanitary Engineer to the Government of Madras,
To—The Chairman, Municipal Council, Vizagapatam.

During my inspection on the 19th instant of your headworks I found that clean sand only to a depth of 4 inches had been laid down on filters nos. 1 and 2 over a layer of dirty sand.

I have, therefore, the honour to invite your attention to the printed regulations issued from this office for the working of sand filters and to my circular letter no. 3443, dated 5th November 1909, and to request that you will be good enough to see that instructions contained therein are carefully attended to if the sand filters are to be of any practical value in supplying the town with potable water.

To emphasise the need for occasional proper cleaning of drainage and filtering medium in sand filters I will repeat the procedure to be adopted for cleaning such filters. As a rule, every filter should be cleaned at least once every two years or oftener if found necessary. When a filter has been found to clog up fast, that is, when the interval

between ordinary cleanings is much less than usual, then the filter should be thoroughly overhauled and relaid. First the dirty water should be run out by the scour valve provided for the purpose. Then the sand should be carefully removed, as soon as it is dry and thoroughly washed in a sand box or other device preferably with water under pressure entering the sand box from the bottom. The sand thus cleaned should be carefully dried and screened with screens recommended by the Sanitary Engineer and stacked near the filter in different heaps according to their grade of coarseness. Any sample picked up at random from the heaps when put into a tumbler of water should impart no turbidity to the water.

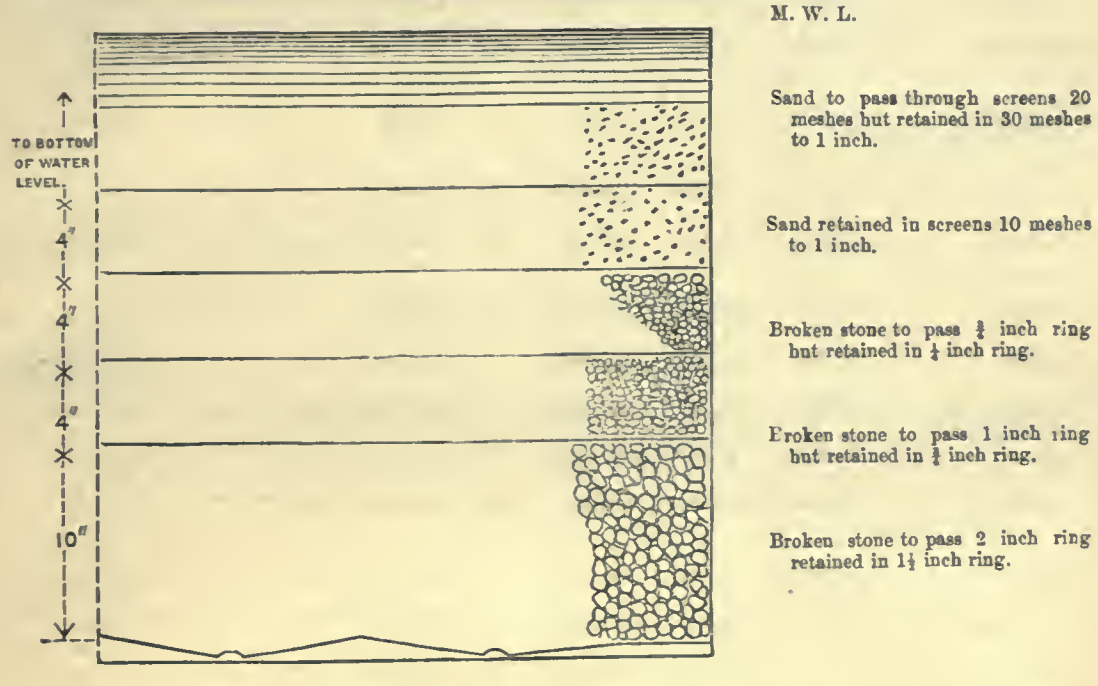
Then the drainage layers should be dealt with as follows:—

Immediately the superimposed sand is removed the drainage layers should be well soaked in water. While they are being thus soaked they should be turned over by a rake, shovel or other contrivance so as to facilitate the removal of deposits or any foreign matter with which they may have become coated. The drainage layer should then be well rinsed in clean water, dried and stacked in heaps according to sizes. Any sample picked up at random and thrown into a bucket of water should impart no sign of turbidity to the water.

The walls, floor, under drains of the filter should then be carefully scrubbed, washed, limewashed and exposed to the action of the sun for a couple of days and re-washed with clean water.

While the filter is thus being treated, advantage should be taken to examine and put right all the inlet and outlet, scour and overflow valves, screens and other appendages.

Then in relaying the filter the drainage layer and sand shall be laid as in sketch below:—




If the materials removed from the filter be found insufficient after washing then new material should be procured and treated as if such material had been removed in the first instance from the filter in a dirty state.

The filter should then be re-started in strict accordance with special instructions contained in my circular letter no. 3443, dated 5th November 1909.

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## FILTER BEDS.

*Rules for starting and working filters.*

### I.—New Filters.

*Filling with water.*—After completion of the filters the unfiltered water should be run slowly on to the surface of the sand, through the copper gauze inlet screen, so as to fill up the filter bed with water.

The rate of filling should not exceed 4 inches per hour and care should be taken to avoid scouring the surface of the sand by a rush of water from the inlet chamber.

If the total depth of the filter bed from bottom to top of water level is 8 feet it should take 24 hours to fill the bed.

If the water is observed to be rushing too fast on to the sand surface, the inlet valve should be regulated so as to reduce the flow and scouring of sand thus prevented.

*Statement showing the towns in the Madras Presidency where water-supply schemes have been completed or are in progress (Madras City omitted).*

| Number. | Name of town. | Population when scheme was drawn up. | Population for which the scheme was designed. | Number of gallons and supply for which works were designed. | | Actual or estimated cost. | Cost per head. | | Remarks. |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Total. | Per head. | | Population in column 3. | Population in column 4. | |
| | | | | | | R | | | |
| 1 | Adoni . . | 26,212 | 30,000 | 300,000 | 10 | 1,57,319 | 6 | 5·2 | Gravitation : Storage tank, filter beds and service reservoir. |
| 2 | Bezwada . | 24,224 | 40,000 | 600,000 | 15 | 3,11,790 | 12·9 | 7·8 | Pumping : Wells and service reservoir. |
| 3 | Cocanada . | 40,685 | 50,000 | 750,000 | 15 | 5,02,342 | 12·4 | 10·5 | Pumping : Storage tank and filter beds. |
| 4 | Conjeeveram . | 42,561 | 56,000 | 840,000 | 15 | 2,69,231 | 6·3 | 4·8 | Pumping : Infiltration gallery and service reservoir. |
| 5 | Coonoor (Hill Station). | 6,049 | 7,500 | 150,000 | 20 | 1,85,394 | 30·6 | 24·7 | Gravitation : Impounding reservoir and service reservoir. |
| 6 | Cuddapah . | 18,982 | 20,000 | 200,000 | 10 | 1,17,615 | 6·2 | 5·8 | Pumping : Gallery and service reservoir. |
| 7 | Dindigul . | 16,000 | 22,000 | 220,000 | 10 | 1,30,150 | 8·2 | 6·0 | Gravitation and pumping : Gallery and service reservoir. |
| 8 | Gudiyattam . | 21,335 | 25,000 | 150,000 | 6 | 81,000 | 3·8 | 3·3 | Pumping : Infiltration gallery and service reservoir. |
| 9 | Guntur . . | 30,833 | 30,000 | 450,000 | 15 | 2,55,471 | 8·3 | 8·5 | Gravitation : Springs and service reservoir. |
| 10 | Kurnool . . | 24,523 | 30,000 | 450,000 | 15 | 2,63,667 | 10·75 | 8·8 | Pumping : Canal, storage tank and service reservoir. |
| 11 | Madura . . | 87,426 | 100,000 | 1,500,000 | 15 | 3,94,738 | 4·5 | 3·9 | Pumping : Submerged filter bed. |
| 12 | Nellore . . | 32,040 | 35,000 | 525,000 | 15 | 1,65,562 | 5·2 | 4·7 | Pumping : Infiltration gallery and stand pipe. |
| 13 | Ootacamund (Hill Station). | 10,000 | 20,000 | 400,000 | 20 | 5,75,836 | 57·5 | 28·8 | Gravitation : Impounding reservoirs. |
| 14 | Salem . . | 70,621 | 80,000 | 1,200,000 | 15 | 9,10,535 | 12·9 | 11·4 | Gravitation : Storage tank and service reservoir. |
| 15 | Tanjore . . | 54,055 | 60,000 | 900,000 | 15 | 4,47,420 | 8·3 | 7·4 | Pumping : Submerged filter bed, service reservoir. |
| 16 | Tirupati . . | 14,242 | 24,000 | 360,000 | 15 | 2,31,000 | 16·2 | 9·6 | Gravitation : Gallery and service reservoir. |
| 17 | Trichinopoly . | 88,715 | 88,000 | 1,320,000 | 15 | 7,68,251 | 8·7 | 8·7 | Pumping : Gallery and service reservoir. |
| 18 | Vellore . . | 44,950 | 50,000 | 750,000 | 15 | 3,22,860 | 7·2 | 6·4 | Gravitation : Impounding tank, filter beds and service reservoir. |
| 19 | Vizagapatam . | 34,487 | 40,000 | 600,000 | 15 | 4,71,804 | 13·7 | 11·8 | Gravitation : Impounding reservoir, filter beds and service reservoir. |
| | | | | *Water-supply schemes under construction.* | | | | | |
| 1 | Berhampur . | 25,745 | 30,000 | 450,000 | 15 | 3,11,000 | 12·1 | 10·3 | Gravitation : Storage tank filter beds and service reservoir. |
| 2 | Chidambaram . | 19,909 | 30,000 | 450,000 | 15 | 3,97,650 | 20·0 | 13·3 | Pumping : Channel, storage tank and service reservoir. |
| 3 | Periyakulam . | 17,960 | 24,000 | 360,000 | 15 | 1,62,670 | 9·1 | 6·8 | Pumping, Infiltration gallery and collecting reservoir. |
| 4 | Vizianagram . | 37,270 | 50,000 | 750,000 | 15 | 4,86,790 | 13·1 | 9·7 | Pumping : Infiltration gallery and service reservoir. |
| 5 | Kodaikanal (Hill Station). | 1,912 | 3,500 | 70,000 | 20 | 82,700 | 43·2 | 23·6 | Gravitation : Impounding reservoir. |
| 6 | Negapatam . | 57,190 | 82,250 | 1,233,750 | 15 | 7,46,760 | 13·0 | 9·1 | Pumping : Infiltration gallery and service reservoir. |

OFFICE OF SANY. ENGR. TO GOVT., CHEPAUK, MADRAS;
*The 10th November 1911.*

W. HUTTON,
*Superintending Engineer,*
*Sanitary Engineer to Government.*

## APPENDIX 9.

### VILLAGE SANITATION.

Sanitation in rural areas of the Madras Presidency is the duty of Taluk Boards and is administered by the Madras Local Boards Act. The result achieved in the sanitary improvement of villages during nearly half a century is disappointing. This is due not to any lack of effort or interest on the part of the authorities responsible, but to the ignorance and ingrained conservatism of the people to be dealt with. The scepticism and apathy with which sanitary reform had in the past been regarded have to great extent disappeared and there can be no doubt that very laudable efforts are now made by local bodies to improve the sanitary condition of villages by attention to conservancy and the improvement of water-supply and drainage. There are obstacles in the way of the achievement of this and these are:—

(1) Lack of funds.

(2) Absence of correctly organised and trained sanitary staffs.

(3) The inadequacy of the law to enforce sanitation.

(4) The failure of the people to co-operate so as to render the measures adopted a success.

The first three are by no means insuperable and could be overcome by some organized plan in each district so as to secure the greatest advantage from the funds available.

The apathy of the people is the stumbling block to all progress.

Valuable suggestions have from time to time been made by many sanitarians as to what is best to be done, but the practicable outcome of all is, that during the half century this work has been going on, the advance in rural sanitation has been so extremely limited that according to the latest returns furnished there were during 1910 only 595 towns and villages conserved out of a total of 42,852 in the Presidency, that is, 98·6 per cent. of towns and villages still remain uncared for by a system of conservancy. In fact, compared with 1909 these figures show a retrograde movement inasmuch as conservancy arrangements were during 1910 withdrawn from three towns and villages. The sanitary plant is such as to be of very little benefit and the staff employed inadequate; they are not organized in correct proportion to the area or population served nor are they under skilled supervision.

During the last 20 years increased attention has been paid to sanitation both by Government and local bodies not only in the matter of funds, but in the introduction of trained staffs such as sanitary assistants to District Medical and Sanitary Officers and Sanitary Inspectors, thus forming the nucleus of a future sanitary service. It is however much to be regretted that these subordinates are employed to a very limited extent in the rural parts of the Presidency.

In every village so much has to be effected that general directions are sure to be disregarded and in fact would be beyond the financial resources of most districts.

There can be no doubt that it can best, indeed, only be done step by step with some definite object in view, but with the clear understanding that in each district there should be, every year, a fair amount done either in the line of permanent improvement of some kind or in the establishment of conservancy operations.

The only way of doing anything at all seems to be to select in each the most urgent and easily remediable need and have it carried out.

There are villages where all-round sanitation is urgently demanded, *viz.*, those which are the perennial haunts of cholera. More good would come from concentrating efforts on these than in making spasmodic attempts to conserve others that are not marked by so heavy a death-roll.

A beginning might be made in each district, in consultation with the medical officer as to what is most urgently needed and most easily set right, and the villages nearest to large towns and cantonments would properly first engage attention.

The rectifying of one insanitary condition is not enough to banish preventable causes of disease and of physical degeneration, but it would help; and as everything desirable cannot be done at once, it seems better that efforts be directed to what is immediately practicable.

#### Water-supply.

The water-supply in most districts furnishes a worthy object for the expenditure of money and of the best endeavours of all concerned in it. Till the people in every district can be said to be supplied with pure drinking water, there need be no difficulty

in laying out to the best advantage the full amount of the allotment for sanitation, much of which is now too often left unexpended. The chief sources of water-supply in rural areas are wells, tanks, rivers, streams and irrigation channels. These are subject to all manner of contamination that it may safely be said that in no village do the people drink a safe drinkable water. Of course it would be impossible to provide a protected water-supply to every town and village and we must for years to come content ourselves with improving existing sources and conserving them.

Protected water-supply schemes are under consideration in several of the Unions, but where these are not possible the provision of wells on standard designs and many of them on clean sites and the improvement of existing wells seem to offer the best solution to the problem of water-supply in villages. All efforts and expenditure should therefore be concentrated towards the attainment of this object. Tanks should be improved by so guarding them as to prevent direct access to the water in the tank. The Sanitary Engineer to Government in Madras Presidency has drawn up plans and specifications showing how this could be effected. The conservation of rivers, streams and irrigation channels seems to be a hopeless task. The method usually adopted is to set apart portions of a river, stream or irrigation channel for drinking purposes and appointing watchmen to prevent contamination, but a more useless way of spending money cannot be imagined. The guarding is merely nominal and moreover where the river is the drinking water source of several villages along its course, the villages lower down must necessarily drink contaminated water coming from the portion of the river set apart for inferior purposes in the villages higher up. In this way cholera is easily spread from village to village as is very frequently observed. If an adequate number of wells are provided, resort to rivers will be avoided so that rivers and streams will soon cease to be drinking water sources. Where funds permit wells should be covered and provided with a pump elevated cistern and taps.

Type design for wells with explanatory remarks.

Type design for hand pumps with explanatory remarks.

Type design for shallow well with explanatory remarks.

Type design for deep well with explanatory remarks.

Type design for protecting tanks.

### Drainage.

To introduce a regular system of drainage, scattered as are the towns and villages, would be an insuperable difficulty, and involve an immense expense beyond the means of any district. The existing side cuttings generally to carry off storm water are adequate enough if kept clear of obstructions for the free flow of water. Where these drains pass near houses they should be rivetted. Household sullage should be disposed of by discharge into fields.

Those parts of a village on lower level to which all or nearly all the drainage of the village gravitates should be provided with a masonry drain to carry the sullage away from the foundations of the houses and convey it to the fields beyond. This I consider is an object of simple improvement on which public funds might be well spent.

Drain from well or water from drinking fountain:—

1. Cesspool.

Type design.

2. Infiltration trench with remarks.

### Conservancy.

Next to water-supply, conservancy, both public and domestic, should receive special attention. There can be no doubt that the accumulation of filth of all kinds in the streets and backyards and compounds of houses, the housing of cattle with human beings, etc., form the foci of many diseases. I would therefore urge that, in order to effect a reform in this direction, every effort for the present should be made towards the proper conservancy of our towns and villages. The main evils can only be grappled with, in detail, village by village, and as a beginning I would suggest that a suitable town or village (having a dispensary) be selected by the President or District Medical and Sanitary Officer in each taluk of a district and made the basis of operation. It should be the head-quarters of a Deputy Collector or Tahsildar, who took an interest in sanitation, and was popular with the people. The town or village having been thus selected, I would recommend the promulgation and observance of the following effective and easily worked rules as to its conservancy, which would entail no money expenditure, as it would be within the power of the villagers themselves to give effect to them. The enforcement of the rules and their observance by the people should be entrusted to the

Deputy Collector or Tahsildar who should be enjoined to obtain the co-operation of the people by explaining to them the various improvements proposed and by persuasion enlist them in the work of protecting their own health.

*First.*—Certain fixed sites should be selected on the outskirts, at least about 200 yards distance from the town or village apart from any source of drinking water-supplies. These should be defined and protected by a low boundary wall or hedge and formed into depôts. All the sweeping and filth of every description from the streets, backyards and compounds of houses should be carried to, deposited and stored in these depôts. They should be under the supervision of the Tahsildar or Deputy Collector or any responsible person the President may think advisable to appoint. The mass of filth, rubbish, etc., thus collected should under the superintendence of the Deputy Collector or Tahsildar, etc., be apportioned off to the several contributors when required by them as manure for their fields which will generally be at the commencement of the cultivating season or sold by auction.

The filth and rubbish, etc., from the backyards and compounds of houses should be carried to the depôts by the owners of the houses themselves and in the event of their failing or refusing to do so the law appropriate to the case should be enforced.

This system has been adopted in other parts of India with decided advantage as to cleanliness, salubrity, and the healthiness of the villages; and what has been accomplished in one place cannot surely be impracticable in another.

*Second.*—All the cattle should be removed from the interior of backyards, etc., and housed outside the village or town. No doubt this measure will be met by violent opposition on the part of owners of cattle, but the constant danger to health inseparable from this practice necessitates their removal. The ryots in some places may be induced to build homesteads on their land for housing the cattle. At any rate some provision should be made for stalling animals in other places than outside houses and backyards. If possible they should be penned on the fields or kept on some open ground within the village.

*Third.*—No one should be permitted to perform offices of nature in the village street, lane or open space. Some pieces of ground outside the town—not near any well or drinking water source—should be set apart where people should resort for the purposes of nature.

Trenches 1 foot broad and 1½ feet deep and as long as required should be dug in the places set apart. Every person using the trench should by notice on a board put up in a conspicuous place be directed to cover up his own filth. As soon as one piece of ground has been so used up all over another site should be selected and the manure ground ploughed and cropped.

Villagers in better circumstances may perhaps object to go to the places set apart for the purposes of nature; such persons should then be directed to have their private privies daily cleaned out by sweepers employed by them for the purpose. Or arrangements might perhaps be made for their convenience as is done in other parts of India to have a group of privies constructed outside the compounds of houses and provided with door and lock and key to be used only by owners. These privies should be kept clean by scavengers employed and paid for by the owners themselves. Type design latrine with remarks.

*Fourth.*—All ruined dwellings should be removed and the sites levelled, all vacant sites cleaned and enclosed by owners, all useless jungle should be removed and prickly-pear and overgrown weed and shrubs cleared away by the villagers, at least once in every 6 months.

There should be no difficulty in so arranging matters as to obtain spaces beyond village limits for the storing of manure, housing of cattle, and for offices of nature.

The example of an improved town or village will tell upon others in its vicinity and create a general conviction among the people of the necessity of sanitary reform.

Much good might be done towards sanitary reform by the distribution of a few simple rules to the village headman on the conservancy of their villages and cleanliness of their dwelling houses, etc.

The tahsildar or medical subordinate attached to a dispensary (should one exist) should inspect and report weekly or monthly on what is being done, care being taken by the inspecting officers not to prejudice sanitary work; and at the end of every month or quarter the President should report to the Sanitary Commissioner as to how the system is working.

I feel confident that if what I have suggested above be adopted as an experimental measure in one or more villages in each district, it will prove successful and the vexed question of village sanitation would, in one important respect at least, *i.e.*, conservancy, be satisfactorily solved by the extension of the system throughout the Presidency.

W. A. JUSTICE, *Captain, I.M.S.*

## APPENDIX 10.

### NOTE ON THE MILK-SUPPLY OF LARGE TOWNS IN INDIA.

The very unsatisfactory state of the milk-supply of large towns in India has long been realized, but it is only within the last few years that the subject of improving it has received much attention.

It is true that there are Government dairies in many cantonments, but these are for the benefit of troops, and their existence may be considered as an admission by the military authorities of their failure to obtain satisfactory milk from indigenous agencies; for it may be safely assumed that they would not otherwise have resorted to the costly expedient of dairies under European management for the milk-supply of troops. It is also true that in some large towns, with a considerable European population, dairies have been established by private enterprise, in which some attempt, often a very feeble one, is made to handle milk by Western methods. These, however, cater for the well-to-do classes who alone can afford to pay the high prices charged for milk at such establishments.

Further, legal provision exists, in the Municipal Acts of most provinces, for the regulation of the milk trade, and some large municipalities have framed milk bye-laws, based upon those in force at home. Even where such bye-laws exist, however, many of them are inoperative or nearly so, and this for at least two cogent reasons; one is the want of the necessary staff to enforce compliance with the bye-laws, and the other the apprehension lest such enforcement should cause a rise in the price of milk out of proportion to any improvement in its quality.

The problem which thus still confronts the civil sanitarian in India is how to obtain from indigenous agencies, namely, the *gwala*, a reasonably pure and wholesome milk-supply at a price within the means of the ordinary inhabitants of Indian towns. It is unnecessary, in a note intended for members of an Indian sanitary conference, to describe the conditions of urban milk-supply which it is our duty to attempt to improve.

Most of us are familiar *ad nauseam* with examples of milch cattle crowded into low, unventilated huts, fed upon garbage and milked in urine-sodden byres. We also know the dirty hovels in which milk is stored, the battered brass milk vessels "cleaned" with mud from the byres, and have seen milk carried long distances in open cans with a wisp of dirty straw floating in it to prevent spillage. We have also had experience of milk obtained from unhealthy animals, or shamelessly adulterated with skimmed or churned milk or diluted with water, from any filthy source.

The problem of improving these conditions is certainly a difficult one, and its difficulty explains why it has aroused less interest than its importance deserves, and justifies the practical wisdom of the Indian consumer in refusing to drink milk unless it has been boiled.

It may, however, afford us some encouragement to reflect that conditions very similar to these just mentioned were common at Home not so very long ago, and that once they received the earnest attention of public health officers improvement was very rapid.

I do not, of course, suggest that we can expect a similar rate of progress in India, nor do I think that success can be attained by similar means. For at Home it is largely by legislation, backed by enlightened public opinion, that the purification of the milk trade has been effected, while from what has been stated above it will be apparent that little is to be expected from resource to stringent bye-laws in India, at any rate for the present. We shall, I think, for some time to come, obtain better results from the education, both of public opinion and of the *gwala* as to the advantages of clean milk, and from the encouragement of voluntary reform, than from resort to legal powers, though this will be necessary for dealing with fraud and wilful obstruction.

One way that has been suggested for dealing with the problem we are considering is that municipalities should establish dairies similar to those in cantonments. I gravely doubt, however, if the intrusion of municipalities into the milk trade would be a wise step. For it would involve large initial expenditure without any prospect of successful competition with the *gwala* except at a considerable recurring loss. Moreover in order to meet the competition so created the *gwala* would undoubtedly resort to still further adulteration of his milk.

If, on the other hand, municipalities were to try to make their dairies self-supporting by charging high prices for milk, they would only benefit the well-to-do classes, whose wants, as has been seen, are already catered for in some large towns. Such action would also certainly cause a general rise in the price of milk. In either case, therefore, the interests of the ordinary consumer are more likely to be injured than advanced, while the main problem—that of reforming the *gwala*—is left almost untouched.

As a preliminary step towards obtaining a cleaner milk-supply, I would suggest the imposition of a tax upon all cattle housed within a town. It might be desirable to exempt from this tax milch cattle kept for purely private purposes, or those housed within certain specified areas, but the main object of the tax would be to exclude, as far as possible, all cattle from towns, in the interest both of the animals themselves and of urban sanitation.

It would be necessary to arrange for the accommodation of the milch cattle so displaced, and I think the best way of doing so would be by inducing dairymen to keep their herds in the neighbourhood, within a few miles of towns, by offering them land, cowsheds or dairies at low rentals. The expenditure on such a scheme need not be great, especially in the case of towns possessing spare lands. It might eventually become remunerative, as when this arrangement was firmly established and its advantages recognised by dairymen it would be possible to charge higher rents. In any case I think such a scheme would be a more suitable object for municipal expenditure, and would afford a far better prospect of improving the milk-supply than would the establishment of municipal dairies.

Such a system would greatly facilitate the inspection of milch cattle, their accommodation and food, the arrangements for the storage and transport of milk and the manufacture of butter and other milk-products.

The low rentals charged should also attract dairymen from a distance; this would bring them also under inspection and would have the further advantage of shortening the carriage of milk, a very important one in a hot and dusty country.

It might be objected that the sudden displacement of milch cattle from a town might dislocate the milk trade. There is, however, no necessity for sudden action, ample warning should be given and accommodation for the displaced animals should be prepared beforehand.

There is, moreover, little danger of any serious dislocation by this means of the milk trade of large towns, in the Punjab at any rate. As it is, a considerable proportion of the milk-supply of towns like Lahore and Amritsar comes from outside.

The trouble is that it is brought in from long distances, as great as twenty miles, mostly by road, and under conditions already alluded to, and it is this which it is desirable to avoid.

To further encourage the reform of the urban milk trade it would be desirable to provide milk vessels and appliances of approved pattern at or below cost price, or to offer subsidies, prizes or certificates to dairymen complying with municipal requirements, or to grant them special facilities for the sale of milk in towns such as the abatement or remission of octroi, or the provision of carriage or of milk shops.

Inasmuch as the urban milk trade is largly carried on by agriculturalists its improvement is a matter which concerns District Boards and provincial Agricultural Departments.

District Boards might therefore be expected to co-operate with municipalities in some of the measures already mentioned, such as the provision of land or cowsheds for dairymen at low rentals.

Agricultural Departments could also render effective help by undertaking the training of *gwalas* in modern methods of milk production, and by improving the breeds of milch cattle.

I may say that the Agricultural Department of the Punjab is already turning its attention to this subject.

So far I have been chiefly concerned with the production of clean milk, and by this I mean not only milk which has been protected from ordinary filth contamination, but which has also been obtained from healthy animals.

It remains to consider the question of the adulteration of milk.

This, although less difficult than that of obtaining clean milk, is not quite as easy as might be supposed. For except in a few large cities there is no one who can make accurate tests of milk and without such tests prosecutions for the sale of adulterated milk would have little chance of success.

Moreover, there exist at present very few observations on the composition of the milk of Indian cows and buffaloes, and it is necessary, before resorting to law for the punishment of fraudulent milk-sellers, that standards should be available with which to compare tests of suspected milk.

Milk standards would probably be necessary for different parts of India and for different seasons; for it is known, for example, that milk yielded during the rains is poorer in fat than at other seasons.

Meanwhile, in the absence of such tests and standards, the best way of dealing with gross adulteration of milk would be to require all milk-sellers to be licensed and to make the sale of pure and unadulterated milk a condition of the grant of a license. Any serious infringement of this condition could thus be dealt with by withdrawal of the license,

without resort to legal proceedings, as it would be easy, by simple tests, such as the comparison of the specific gravity of milk with the amount of cream obtained from it on standing for, say, six hours, to detect any gross adulteration.

I have not dealt with butter or other milk products, for their improvement will follow, as a matter of course, upon that of the milk-supply.

E. WILKINSON, *Lieutenant-Colonel, I.M.S.*

## APPENDIX 11.

### IMPROVEMENT IN THE AGENCY FOR THE REGISTRATION OF VITAL STATISTICS.

While ascertaining the causes of death during my investigation of malaria in the Central Provinces, I was much impressed by the amount of information regarding infantile mortality which could be derived by questioning the native *dhais*.

This is a source of information relating to vital statistics which is at present little, if at all, utilized.

In rural areas there is practically no inaccuracy in the numerical return of births and deaths; the unit is too compact and the event of a birth or death is sufficiently known and isolated not to escape record; there is also to a certain extent fear of police enquiry and interference should any concealment occur.

In such areas the village kotwal (the local registration officer) returns the great majority of infantile deaths as being due to fever; even infants dying as soon as 1 to 2 hours after birth are reported as the victims of fever: a few deaths are also credited to "dabba" and to "sukkhi".

A few questions to the village *dhai* throw considerable light on these reported fever cases; it is found that hereditary syphilis, convulsions, neglect or exposure, etc., etc., have a large share in the mortality factor and that the greatest inaccuracy prevails as regards the recorded length of time the child lived after birth.

The *dhais* know the history of each and every case and usually have no hesitation in supplying details.

In urban areas, on the other hand, the vital statistics are unreliable, not only from the point of view of "causes of death," but also as a numerical record, more especially in connection with births. The inclusion of the *dhais* in the reporting agency of towns will, therefore, bring about improvement in two directions:—

(*i*) In the calculation of the birth-rate.

(*ii*) In the ascertained causes of infantile mortality.

To give an instance of the advantage of utilizing the *dhais*, Burhanpur City, of 35,000 inhabitants, gave a yearly birth-rate sometimes slightly in excess, but mostly considerably below, the death-rate.

In 1909-10 I advocated the use of *dhais*, as a reporting agency and the adoption of the plan by the municipality in the present year has been followed by an increase of 12 per mille in the annual birth-rate.

I would suggest that steps be taken to include the *dhais*, in rural areas, as part of the provincial reporting agency; their reports could be made to the local registration officer (the kotwal in the Central Provinces), the inducement being a small annual reward.

In municipal areas the Committee could make similar arrangements. If adopted, this plan would have the advantage of effecting the registration of *dhais*, a preliminary to any real reform in the domestic sanitation of the Indian home.

The *dhais* would become more accessible to the efforts which are at present ineffectually made to improve their unskilled methods and somewhat lessen the infant mortality of the country.

W. H. KENRICK, *Major, I.M.S.*,
*Officiating Sanitary Commissioner,*
*Central Provinces.*

## APPENDIX 12.

### NOTE ON THE VERIFICATION OF VITAL STATISTICS.

It has long been a matter of comment that although the numbers of births and deaths recorded in India are very fairly accurate, the reported causes of mortality are very far from correct.

This defect is, of course, chiefly due to the want of accurate diagnosis, most persons in India dying either without any medical treatment at all or with only that of village practitioners of indigenous system of medicine to whom accurate diagnosis is a superfluity as well as an impossibility.

Wilful mis-statements as to the causes of deaths are sometimes made, as for example, when deaths from cholera or plague are reported as having been due to some other cause in order to avoid interference. Such mis-statements, however, are of but slight importance from statistical point of view, for their aggregate is not great and they are often refuted by the unmistakable evidence of serious epidemics or can be corrected by consideration of the local death returns for a series of years. It is thus, for example, that a high mortality in a Southern Punjab town in May, reported to have been caused by "fever," can be ascribed, not to malaria, but to plague.

There are many agencies for checking the number of births and deaths reported. The most important of these is the vaccination staff, the members of which, in order to ascertain the number of children which should be available for vaccination, have to examine birth and death registers and to make enquiries as to their correctness.

In the Punjab there are also Divisional Inspectors of Vaccination and Vital Statistics whose duty it is, besides inspecting the work of the vaccination staff, to make careful examination of the birth and death-registers, to check them by enquiries (chiefly from *baids*, *hakims* and *dhais*) and to report any omissions or mistakes that they may discover. These men, however, are only promoted vaccinators without any medical knowledge, and they are thus of little or no use for ascertaining the causes of death. Further checks on the number of deaths reported are provided in some towns by the records maintained at burial grounds and burning ghats or by the registration of funerals passing octroi barriers, but these too are of little or no use for ascertaining the causes of deaths and except by special enquiries instituted in connection with epidemics there is, in the Punjab, no means of ascertaining the true causes of mortality.

It might be thought that the examination of hospital and dispensary registers might shew the prevalent diseases in any given locality and thus furnish some idea of the causes of mortality. This, however, is the case to only a very limited extent and malaria is almost the only disease the mortality from which is reflected in hospital and dispensary registers. This can be understood when it is considered that patients with acute diseases such as cholera, plague and small-pox, rarely, if ever, resort to hospitals for treatment, except in large towns.

Further I have found, when examining such registers for evidence of the prevalence of particular diseases such as tuberculosis, that great fluctuations occur in the entries which can only be accounted for by some external cause such as changes in the medical staff. This may result either in changed diagnoses or in increased or diminished attendances for certain classes of ailments according to the reputation of the medical officer.

It is possible that the proposed registration of medical practitioners in India, when carried into effect, may result in some improvement as regards our knowledge of the causes of mortality. For it is to be presumed that registration will carry with it the obligation of furnishing certificates of the cause of deaths, and these should be valuable as data for checking the causes of uncertified deaths. It will, however, be long before such data are available outside the larger municipalities and it will thus be necessary to employ some special agency to enquire into the causes of rural mortality.

In the Punjab the nucleus of such an agency might be supplied by the appointment of Assistant Surgeons or Sub-Assistant Surgeons as Divisional Inspectors of Vaccination and Vital Statistics, in place of promoted vaccinators, and this is a step I have under consideration. It would, however, only deal with the fringe of the problem and it is chiefly with the object of ascertaining what is being done in other parts of India and of initiating a discussion on the subject that I have prepared this brief note.

E. WILKINSON, *Lieutenant-Colonel, I.M.S.*

## APPENDIX 13.

### REGISTRATION OF VITAL STATISTICS.

In the United Provinces the returns of vital statistics are tabulated separately for town and rural circles, each comprising from 10,000 to 15,000 inhabitants, and separate registers are kept for births and deaths. Both these registers give the date of the occurrence, the sex, the name of the father or head of the household, and the religion, and, further, in the case of deaths, the age and the cause of death are also shown. For registration purposes, whole-time officers are not, as a rule, employed and, generally, the writer at each police station is the recording agent except in the hill tracts where the village accountant takes his place. These officers obtain their reports in rural tracts from the village chowkidars who report weekly, in the municipalities and cantonments from the police who report daily and also from sweepers and the heads of households or the managers of public institutions, and in the hill tracts from the village headmen. Monthly, the registration officers submit abstracts of their registers of births and deaths for each sub-circle to the Civil Surgeons of their districts and by the latter officers the abstracts are tabulated and forwarded to the Sanitary Commissioner for check and publishing in the Gazette.

For the purposes of checking and testing the registration several agencies are employed. In some municipalities and cantonments special inspecting registrars are entertained, but, as a rule, the work is done by the Civil Surgeons. In rural areas the revenue staff, the police, the officers of the medical and sanitary departments, and the vaccination staff, all assist.

The whole system has the very decided merits of simplicity and cheapness and it is generally admitted that the returns, so far as total registration is concerned, are reasonably accurate. With regard to births this is practically all that is required, but I think you will all agree with me that in the case of deaths we want much more and it is here the system fails. The registration of the causes of death is very defective and even the statements as to age, sex, place, and date are frequently far from correct. Most persons die in India either without any medical treatment at all or with only that of the village *baid* or *hakim*. No accurate diagnosis of the disease is made and to this are probably due most of the errors as to the causes of death. This, however, will not account for the want of differentiation between such easily recognisable and well-known diseases as fever, cholera, small-pox, diarrhœa and dysentery, etc. In such cases some other explanation is necessary and this, it appears to me, is to be found in the carelessness of the officials who do the actual registration. These men have little interest in the accuracy of the returns which they consider as something apart from their regular duty and of little importance—an opinion which is fostered by the fact that the checking and supervision are left to busy officials whose time is otherwise fully occupied.

To remedy these defects it would be necessary to institute a separate paid agency for the registration, and another for the checking, of vital statistics. In rural tracts, I may say at once, this would be out of the question at present. The labour and cost would be enormous and the results far from commensurate with them. The present system seems the only one feasible supplemented in the case of particular enquiries by detailed verifications by special officers. As the statistics from such verifications increase, it should also be possible to strike general averages for particular tracts quite accurate enough for all practical purposes.

In the municipalities and the larger towns, however, the position is quite different. Complex sanitary questions are now constantly cropping up and large improvement schemes involving heavy expenditure are frequently under consideration. It appears to me that the time has arrived when sanitarians in India might reasonably expect to be furnished with more reliable and accurate statistics on which to base their recommendations, and by accurate statistics I mean not only accurate as to totals, but also at least approximately true as to other details such as date, age, sex, place, cause, etc. Such returns are the true basis of all recommendations and action in sanitary matters and without them such recommendations have to be made, and action to be taken, more or less in the dark. What the compass is to the navigator, statistics are to the sanitary officer. A skilled seaman may bring his ship safe to harbour guided only by experience and the sanitary officer, by a careful use of general principles, may avoid the many pitfalls in his path, but in either case it is largely a matter of luck. Further, correct and full vital statistics are the only gauge by which we can measure the good which has been done and without them it is impossible to give a satisfactory and convincing

reply to the criticism one now often hears that the money spent on sanitary improvements has given no tangible return. It may be suggested that dispensary registers would give us all the information required. These are no doubt useful and throw considerable light on the prevalence of particular diseases and causes of mortality, but there are many diseases (phthisis is a prominent example) which may be common and yet, for various reasons, the hospital registers give no indication of their presence. In my own provinces all Civil Surgeons and all medical subordinates send to me returns of the deaths occurring within the limits of their practices and independent medical practitioners have been encouraged to do the same. These returns too are useful as a general guide, especially as to the age distribution of particular diseases, but they fall very far short of being a complete key to what we require, *viz.*, the causes of mortality in particular places.

The whole matter seems to me of the very first importance and I would put forward the following scheme for the registration of vital statistics in municipalities for discussion:—

(1) That all heads of families and all superintendents or managers of public institutions be required to report births and deaths occurring within their respective jurisdictions within three days subject to a penalty of fine not exceeding ₹10.

(2) That, as a check on this reporting, all sweepers be required to report similarly subject to a penalty of ₹2, but also that a reward of one pice be given for each correct report made by them.

(3) That all reports be made to, and the actual registration be done by, one or more *medical* registrars of the grade of Sub-Assistant Surgeon specially appointed by the municipality for this duty and for the verification of the reports *only*.

(4) That the Health Officer should be the registrar of vital statistics for the municipality and be responsible for the supervision and checking of all registration.

This scheme is not altogether a new one but is rather only an extension and amplification, to obtain greater accuracy, of the system at present in vogue. The expenses would not be great. A population of 25,000 would give on an average 150 reports each month so that one Sub-Assistant Surgeon should be able easily to overtake the work in a town of that number of inhabitants. Government are yearly granting large sums for the improvement of sanitation in the municipalities, and it seems to me that part of this money might be most usefully earmarked for grants-in-aid to such towns as are willing to appoint the necessary staff.

My contention is, gentlemen, that with such large interests at stake we should trust nothing to chance but should seek round for every help to guide us that is possible. We are not dealing with a highly developed science but with one which, as applied to India, is still in its infancy and requires investigation and enquiry at every step. The groundwork to all such enquiries is a full and complete birth and death return.

J. C. ROBERTSON, *Major, I.M.S.*

## APPENDIX 14.

### NECESSITY FOR A UNIFORM METHOD OF WATER ANALYSIS IN INDIA AND A UNIFORM NOMENCLATURE OF FÆCAL ORGANISMS.

In a meeting constituted such as this it is obviously unnecessary for me to discuss at any great length the necessity of an uniform method of water analysis and a uniform nomenclature of fæcal organisms found in water. It may, however, just be pointed out that the following are the main advantages that would accrue from the above proposal:—

(1) With the amount of routine work that one has to perform only a limited amount of research work can be done, consequently it would take many years for any single institution to really investigate the natural conditions of drinking water in this country. It is obvious that if all the laboratories work on the same lines this can be totalled up and progress will be much more rapid.

(2) That the results of research and routine work will be comparable the one with the other whether the water be taken in from the Punjab or Madras provided the method of examining the sample is similar in both instances. On the other hand supposing each laboratory in India where water examination is carried out, use a different method and different series of media, etc., it is perfectly obvious that results which are valuable in themselves will not be able to be compared with those of other parts of the country and there will be an enormous waste of scientific energy in consequence. I therefore beg to lay before this meeting the following as being the most suitable method for examining water in all the laboratories in this country:—

(*a*) The total number of colonies that are visible to the naked eye grown on the neutral agar (+10 to normal carb. solution) incubated at a temperature of 37 for a period of 2 days. This record has undoubtedly certain uses though its utility is very variable in different parts of India, for instance the Hughli water contains a very large number of spore-bearing organisms which covers the whole of the plate and renders counting quite impossible. On the whole I consider it should be continued as it may give valuable information.

(*b*) Water should then be put into bile salt neutral red lactose broth tube in the following quantities: 1·20 c.c., 2·10 c.c., 3·5 c.c., ·31 c.c., 3·1 c.c., 3·01 c.c. This is after all only the usual method. We consider that in order to save medium 3 tubes for each quantity give fairly satisfactory results. If acid and gas be present in 2 out of 3 of any given series, it is recorded that the fæcal organisms are present in that quantity of the original sample.

2. In this step several points are open for discussion. By far the most important of this is, shall we use a lactose or a glucose broth? From a very large amount of research work (which will shortly be published) it is found that there are advantages in both, but as there is a limit to the amount of work that can be carried out we recommend a lactose broth. There is no doubt whatever that for samples where a very thorough knowledge of the conditions of water at any given time is required both glucose and a lactose broth should be used and the difference between the two compared, but this is both a long and a somewhat troublesome piece of work. Therefore for routine methods lactose broth only should be used for the following reason:—

By far the majority (96 per cent.) of all organisms in fresh fæces, that flourish in bile salt media, ferment lactose; the true intestinal organism is a lactose fermenter. There are varieties which do not ferment lactose but these are not numerous in fæces; in water analysis it is better if possible to form an opinion as to the condition of pollution by a study of the common organism rather than rare ones. A further discussion of this most interesting point will, as I have already mentioned, be published shortly. All bile salt broth tubes should be incubated at 42°C. for 48 hours before the results are recorded.

3. The next step is to make a study of the organisms which have grown in the bile salt lactose broth. In order to do this these bacilli have to be planted out on a solid medium and I recommend bile salt neutral red lactose. The originator of this as a solid medium was Dr. MacConkey. From many years' experience it has been found to have no equal as a solid medium for the ordinary intestinal organisms. The technique

of making plates need not be described to this meeting. The organisms for plating out should be taken from a 20 c.c. tube, otherwise the natural mixture is not obtained; 18 hours incubation is usually sufficient; it is important not to wait longer as the increasing acidity may kill off some bacilli and so alter the picture of the flora in the water.

4. Having got plates with isolated colonies, we now approach the difficult point as to what is the best method of taking the process further and it is this step which is really open to so much difference of opinion. There are two important methods which are largely followed by water analysts all over the world. Dr. Houston is the great exponent of the first of these. Having obtained isolated colonies in the way described each is tested to ascertain (1) whether it ferments lactose, (2) whether it ferments saccharose, (3) whether they give the indol reaction. If it gives lactose + saccharose – indol + he calls it "true coli." If a colony give lactose – or saccharose + or indol – or any combination of these he calls it an "atypical coli."

5. The second method and by far the most useful one is the one recommended by MacConkey. He passes each colony through the following carbohydrates:—

Saccharose Dulcit Adonit Inulin, Vosges and Proskauers reaction, Indol reaction, and examines them for Motility. By this method, which sounds very much more complicated than it really is, it is possible to separate the important species of all intestinal organisms that will grow in a bile salt media. A reference to the table further on will give the number of fæces already isolated.

These are the two important methods; let us first of all consider the advantages and disadvantages of Houston's method. The advantage that may be claimed for it is that it is short and simple. This is about all that can be said for it. The disadvantages are of a scientific nature: (1) it makes use of the terms "true coli" and "atypical coli" both of which terms are unhappy, for they do not convey the same meaning to all scientists and no two water analysts agree as to the significance of these groups. Secondly, the term "true coli" includes many different species, for by the use of MacConkey's method it can be demonstrated that these are entirely different organisms, such as bacillus acidi lactici, mutabilis, and others which give all the tests of Houston's true coli. It is therefore obviously objectionable to call 10 or a dozen entirely different organisms by one name. A very important fact frequently lost sight of by bacteriologists is that the laboratory reactions of one organism do not give any indications whatever of the conditions under which they live in nature or resist inimical influences. Supposing all the letters of the alphabet represent different organisms found in fæces, and assuming A, D and Q are found by experiment and by study of nature to be very delicate and to disappear rapidly from water, it is obviously advisable to find out whether a sample contains any of these varieties. On the other hand if B and G are very resistant and live for weeks in water it is obviously necessary to look for these varieties because of the conclusions that can be drawn from their presence. Obviously therefore we must separate species; ill-defined groups such as "true coli" and "atypical coli" are not satisfactory. A study of the natural characteristic of these various organisms is of course a long and tedious business and will take years before anything like finality can be arrived at, but my point is this:—If by the use of MacConkey's method we find out what organisms are present in a sample, so there is some hope that a conclusion may be drawn concerning the pollution. If on the other hand we simply are content with the fact that intestinal organisms exist in the water it means that practically every sample of water in India will be condemned. From a very great deal of experience now extending over four years (the results of which are shortly to be published) there can be no doubt whatever that by finding out what organisms are present in a sample, it is possible in India to make a very fair guess at a time when the pollution was added. Consequently MacConkey's method is vastly superior to all others. I recommend that 10 colonies from each sample be put through these various tests. At the end of this paper will be found the quantities required for the making of the various media. The indol reaction should be done with paradimethylamido benzene, the tubes being incubated four days at least.

6. It may be contended that this method is too elaborate for routine. As a matter of fact I disagree entirely with this contention, because if water is worth analysing at all you must find out all you can about it in order to give an opinion, but I admit that in some cases this elaborate method does give more information than is necessary. Therefore as an alternative or short method I suggest the following, *viz.*, that the colonies growing on the bile salt neutral red lactose agar be put through the two broth tests only, namely, saccharose and dulcit; this will divide the organism into MacConkey's four classes which are:—

Class I—saccharose – dulcit –
Class II—saccharose – dulcit +
Class III—saccharose + dulcit +
Class IV—saccharose + dulcit –

The method of interpreting the results obtained is based on one fact, *viz.*, that practically all organisms in class II should be looked upon with very grave suspicion. Most, though not by any means all, of these belong to the varieties which are very susceptible to the action of sunlight. This rule does not by any means hold good entirely, because there are one or two varieties in classes III and IV which are also probably very delicate organisms. In making use of this abbreviated method great attention should be paid to the number of fæcal organisms present that grow in lactose broth. It is the *amount* of lactose fermenting pollution which will really give the main indication as to whether the water is pure or highly polluted; but it is advisable also to find out whether organisms which are saccharose – dulcit + are present as well. If in any sample lactose fermenters are present in ·1 or ·01 of c.c. and amongst these organisms certain which are saccharose – dulcit + are common it is quite sure that the pollution is of a dangerous character.

It must be understood that I disapprove of classifying organisms according to their fermentative reaction. The only sound classification from the point of view of water analysis is whether an organism is susceptible or resistant to natural influences.

As regards the nomenclature of organism we have found that suggested by MacConkey is the best for all practical purposes. I herewith append the table and I recommend that bacilli isolated from water be named and numbered in the way described by this author.

## TABLE I.

| Number. | — | Lactose. | Saccharose. | Dulcit. | Adonit. | Inulin. | P. and V. reaction. | Indol. | Motility. | Gram stain. | Gelatin. | Litmus milk. | Acidity in litmus whey. | Reduction of nitrates. | Inosit. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | Per cent. | | |
| 1 | ..... | + | — | — | + | — | — | + | + | — | — | + | ... | + | — |
| 2 | B. Acidi lactici (Huppe) . . | + | — | — | + | — | — | + | — | — | — | + | 23 | + | — |
| 3 | B. Levans . . . . | + | — | — | — | + | + | — | + | — | + | + | 14 | + | — |
| 4 | B. Grunthal . . . . | — | — | — | — | — | — | + | + | — | — | + | 20 | + | — |
| ... | B. Sulcatus gasiformans . . | ... | ... | ... | ... | ... | ... | ... | ... | ... | .. | ... | ... | ... | ... |
| ... | B. Castellus . . . . | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 5 | B. Vesiculosus . . . | + | — | — | — | — | — | + | — | — | — | + | 25 | + | — |
| 6 | ..... | + | — | — | — | — | + | + | — | — | — | + | ... | ... | ... |
| 7 | ..... | + | — | — | — | — | — | — | + | — | — | + | ... | — | — |
| 8 | B. Coli mutabilis (Massini) . | + | — | — | — | — | — | — | — | — | — | + | ... | ... | ... |
| *9 | ..... | + | — | — | + | — | + | + | — | ... | ... | ... | ... | ... | ... |
| *10 | ..... | + | — | — | — | + | — | ... | ... | ... | ... | ... | ... | ... | ... |
| 33 | ..... | + | — | + | + | — | — | + | + | + | — | — | ... | ... | — |
| 34 | B. Coli communis . . . | + | — | + | — | — | — | + | + | — | — | + | 28 | + | — |
| ... | B. Cavicidæ . . . . | + | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 35 | B. Schæfferi . . . . | + | — | + | — | — | — | + | — | — | — | + | 22 | + | — |
| 36 | ..... | + | — | + | — | — | — | — | + | — | + | + | ... | + | — |
| *37 | ..... | + | — | + | — | — | + | ... | — | ... | ... | ... | ... | ... | ... |
| *38 | ..... | + | — | + | + | — | + | ... | ... | ... | ... | ... | ... | ... | ... |
| *39 | ..... | + | — | + | — | + | — | ... | + | ... | ... | ... | ... | ... | ... |
| 65 | B. Oxytocus perniciosus . . | + | + | + | + | + | + | + | — | — | + | + | 26 | + | + |
| 66 | ..... | + | + | + | + | — | — | + | — | — | — | + | ... | + | — |
| 67 | ..... | + | + | + | + | — | + | — | — | — | — | + | ... | + | + |
| 68 | B. Rhinoscleroma Pneumoniæ . | + | + | + | + | — | — | — | — | — | — | + | 14 | + | + |
| 69 | ..... | + | + | + | — | + | + | — | + | — | + | + | ... | ... | — |
| 70 | ..... | + | + | + | — | + | — | — | + | — | + | + | ... | ... | — |
| 71 | ..... | + | + | + | — | — | — | + | + | — | — | + | ... | + | — |
| 72 | B. Neapolitanus . . . | + | + | + | — | — | — | + | — | — | — | + | 22 | + | — |
| 73 | ..... | + | + | + | — | — | + | — | + | — | + | + | ... | + | — |
| 74 | ..... | + | + | + | — | — | — | — | + | — | — | + | ... | ... | ... |
| 75 | ..... | + | + | + | — | — | + | — | — | — | — | + | ... | ... | + |
| 97 | ..... | + | + | — | + | + | + | + | — | — | + | + | ... | + | — |
| 98 | ..... | + | + | — | + | + | + | — | — | — | — | + | ... | + | + |
| 99 | ..... | + | + | — | + | + | — | — | — | — | — | + | ... | + | + |
| 100 | ..... | + | + | — | + | — | — | + | + | — | — | + | ... | ... | ... |
| 101 | ..... | + | + | — | + | — | — | + | — | — | — | + | ... | + | + |
| 102 | ..... | + | + | — | + | — | + | — | + | — | + | + | ... | ... | ... |
| 103 | B. Lactis ærogenes . . . | + | + | — | + | — | + | — | — | — | — | + | 30 | + | + |
| ... | B. Dysentericæ Vitulorum . | ... | ... | ... | ... | ... | ... | .. | ... | ... | ... | ... | ... | ... | ... |
| ... | B. Capsulatus (Pfeiffer) . . | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 104 | B. Gasiformans non-liquefaciens . | + | + | — | + | — | + | — | — | — | — | + | 12 | + | — |
| 105 | ..... | + | + | — | — | + | + | — | + | — | + | + | ... | ... | — |
| 106 | ..... | + | + | — | — | — | — | + | + | — | — | + | ... | ... | — |
| 107 | B. Coscoroba . . . . | + | + | — | — | — | — | + | — | — | — | + | 25 | + | — |
| 108 | B. Cloacæ . . . . | + | + | — | — | — | + | — | + | — | + | + | 20 | + | — |
| 109 | ..... | + | + | — | — | — | — | — | + | — | — | + | ... | ... | — |
| *110 | ..... | + | + | — | — | + | — | ... | ... | ... | ... | ... | ... | ... | ... |

I also recommend that the term "coli," "true coli" and "atypical coli" be entirely given up in reporting on the samples of water. If any class of intestinal organisms are indicated they should be described as lactose fermenter or glucose fermenter as the case may be, thus:—

Reports should read "lactose fermenting organisms present in 5 c.c." instead of "coli in 5 c.c." The term Coli Communis being reserved for Escherichs organism which gives the following reactions:—

Saccharose −, dulcit +, adonit −, inulin −, Vosges and Proskauers reaction −, Indol +, Motility +.

*List of Media used in the work.*

I. (Stock solution A).—Bile salt glucose peptone neutral red broth—

| | |
|---|---|
| Peptone | 60 grms. |
| Sodium taurocholate | 15 ,, |
| Glucose | 15 ,, |
| Water | 1 litre. |
| Neutral red | 10 c.c. of 5 per cent. solution. |
| Normal sodium Carbonate solution | Till neutralised as indicated by the neutral red. |

(B Solution)—

2 parts of A solution + 1 part of water.

(C Solution)—

1 part of A solution + 1 part of water.

(D Solution)—

1 part of A solution + 2 parts of water.

II. Bile salt lactose, peptone neutral red broth—

Same as above, lactose being substituted for glucose.

III. Bile salt lactose peptone agar—

| | |
|---|---|
| Peptone | 20 grms. |
| Sodium taurocholate | 5 ,, |
| Lactose | 10 ,, |
| Agar | 20 ,, |
| Water | 1 litre. |
| Neutral red | 10 c.c. of 5 per cent. solution. |
| Normal sodium Carbonate solution | Till neutral point is reached as indicated by the neutral red. |

IV. Nutrient agar—

| | |
|---|---|
| Agar | 20 grms. |
| Lemco | 5 ,, |
| Peptone | 10 ,, |
| Sodium chloride | 5 ,, |
| Water | 1 litre. |

Standardised to + 10 using normal solution of sodium carbonate.

V. Nutrient broth—

| | |
|---|---|
| Peptone | 10 grms. |
| Sodium chloride | 5 ,, |
| Lemco | 5 ,, |
| Water | 1 litre. |

Standardised to + 10 using normal solution of sodium carbonate.

VI. Bile salt peptone neutral red sugar medium—

| | |
|---|---|
| Peptone | 10 grms. |
| Bile salt | 5 ,, |
| Sugar | 5 ,, |
| Water | 1 litre. |
| Neutral red | 5 c.c. of 5 per cent. solution. |

To prepare different sugars, the particular sugar is substituted in the column of sugar in the above solution.

The following sugar media are made:—

| | |
|---|---|
| 1. Saccharose. | 3. Adonite. |
| 2. Dulcite. | 4. Inulin. |

VII. Glucose medium for Vosges and Prosk. reaction—

| | |
|---|---|
| Peptone | 10 grms. |
| Glucose | 5 „ |
| Water | 1 litre. |

VIII. Strong peptone solution for vibrios—

| | |
|---|---|
| Peptone | 100 grms. |
| Sodium chloride | 50 „ |
| Water | 850 „ |

10 c.c. of this in 90 c.c. of suspected water converts latter into 1 per cent. peptone water.

W. W. CLEMESHA, *M.D., D.P.H., Major, I.M.S.*

## APPENDIX 15.

### INFANTILE MORTALITY.

With Captain Graham I have investigated the causes of death in the case of 661 children dying under one year of age in four different towns, and as the results we obtained are somewhat different to those generally shown, I thought it might be of some slight interest to give a short note on the subject without entering into very great detail. The causes of the mortality were as follows:—

| | | |
|---|---|---|
| Malaria | 149 | |
| Diarrhœa and dysentery | 108 | |
| Bronchitis and pneumonia | 87 | |
| "Born weakly," premature birth and inanition | 214 | (A large majority of these were indirectly due to malaria, though some had their causes in other diseases.) |
| "Other causes" | 43 | (including 14 due to tetanus). |
| Plague | 21 | |
| Not diagnosed | 39 | |
| Total | 661 | |

As a single direct cause of death malaria was by far the most important giving 149 or 22·5 per cent. of the total. This was probably due, to a certain extent, to the fact that the enquiry was made in towns which had rather a bad reputation for that disease but, even making due allowance for this fact, malaria would appear one of the chief direct causes of infantile mortality. If the 214 deaths under "born weakly," premature birth, and inanition are taken as for the most part caused by it as well, it was indirectly responsible for a very large proportion of the mortality indeed.

"Diarrhœa and dysentery," with 108 deaths or 16·3 per cent. of the total, came as the next chief cause. These were generally to be attributed to insanitary surroundings —filth-soaked soil due to defective conservancy and the insanitary habits of the people.

Bronchitis and pneumonia, with 87 deaths or 13·1 per cent. of the total mortality came as a close third. Most of these were cases of very ordinary colds which, with a little care, should have quickly cleared up and done no harm but which, being neglected, gradually developed to a fatal issue from broncho-pneumonia.

Of the "other causes" tetanus was the most important and caused 14 deaths or 2·1 per cent. of the total mortality. I know, this is not the usual position given to this disease as a cause of infantile mortality, but we made most careful enquiries and I feel convinced that its influence, in the present series of cases at any rate, was not underestimated. Many children develop convulsions in the course of other diseases shortly before death and these I feel sure have very frequently been mistaken for tetanus by the parents and their diagnosis been too readily accepted as accurate.

I would classify the causes of infantile mortality in the four towns examined, in their order of importance, as follows:—

(1) Malaria—operating both directly on the infant and indirectly through the mother,
(2) Diseases due to insanitary surroundings,
(3) Diseases due to ignorance on the part of the mother with regard to the feeding and care of the infant, and
(4) Accidents and diseases due to childbirth.

J. C. ROBERTSON, *Major, I.M.S.*

## APPENDIX 16.

### RECENT RESEARCHES IN CONNECTION WITH PLAGUE IN INDIA.

*A review of the work of the Plague Commission during the year 1910-1911 by Major W. Glen Liston, M.D., D.P.H., I.M.S., Senior member, and Captains Gloster, Kunhardt, White and Taylor, with their assistants.*

#### Part I.

Under the first head we will consider:—

(*a*) Observations on the habits and breeding of the Indian house rat *Mus rattus*.
(*b*) Observations on the development and multiplication of the Indian rat flea *Xenopsylla cheopis*.
(*c*) Observations on natural immunity to plague in *Mus rattus*.
(*d*) Observations on chronic or resolving plague in wild rats.

#### (*a*) *Observations on the Habits and Breeding of Mus rattus.*

Most of the work which has been done in the past on this subject has referred to the rat known as *Mus decumanus*. Our experiments have been made with *Mus rattus*, the common house rat of India. Attempts to breed wild rats in captivity have generally been unsuccessful. After many failures we at last succeeded in breeding and observing wild rats in captivity in specially constructed godowns, which we shall be glad to show to any members of this Conference. These godowns afford shelter to the rats in artificial burrows and nests which can be opened easily for purposes of inspection. Preliminary experiments in these godowns revealed the fact that rats would not breed when overcrowded. These first experiments were made with one, two, four, eight and sixteen pairs of rats in each godown. They covered a period of over two months but, save only in the godowns in which a single pair of rats was confined, no young were produced. It was interesting to note that, in the godowns with four or more pairs, an examination of the females after they had been killed showed that no one of them was pregnant. This excluded the possibility that young rats had been born and had been eaten before they were seen by us. It also showed that when overcrowded the rats do not breed.

Our further experiments were carried out generally with single pairs of rats and a large number of young rats were bred. Some of these young rats were used in certain immunity experiments to be referred to later, others were used to breed second and third generations of rats. The number of young produced by a series of single pairs is of interest. One pair produced thirty-four young ones in nine months and twenty-six days with an average of about five young per litter. Another pair produced in seven litters forty-three young in thirteen months and twenty days. A third pair in three litters produced seventeen young in four months and thirteen days. A fourth pair had twenty-nine young in seven litters during eleven months and ten days. A fifth pair had thirty-three young in five litters in eleven months and twenty-two days.

These figures give an average of thirty-six young per pair in one year or a litter of six (the most frequent number) every two months. In sixteen observations the average interval between any two litters was approximately fifty-three days.

A pair of rats bred in the godowns gave a litter when the male was four and the female five and half months old. Rats, however, look fully grown by the end of the third month and in nature may breed at this age. The period of gestation we found was between three and four weeks. We observed that a few more females than males were born in captivity. Of fifty-five young rats born in the godowns and noted for this purpose, 24 or 43·6 per cent. were males and 31 or 56·4 per cent. females. Compare these figures with rats caught in Bombay. In 30,000 observations, 51 per cent. were males and 49 per cent. females.

The young rats born in captivity were frequently eaten by their parents. Ten out of thirty-five litters were so destroyed. Six of these ten were eaten by the female alone, while four others were eaten either by the male or the female. The extent to which this destruction goes on under wild conditions is probably an important factor in keeping rat infestation at a comparatively constant level. It is possible however that in our godowns more young rats were destroyed in this way than actually occurs in nature, for our young rats were much handled to make measurements and obtain weights at different ages as we shall relate presently. Nevertheless some litters were eaten before they were handled.

With these data we are in a position to gauge approximately the reproductive powers of rats. A single pair produce say six rats every two months; these young rats in turn are able to produce young ones in approximately four months. Males and females are produced in about equal numbers. On an average say one litter of every three produced is destroyed by the parents before the young reach maturity. In these circumstances in less than one year a single pair may have multiplied to fifty pairs. If this rate of multiplication were continued for a year and a quarter the number of rats would be very great indeed. As a matter of fact observations in the field show that such rapid multiplication does not actually take place; it is probable that overcrowding, destruction by natural enemies and disease keep down the numbers. There is another very important factor which has to be taken into consideration in making such calculations. It should be remembered that not every pair of rats is at all times equally fertile. The number of rats we experimented with was too small to yield any reliable estimate on this score, but by a somewhat complicated calculation we reckon that nearly one pair in every four may be considered to be relatively infertile in the sense that reproduction with them does not go on at the estimated rate of a litter every two months. Even making this allowance but taking no account of the effect of disease and destruction by enemies, it does not seem possible to give a lower estimate than that a single pair of rats may multiply to forty pairs in the course of a year.

Experience in the field, as will be shown later, does not by any means confirm this estimate. Difficulties are met with in the field that prevent us making an accurate estimate of the rat infestation of any place; but the field experience is sufficient to put us on our guard in calculating the reproductive power of rats solely from laboratory observations. Nevertheless these experiments have convinced us that rats can multiply very rapidly and the important deduction can be drawn from them that any destructive measures against rats must be very thorough and very persistent.

Some observations have been made on the rate of growth of young rats. The weight of a young rat at birth is about four grammes. The average weight of each young one in seven litters was noted at 4·3 grammes. The rate of increase of weight was approximately one gramme per diem for the first three months. Thus, according to our observations, the weight of a rat in grammes, minus four grammes, the weight at birth, gives a figure approximating to its age in days.

At birth the tail of the young *M. rattus* is only about half the length of the head and body together, but it grows rapidly and is equal in length to the head and body a fortnight after birth. At the end of the first month the tail has attained its proper length in proportion to the head and body.

(*b*) *The Development and Multiplication of the Rat Flea Xenopsylla cheopis.*

It would take too long to detail the many and prolonged series of experiments that have been carried out, but we may state that it has been found that, with certain limits of temperature, the humidity of the atmosphere materially affects the life and development of the rat flea. To begin with it has been found that during the dry season in Poona, January to April, ninety-five fleas kept in dry test tubes plugged with cotton wool and covered with rubber caps laid 145 eggs or 1·5 eggs per flea, while in a similar series of tests, save only that a drop of water had been placed in the plugs before the tubes were capped, forty-five fleas laid 110 eggs or 2·4 eggs per flea, an increase of sixty per cent. in the moister atmosphere. Humidity thus favours the laying of eggs and succeeding experiments show that it has even a greater influence on their hatching.

The eggs laid by the fleas were transferred to three series of test-tubes, each containing a little bran. In the first series the tubes were plugged with cotton wool and covered with air-tight rubber caps so that in them the atmospheric moisture at the beginning of the experiment remained constant throughout. In another series an artificially moist atmosphere was created by placing a drop of water on the cotton wool plug, while in a third series the air was dried by placing in the tubes a small drying disc (asbestos saturated with calcium chloride).

Of 150 eggs placed in the untreated tubes forty-three or twenty-eight per cent. developed into larvæ. One hundred and fifty-one eggs in the moist air tubes yielded sixty-six larvæ or nearly forty-four per cent., and of twenty-eight eggs in the dry air tubes not one developed.

Humidity has also a marked influence on the lives of flea larvæ. It was found that, during the dry weather months in Poona, January to March, not a single larva out of 316 lived to become a pupa, while in an artificially moist atmosphere 13 out of 276 larvæ reached the pupal stage and all ultimately emerged as fleas.

That atmospheric humidity has further a marked influence on the life of the adult flea or imago will be seen in the following experiment. Three series of test-tubes were taken similar to those described above and in each test-tube were placed five fleas. The fleas were not fed on blood so that they gradually died but the number alive each day was noted. Each flea alive at the end of the first day received one mark, each alive at the end of the second day received two marks, each alive at the end of the

third day three marks, and so on till all were dead. The marks thus obtained were totalled and then divided by five, the number of fleas used in each test-tube; a figure was thus obtained which, for want of a better name, we have called the aggregate average life of five fleas in days.

The experiments were carried out in Poona from January to April. In the untreated tubes forty-five fleas gave a mean figure of 18, and thirty fleas in the dry air tubes gave a mean figure of 5·1. It will thus be seen, at the temperature of Poona during the months January to April, a humid atmosphere favours the laying of eggs by fleas; more eggs hatch into larvæ, more larvæ develop into pupæ and the life of the fully developed flea is likewise prolonged.

It remains only to add that when humidity is in excess (over 80 per cent.) and the temperature high (over 85° F.) moulds develop in the media on which the flea-larvæ feed, and these apparently kill the larvæ so that few reach maturity.

This laboratory experience is in accord with our observations in the field. The number of fleas found on rats during the hot and dry season is very much less than during the cold and relatively humid period of the year; and we may draw the conclusion that, on the whole, a relatively humid cold weather is likely to be associated with a severer epidemic of plague because the flea prevalence under such circumstances is likely to be high. There are, however, other factors which influence the prevalence of plague in any place, and these may cause us to modify this conclusion. Such factors are a scarcity of rats, which may occur after a recent epidemic, or an immunity to plague among the rat population, and this, we will see, is gradually brought about after a series of epidemics.

*(c) Observations on Natural Immunity to Plague in Mus rattus.*

We will now consider some observations on natural immunity to plague among *M. rattus*.

Perhaps no more important observation during the whole work of the Commission has been made than that in the course of a series of epidemics of plague there is evolved a race of rats which is naturally immune to the disease. This is a comforting discovery, for it assures us that in process of time, it may be after very many years, plague will disappear from India, as it has done in the past ages. One of us once made certain suggestions for the prevention of plague and an influential opponent of the proposed measures concluded his remarks by saying, "if you can tell us how plague disappeared from India in past ages, in spite of the fact that then there were no modern methods of sanitation to account for its disappearance, we will believe that you know something as to how plague is spread." At the time an entirely satisfactory reply to this challenge could not be given. But now we seem to have found the explanation and it is that, following the introduction of plague, a race of rats, which is comparatively immune to the disease, is established gradually by a natural process of selection and the survival of the fittest.

Thus, using for experimental inoculation a minute dose of plague virus, say twelve to twenty-four thousand virulent plague bacilli, which is equivalent to about one hundred thousandth part of a grain of an infected rat's spleen, we at present find that ninety-seven to one hundred of every hundred rats from Madras City die after infection and that only some twenty out of every hundred rats from Bombay City will succumb. Not only so but, repeating the experiment with large numbers of rats, we find that plague-free towns such as Madura, Raipur and Dacca yield rats which give a 90 to 100 per cent. mortality from plague and that plague-stricken places like Cawnpore, Lucknow, Poona and Bhagalpur yield rats highly immune to the disease and giving a mortality of only 20 to 40 per cent. Moreover the immunity of the rats in each of these places is in proportion to the number and severity of the epidemics from which each town has suffered. Cawnpore shows the greatest immunity with a mortality between 12 and 20 per cent. Poona and Bombay come next with a mortality between 16 and 25 per cent. Lucknow and Bhagalpur follow with 30 and 40 per cent. respectively.

That the immunity to plague is transmitted from parents to offspring, and is not acquired, is indicated by the fact that young rats from Bombay and young rats from Poona, caught at an age and at a time when they could not have been exposed to infection, are only very slightly more susceptible to plague than the adult rats of the same places.

This view of the hereditary transmission of natural immunity has been confirmed by two series of godown experiments in which rats bred in the godowns from known stock were used.

In the first series ordinary wild Bombay rats were allowed to breed and their progeny, when a sufficient number had been collected, were inoculated and compared with a similar series of wild Bombay rats. The mortality among the wild rats was 21 per cent. while that among fifty godown-bred rats, treated with the same dose, was 20 per cent.

In the second series, rats bred from the survivors of experimentally produced epizootics in the godowns were used. Their parents had all been exposed to most severe infections and were therefore probably highly immune. That their young were extraordinarily resistant to plague was proved by only one out of twenty-five or 4 per cent. succumbing to a dose of virus sufficient to kill 19 per cent. Cawnpore rats, 21 per cent. Bombay and Poona rats, 32 per cent. Lucknow rats, and 99 per cent. of those from Madras.

We have, we believe, in these experiments good evidence to show that in time plague will of itself die out of India. It may be long hence, and will in all probability be very long, unless rational measures are taken to fight the disease.

*(d) Observations on Chronic or Resolving Plague in Rats.*

Only briefly do we wish to refer to our work on Chronic or Resolving Plague. We are more convinced than ever that a large number of rats recover from the disease; this is especially the case in places which have suffered from repeated epidemics. Moreover, we have been able to produce chronic plague in many of the thousands of rats we have inoculated in connection with the immunity experiments referred to above. The lesions found in these rats correspond exactly in character to those which we have found in naturally infected rats, but which for one reason or another we were unable to prove were plague lesions. In the light of further experience of plague in rats we have amended our classification of plague lesions into acute, sub-acute, resolving or chronic, and recovered plague lesions and we can reaffirm, after more extended observation, the opinion expressed in our reports that we have no reason to think that chronic plague lesions play any part in the annual recrudescence of plague.

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## Part II.

We will pass on to review our recent work in the field and in this connection we will consider:—

(*a*) The work in Eastern Bengal and Assam.
(*b*) The work in Poona City.
(*c*) The work in the United Provinces.
(*d*) The work in the Madras Presidency.

*(a) The Work in Eastern Bengal and Assam.*

Our work in Eastern Bengal and Assam was brought to a close towards the end of last year. The problem we had set ourselves to solve may be stated thus. From the time that plague first appeared in India in 1896 to the present date only two very limited epidemics of the bubonic type of the disease have been reported in the Province of Eastern Bengal and Assam.

One of these epidemics occurred in 1903 in the town of Dibrugarh in the extreme North-East of the Province. During this epidemic there were thirty-six cases and twenty-eight deaths and it was localised to certain grain godowns and their immediate neighbourhood. Evidence of a co-existing epizootic was furnished by the finding of dead rats. The second epidemic of bubonic plague was of a more doubtful nature. Eight cases with seven deaths were reported in 1907 in a small hamlet in the Manipur district in the extreme east of the province. No evidence of rat mortality was obtained on this occasion and the true nature of the outbreak was never definitely determined.

Apart from these two epidemics a small number of imported cases of bubonic plague have been recorded on a number of occasions in different towns and villages. While this has been the experience of the Province as far as the bubonic type of the disease is concerned, it has been different in respect to the pneumonic. Cases of pneumonic plague were known to have been imported into the Province on at least nine separate occasions. On each occasion the imported case has been associated with cases of local origin and epidemics of pneumonic plague, more or less severe, have developed in connection with these imported cases.

When we remember that only about 3 per cent. of the cases of plague in India are of the pneumonic type, that no very elaborate precautions are taken to register all cases of plague in the Province and that communication with infected areas is freely allowed, we are forced to the conclusion that many cases of bubonic plague must be imported into the Province, but are not registered and that pneumonic cases come to notice mainly because they are associated with epidemics of the disease.

Having established the fact that communication with infected places was maintained to some extent and that the nearest plague-infected places, apart from Calcutta

City, were found in Behar, it was necessary to enquire why epidemics of bubonic plague were so rare in Eastern Bengal and Assam, while the disease flourished in parts of the adjoining districts of Behar. With this object in view, an examination of rats and fleas was made in certain selected places in Dacca town, Chittagong and Jaktabari in Eastern Bengal and in Bhagalpur and Purneah in Behar. The last place was selected because it was itself free from the disease and is situated between plague-smitten Bhagalpur and the Province of Eastern Bengal and Assam. Observations in these places showed that while fleas were fairly numerous upon the rats (at one time in the month of April numbering nearly nine per rat in Dacca City), the number of rats caught in the towns of Eastern Bengal and Assam and in Purneah in Behar were very few in comparison with the number caught in plague-stricken Bhagalpur, where, too, the fleas on the rats were numerous.

Thus, in all the abovementioned places, save only in Bhagalpur, the number of rats caught per 100 traps set was under ten, whereas in Bhagalpur thirty-four rats were caught in every hundred traps set. The greater rat infestation of Bhagalpur, as compared with the towns of Eastern Bengal and Assam, is accounted for by the structure of the houses and the habits of the people. While in the former place the houses resemble those found in Poona and Belgaum being built closely together, constructed for the most part of mud, roofed with country tiles, and frequently strewn with rubbish, those in the latter places are generally scattered and are either solidly constructed with cement plinths and with roofs of stone slabs or they are more of a flimsy build with walls of bamboo matting and roofs of corrugated iron or thatch, affording little shelter for rats. Moreover the houses are kept in good repair, and the heaps of litter and rubbish, so commonly seen in Bhagalpur and Poona, are more rarely met with in the towns and villages of Eastern Bengal.

We believe from those observations that the habits of the people and the structure of their houses have much to do with the presence or absence of plague in their midst.

### (*b*) *Observations in Poona.*

We have now carried on work at Poona continuously for three years. During two of these years, the city has been practically free from indigenous plague, so that, on rats and fleas, we have made observations which have not been interfered with by the presence of an epizootic. During the first year we were able to follow the course of an epidemic. In the two following years we studied what may be regarded as the normal conditions and now we are at the commencement of another epidemic. The observations during these three years are of much interest, but we can only briefly refer to the more important.

At the close of the first epidemic, we found that the number of rats per 100 traps set was as low as nineteen. The number of rats caught thereafter steadily increased from this figure to something over sixty rats per 100 traps set—the figures at the commencement of the present epidemic—although during this period we caught and destroyed more than seventy-two thousand rats or from two to three thousand rats every month.

This increase in the rat population, though not so great as might have been expected from the calculations made from the figures obtained in our breeding experiments in the laboratory, is yet sufficiently imposing to convince us that the decrease of the rat population of any place will be accomplished more satisfactorily, if more slowly, not by waging a direct war upon the rodents, but by improving the structure of buildings, especially grain godowns, and such buildings as are liable to harbour rats and by instituting a thorough system of scavenging which will diminish their food supply.

During the three years, the flea counts on rats showed a very constant seasonal variation from about two fleas per rat in the hot weather to an average of nine per rat for the month of September. The months of high humidity are particularly favourable to flea multiplication, while dry hot weather is unfavourable.

We have been able to keep a close watch on imported cases of plague, our experience has shown that a large number of persons have come to Poona from infected places. The present epidemic in Poona City has been started by persons carrying the disease with them from Lonacla, where an epidemic existed for some weeks before it was known to the authorities. The experience we have had in Poona has fully convinced us of the enormous importance of what we have called "the importation of infection" and the urgent necessity for a better system of intelligence so that early information can reach the authorities of the outbreak of an epidemic disease. How this can be accomplished is a pressing problem in plague prevention and in all Indian sanitation and certainly deserves the attention of this Conference. At one time as many as eighty persons were coming to Poona City daily from the plague-infected centres, most of these, and we wish to emphasize it, were refugees from infected towns or villages. Fortunate it is that plague infection is carried from place to place only with difficulty.

The present epidemic started in three well-defined foci and is spreading from the infected areas to other parts of the town (*a*) by direct rat to rat infection; (*b*) by the

carriage of infection by persons coming from the infested areas to healthy parts of the city.

The epidemic is at present not severe (1) because the conditions are daily becoming less and less favourable for flea multiplication, the epidemic started with a failing flea prevalence; and (2) the number of rats, which are immune to the disease, is very large, more than 70 per cent. of them are immune to a moderate dose of virulent plague bacilli; (3) the number of foci of rat infection is still small. Should the disease continue to prevail during the coming quiescent season and the number of foci of infection increase, a moderate to a severe epidemic may be predicted during the next rains when the conditions are favourable to flea multiplication.

*(c) Work in the United Provinces.*

In the beginning of this year work was started in the United Provinces. The work has been undertaken with the object of solving if possible certain apparently obscure problems connected with the distribution of plague.

The questions to which we are endeavouring to find answers are—

(*a*) Why has Cawnpore persistently suffered from more severe and more frequent epidemics of plague than has the adjacent city of Lucknow? Why do Cawnpore epidemics almost invariably commence some months earlier than the plague epidemics in Lucknow?

(*b*) In the Ballia District, what are the factors which account for the severity of plague, greater here than in any other district of the United Provinces?

(*c*) Why have the Bundelkhand Districts of the United Provinces escaped infection from plague?

(*d*) What accounts for the greater severity of plague in the Muttra and Muzaffernagar Districts as compared with the other Western districts of the Province?

There are other questions of minor importance that will engage our attention, and it is too early yet to make final and definite statements about any of the questions raised above. Several facts of interest, however, have already come to light, and we may refer briefly to them.

Before doing so we would draw attention to the remarkable and sometimes very large discrepancies between the plague statistics published by the Sanitary Commissioner and those of the Special Plague Reports of the United Provinces. A difference of fifty per cent. in the figures is not unknown. The matter, we think, is one worthy of consideration by a Conference of this kind and for this reason we mention it.

(*a*) Let us proceed to the results of our inquiry in Cawnpore and Lucknow. These two cities, separated by less than fifty miles, and possessing climates remarkably similar, have plague histories that present striking differences. Epidemics in Cawnpore have been more severe than those in Lucknow. Most of the severe epidemics in Cawnpore have commenced in the autumn months and reached their height in December or January. Those in Lucknow have never attained their height before March or April. In this connection Lucknow is typical of the United Provinces as a whole, Cawnpore being a striking exception. Of late years there has been a slight tendency for Cawnpore epidemics to approximate in type to those of other places in the United Provinces but they still occur early.

An examination of rats and fleas was commenced in Lucknow in January and in Cawnpore in February. Without going minutely into figures it can be stated that:—

(1) Rats (*M. rattus*) are very much more numerous in Cawnpore than in Lucknow (probably twice as numerous).

(2) Fleas are persistently more numerous on the Cawnpore rats than on the Lucknow rats and the post-monsoon rise in the number of fleas takes place several weeks earlier in Cawnpore than in Lucknow. The highest flea counts in Cawnpore to date have been approximately seventeen in one week in October and one week in February. In Lucknow the figures are about twelve in the same months. The minimum flea counts were obtained in June when 2·5 fleas per rat were noted in Cawnpore and approximately two in Lucknow.

(3) Rats in Cawnpore are at the present time much more immune to plague than they are in Lucknow, a reference has been made to this when immunity to plague in rats was under consideration. Thus, while only twelve per cent. of Cawnpore rats died of plague, thirty-seven per cent. of Lucknow rats succumbed to the same dose, this dose killing ninety-five per cent. of rats from Madras. The rat flea that is most in evidence in both these towns is *X. cheopis*. *Ceratophyllus fasciatus*, or an allied species, is fairly often found in Lucknow on rats during the cold weather and was very much less frequently met with in Cawnpore. This species of flea

disappeared completely with the onset of the hot weather and to the present date has not re-appeared. Factors of very special importance in connection with the Cawnpore and Lucknow problem appear to be—

(1) Crowding and congestion of people and houses in Cawnpore is much greater than in Lucknow.

(2) Cawnpore is a very large grain collecting and distributing centre. This latter factor we believe is of importance in maintaining the large rat population of that city and exposes it to early infection from surrounding infected areas. Grain and fodder we know are well recognised media for the distribution of infection either by the rats or the fleas which find shelter in them.

(*b*) Work was also started in the Ballia District early in the year and observations on rats and fleas have been made in several towns and villages on lines similar to those in Cawnpore and Lucknow. Our work has, however, met with several interruptions owing to the opposition of the people to trapping, but, in spite of these, some facts of interest have come to light.

Flea counts in this district have never fallen so low as they have done in Cawnpore and Lucknow. A flea count of nearly six per rat was noted at Bansdih in July, a time when the count in Cawnpore and Lucknow approximated to only three. Possibly, as a consequence of this sporadic cases of plague, during the non-epidemic season, are more frequent in this district than in other districts in the United Provinces. This is a matter of importance in connection with the severity of the disease in this district for the more numerous the foci of infection the greater are the opportunities for the spread of the disease, especially at a time when fleas are becoming more numerous.

(*c*) The plague-free district, Banda, in Bundelkhand was also selected for observations. Work has been going on there for the past two months. Trapping in Banda town has revealed the somewhat surprising fact that both rats of a high degree of susceptibility and fleas are present in abundance. If the present high flea count is maintained in Banda throughout the cold season the explanation of the immunity of this district from plague will be difficult and the inquiry is expected to be of special interest and importance.

(*d*) The fourth problem, the severity of plague in Muttra and Muzaffernagar, has not yet been investigated on the spot.

Much laborious work has been done on the relation between meteorological conditions and the severity and the distribution of plague in the Province. It is abundantly clear that humidity and temperature are factors of great importance, but it is exceedingly difficult to assign to either its relative value.

### (*d*) *Observations in the Madras Presidency.*

During the past six months the Commission have also been engaged in the Madras Presidency. Here, as in the United Provinces, the problem we have set ourselves to solve is the peculiar geographical distribution of the disease. We wish particularly to find out why a large part of the Madras Presidency has escaped infection while most of the rest of India has been severely smitten.

It has been urged by some that the Madras Presidency has escaped because, relatively to the amount of plague present in the Presidency, a far greater sum has been expended on plague preventive measures in Madras than in any other Presidency or Province. Up to the end of 1909 more than half a million sterling had been spent in keeping plague at bay.

The question resolves itself into finding out whether the comparative freedom from plague has been due to these measures or whether these measures have been materially assisted by the natural conditions which exist in the Presidency and which themselves are less favourable to the spread of the disease. We are not yet in a position to give the answer but the following is a brief summary of our observations to date.

In Madras City rats are numerous and are, as we have seen, extraordinarily susceptible to plague. *Mus rattus* forms approximately fifty per cent. of the rodent population of the city, the remainder of the rodent population is made up of bandicoots and mice. But while rats are numerous, the number of fleas found on them is low compared with places where plague has been epidemic. For less than two months in the year an average of five fleas per rat was found. This is the maximum figure and can be compared with eighteen per rat in Belgaum, seventeen in Cawnpore, fourteen in Lucknow and eleven in Poona.

In May of this year observations were commenced in Madura and Coimbatore. The former city has never suffered from plague, and here, although rats are numerous, fleas are scarce. On the other hand, in Coimbatore, situated more than 1,000 feet above the sea level and enjoying a climate cooler than that of Madura, rat fleas are more numerous and the town has suffered from several epidemics of plague. On an average during the month of September as many as 10 fleas per rat were noted.

Observations have been made at a number of other places, among them Vaniyambadi and Deccanikota. The former town is situated about 2,000 feet, while the latter is more than 3,000 feet above the sea level.

Vaniyambadi has had one severe epidemic of plague which lasted for nearly two years destroying during that time nearly one-quarter of its inhabitants. Since this epidemic the place has been free from plague. Rats, even now, seven years after the epidemic, are comparatively scarce, in the town only 10 rats being caught in every 100 traps set.

Deccanikota on the other hand is situated on the Mysore plateau where plague has been present for many years. Here the number of fleas found on rats is greater than that found in any other part of the Madras Presidency.

So far as our work at present goes it seems as if that part of the Madras Presidency which is situated below an elevation of 1,000 feet has escaped plague largely because of the scarcity of the fleas on the rats and this again appears to be due to the climatic conditions.

Some interesting observations have been made at Coonoor and Ootacamund. Here the species of fleas found on rodents differ remarkably from those of the plains.

In Coonoor mice are very numerous and rats are comparatively few. Four hundred and seventy-three mice were caught with only fifty *M. rattus*, and the common mouse flea *Cotenophysylla musculi* is found both on mice and on rats. This flea is very rarely found in other parts of India. Field rats are also numerous and on them a new species of flea has been found which is closely allied to *Pygeopsylla ahalæ*. A species of flea was also found on *M. rattus* which closely resembled *Ceratophyllus fasciatus* and which has been identified by Rothschild as *C. alladines*.

Observations are now being extended to Calicut, Palghat, Trichinopoly and certain other towns in the Presidency.

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## Part III.

In conclusion we review our work in the hospital.

Through the kindness of Dr. Choksy we have been able, during the past three years, to carefully study some 444 cases of plague. Exactly half this number were treated with anti-plague serum in varying doses given both intravenously and subcutaneously and the other half were retained as controls under ordinary treatment. The treatment of the patients in the two groups of cases was similar except that the patients of one group in addition were treated with the anti-plague curative serum. There were 222 cases in each group. The case mortality in the serum-treated patients was 66·1 per cent., in the control cases 73·4 per cent. This shows a slight advantage to the serum-treated cases, but a further analysis considerably minimises this advantage. Cultures from the blood of every case were made daily from the day of admission till the recovery or the death of the patient and the two groups of serum and control cases were further sub-divided according to the result of the examination of the cultures taken immediately before treatment was begun as follows:—

(*a*) those without any bacilli in one quarter of a cubic centimeter of their blood;

(*b*) those with less than ten bacilli in each quarter of a cubic centimeter of blood;

(*c*) those with over ten and less than one hundred bacilli in each quarter of a cubic centimeter of blood;

(*d*) those with more than one hundred bacilli in a quarter of a cubic centimeter of blood.

Here we may state that no case in groups (*c*) and (*d*) whether among the serum or among the control cases recovered. We have therefore to consider only groups (*a*) and (*b*) to apprise the value of the serum treatment.

Among the serum cases 85 belonged to class (*a*), that is, had no bacilli in their blood at the beginning of their treatment while there were only 70 of this class among the controls. Again among the serum group in class (*b*) there were only 43 cases while there were 47 cases among the controls. There was thus a slight advantage in favour of the serum cases when the severity of the disease in each group is considered. The subjoined tables clearly demonstrate the results obtained.

It may be said that clinically one could observe that the serum modified the course of the disease: life was prolonged and the bacteria tended to diminish in numbers in the circulation becoming localised in the tissues where they caused necrotic nodules and abscesses.

A reduction in the degree of septicæmia occurred in fifty-three of the serum cases and in only thirty of the controls. It would seem then that, in a case that was hanging in the balance between recovery and death, the serum fortified a little the resisting powers of the patient, but, where a patient would have in any case recovered, the severe urticarial and painful erythematous rashes and the arthritis produced by the serum prolonged his stay in hospital and added to his discomfort. These results are by no means encouraging but we have a ray of hope in the fact that certain experiments conducted in the laboratory of the Lister Institute by Dr. Sydney Rowland with a serum prepared by a new method has yielded much more satisfactory results when tested on infected rats. Some of this serum is now in my hands, and I hope to have an early occasion for trying it on men.

*Serum Cases.*

| | Actuals. | | | | | Percentages. | | | |
|---|---|---|---|---|---|---|---|---|---|
| | A | B | C | D | Total. | A | B | C | D |
| Survived . . . | 63 | 12 | 0 | 0 | 75 | 84·0 | 16 | 0 | 0 |
| Died . . . | 22 | 31 | 18 | 76 | 147 | 15·0 | 21·1 | 12·2 | 51·7 |
| Total . | 85 | 43 | 18 | 76 | 222 | 38·3 | 19·4 | 8·1 | 34·2 |

Diminution of Septicæmia { Survivors . . . . . 11
Died . . . . . 42
53

Case mortality 66·1%.

*Control Cases.*

| | Actuals. | | | | | Percentages: | | | |
|---|---|---|---|---|---|---|---|---|---|
| | A | B | C | D | Total. | A | B | C | D |
| Survived . . . | 46 | 13 | 0 | 0 | 59 | 78·0 | 22·0 | 0 | 0 |
| Died . . . | 24 | 34 | 24 | 81 | 163 | 14·7 | 20·86 | 14·7 | 47·63 |
| Total . | 70 | 47 | 24 | 81 | 222 | 31·5 | 21·1 | 10·8 | 36·4 |

Diminution of Septicæmia { Survivors . . . . . 13
Died . . . . . 17
30

Case mortality 73·4%.

## Conclusion.

In conclusion, gentlemen, I trust that I have made it clear that, although the Plague Commission have done much to advance our knowledge of plague, there still remain problems worthy of study and that success in the elucidation of these problems is only possible when laboratory work is combined with epidemiological and clinical inquiries.

I have purposely said little about preventive measures; these, after all, are of first importance. But the carrying out of suitable measures in so vast a country as this can

only be accomplished by those who have an intimate knowledge of the very varying customs, habits, and temper of the people in the different parts of it. It therefore remains for you, members of this Conference, to suggest and carry through such measures as your experience of the people in your several Provinces permits you to believe are practicable, bearing in mind always that few measures can be successful which are not based on a true knowledge of the ætiology of the disease. A study of the disease must first be made and preventive measures can then be based on the knowledge gained. It has been our duty to study plague; it remains for you to devise practical measures for its prevention.

W. GLEN LISTON, *M.D., D.P.H., Major, I.M.S.,*
*Senior Member, Plague Research Commission.*

PAREL;
*The 4th November 1911.*

## APPENDIX 17.

### PASSPORTING OF GRAIN AND GRAIN GUNNY BAGS FROM LOCALITIES INFECTED WITH PLAGUE.

My reason for bringing this forward is on account of the frequency with which I have observed that outbreaks of indigenous plague have very frequently occurred in grain godowns or in their immediate vicinity. Examples of this which have come under my personal observation existed in Calcutta in 1898 in and around grain godowns of Kidderpore. It seemed to me a curious coincidence that the outbreak in the southern divisions of the city which are separated by a broad maidan and Tolly's Nullah from the northern sections should occur simultaneously in each. The rat itself could not be the means by which infection was carried owing to the risk to its life which such a journey would involve. That some other means of conveying infection must exist was strongly impressed upon me, and I concluded then that the vehicle of infection was grain. In the light of more recent knowledge and working on the flea theory of the spread of plague I venture on a hypothesis that the infection was conveyed by means of the flea in the grain or gunny bags. In support of this we have also the case in this Presidency of the Bellary town. In this instance the oilseeds were imported from a locality well-known to be infected in the Nizam's dominions to the railway goods-shed in which after about a week an epizootic amongst the rats was discovered. The disease next appeared among the people in the town in the shops of Cowl Bazaar where this oilseed was retailed.

It is a well-known fact that the rat population of these grain godowns is much greater than that of any other class of building. Systematic trapping of villages has shown that the rat population is greater in grain godowns and grain shops than in any other class of building. The number of rats which can be got in these godowns is much greater than can be obtained in dwelling houses and small bazaar shops which do not sell grain. This is a matter of very common experience. One can go on trapping these godowns over and over again and still continue to catch rats. These godowns present every condition favourable to the spread of a virulent epizootic provided there is a sufficient flea prevalence.

Up to date no really satisfactory regulations for the control of plague from infected localities have been made in accordance with the latest finding of the Plague Commission. The last interim report contains the following statement:—

> "Plague appears to be commonly imported into a fresh locality about the persons of human beings, though the transference of infected rats and fleas in merchandise must be considered."

In the Madras Presidency at present a system of passporting individuals from plague-infected localities is carried out at great expense and is based upon ideas which have undergone considerable modifications since the scheme was first drawn up. This passport system would probably require considerable modification to bring it up to modern ideas on plague prevention for while exercising a supervision over the individual it entirely neglects the other possibility of the carriage of plague in merchandise. The possibility of the transmission of infection in merchandise more particularly the grain bags is one which must have occurred to any one who has watched the spread of plague in districts.

The rat population in grain godowns is so great that in the event of infection appearing amongst them the number of infected fleas which must necessarily fall on the grain and gunny bags must be considerable—

(2) The frequency with which plague spreads to the district after shandy would lend colour to the idea that infected fleas are transported in merchandise. The possibility however of the human factor here cannot be neglected.

(3) Gunny bags possibly contain infected fleas or plague-infected dead rats, and this makes it very important that such gunny bags being sent from infected localities should be observed in some way.

If the above hypothesis after experiment proves to be correct I would suggest for your consideration some method of passporting these grain bags:—

(*a*) These bags should be ticketed—the name of the town or village and date of export.

(*b*) Before entering a non-infected locality they should be submitted to sun or cyanide disinfection in accordance with the recent memoirs on the subject of flea destruction.

Such a method would be much easier to carry out than observation of individuals and would give less trouble to the people. We have frequently found in districts which have been infected previously that the villagers will not allow newcomers from infected villages to enter their villages and will scarcely give them food. In the Bellary district a tahsildar's son came to visit his father from an infected locality. The villagers sternly refused to allow him to enter the village and he was kept outside the village four nights. This is only one of the many instances reported. People would be even more likely to exclude grain if it were possible to know that it came from infected localities. In the ceded districts of the Madras Presidency very much the same conditions as to temperature and humidity prevail throughout. Here Bellary district has been infected since the year 1898 and the neighbouring district of Kurnool has been free for six years. The Collector of the district informs me that very little grain is imported into Kurnool district and this in my opinion must have considerably helped to bring about this state of affairs.

I would suggest this is a suitable line for research by the Plague Research Commission.

W. A. JUSTICE, *Captain, I.M.S.*

## APPENDIX 18.

### ACTION OF HYDROCYANIC ACID GAS ON GRAIN AND OTHER FOOD-STUFFS.

This paper is the outcome of a request from the Director General, for a note on the action of Hydrocyanic Acid Gas on grain and especially rice. It seems that there is some ground for the belief that the recrudescence of plague in Persian Gulf Ports is due to the importation of rats in rice bags. Therefore it becomes of importance to fumigate vessels carrying rice in such a manner as to kill the rats and the fleas on them without injuring the cargoes.

The Bombay Port Health Officer in a letter to the Secretary to the Bombay Government, General Department, draws attention to the ineffectiveness of the present methods of fumigating a fully laden vessel, and quotes from the report of Dr. Wade to the local Government Board (May 7th, 1906) to the effect that "the problem of fumigating a ship in order to destroy rats, etc., without damaging the cargo.....is as yet unsolved."

In Bombay Sulphur Dioxide Gas is used for disinfection purposes. The strengths of that gas which are effective, *viz.*, 3 per cent. for 8—12 hours, are injurious to wheat but leave barley and maize unaffected. So far as I am aware the effect on rice has not been noted.

In Hamburg, Carbon Monoxide is used for fumigation and probably its action on rice is innocuous. But there are two serious objections to its use:—(1) The large cost of the plant and of its installation. (2) The gas does not destroy fleas. This may not be a serious objection as by the time the boat conveying the rice bags reaches the gulf, the fleas may have died of starvation.

Of the two other gaseous agents mentioned by Wade in his report, Carbon Dioxide is expensive and its use is open to the same objections as that of Carbon Monoxide. Formaldehyde vapour is said to be non-toxic to rats and insects.

The action of Hydrocyanic Acid Gas has been to some extent discussed in a paper in the Scientific Memoirs. From the reviews of that paper it is evident that the fear of the lethal action of that gas on men is very strong. Now, while in the Memoir, the gas is not recommended for indiscriminate house disinfection, it is stated that disinfection of clothes in a properly built godown should, with proper precautions, be attended with little or no danger; and the paper was written as a request for permission to use the gas experimentally in selected native houses. Such an experiment was not possible without sanction.

In our opinion what is true of the disinfection of clothes applies even more strongly to ship disinfection, though no experiments have been carried out in this direction.

Hydrocyanic Acid Gas has been widely used all over the world for ridding orchard trees of their pests and the disinfection of nursery stock. In fact in certain of the States of America its use is compulsory. In South Africa, jails have been fumigated with this gas to get rid of bed bugs, and in 1901, in a report of the Government Entomologist to the Cape of Good Hope, it was stated that "the use of the gas for the destruction of vermin in sleeping carriages of the Cape Government Railways has now been practised for three years with perfectly satisfactory results and without any accident." The precautions possible on land are even more possible, we think, on board ships.

The great danger of all these poisonous gases is not actually at the time of generation, but later, when one wishes to open a building or ship for ventilation. With Sulphur Dioxide the fumes are a sufficient indication of the presence of the gas, but with Carbon Monoxide there is no such indication. The latter is very poisonous for man, causes unpleasant sensations in minute quantities; and there is no chemical test to detect the presence of small traces of the gas. It must be determined by animal experiments. In Hamburg living mice in cages are lowered into the hold, left for two hours and the physiological effects on them noted.

It is quite otherwise with Hydrocyanic Acid Gas. By the Prussian Blue test we can detect the minutest traces.

The action of the gas may be considered under the following heads:—(1) On rats and on rat fleas. (2) On foodstuffs. (3) On fabrics.

I. The action on rats and rat fleas was considered in the Memoir from two points of view:—(*a*) The disinfection of ordinary non-airtight houses. (*b*) The disinfection of clothes to get rid of fleas. This would be carried out in special airtight godowns.

In the disinfection of a ship's hold the conditions approach those in a comparatively airtight godown.

We shall detail one of our latter experiments. Into a comparatively airtight room of 830 cubic feet capacity 4·38 cubic feet of gas diluted with air were pumped in (equivalent to about $1\frac{1}{2}$ ounces of the 98 per cent. potassium cyannide salt to 100 cubic feet air space) and allowed to act for 20 minutes. Fleas in all parts of the room were killed, even though the tubes containing them were wrapped up in several layers of thick sheeting and blankets. Fleas put in cages with bran and sand at the bottom were all killed showing that the gas does to some degree penetrate. Larvæ and eggs of fleas were found to be very susceptible to the action of the gas, cocoons being more resistant. On rats, even in rooms not at all airtight, the effect is very lethal, but in burrows the gas to be effective has to be pumped into their inlets. If the gas be simply generated in capsules in the rooms it does not enter the burrows.

With reference to the question of disinfection of ships' holds we have to consider first whether there are holes or crannies in which the rats may take refuge. If there are, unless tubes are led into them the rats will not be killed. Secondly, whether the gas will penetrate deeply into bags of rice. Experiments are required on these points before definite statements can be made.

II. The action of the Hydrocyanic Acid Gas on food-stuffs:—

It is generally agreed that dry grain is not made poisonous by the action of the gas. (Report of Entomologist of Cape of Good Hope, 1901.) We made one experiment on this point. Gas which killed fleas in five minutes did not affect bajree, wheat, jowaree, radish seeds or rice. Monkeys, rabbits, hens and pigeons were fed on the grains for 24 hours and remained quite well. Chapatis made of the wheat, jowaree and bajree were given to monkeys and hens with no ill results.

On the other hand moist food-stuffs such as water, milk, butter and flesh are said to absorb the poison.

The gas does not affect the germinating powers of the grains we experimented with, namely, bajree, wheat, jowaree and radish seeds. Rice, however, we did not try, as we were working with milled rice.

III. The gas has no action on metals and fabrics.

W. D. H. STEVENSON, *Captain, I.M.S.*

## APPENDIX 19.

### MEMORANDUM ON THE MANUFACTURE OF GLYCERINATED CALF LYMPH AND LANOLINE VACCINE.

While on furlough last year I availed myself of the opportunity of visiting the Vaccine Institutes at Hong Kong, Tokio and the local Government Board Depôt at Hendon. At Hong Kong the manufacture of calf lymph is on a very limited scale and follows the lines employed at Hendon and need not be referred to further. I propose to give a general outline of the manufacture of glycerinated calf lymph as carried out at Tokio and Hendon and in addition any information from other sources I possess bearing on the subject and finally a brief outline of the methods at each institution and a note on the manufacture of Lanoline paste at the King Institute of Preventive Medicine, Guindy.

*Selection of calves.*—It goes without saying that the calves must be robust, free from disease, of clear eye, shiny coat, moist nose, etc., skin soft, silky and souple. Black calves or calves with pigmented pimply or rough skin are to be avoided. Roan calves are specially desired by Hendon and after that red or red and white. It would appear that red and red and white or light coloured calves are the most common type in all countries. Age 2—4 months old or older. In southern Germany young uncastrated bulls aged from six months to two years are used. The size of the animal in Europe and Japan is greater than the small calves of Madras. There is much to be said in favour of a large animal being used. The amount of pulp obtained is greater and consequently a fewer number of calves are used which is economical. On the other hand with a large animal there is a greater risk of tubercle and subsequent loss of the pulp. The smaller animal is much more readily handled.

*Sex.*—Females are more suitable than males solely, however, with reference to retention to cleanliness. When bulls are vaccinated it is stated by the Director, the local Government Board Depôt, Hendon, that "the lymph collected from the surface of the scrotum is of greater activity than other lymph" and therefore this practice increases the value of the lymph.

*Care of the calves on arrival at the Depôt.*—Calves as a rule are obtained from contractors who are not particular where they get them and being sparingly fed beforehand are apt to indulge in the good food provided for them at the institutes and many losses have occurred by the attendants giving them too much fodder in their mangers. Feeding therefore is of great importance during the stage of quarantine which is usually five days to one week. This also allows the animal to overcome the effects of a journey before being submitted to the operation of vaccination.

In England the condition of calves at different seasons of the year varies and has an appreciable effect on the quality of the lymph. During June and in the spring of the year this is especially noticeable when a distinctly superior quality of lymph is obtained and may be attributed to the abundance of fresh fodder. In Madras the condition of the calves in the hot months is poor owing to the scarcity of fodder.

*Post mortem examination.*—No *post mortems* are held on our calves in Madras. At Hendon since 1899-1909 the total number of calves inoculated was 6,067; of these 47 were at the *post mortem* found to be tubercular, in 77 per cent. of these the infection was limited, in 50 per cent. of cases to a single mesenteric gland. The calves in India are less liable to tubercle owing to continually being in the open air. No *post mortem* is held in Japan but the calves are subjected to the tuberculin test. In Cologne in Germany the calves are slaughtered a few minutes before the pulp is collected.

*Original lymph.*—The lymph used for inoculating calves ought to be the very strongest. The best stock lymph is derivable by the cultivation of small-pox virus through four to five calves and continued without admixture (see experiments by Colonel W. G. King, I.M.S., reported in Proceedings of the South Indian Branch of the British Medical Association, for April 1891). At Guindy each day one or more calves, according to requirements, is vaccinated by direct insertion from selected vesicles on a calf previously vaccinated in a similar fashion. The resulting lymph may be called the stock seed lymph. In Tokio the vaccinated surface is made smaller, *i.e.*, the proportion to be inoculated is three square centimetres for every four kilogramme of the calf's weight—the lymph to be used is mixed with diluted glycerine containing 1 per cent. carbolic acid, in the proportion of 1: 4. In same German vaccine institutes rabbits are employed, the lymph collected from four rabbits usually furnishing enough pulp to vaccinate a calf. For this purpose also lymph is frequently taken from the arms of children at the public stations—human lymph thus obtained is mixed with glycerine and water—four children affording enough material for the vaccination of a calf.

*Operation.*—The region operated on is usually the calf's belly. In Hamburg the belly is not vaccinated, only the perineum and the right side of the animal to its shoulder. The amount of surface shaved varies with the size of calf and the amount of lymph which it may be expected to produce. The toilet of the shaved surface varies; some using antiseptics whilst others are content with soap and water and thorough cleanliness. When the toilet is completed the parts should be kept covered with a sterilized cloth or cloth wrung out of carbolic lotion until the time of inoculation.

*Inoculation.*—After removing the cloth the prepared part is scarified with a lancet and the lymph rubbed in with an aluminium spatula or by the fingers. The incisions are made *en echelon* from ½ to 1 inch apart. Colonel King, I.M.S., recommends that lymph from the stock calf should be introduced into each line carefully by running along it a painter's flexible steel pallette knife moistened with lymph.

If it be wished to inoculate a calf with lanoline vaccine any blood or serum oozing from the scarifications should be removed by clean (sterilized) blotting paper and the paste should then be carefully inserted by the rounded end of a thin spatula into the entire length of the lines whilst making them gape line by line; that is general plastering over the whole surface must not be practised. The puncture in unskilled hands is not to be recommended; if followed it must be seen that such valve-like flap of skin made really contains a small portion of the paste, otherwise the making of each puncture will simply clean the lancet, leaving the paste on the skin where it can have no effect; but for starting stock for which lanoline vaccine is most valuable, punctures should be used by preference. (Colonel King.)

After insertion of the paste, the calf should be retained on the table for at least half an hour to permit of absorption. After the operation the abdomen should be covered with a clean cloth or bandage which must not be tied too tightly. The calf is provided with a collar which prevents his licking the inoculated part or the stalls in the stable are so contracted as to prevent him doing this.

The depth of the scarification varies with the thickness of the skin—the general rule is to cut not so deep as to draw blood. If too large a quantity of serious fluid should come out, it must be carefully wiped off with a piece of clean sterilized cloth and then the lymph rubbed over the scratches.

*Collection of the pulp.*—The time at which the pulp is collected varies—in hot countries and in hot weather the vesicles ripen more quickly. It may be put down as from 72 to 120 hours.

*Removal of the vesicle for pulp.*—Vesicles intended for preparation of pulp should be removed not later than the 120th hour, or at such time as the vesicle formation is complete and is of a pearly glistening white aspect and showing only the slightest visible attempt at umbelification as could be represented by a thin dark line running down the centre of the vesicles. All vesicles showing any degree of opacity or prominent umbelification with formation of crusts in the centre must be discarded.

The toilet of the belly before collecting and the method of preparation of the pulp varies in different places, but the general idea is the same, *viz.*, its collection under scrupulous cleanliness. This and the subsequent treatment of the pulp after removal is described under method of collecting tissue at each institution.

The average amount of pulp collected per animal varies greatly: 6—17 grammes in calves and in bulls from 15—40 grammes.

*Glycerine lymph.*—The pulp when it is collected is saturated with glycerine and water in proportions generally of from equal parts to 4 of glycerine and 1 of water; the resulting emulsion finally containing 1 part of pulp to 3 or 4 of the glycerine and water mixture. Very active lymph is further diluted in some cases up to 1 in 9.

The pulp from as many as eight calves may on occasion be amalgamated—as a matter of experience I understand it is found that a uniformly active lymph is in this way produced, any less active lymph in the group becoming incorporated with that which is more active. The whole is placed in a sterilised tube with cork and kept at a temperature of 15° C., for one week. It is then placed in a cold storage. The cold storage is at a temperature of 20° below freezing point. Lymph after two years in a cold storage gave 99 per cent. success in England.

### Lanoline Vaccine.

The pulp should be weighed in the glass pan in which it was collected and at once be transferred to an agate mortar. In this it should be carefully pulped until it is impossible to distinguish one particle from another; on spreading it out with the pestle, it should be absolutely homogeneous. The careful and patient effecting of the process is absolutely necessary.

Anhydrous lanoline (Benno Taffe and Darmstaeder, Martinikinfedle near Berlin) of absolute purity and neutrality should then be mixed in the proportion of 1 of the vesicle pulp to 6 of lanoline. They should then be mixed in a small glass mortar by means of a painter's steel flexible pallette knife. This should be persevered in, till no shade of doubt can remain that the pulp and the lanoline are completely and evenly

mixed. The process should be so complete, that not a single particle of any pulped matter should be visible in the lanoline. It is no use attempting to remedy mistakes as to complete pulping of the vesicles by pounding after the admixture of lanoline: the pulping must be perfected before its addition. (Colonel W. G. King, I.M.S.)

The greatest trouble exists in maintaining the lymph at its highest efficiency. The condition of the calves for one thing; when fodder is scarce and their condition not so good there is deterioration in the lymph. Again it is said the passage of the virus through a number of calves weakens the effective power of the lymph and finally that animal lymph contains a very small quantity of the virus. Mr. Umeno under the direction of Prof. Kitasato claims that the cause of calf lymph becoming non-effective was due to the wrong method of inoculation. He states as follows:—"The quantity of virus in animal lymph is much greater than in humanized lymph. Unless therefore it is diluted before inoculation, the very existence of superabundant virus will hinder its growth. The portion of the calf's body inoculated should be small and the vaccine must be carefully nourished, otherwise its effective power will not be preserved." If therefore the lymph is sufficiently diluted and inoculated into the belly of a calf over a small surface it will continue to produce the same result, however often it may go through the calf's body.

### Inoculation of Rabbit.

The whole side of a rabbit is shaved very carefully on account of the thinness of the rabbit's skin. The rabbit is held by an assistant and with a wooden match the surface of the skin is rubbed over till a slight erythema is produced, the lymph from the stock is then rubbed over the surface with a spatula. The vesicles mature in three to four days. The rabbit is then killed, the skin stretched and the lymph removed.

### Plating out on Agar.

A platinum loopful of the lymph is rolled up in a tube of agar and transferred to a Petri dish. The dish is then placed in an incubator at 37° C. for 48 hours and for the rest of a week at room temperate. The colonies are then counted and search is made for any colony which may appear to be suspicious. As a rule no other colonies except those of *Staphylococus albus* and *aurius* are detected.

### Lymph Institute, Tokio.

Calves are from two to four months old and are examined by the tuberculin test. No *post mortems* are held after removal of pulp.

*Method of inoculation.*—The hair of the belly is shaved, the parts are thoroughly disinfected with soap and alcohol, and the skin wiped with sterilized cotton. The scarifications are made by a special instrument invented by Dr. Umeno and over these cross scarifications are made with the same instrument. The lymph is then rubbed over the scratches. The belly is then covered with sterilized cotton on which a cotton wadded cloth is placed and the calves led into the stable.

*Method of collecting tissue.*—The inflamed portion is first moistened with sterilized water, then washed with soap and 3 per cent. carbolic acid solution rubbed with a piece of cotton and the moisture carefully wiped off with a piece of sterilized cotton. Standing on the left of the calf which has been placed on its back the skin is pressed from a little behind the row of the vaccinated portion with a stretcher in the left hand (an inverted T with a handle) while with a lymph collector shaped like a broadened out Volkman's spoon in the right hand, the vesicles are scratched off from the hinder part towards the front. Then the rows of vaccine vesicles thus scraped off one by one are put in a dish. When this is all finished, a mixture consisting of 10 parts of iodoform and 90 parts charcoal dust is put over the wounds.

*Mode of preparation.*—The pulp thus obtained is weighed and ground by Doering's lymph grinding mill. When it is sufficiently ground, the carbolic acid-glycerine is mixed with the vaccine in the proportion of 4 to 1, the result being five times diluted lymph. A glass tube with a stopper at the bottom is used to remove the spume or froth. The spume is easily removed by turning it in a centrifugal apparatus, when it will come up on the surface. After removal of the spume the stopper is taken off and the fluid collected. When this is done a perfect lymph is produced. It is then put into lymph tubes by a lymph sucker by agile assistants and sealed at both ends. The lymph sucker is a glass tube having a rubber ball at one end and at the other a rubber stopper with a small hole in the centre, into which a lymph tube is inserted in order to fill it with lymph. The rubber ball has also a small hole which is intended to regulate the passage of the air by the motion of a finger placed upon it.

A set of the instruments used at Tokio Calf Lymph Institute will be shewn.

### L. G. B. Institute, Hendon.

Calves are obtained from Ireland by contract, they are examined on arrival in England by a Veterinary Surgeon of the Agricultural Board for any infectious disease.

The tuberculin test is applied. The calves are between the ages of 3-4 months—a month or two older in some cases. They are kept under observation for one week. After the operation an antopsy is made by a Veterinary Surgeon. The finding of tubercle excludes the use of the lymph from that calf.

*Method of inoculation.*—The belly is shaved, the amount of surface shaved varies with the size of calf and the amount of lymph which it may be expected to produce. Bull calves are preferred—the scrotum is most carefully shaved and is a fertile source of the best calf lymph.

*Toilet.*—The shaved portion is most carefully washed with soap and water and then with sterilized water. Inoculation is performed with a lancet and the lymph rubbed in with an aluminium spatula. The area inoculated varies with the size and condition of the calf. Calves are inoculated on Friday and pulp collected on Wednesday.

*Method of collecting.*—The parts are well washed with soap and water and then well washed with sterilized water, sterilized cotton gauze is used for drying the parts after washing. A sterilized spoon which is kept in alcohol is used for scraping the vesicles—the skin being kept tense by an assistant during the operation. The resulting pulp is put in a sterilized bottle and weighed. No dressing is used after the operation.

*Method of preparation.*—The pulp is ground in the screw (Catalogue, Baird and Tatlock, p. 1235) with four parts of glycerine added making a 1-5 dilution. After thorough grinding the whole is placed in a tube fitted with a sterilized cork and kept at a temperature of 15° C., for one week, after this time it is placed in the cold storage.

No carbolic acid or disinfectants of any kind are added to the lymph or used in the preparation. It is found after a long period of research at the laboratories that the micro-organisms found in the lymph are those naturally present on the calf's skin and can do no harm. On the contrary they are necessary and an experiment by Kelsch would support this. He vaccinated one arm of a child with an amicrobic lymph and the other arm with ordinary lymph—the former produced a very inflamed and invisible looking vesicle whereas the latter ran a very mild and ordinary course. In the cold storage the number of micros is enormously reduced during the first week, after this although they are reduced—it is to a very insignificant extent—the numbers usually remaining about the same in the cold storage.

W. A. JUSTICE, *Captain, I.M.S.*

*The 1st November 1911.*

## APPENDIX 20.

### CULTIVATION AND PRESERVATION OF COW-POX VACCINE AS PRACTISED AT THE KING INSTITUTE, GUINDY, MADRAS.

*Cultivation of the Virus.*

This is carried out on calves which are bought from a contractor with whom there is however no definite written contract. He brings, as a rule, about 35 calves once a week and often a truck once a fortnight. His supply is most irregular and cannot be depended on. This is a constant source of anxiety and has in the past led to almost a total stoppage of the issue of vaccine.

The calves on arriving at the Institute are placed in the reserve enclosure and given, if possible, 48 hours' rest. On many occasions this is not possible and they are only given 12—18 hours' rest. Before being taken over by the Institute they are examined for disease and general suitability. In the old days when there were four contractors supplying calves, it was possible to pick and choose; thus all animals with severe tick-bites were rejected as well as the undersized and weaklings. Owing to the shortage of calves and the constant demand for vaccine it is now only possible to reject the very sickly animals. Those which appear only slightly indisposed are kept a day or two apart, and, if they pick up, are accepted. The contractor is paid R7-12-0 to R8-4-0 per calf according to the size and condition of the animal.

The evening before vaccination, the required number of calves are shaved by two expert barbers who are supplied with the best procurable razors. The calves are then transferred to the waiting-shed and are vaccinated as follows:—

The calf on being fixed to the table, the skin of its abdomen is thoroughly cleaned with water and carefully dried with a clean towel. The scarifications are made with a small lancet, the edge of which is sharpened but not made too keen, so as to avoid drawing blood. The cuts are made from 2 to 4 m.m. apart and from 5 to 6 c.m. long; they are always made in groups of three and in all from about 45 to 50 such groups. Before making each cut the point of the lancet is dipped in the seed vaccine—always glycerinated—so that at the moment the cut is made the virus is deposited in it. In calves with very thick skins they should be made to gape so that the vaccine virus readily enters. When the whole are completed, it is customary to go over each group again putting in fresh virus. Three calf watchmen always attend each vaccinator and one should be provided with a fan to keep off flies, and to help in rapidly drying the cuts. This is important for it is not advisable to keep an animal long on the table. Dislocations and serious cramp have over and again occurred as a result. The animal on being removed from the table is taken to the paste shed, and when the cuts are dry a clean bandage is attached to the abdomen. Prior to this the tail should be fixed, and a collar placed round the neck, and the animal must not be allowed to lie down.

The calves are first inspected 58 to 60 hours after vaccination, again at about 80 hours and lastly at 96 hours or later. There are always three inspections during the 12 hours and frequently one at night, in this way the vesicles are always caught at their maximum stage of growth.

When the vesicles on a calf are ready to be pulped it is taken to the vaccination room and again fixed to a table. The abdomen is thoroughly washed with water and dried and before the vesicular matter is removed, the scabs overlying it are cut out with a lancet; washing with warm water greatly facilitates this. The operator then seats himself before the calf and with the lancet rapidly scrapes off the vesicular matter and places it in a clean watch glass. The whole is weighed and the weight recorded. It is then placed in a glass mortar or an agate mortar, and slowly and steadily pulped, and ground up till on smearing the substance over a clean part of the mortar, no particulate matter is seen. This operation lasts about half an hour. It is then without any desiccation thoroughly mixed with five times its weight of pure anhydrous lanoline (Liebreick's formula). Each pot of lanoline is tested by the Chemical Assistant to see whether it is acid or neutral, the former are always rejected. The consistency of the resulting mixture is that of a thick sauce, for instance, magonnaise.

The lanolinated vaccine prepared during the day (7 to 8 A.M.) is next taken to the loading room and packed into clean glass jars which are labelled and stored in ice. Evenness in the quality of the vaccine is secured by mixing the vesicular matter from a number of calves.

In rotation the vaccine which is stored in ice is loaded into tin collapsible tubes holding from 5—150 cases, the nozzles and shoulders of these tubes previous to filling having been dipped in melted paraffin to render them airtight. The tubes are filled by hand from the bottom by means of an ordinary silver probe, care being taken that the vaccine is cleanly pushed down to the screw nipple and shoulder of the tube so that no bubbles of air are left. The excess portion of the tube is cut off leaving about 2 c.m. above the level of the vaccine; this portion is carefully flattened out and bent over several times to occlude the opening. Approximately 27 milligrammes of the mixture is allowed for each case.

In all the process of preparation, cleanliness rather than antiseptic and aseptic precautions are aimed at. It is not claimed for the vaccine that it is free of organisms; these have, however, been examined several times and found to be only the skin organisms present on the skin of the calf.

There are two serious obstacles in the cultivation of cow-pox vaccine at this Institute:—

(1) Inferior calves.

(2) Difficulty of maintaining the strain owing to the temperature and the want of an efficient cold store.

With regard to (1) it has already been pointed out the supply of calves is always a cause of anxiety, and owing to the shortage it is impossible to reject the inferior ones. There is no other course open. Undersized and sickly calves are obviously unsuitable for the preparation of cow-pox vaccine; yet it is these that are in the great majority the ones that are used. Further, even a short stay in the Institute where there is no grazing does not improve the condition of even the best calves and the weaklings become weaker. From long experience it has been found that to keep a large reserve of calves at the Institute is courting disaster, and this should not be allowed under any circumstances. Such serious diseases as foot and mouth disease, Piroplasmosis, and fatal and rapid form of diarrhœa probably due to Bovine Coccidiosis can only be avoided by keeping the reserve down, never letting it exceed 100 or thereabouts. Outbreaks of these diseases have occurred in the past and they have disorganised the work.

With regard to (2) it is hardly necessary to point out that in order to carry out the cultivation of cow-pox vaccine it is of the first importance to have good working strain, a strain which gives equable results under all conditions. Such a strain has not yet been found and this is therefore the most disappointing part of the whole work. Colonel King strongly advocated keeping special calves for stock purposes. From experience of the last five years this has been found to be quite impracticable. In the first place good calves cannot be procured; secondly, after a most careful trial of Colonel King's methods in 1909, it was abandoned for the simple reason that no better results were obtained by adopting it. Stock calves were selected and fed on special food, and vaccinated by the single flap method so strongly advocated by Colonel King. The vesicles obtained in this way were in no way better than those seen on calves vaccinated by the three line method described above. It was not practicable as the yield per calf is small and in order to keep up the reserve of vaccine, the turnover must be a steady one, so that in order to keep pace with the output many calves had to be used for stock; this is a pure waste. Since then the strain is maintained by watching the calves vaccinated each day and selecting the best vesicles and making it into glycerine paste and storing it for short periods in ice; there being no cold store at the Institute.

Here again owing to the temperature and the hot dry winds every strain ultimately deteriorates and no way has yet been found which will enhance its virulence. Donkeys, sheep, rabbits, guinea pigs have been vaccinated and the vesicular matter as well as that from children showing good cow-pox vesicles have been used. Strains have been obtained from England, the Continent of Europe, the Vaccine Institute, Belgaum and Bangalore and also from Burma, but the result is always the same, a steady deterioration. Under such conditions and coupled with the fact that the vaccine is often carelessly used by the vaccinators, good results can hardly be expected.

Lastly, instead of a reserve of calves, a reserve of lanolinated vaccine is always kept; it is stored in ice in large ice chests. This reserve is sufficient for one month to two months, and when calves are plentiful, enough for three months has been kept. It is imperative to have this reserve to fall back on when calves cannot be got. It can be readily understood that, kept in this way, the temperature cannot be maintained constantly low, but it is hoped when the cold storage installation is ready and in working order to keep the reserve in a properly insulated condition.

W. S. PATTON, M.B., *Captain, I.M.S.*,
*Acting Director.*

KING INSTITUTE, GUINDY;
*The 26th October 1911.*

## APPENDIX 21.

### TUBERCULOSIS.

In inviting discussions on the spread of Tuberculosis in Calcutta I would depend greatly upon the figures I have given in my feeble note on the subject. These figures clearly demonstrate that Tuberculosis is on the rise and that the time has come when strenuous efforts should be made to arrest its further progress. Tuberculosis is more prevalent in towns and cities than in suburbs and villages. Indian females from their peculiar habits and social customs suffer twice as much as males. I have based my paper principally upon the result of my own personal observations. As most of the facts are commonplace things and do not form important subjects for discussion by this learned body, I had better not take up the time of the conference by considering them here. I would simply solicit your valuable opinions on points which affect the interest of Government and the people alike. Taking into consideration the site of Calcutta and its surroundings one would be naturally tempted to know whether in the opinion of this conference the city itself offers facility to the dissemination of Tuberculosis and whether it does not require radical structural changes to make it healthy. It is an admitted fact that Tuberculosis spreads through overcrowding, and prevention of overcrowding is the essence of town-planning. The dust of the streets of Calcutta is impregnated with the germs of Phthisis and when wafted by the wind gets access into the systems of the people through their respiratory tract. In preventing the spread of the disease this conference should, if possible, devise means to admit more pure air by preventing the growth of lofty houses in total disregard to the width of the streets and the construction of rooms despite the elementary rules of the laws of health. This would be easily done by changing or modifying the existing building regulations and bringing the improvement scheme into operation. Men who understand sanitation should only be entrusted with the work. I would respectfully urge this conference to consider the desirability of establishing a separate hospital for the treatment of Phthisis and other tubercular diseases. At present, as I have said in my paper, there is no control over the milk supply of Calcutta; there is no means to isolate a diseased cow from her flock; and this conference is to discuss the necessity of removing the evil. The propriety of building suitable houses and huts for the poor working classes of people may be thoroughly discussed. The importance of personal and domestic hygiene should be impressed upon the minds of the people by introducing principles of hygiene into the curriculum of study of their younger generation. These are the points which I think and I believe justly entitle me to court discussion on the subject.

### THE SPREAD OF TUBERCULOSIS IN CALCUTTA.

No preamble is necessary to introduce Tuberculosis as a fit subject for discussion amongst the learned members of this conference. The reports of the Sanitary Commissioners of the various provinces, when read with the sanitary reports of the local Governments tend to demonstrate the fact that Tuberculosis is vigorously pushing its way through the crowded streets and lanes of the populous city of Calcutta and no step has yet been taken to resist its course. In spite of all care to improve its sanitation and in spite of all our endeavours to improve the health of its people, we have hopelessly failed to stamp out Tuberculosis. Within the last twenty years it has taken a firm hold on Calcutta and from the rate at which it has been spreading it is no exaggeration to say that at no distant date it will be a very serious problem. The toll which Calcutta and its suburbs annually pay to the assessor of death on this head is simply appalling. We may grudge to pay a penny over the fixed municipal rates to the assessor of the corporation for carrying out certain important improvements, and we may move heaven and earth to rescue us from the oppression, but we are offering no opposition to the demands of the ruthless assessor of Tuberculosis. This inaction is detrimental to the interests of Government and to the well-being of the city itself. I regret that for want of an accurate system of the registration of the causes of death I cannot give here an exact figure of deaths from Tuberculosis and its various forms, but roughly speaking nearly one-eighth of the total number of deaths in Calcutta is due to this cause. From the records of the Calcutta Corporation and more especially from the report of Doctor Pearse, we find that the disease has already spread all over the town and has not even spared the quarters in which dwell the most intelligent and wealthy classes of its people. The disease has got a peculiar liking for the softer sex and as for men it always prefers for its victims those who are most useful members of their families, to those who are worn out by age and infirmity. Unlike cholera it selects for attack Mahomedans more

than Hindus and Christians. In the absence of any special arrangement for ascertaining the predominance of one variety of Tuberculosis over another it is difficult for a medical man to make an impression upon the public as to the magnitude of the evil done to them by the germs of Tuberculosis. Intelligent and fairly educated classes of people are thoroughly acquainted with the characteristic features of Pulmonary Phthisis and its pernicious effects upon its victims; but they are quite ignorant of the danger they themselves incur by allowing a phthisical patient to live in their midst, who by his each breath contaminates the air which is breathed by his friends. It is not for me to tell anything to this conference as to the life history of the specific bacilli, nor is it necessary for me to speak on their effects on their hosts, for these facts are too well known to need mention. I would humbly crave permission to speak a few words upon the action of tubercle bacilli and the channel through which they get access into the lungs and this I do for the non-professional gentlemen who are interested in the study of Tuberculosis. The germ enters into the system through the respiratory tract, it is generally inhaled with the dust when wafted by the wind. To a strong person of considerable resisting power it is absolutely powerless. It cannot grow on a mucous surface unless it finds a foothold in some breach in the tissue weakened by previous illness, congestion or inflammation. But when absorbed with the dust of the air and lodged in the respiratory tract of a weak person with tissues soft enough for the germ to penetrate into, it then slowly makes its way into the most delicate structures of the lung cells. Every case of consumption is a bronchitis at the beginning, and if we can give the sufferer a good supply of pure air we can save him from Pulmonary Phthisis: if otherwise, we simply hasten his destruction. It is, I believe, not unknown to the fairly educated class of our countrymen that Phthisis, when it secures a foothold in a big family, attacks one member after another until the survivors quit the place and retire to a hill station where the air is wholesome. The slovenly habit of spitting on the street, floor, courtyards, and walls of the room is an especial means of transmission of the disease, but alas! habit is second nature and unless we can alter it by legislature and education there is no immediate prospect of stopping it. One drop of sputum contains a countless number of the microbes, which under favourable conditions retain their vitality for a considerable length of time. Doctor Pearse, who has profitably utilised his time in investigating the circumstances connected with the incidence of Pulmonary Phthisis in Calcutta, gives the death rates during 1905 from which we find that it was the highest—

| | |
|---|---|
| Amongst men in Ward no. 4 | (2·5 per thousand ) |
| Amongst females in Ward no. 14 | (5·0 „ „ ) |
| Amongst Mahomedans in Ward no. 4 | (5·0 „ „ ) |
| Amongst Hindus in Ward no. 5 | (2·7 „ „ ) |
| Amongst Hindu males in Ward no. 1 | (2·2 „ „ ) |
| Amongst females in Ward no. 14 | (4·8 „ „ ) |
| Amongst Mahomedan males in Ward no. 14 | (3·8 „ „ ) |
| Amongst Mahomedan females in Ward no. 5 | (12·8 „ „ ) |
| Amongst Mahomedan females in Ward no. 4 | (7·5 „ „ ) |

The collection of figures for sixteen years on the death-rate from Tuberculosis is given below:—

| | |
|---|---|
| 1876 | 407 |
| 1877 | 361 |
| 1878 | 302 |
| 1879 | 299 |
| 1880 | 454 |
| 1881 | 482 |
| 1882 | 482 |
| 1883 | 540 |
| 1884 | 525 |
| 1885 | 516 |
| 1886 | 536 |
| 1887 | 468 |
| 1888 | 572 |
| 1889 | 666 |
| 1890 | 743 |
| 1891 | 729 |

I do not think it would be of any value in collecting the records of the number of deaths from tuberculous diseases for a further period of twenty years, for they are all given in the municipal administration reports. To convince the public about the steady progress of this terrible distemper I include further records of four years which show the onward progress of Tuberculosis:—

| | |
|---|---|
| 1901 | 1,064 |
| 1902 | 1,350 |
| 1903 | 1,580 |
| 1904 | 1,608 |

Since the advent of the new century, Tuberculosis in its various forms is regularly progressing in Calcutta and the number of deaths from Phthisis amongst the females predominates over the death-rate amongst members of the opposite sex, as is shown in

the corporation report of the Health Officer in dealing with the health of Wards nos. 5, 8, 10, 14, 19 and 20. Men living in Ward no. 4 are especially liable to diseases of the respitatory tract and Phthisis alone carries off a good number of them. It is for this conference to decide what steps are to be taken to arrest its further development, but before I ask the learned members to advise Government and other municipal bodies on this point, I must place before them the factors, which to my mind seem to play an active part in the dissemination of the disease. I have arranged these under several heads, with a few general observations upon each of them.

*The site of Calcutta and its disadvantages.*—The site of Calcutta is a dead flat with a slight inclination to the east and as such it does not allow efficient flushing of its underground drainage except during the rains. The drainage system is not sufficiently ventilated. The drainage is contrived for the carriage of sewage and rain water. The pipes percolate and the sewers leak. Of the two principal defects, the one contaminates the soil, the other the air. This is a factor which lowers the resisting power of the people. The soil on which the city stands is a recent alluvium. The level of the subsoil water during the rains sometimes rises to its ground level. The soil is therefore damp and as such favourable for the growth of disease germs. Most of the streets, roads and lanes in the northern division of the town are narrow and lofty houses standing on either side of them obstruct perflation of air, and the access of the sun. Owing to these structural defects of the city, the utility of the germicidal power of the sunlight is lost to the people.

*Residents of Calcutta.*—Calcutta is inhabited by various communities of people, each class separated from the other, by its peculiar habits, customs, rites, and mode of living. All these conditions have their relative value in increasing or reducing their susceptibility to diseases. Much has been done by the Corporation of Calcutta to improve the sanitary condition of the city; but more still remains to be done. There are other structural defects of the town which will continue to be a menace to health and a reproach to the sanitary authorities. Besides these structural evils of the town there are other auxiliary defects, which, if allowed to remain in Calcutta, will act as so many factors of the diseases of the respiratory organs, amongst which Phthisis occupies a prominent place. The existence of mills and factories amidst the residential quarters is an evil of no small magnitude. The cause of the increased number of deaths from Phthisis in Ward no. 4 is attributable to this source. I might mention that the smoke nuisance in Calcutta is daily increasing. Every evening long before the sun sets, you will notice a belt of a dark blue coloured smoke forming the boundary of the town, and as soon as the sun goes down the horizon, the girdle or belt, whatever you may be pleased to call it, begins to expand and converts itself into a regular canopy or shamiana, as if intended to guard against the access of pure air. This canopy is made up of smoke, presumably emanating from the chimneys of mills and from furnaces of blacksmiths' shops, etc. The smoke is not merely the product of combustion of coal or fuel, but contains other deleterious substances also, which have their pernicious effect upon the system of man and beast. The smoke does not possess any antiseptic property; but it is an evil which should be forthwith removed. It penetrates into the air passages and lung cells and renders them susceptible to the influence of various kinds of organic diseases. Chronic Bronchitis, Phthisis and other diseases are frequently seen amongst the people who live in the neighbourhood of mills. Soot can be seen in the pocket handkerchiefs after they have been used. The visible mist is nothing else than particles of foreign matters floating in the air and these particles chiefly consist of dust and smoke, horse refuse, ammonia and germs of various kinds. It is necessary for me to explain how it affects health. A man breathing pure air obtains as he requires 2,164 grains of oxygen per hour, whilst an individual breathing bad air gets about 2,000 grains, the deficit is replaced by pernicious matters. If the air is loaded with impurities, the lungs get clogged and their power of absorbing oxygen that is present in the air is diminished.

*Factors of Tuberculosis created by the people themselves.*—We now come to consider the factors which have been created by the people themselves and for which they alone are to blame. The erection of houses in total disregard of the fundamental rules of hygiene; the collection of refuse inside of the courtyard; close proximity of bed rooms to privies; keeping the gullies and pits choked up with débris of organic matter; throwing excreta of infants and invalids into the already chocked up pits; spitting recklessly everywhere and in every part of the house, are things which are detrimental to the interest of health and favourable for the dissemination of Tuberculosis. I have often tried but failed to induce people to believe that there is much risk in collecting refuse inside the house.

*Overcrowding.*—Of all the known factors conducive to the spread of Tuberculosis, none is so potent as overcrowding. We have got our own rules for the building of new houses, we have our own bye-laws to govern their height; but, to our shame be it said, we have none to regulate the dimension of rooms according to the number of their occupants. Neither have we got any clause regulating the size of openings for ventilation in relation to the size of rooms, nor the height of windows in relation to the height of the

rooms. A man who has visited Burra Bazar can write an essay on the subject of overcrowding and its pernicious influence upon health.

It must be clearly understood that a good room in a commodious house has its value upon the health of its occupants. It has been stated before that Moslem women are more susceptible to Tuberculosis than their men and the reason of this is that their purdah system deprives them of the privilege of enjoying fresh air and keeps them constantly cooped up in a room along with their children, whose number is sometimes very great. If a record of the standard of health of the inmates of overcrowded houses be kept, it would invariably show that it is much below par, although the inmates may be well fed and clad. Congested rooms and diseases of the lungs are linked together. The increased rate of mortality in Ward no. 5 is chiefly, if not wholly, due to the construction of its buildings. The houses are lofty and their height generally exceeds four times the width of the street. Being built back to back they do not admit free ventilation. I have often seen and can easily demonstrate by example that the vitiated air of an ill-ventilated house apart from its deleterious effect upon the health of its inmates has got a demoralising effect upon their character.

Besides living in congested rooms Mahomedans have certain customs which favour the spread of Tuberculosis amongst them. They dine together and even confirmed phthisical patients are allowed to partake of food from the same dish. You can estimate the amount of danger that emanates from this awkward practice. In Ward no. 5 most of the houses are old, rickety, and damp, and are inhabited by colonies of people who have migrated into Calcutta for trade or business. The houses built under the new regulation are not even good from a sanitary point of view, and their surroundings are bad. One room of $10' \times 8' \times 10'$ is made to accommodate from two to eight inmates; half the floor space is taken up by furniture. People give better attention to the decoration of the room than to their own comfort. A brief description of a room occupied by a consumptive gentleman of means and position in life may not be wholly out of place. The dimensions of his room were $10' \times 8' \times 10'$ with two windows and a door. The walls were painted with water colour, the cornices, ceilings and corners were fantastically painted with rich colours. More than two dozen pictures hung in rows on the walls. Six to nine lanterns were placed in the room. A kerosine lamp with a chimney remained lit during the night. One small iron safe on stand and a big wooden chest occupied one side of the room. On another side there was a cot with a miniature charpoy underneath. Just over the wooden chest hung the frocks and *sarries* of the housewife. The gentleman had six children. This is the pattern of room and decoration usually used by Marwari gentlemen of means.

The poorer class of people occupy rooms with one window and a door to enter; half of the floor is used as a cooking place during the day, utensils are kept in one portion of the room. My friend Major Dyson, the late Sanitary Commissioner of Bengal, whilst inspecting plague-stricken houses came across one,—a room whose dimensions were $12' \times 10' \times 10'$ and which had two doors and one window,—in which there were nine inmates, two of whom were laid up with plague and one was suffering from Phthisis. The description of a kutcha hut occupied by the poorer class of people with its number of inmates is something horrible like that of the Black Hole of Calcutta. People dread the admission of fresh air during the night, carefully closing windows and door, and they never forget to plug the small openings caused by broken panels of doors and windows with rugs and cotton. Those who have advised them to give up this suicidal practice of preventing access of air have incurred the censure of these foolish people. So far I have spoken about the causative factors of the disease. I would now shortly bring to your notice the part played by foodstuffs in propagating and disseminating Tuberculosis. Of all food-stuffs supplied to the people of the city, none is charged so much with introducing Tuberculosis into their families as milk, and I will confine my remarks to it alone.

Milk which is essentially necessary for the support of man in all stages of life has become so dear that people of limited means can ill afford to buy it. Only those who have moderate means can do so. In Calcutta the bulk of the milk supply comes from villages outside the jurisdiction of the corporation and its quality can never be guaranteed. It is often contaminated with germs of disease. That milk brings Tuberculosis is a settled fact and no argument is necessary to establish it. There is no special arrangement for isolating a tubercular cow from the herd and the quality of milk is only judged by the lactometer. In the laboratory of the corporation the analyst conducts bacteriological examinations, and prosecutes the vendors who deal in contaminated milk. Fines and prosecutions have no deterrent effect upon the offenders. The law is on their side. If the vendor chooses to evade punishment he can easily do so by attaching to a doubtful sample a label with the words "mixed milk" written in English. The danger arising from this source can be better imagined than described. The intelligent class of people say that boiling kills all germs and they need not therefore be afraid of milk. We fully appreciate the force of their argument; but what will be the fate of those who take milk in its unboiled state? And the number of such persons is not small. Milk before it is boiled and put into the can is kept for some time in a bowl where flies

have free access and these carry the germs of Tuberculosis from the unboiled milk to other foodstuffs kept ready for use. Leaving out of the question the care of a cow with disease of the udder supposed to be due to tubercular bacillus, the milker himself may suffer from Tuberculosis. In a big dairy farm consisting of 150 cows with a pretty large establishment and under competent supervision, out of six milkers one was found to be suffering from Phthisis. We see every day in Calcutta that in the transit of milk from the dairies to the stall the dealers invariably place straws in the receptacles to prevent splashing and in these receptacles float hundreds of dead flies and live flies swarm over them. Vendors who sell prepared foodstuffs may suffer from Phthisis and contaminate them. It has often been found that a consumptive patient after partaking of half the contents of a cup of sago or soojee passes it to the little folks who flock round him. It might be incidentally mentioned that agriculturists, who spend their days and nights in open fields, are less liable to Phthisis. Tubercular diseases of bones, glands, kidneys, peritoneum and intestines are almost unknown to them.

I would now hasten to consider the means by which we can arrest the dissemination of Tuberculosis and ultimately stamp it out altogether from our city. Nothing would answer our purpose better than to radically remove the structural defects of the city, and this we could not possibly do better than by opening out broad streets, by demolishing old rickety houses, by changing the existing regulations for the erection of new houses, and so bringing them in conformity with the rules of hygiene. It is also desirable that the rooms should be made according to the number of inmates they are intended to accommodate; that the size and number of windows should be determined by the dimension of the rooms whose minimum height should be 13 feet. It is also necessary to see that sufficient space be left on all sides of the house to ensure free ventilation. The erection of houses and the materials used in constructing them should be frequently examined by reliable experts and the arrangement of drainage and sewerage be left in the hands of sanitary experts. Special arrangement should be made for the better housing of the poor industrious classes, on whose health depends the well-being of a city. The present method of reclaiming bustee is bad and the process of clearing out bustee without making provision for the ousted people is wrong in principle. Closed huts harbour Tuberculosis and their inmates are soon affected by it. It is hardly necessary to say that these bustee people form the bulk of the menial establishment of respectable houses and if any of the menials contract tubercular disease, there is every likelihood of the germ being carried to the inmates of the house they serve in. When plague broke out in Ward no. 5 the question of cleansing the bustees was pushed forward by the commissioners; but beyond making some spasmodic efforts during panic, nothing of a radical nature was done. The time has come when further delay in carrying out the improvement work will be detrimental to the interests of the people and the city they live in. Objections will be raised by wealthy class of men whose interest will be affected, but private convenience must give way to public good. We have reason to hope that with the opening out of broad streets and demolition of houses unfit for human habitation and the removal of overcrowding further spread of Tuberculosis will be arrested. The importance of a separate hospital for the treatment of Pulmonary Phthisis and other tubercular diseases can never be over-rated. The idea of treating these cases along with other diseases is itself bad. It is unwise and culpable to expose the other inmates of a public charitable hospital to the influence of this terrible disorder of the human frame. It is high time to think of a separate hospital, the number of tubercular cases is fast multiplying and the question of erection of a suitable hospital for the reception of phthisical patients has become imperative. But where are the funds to come from? We cannot reasonably ask Government to take the burden of expense on its own shoulders. We want the hearty co-operation of all intelligent and well-to-do classes of people to create a suitable fund by raising subscriptions from amongst themselves to give immediate effect to this most laudable scheme. The institution must be large enough to accommodate at least five hundred patients and it should stand on a suitable site. There ought to be a sanatorium for the benefit of the middle class of people, who for want of means cannot easily go to a hill station, or to Puri, so that they may derive the benefit of change and open air treatment which is of great value to patients suffering from the incipient stage of Phthisis. There was a proposal to this effect and a committee was appointed; but why it did not develop further nobody knows. At the instance of Maharaj Dhiraj of Burdwan a scheme was framed, a suitable site was selected, and plans and estimates of buildings were made out. The idea was, however, finally abandoned. The question may, if possible, be re-opened and steps taken to advance it.

For these reasons I trust that local Governments will take steps to alter the existing laws relating to the building of residential houses and the sale of adulterated foodstuffs and to put a stop to the practice of spitting on the streets by making it penal under the Nuisance Act.

KAILAS CHUNDER BOSE, *C.I.E., L.M.S.*

## APPENDIX 22.

### EPIDEMIC DROPSY.

In inviting discussion on this humble paper of mine, I might with your permission mention that the recent outbreak of Epidemic Dropsy in and around Calcutta has given an impetus to the minds of professional men to work out its causative factors, and thus to provide themselves with means to ward off its further inroads. In my short paper I have tried to refer in one place to the various hypotheses and their relative value in the causation of the disease. In discussing the paper I need only place before you the points which tend to show that the conclusions hitherto arrived at, are not sufficient, and further investigations are necessary to elucidate the truth. I do not like to take up your valuable time by discussing questions which relate to the nomenclature of the disease, for they are at present involved in complications, but it is reasonably hoped, however, as I have said in my paper, that sooner or later the question will be finally settled, and the two diseases, Epidemic Dropsy and Beri Beri, will be included under one head. Attempts have been made to bring it under the heads of exanthemata, malarious fever, angeoneurotic œdema and other diseases. It has also been suggested that the disease is due to a peculiar condition of the nerves produced by the consumption of polished rice devoid of its phosphorous element. The reasons for our not being able to adopt the views of the workers have been given in my paper. To finally settle the dispute on this point of nomenclature is my apology for inviting further discussions. Regarding the etiology of the disease the learned workers have not yet been able to decide the point. Of all arguments urged in favour of the theory that foodstuffs play a considerable part in the production of Epidemic Dropsy, none has been threshed out with so much force as the plea of consumption of polished or decorticated rice raised by Dr. Craig, the learned specialist appointed by Government to investigate the cause of the disease. The value of the rice theory is greatly depreciated if not altogether lost by the fact of Dr. Craig's not being able to give us a complete list of articles which form the food of the Indians. The allegations of the immunity of the Marwaris from the disease is not correct. They badly suffered from the disease during the epidemic of 1888. In discussing the theory of mustard oil as a causative factor of the disease I might mention that the remarkable coincidence of the discontinuance of the oil and improvement of symptoms should be taken into consideration. To decide the question of the disease being of microbic origin requires further research on the subject, and I do not wish to court discussion on this head but crave permission to mention that a medical gentleman, who, whilst operating upon a patient suffering from Epidemic Dropsy, inoculated himself by puncturing his finger and contracted the disease. I would now beg to discuss the question of the disease being due to changes in the character of the soil produced by the meteorological phenomena attended with heavy rainfall. I submit this argument on the basis of fact mentioned in my paper. I also submit for the consideration of this learned conference that the disease has its own cycle which comes once every ten years, and this I think and I believe I have been able to prove by facts given in my notes. I do not like to encroach upon your time by raising points which have been thoroughly discussed elsewhere.

#### *Epidemic Dropsy or Beri Beri.*

In spite of the massive literature on the subject of so-called Epidemic Dropsy, there is still some room left for further discussion on the nosological and etiological aspects of the disease. The profession and the public are alike interested in the finding out of the causative factors of Epidemic Dropsy, which, when it breaks out in an epidemic form, not only exhausts the health and wealth of the sufferers, but permanently makes them invalids. The new distemper, strictly speaking, is an evil of the State, since it seriously tells upon its resources; a large number of its ministerial officers enter into the sick list, the wage-earning capacity of the industrious classes of its people is reduced to a material extent and poverty stares them in the face. We cannot definitely say when the disease first paid its visit to Calcutta, for the ancient records of Government hospitals and the reports of the Health Officer are silent upon this point. It is also difficult to ascertain whether it first invaded the metropolis of the British Indian Empire and then spread into the suburbs, or if it migrated into Calcutta from other centres of the country. We do not know whether before the year 1877 our predecessors used to return these diseases under the heads of Morbus Bright, Morbus Cordis, or general anasarca. To Dr. Norman Chevers is, however, due the credit of first differentiating the disease from the group of dropsical diseases which abounded in Calcutta, but the honour of throwing additional light on the subject was reserved for Colonel Kenneth McLeod, who in the year 1888 came forward to lift up the veil which had hitherto concealed the foe from our sight and thus caused an impetus which has since stirred up the

medical profession to strive hard to know the various phases of the disease. Regarding its nomenclature opinions are divided. One school emphatically holds that it is Epidemic Dropsy, altogether a new disease, whilst another deliberately maintains that it is the true Beri Beri of Ceylon, China and Japan. By the united efforts of learned scientists and clinicians we have been able to glean some knowledge of the characteristic features of the disease and we may now reasonably hope that before long we shall be able to come to a definite conclusion. The question now before us is whether the two schools have made up their differences or are still at variance; if they are not agreeable to each other, the functions of the Conference should be to settle the difference, for no real good could come out of such unprofitable disputes. We cannot possibly expect a correct return of the vital statistics of a city, unless we can put its prevailing diseases under their respective heads. The line of demarcation between Epidemic Dropsy and Beri Beri as at present pointed out by the scientists is too narrow, and reasonable fear is entertained that in course of time it will be obliterated and the two diseases will be included under one head. As it is not in the province of this Conference to open discussions on the pathology of a disease, I dare not take up its time by dwelling upon it. It is necessary that to finally settle the question of nosology I must mention a few salient points on which the scientists based their arguments in recommending it for a separate place in the nomenclature of diseases. Colonel K. McLeod, who paid special attention to the study of the various phases of this distemper, speaks from his wide experience that it is a kind of exanthemata. Sir Patrick Manson, the highest authority on tropical diseases, holds the same view, but his description of the character of the rash was different from the description given by Colonel McLeod. Professor Rogers, another keen observer, was, it seems, also led to believe that it was a kind of eruptive fever. The views expressed by these respective authorities, far from being one, tend to complicate matters and throw doubt upon the correctness of their inferences; besides, in the majority of cases the rash was conspicuous by its absence. It is I believe universally admitted that an eruptive fever has got a distinct period of incubation, a definite course to run, and has one uniform method of termination; the temperature is always high at the commencement and takes a downward course on the appearance of the rash and gradually comes down to its normal level. Any breach in its characteristic features is an anomaly which it should be the endeavour of the learned observers to remove by further investigation and reseach. Professor Rogers' observation on the character of the fever in Epidemic Dropsy was not supported by other Indian clinicians. The majority of cases had little or no fever. It was only when the sufferers had other complications the temperature had its upward tendency. The theory of exanthemata, I fear, has not been satisfactorily proved. Next to the theory of exanthemata comes the theory of angeoneurotic œdema preferred by the Hon'ble Surgeon-General Lukis, and the arguments urged by him in its favour seem to be too strong to be refuted, but before it can be finally adopted the medical profession has a right to enquire whether such extensive swelling of the skin can be effected by such pathological conditions or it may be due to other factors which have not yet been definitely known. Any agent causing vasomotor paresis could be credited with the production of dropsy. In angeoneurotic œdema the swelling is always circumscribed and transitory in character. The circumscribed swollen patches follow no definite course, they come and go away at will. The swelling is well defined by a slightly raised border; one attack is followed by another. The swelling is usually red. Gastric disorders account for the skin changes. Adults are less liable to this complication. Angeoneurotic œdema is often complicated with inflammation of serous membranes, a grave form of evil not rare in cases of Epidemic Dropsy. The majority of the learned workers in the field have laid great emphasis on the existence of patellar reflexes and on the absence of ataxic gait, which, according to their views, are symptoms which at once distinguish this disease from Beri Beri, but close observation will demonstrate the fallacy of the argument. In nearly twenty-five per cent. of cases of Beri Beri we may expect to find these two things, and as I do not like to introduce pathology in discussing the nosology of the disease, I would simply satisfy myself by saying that absence of patellar reflexes and the presence of ataxic gait are often met with in cases of Epidemic Dropsy. I might with your permission mention that when the disease broke out amongst the inmates of the Alipore Reformatory, Dr. Pearse, the learned Health Officer of Calcutta, and myself went to the spot to study the phases of the distemper and we were surprised to find that nearly two-thirds of the entire number of patients placed before us had the characteristic gait of Beri Beri and they had no patellar reflex. Colonel Brown, Civil Surgeon of the 24-Parganas, kindly offered us every facility for the study of the character of the disorder. The next point of importance is the theory of Plasmodium Malaria playing a considerable part in the production of the disease, but the result of experiments do not in the slightest degree support it. From arguments adduced, it seems that the learned workers have tried but failed to differentiate Epidemic Dropsy from Beri Beri. I do not know whether patients suffering from actual Beri Beri readily bleed from the gums, nose and rectum. During the recent outbreak of the so-called Epidemic Dropsy the medical practitioners had frequent occasions to treat hæmorrhages from the nose and intestines. Nævoid growths become enlarged and bleed profusely quite spontaneously and on slight pressure, often requiring interference to stop it. The theory of the disease being of microbic origin has been started by some lead-

ing men of the profession, but the mere fact of the bacteriologist's inability to discover the special bacilli is no reason to infer that Epidemic Dropsy is not a bacillary disease. To help the Conference with material to work upon this point, I might mention that an Indian surgeon of established reputation whilst removing a bleeding angioma from the person of a patient suffering from Epidemic Dropsy had accidentally punctured his finger with the point of the needle, he took no special notice of it. On the third day he manifested unmistakable symptoms of the disease and is still suffering from its sequel. If we count from the moment of the accident to the development of the symptoms we could roughly estimate the period of incubation to be 48 hours. In connection with the estimation of the incubative stage I might mention the case of a warder who was transferred from Buxar Jail to the Calcutta Reformatory. He lived one night with the sick inmates of the Reformatory and the next morning he showed symptoms of the disease. On analysing the facts collected from the report of the various workers on this subject it is difficult to find out in what characteristics of symptomatology Epidemic Dropsy differs from Beri Beri of China and Japan. It would be unwise to suppress the fact that during the last epidemic we had complications which were never seen before, such as hæmorrhage in the retina, iriodochoroiditis, iritis, glaucoma and other diseases of the delicate structures of the eye. These complications were not known to the writers on Beri Beri. I am constrained to say that the name Epidemic Dropsy has been hurriedly coined to meet emergencies; it is a misnomer. It is the Beri Beri which has under peculiar conditions undergone change in type during epidemic. This is my humble view, but it should be the function of the Conference presently to settle the dispute, which, if prolonged, will surely give rise to unprofitable discussion and leave the problem unsolved. Leaving the consideration of the question of nomenclature to the sense of the Conference we now come to consider the causative factors of the disease, and here again we meet with difficulties which we the practitioners have not yet been able to tide over nor do we find any ready means to do so. Since 1877 the disease has visited Calcutta and its suburbs altogether four times and each time it has put a new garment upon it. The recent outbreak of Epidemic Dropsy has caused a regular panic in the minds of the people and the medical practitioners of the town. Various hypotheses have been formulated and the conclusions arrived at, far from being satisfactory, do not compensate for the labour spent on them. The fact of its always preferring the rainy season leads to the suspicion that it may be due to the dampness of the soil, or to some alteration in the normal level of its sub-soil water, or to some special deviation in the barometric pressure or in the thermometric readings. The collection of meteorological notations of the epidemic years and collection of similar reports from other centres of the country where the disease is prevalent, can only help us in coming to a definite conclusion on this point. I have collected the reports of the meteorological observations for the years 1877, 1878, 1879, which covered the period of its first outbreak, the record of the year 1888, the time of its second invasion; of 1901, the period when it paid a flying visit to Calcutta, and of 1908-10, the lengthy duration of its direst outbreak. In studying the report we find that barometric and thermometric readings of the epidemic years were almost uniform. Let me now place before you the amount of rainfall of the epidemic years of Calcutta and of the condition of the sub-soil water and its level and you will find that barometric and thermometric readings of the epidemic years were almost uniform. If we take into serious consideration these meteorological conditions *plus* the character and nature of the sub-soil water of Calcutta and the liability to its contamination by sewage matter, we would find that the causative factors of the disease were imbedded in the soil of Calcutta. As I cannot reasonably include my name with those of the workers in the field of investigation, I cannot possibly do more than simply place before you material, for further consideration. From the meteorological records collected through the kind help of Dr. Pearse and his worthy assistant Dr. Mazumdar, D.P.H., as given below, we may not be wrong in concluding that the meteorological conditions were peculiarly favourable for the outbreak of diseases. It is a matter of regret that I have not been able to collect the meteorological reports of other places where the disease was equally prevalent, and compare them with our own records to enable us to draw final inferences. I must candidly confess that in the absence of a complete report on the subject the value of the theory of the soil playing an active part in the causation of Epidemic Dropsy is greatly reduced; but there is not the slightest shadow of a doubt that it has got its share in the production of the disease. Even if we fail to give our final decision on the point, there is no reason why further investigation on this line should not be carried out. I humbly think and believe that these telluric conditions rendered the soil peculiarly favourable for the reception of the disease, and so long as they are not removed by sanitary improvement or by nature herself the disease will continue to pay its periodical visit. In Calcutta the disease is most prevalent in those wards where the Indians live and where the light of the sun has to struggle to peep into the rooms of the people. Indian gentlemen, who have not much altered their habits but live in the southern division of the town, did not at all suffer from the disease. Instances are not wanting to show that patients made wonderful improvement by going to a drier place and suffered from relapse on their return to Calcutta. The Conference is particularly requested not to lose sight of this important fact. The drainage of Calcutta, which for more reasons than one is not perfect; the lofty houses

in Indian quarters and their peculiar construction are undoubtedly points for our serious consideration. Before I dismiss the subject of meteorology and the condition of the soil, I would beg leave to point out that outbreaks of Epidemic Dropsy have invariably followed a heavy rainfall. I would here cite the year 1908. In this year the rainfall was unusually great. Likewise the rainfall during other epidemic years was great. Besides in the year immediately preceding the year of the last epidemic, Calcutta was submerged under water for more than 24 hours and jolly-boats were seen plying in the streets of Calcutta. Next to the question of soil we come to the question of food of the people, on which much greater stress was laid by former workers. As the list of articles which constitute the principal diet of the Indian gentry and the mass has been elaborately given by the various writers on the subject, I need not take up the very valuable time of the Conference by enumerating them here. I would simply make a feeble attempt to fill up the omissions which I doubt not must have been inadvertently made by the writers, most of whom were Europeans and as such had to depend a good deal upon information supplied by their Indian friends. In his very interesting report Major Greig, the learned specialist appointed by Government to investigate into the causative factors of the disease as far as was possible during the short time at his disposal (for he was appointed when the disease had exhausted all its virulence and was on its decline), gives a list in which he inadvertently omits to mention that fish and milk are invariably consumed by the Bengalis. Meat and eggs are also freely used by the middle and wealthy classes of the people who were specially selected as victims of Epidemic Dropsy during the recent epidemic. From time immemorial the majority of the Bengali gentlemen used hand-made *chapaties* for their evening meal. In the most ancient records of the hospitals you will find mention of this habit. The deficiency of phosphorous elements of polished rice was amply compensated by the condiments they used with their staple food. It is not the place to mention what was the chemical composition of the green vegetables most commonly used by the Bengalis. Suffice it to say that the list of articles which constitute the food of the Indians as given by the specialist was not complete. The Mahomedans who had a different scale of diet were not immune from the disease. The Marwaris, though fortunately they escaped during the last epidemic, suffered severely from it during 1888 when the disease was mostly confined to their quarter. There were also few cases amongst them during 1901 when, as I have said before, Epidemic Dropsy only paid a flying visit to Calcutta. It would be not out of place to mention that in a family consisting of five members, four were seriously laid up with the disease, and of them two died. These cases were seen by the then Health Officer of Calcutta. The mere fact of the absence of Epidemic Dropsy amongst the Marwaris during the epidemic of 1909 is no reason to infer that as a class they were exempt from the disease. From the transactions of the Calcutta Medical Society, an institution organised by the efforts of Lieutenant-Colonel McLeod and other learned professors of the Medical College, you would find that in a short paper read by me under the head of Acute Œdema I had to mention amongst other things that Epidemic Dropsy had broken out in Burra Bazar and I had to treat several cases amongst the Marwaris. As it is an important matter, I may be pardoned if I reproduce what I then said at that meeting, and in doing this I must not take more than a couple of minutes of your valuable time.

"Within the short space of two months, I have seen thirty cases in and around Burra Bazar. The peculiarity I have observed in this disease is that the œdema commences from the dorsum of the feet without exciting any anxiety in the mind of the patient; the swelling gradually rises upwards and attacks the whole limb. It is now that the patient's attention is drawn towards his limbs; his general health fails; his appetite is lost; his urine becomes scanty; there is fever towards evening; insomnia and burning of the hands and feet with constipation of the bowels, and sometimes, though not in every case, vomiting during morning. The duration of the disease is from three weeks to as many months. Bronchitis is a common complication of this disorder, and in some cases diarrhœa or dysentery supervenes during the stage of convalescence.

"Those cases, where diarrhœa sets in early, do well invariably. I have not seen a single case prove fatal by this disease. Only one out of thirty cases died and here pneumonia was the cause of death. People, who live in confined rooms, suffer longer than those who live in well-ventilated houses. This year the disease is confined to Section G of the town of Calcutta. In no. 53, Cotton Street, Burra Bazar, it made its first appearance. In this house a family consisting of six members were all affected with the disease. In no. 16, Mullick Street, a family of four members were next attacked with the disease. The husband first noticed that he could not put on his shoes with the same amount of ease as he used to do before. It made him anxious and in the course of a week his feet assumed double their usual size; he had fever, and was soon confined to his bed. His wife, who attended upon him, was next taken ill and likewise the children. A gentleman who came to visit him got the disease; he occupied a room in Hanspooker Lane. This man had his wife and a child living with him, but fortunately they escaped. In no. 55, Banstolla Street, Sewbux Sereka, a gentleman of considerable wealth and fortune, was next taken ill, his wife and her brother, together

with the other members and menial servants, were all confined to bed. The number of patients in the family I counted was more than a dozen. In premises no. 49, Cotton Street, 15 out of 30 members of a mess were laid up with this disorder, and I am told by an inmate of the house that they are still suffering under it."

From the report just placed before you, you would find that the Marwaris whose diet materially differs from the diet of the Bengalis were not exempted from the operation of the disease. Rice has been ungenerously accused of producing the disease. I do not dispute that it is a factor of weakness amongst the race of people who consume it, but that it is not a factor of Epidemic Dropsy can be easily proved by the fact that the people of Bengal have been using rice ever since the creation of the world and they never suffered before from Epidemic Dropsy. Another fact which I might with your permission mention is that the epidemic is now over, but the habit of rice taking is not changed, the quality of rice has not been improved, but the people do not suffer from the disease. If the rice theory is still held by the members of this Conference it will enable them to link the Epidemic Dropsy and Beri Beri together and discontinue to call it by another name; beyond this the rice theory has got no intrinsic value of its own.

Adulterated mustard oil has been held as a factor of the disease and the discussions on this point have not yet been finally closed. I do not think it would be wise to comment upon them at this stage. Dr. Satya Saran Mitra, who has made Epidemic Dropsy a special subject of study and whose excellent papers on the clinical phases of the disease form a complete literature on the subject, has by facts and figures been able to make out a case against mustard oil. He has been well supported by Dr. Satyendra Nath Sen, Assistant Chemical Examiner to the Government of Bengal, and Dr. B. M. Chakraburty, B.A., L.M.S., also of the Chemical Laboratory, Medical College, who have very reasonably kept the discussion open. Rai Bahadur Chooni Lal Bose, Additional Chemical Examiner to the Government of Bengal, was strongly opposed to the theory. Dr. J. N. Dutt, the learned and veteran analyst of the Calcutta Corporation, has shown by facts and figures taken from the analytic work done in his laboratory that much needless anxiety was felt by the people and there was no foundation of truth in the report that mustard oil was adulterated with mineral oil. It is not my intention to bring this controversial point before the learned assembly, for it has been discussed and published in the transactions of the Calcutta Medical Club. I do not criticise the theory of mustard oil, but simply submit for the information of the learned members that the Health Department took the matter up in right earnest at a time when the dealers themselves were convinced of their folly and discontinued mixing mineral oil with mustard oil. I remember a petty dealer saying that he had dearly paid the penalty by introducing this disease into his family and he swore he would never do it again. Whatever may be said against the theory of mustard oil playing a part in the causation of Epidemic Dropsy, it cannot be denied that there was a remarkable coincidence between the discontinuance of the oil and the improvement of systems. Dr. Satyendra Nath Sen has been able to demonstrate it by facts and incidents mentioned in his interesting paper on Epidemic Dropsy. As it is not my intention to write an essay on the etiology of Epidemic Dropsy I need not do more than place the facts before you for discussion in the hope that we may come to a final conclusion. Sir Patrick Manson in his instructive paper on Epidemic Dropsy has said that medical men were not affected by the disease. I wish I could agree with him, but unfortunately the experience of the last epidemic has taught a different lesson. A fairly large number of medical practitioners became victims and one young Assistant Surgeon with a bright future before him was so far run down that he had to retire on pension at the age of 32.

On analysing the arguments placed before the profession by the scientists and clinicians who made Epidemic Dropsy a special subject of study, we find that the workers are not unanimous in their finding and further research is necessary to elucidate the truth. I must candidly confess that I have not been able to form any decided opinion as to the identity of disease; I still hold that it is the Beri Beri of Ceylon, China and Japan and the discrepancies mentioned by the keen observers are mere anomalous phases of the disease. It is, in my humble opinion, a disease of the soil, which under certain meteorological conditions undergoes certain physical changes, which, when they reach a climax, produce the disease. In support of this theory I might mention that the people affected by the disease improved their condition to a material extent by leaving the contaminated area, but were destined to suffer from relapse on their return.

However much we may differ in our views regarding the nomenclature of the disease, we must all admit that we are unanimous in holding that it is an epidemic disease. If we look at the chart as prepared by the learned Health Officer of Calcutta we shall find that it follows the usual course of an epidemic disease; its curve at the beginning is low, and then by leaps and bounds it goes high and remains so, till the disease has exhausted all its virulence and then slowly and gradually descends with the decline of the epidemic. It has got a definite cycle of its own which comes once in every ten years and this I humbly venture to establish by facts taken from Medical Gazette and other authentic and absolutely reliable sources. The first outbreak of the disease was in 1877-78, the second 1887-88 and 1898-1901, the fourth was in 1908-09. About the first we have got positive evidence from the reports of hospitals; the second has, I trust, been

satisfactorily proved from the records of transactions of the Calcutta Medical Society. I regret that I have not been able to show from any published record the existence of Epidemic Dropsy of 1898, but if my memory serves me aright, I remember seeing a few cases amongst the Mahomedans of Amratolla that year. Its existence in 1901 has been amply proved from the writings of the various workers as well as from the Indian Medical Gazette; the fourth and the last was in 1908-09. From the record just placed before the learned assembly it would be found that Epidemic Dropsy has got a cycle of ten years. As an epidemic disease it is preventable and we may reasonably hope to be able to make it a thing of the past, but to achieve success we require the help of Government and the hearty co-operation of the people. It is true that the sanitarian has not always been able to trace out successfully the source of all epidemic diseases, but he must do everything to arrest their spread by enforcing rigidly the bye-laws which vest him with power to look to the sanitation of the town where it breaks out and to the supply of its foodstuffs. I trust I may be pardoned for once more repeating that Epidemic Dropsy has its close relation with the soil and other meteorological conditions of a town, city or village, where it pays its visit. In Calcutta the epidemic has always broken out in the year in which the amount of rainfall was heavy and the level of the sub-soil water was less than 5 feet. The drainage system of Calcutta, far from being perfect, has often been found leaky and the danger arising from this source could be better imagined than described. To enable the Conference to satisfactorily trace the causative factors of the disease, I have collected the meteorological reports which I beg to append here in the hope that they may be of some use to the learned members of the Conference in ascertaining the etiology of a disease which has proved itself a powerful enemy of a prosperous city. I thank you for your patience and apologise for the meagreness of my paper.

KAILAS CHUNDER BOSE, *C.I.E., L.M.S.*

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*Sub-soil water.*

(1) Trial well no. 1.

At Ellenborough Course.

Date of collection, 18th May 1892.

*Analysis—*

| | | |
|---|---|---|
| Total solid | 76·5 | per 100,000 |
| Fixed „ | 67·5 | „ „ |
| Chlorine | 4 | „ „ |
| Free $NH_3$ | 0·0525 | „ „ |
| Albuminoid $NH_3$ | 0·0215 | „ „ |

(2) No. 2 well near Dufferin's statue.

Date of collection, 18th May 1892.

*Analysis—*

| | | |
|---|---|---|
| Total solids | 45 | per 100,000 |
| Fixed „ | 35 | „ „ |
| Chlorine | 7·6 | „ „ |
| Free $NH_3$ | 0·066 | „ „ |
| Albuminoid $NH_3$ | 0·033 | „ „ |

(3) Trial well at Canning Street.

Date of collection, 20th July 1892.

Depth of water from surface, 5 feet.

Depth of water (in the well), 6 feet 9 inches.

*Analytical Report—*

Colourless and slightly turbid.

Odourless alkaline.

No smell of $HS_2$

| | | |
|---|---|---|
| Total solids | 47 | per 100,000 |
| Fixed „ | 34 | „ „ |
| Free $NH_3$ | 0·0025 | „ „ |
| Albuminoid $NH_3$ | 0·017 | „ „ |

(4) Trial well at Emambag Lane.

Depth of water from surface, 7 feet 3 inches.

Temperature of water 28° C.

Date of collection, 20th July 1892.

*Physical character—*

Colourless and slightly opaque.

Alkaline.

No smell of $HS_2$, odourless.

| | | |
|---|---|---|
| Total solids | 30 | per 100,000 |
| Fixed „ | 26 | „ „ |
| Chlorine | 3·2 | „ „ |
| Free $NH_3$ | 0·0105 | „ „ |
| Albuminoid $NH_3$ | 0·011 | „ „ |

| Year. | Total N.-E. monsoon. December to April. | Total S.-W. monsoon. May to November. | Total. | Remarks. |
|---|---|---|---|---|
| 1877 | ? | 52·50 | ? | |
| 1878 | 6·85 | 53·55 | 60·40 | |
| 1879 | 0·72 | 42·89 | 43·61 | |
| 1880 | 5·82 | 63·90 | 70·72 | |
| 1881 | 5·57 | 63·80 | 69·47 | |
| 1882 | 4·68 | 61·86 | 66·44 | |
| 1883 | 6·64 | 43·40 | 50·04 | |
| 1884 | 4·29 | 60·86 | 65·15 | |
| 1885 | 4·11 | 61·72 | 65·83 | |
| 1886 | 4·52 | 61·57 | 66·09 | |
| 1887 | 5·63 | 52·44 | 58·07 | |
| 1888 | 8·80 | 60·91 | *69·71* | Epidemic year. |
| 1889 | 4·85 | 52·59 | 57·44 | |
| 1890 | 2·13 | 59·15 | 61·28 | |
| 1891 | 5·42 | 41·54 | 46·96 | |
| 1892 | 1·69 | 44·98 | 46·67 | |
| 1893 | 7·02 | 78·21 | 85·23 | |
| 1894 | 5·22 | 43·36 | 48·58 | |
| 1895 | 2·04 | 37·42 | 39·46 | |
| 1896 | 0·25 | 52·97 | 53·22 | |
| 1897 | 3·83 | 54·50 | 58·33 | |
| 1898 | 1·40 | 58·12 | 59·52 | |
| 1899 | 3·03 | 68·92 | 71·95 | |
| 1900 | 3·62 | 85·65 | *89·27* | Epidemic year. |
| 1901 | 4·76 | 65·28 | 70·04 | |
| 1902 | 7·62 | 54·00 | 61·62 | |
| 1903 | 3·99 | 50·81 | 54·80 | |
| 1904 | 6·33 | 57·67 | 64·00 | |
| 1905 | 11·02 | 58·74 | 69·76 | |
| 1906 | 11·85 | 45·34 | 57·19 | |
| 1907 | 7·06 | 47·75 | 54·81 | |
| 1908 | 1·60 | 79·70 | *81·30* | Epidemic year. |
| 1909 | 6·05 | 65·52 | 71·57 | |
| 1910 | 4·64 | 51·24 | 55·88 | |

From the schedule appended herewith we find that the amount of rainfall in the epidemic year or the year immediately preceding it has been pretty high; the surface level of Calcutta is 20′ and the level of its sub-soil water is 15′ 5″. During heavy rains and floods it sometimes becomes 16·5.

KAILAS CHUNDER BOSE, *C.I.E., L.M.S.*

## APPENDIX 23.

### EDUCATION AND PUBLIC HEALTH.

In several of the papers submitted to the Conference stress has as usual been laid upon the difficulty of carrying out measures for the improvement of public health in India in face of the apathy and ignorance of the great mass of the people.

It is generally admitted that this ignorance is the great bar to sanitary progress, but no one suggested to the Conference the desirability of measures being adopted for surmounting the difficulty. Apathy and ignorance in the matter of public health are practically one and the same and therefore the same remedy applies to both and that remedy manifestly is education. It is hardly fair to blame an absolutely illiterate man for being apathetic and ignorant concerning matters which he has never heard of or which, if he has heard of, he has been incapable of understanding.

Education concerns the sanitarian probably more than any other administrator in this country, but it is surprising that at the Conference no reference has been made to Mr. Gokhale's Elementary Education Bill and no stress has been laid upon the urgent necessity for the spread of elementary education. The President alone remarked: "I believe with all my heart in the slow but sure results of education, the forerunner of sanitation."

I believe that the sole reason why the Conference refrained from urging the question of education is that the members are of opinion that the subject had better be left to those directly responsible for education, but it would surely be a stimulus to the Educational Department if the Conference declared in unmistakable terms its belief in the dependence of sanitary progress upon education.

Whilst acting as Health Officer of the city of Madras, I was able to demonstrate that the sanitarian may with advantage invade the domain of the educationalist without being regarded as an intruder, and it is to the excellent results likely to accrue from the co-operation of the two departments in Madras city that I would invite attention.

The Madras Corporation is now engaged upon the carrying out of schemes for providing the city with a pure and abundant water-supply and with a complete sewerage system. These schemes have been carefully worked out and definitely accepted and for the present they give the Medical Officer of Health no concern. He is consequently left free to devote his energies to the dozens of other comparatively minor factors which collectively play such an important part in determining the health of a city. Whilst investigating these problems one could not help being struck by the fact that the solution of most of them depended upon the co-operation of the people or upon their individual efforts. I made many suggestions to the President and was almost invariably given permission to carry out my suggestions, but I imagine now that the permission was often given with a wink of the eye of the more knowing Commissioners. Practically no appreciable result followed our well-meant efforts and in the end I was forced to report to the President that in the present state of ignorance and apathy of the people of Madras we had reached a deadlock in the matter of efforts to improve the public health, and I offered as the only possible solution of the problem the extension of primary education with a view to having it made free and compulsory at the earliest possible date. This suggestion went up to Government in the President's Annual Administration Report and the Madras Government was pleased to note the suggestion favourably. Having got the ear of the President and the sympathy of Government the Inspector of Schools for the city of Madras was next approached. He also viewed the proposal favourably, but of course pointed out that before any move was possible in the direction of compulsory education it was first of all necessary to have the schools which the children were to be compelled to attend.

Matters had now reached the stage when it seemed desirable that the scheme should be placed in the hands of a responsible Committee. The President, the Commissioners and Government were again approached with the result that Government eventually appointed a Committee to investigate the subject and submit proposals through the Corporation. In the end it was decided and sanctioned that the Corporation should provide for the whole city a sufficient number of school buildings on a model plan and that Government should pay the teachers, the Corporation being relieved of all other expenditure upon education whilst the building programme is being carried out, and that when sufficient buildings had been erected and teaching staff provided the question might be raised of making education compulsory for boys to begin with and in time for girls also.

Matters have now reached the stage that the Corporation has already constructed four excellent schools, their building programme being the construction of at least two schools each year for the next ten years, but as land is now cheaper than it is likely to

be in the future a considerable number of additional building sites are being acquired this year.

The schools are intended to be models of construction, object lessons in fact for the children. A walled in play-ground of sufficient size surrounds each building permitting of a free circulation of air on all sides. Latrines and bath-rooms occupy a corner of the play-ground. Needless to say lighting and ventilation receive particular attention. Each school costs from ₹6,000 to ₹9,000 exclusive of cost of site and as building work can be done comparatively cheaply in Madras it is evident that we are not going in for kutcha or temporary structures.

We are now within measurable distance of the time when elementary education shall be free and compulsory in Madras, and since the Medical Officer of Health has for so far been welcomed in his co-operation with Educational Department it is not anticipated that any difficulty will arise in persuading the Educational Department to include the elements of hygiene in the curriculum to be taught in these schools.

With the elimination of ignorance and prejudice which must follow upon the spread of education amongst the masses questions which now seem insoluble to the sanitarian will doubtless solve themselves.

I would suggest to the members of the Conference the placing of education in the forefront of their sanitary programmes. Practically all the leading municipalities have declared in favour of Mr. Gokhale's Bill, and now is the time to ask them to reduce their professions to practice.

T. S. ROSS, *Major, I.M.S.*

CALCUTTA
SUPERINTENDENT GOVERNMENT PRINTING, INDIA
8, HASTINGS STREET