(No. 21.)

1896.

SESSION II.

PARLIAMENT OF TASMANIA.

DIPHTHERIA IN HOBART AND NEIGHBOURHOOD:

REPORT BY C. E. BARNARD, M.D., AND A. MAULT, WITH APPENDICES.

Presented to both Houses of Parliament by His Excellency's Command.

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DIPHTHERIA IN HOBART AND NEIGHBOURHOOD.

To the Hon. Sir P. O. Fysh, *K.C.M.G., President, and the Members of the Central Board of Health.*

Gentlemen,

At your meeting held on the 10th February last, your Secretary reported "that seven cases of "diphtheria, of which two had proved fatal, had been notified from Hobart during the preceding "week. As in all these cases the milk supply of the family in which they occurred had been "obtained from one dairy, Benjafield's, (to whose family two of the patients belonged), he had "recommended to the Hobart Local Board of Health to have the dairy immediately closed and "the sale of milk from it prohibited, and an order to this effect had been immediately made. "Benjafield's dairy was simply a milk-vending establishment, keeping no cows; but a list of all "dairy farms supplying it with milk had been obtained, and the Local Boards of Health of the "districts in which they were situated had been requested to immediately have inspections made of "the dairy establishments and of every person and of the milch kine connected with them." Minute No. 32, 1896.

You thereupon determined "that the strictest enquiry should be made into the whole matter, "and the Secretary was instructed to ask Dr. Barnard to assist, and undertake such analytical, "microscopic, bacteriological, and other investigations as might be necessary." Reference of matter to Dr. Barnard and Secretary.

Dr. Barnard was accordingly asked, and undertook to assist in the enquiry.

The Extent of the Outbreak.

From the list given in Appendix A., it will be seen that 36 cases in all are reported between the 5th of January and the 4th of March. In 25 of these cases the patients were residents of Hobart; in four of them they were serving in the fleet while stationed at Hobart; in three cases they were residents of Kingston; in two cases, of Glebe Town; in one case, of Rural Queenborough; and in one, of the Queen's Domain District that is in the jurisdiction of the Central Board. The cases from Kingston and Rural Queenborough are included in the list for reasons connected with the causation of the outbreak that will be given further on. Distribution.

In all 7 cases proved fatal. It has been ascertained that anti-toxic serum was administered in 18 cases, with the result that 16 cases were cured and 2 cases proved fatal—the mortality being equal to 12·5 per cent. of the cases. In the 18 cases in which the serum was not used 5 proved fatal, being equal to a mortality of 38·4 per cent. on the cases. In explanation of these percentages, it should be pointed out that as a rule the serum was only administered in the more malignant cases, and in them sometimes at a very late stage of the disease, when other treatment had apparently failed. It was found impracticable to ascertain in every case at what period of the duration of the disease the serum was administered, and consequently this useful information cannot be given. It will be noticed that 19 of the cases were admitted to the Hospital, of which only two were fatal—a remarkable result when it is remembered that too frequently the Hospital is regarded as the last resort in desperate cases. Mortality, treatment, and results.

Milk Supply.

In nineteen of the 36 cases recorded, the milk supply of the families in which they occurred was derived from Benjafield's dairy in Hobart; and in four of the other cases there was a connexion with the Bonnet Farm, which is situated in the Health District of Rural Queenborough, in close proximity to Kingston. This Report is chiefly concerned with these 23 cases; in the other cases inspection has been made by the local authorities, and precautions taken, under the ordinary current administration of the Health Acts.

As previously mentioned, Benjafield's dairy was closed. The following is a copy of the report of the City Sanitary Officer on the subject:—"In consequence of a communication from the "Secretary of the Central Board of Health to this Local Board, I visited Benjafield's dairy in Benjafield's dairy. Inspection by City Sanitary Inspector.

"Liverpool-street. There were no cows kept upon the premises. The rear portion is dilapidated; "but the front, where the milk was received and distributed, was clean and in good order, and also "the milk vessels in use. The same day, 7th February, 1896, I served a notice, under By-law 23, "to prohibit the sale, vending, and forwarding of milk from the said premises; but the dairy had "been practically closed before that date, and has not been re-opened.—W. MASON, *City Sanitary "Inspector. 9th March*, 1896."

Inspection by Engineering Inspector of Central Board.

The Secretary and Engineering Inspector subsequently made an inspection of the premises when they had been vacated. They stand, as shewn on the accompanying sketch, on the southern side of Liverpool street, and between it and the Hobart Rivulet. The milk shop was clean, as described in Mr. Mason's report. The dairy was a wooden lean-to, not in good condition. There were three stables for accommodating six horses, and one of these stables was a few feet from the dairy; the yard was fairly clean, but about 20 fowls had been kept, which roosted in the loft over the stables. There were cellars under the house, one of which had an earthen floor, was dry, and fairly clean, and the other was closed and its condition could not be seen. The Hobart Rivulet is here unpaved and full of boulders, and the neighbours complained of the foul odours arising from it, and these were noticeable on the day of inspection. As the whole of the north-west side of the premises is occupied by a butcher's shop, sausage factory, and meat-curing sheds, the only ventilation of the dairy came from the stable and fowl-yard, with the Hobart Rivulet at the bottom of it. The place was certainly very unfit for a large milk depôt, and is over-occupied by buildings.

Sources of Benjafield's milk supply.

Inspection of dairy farms: Kingston. Moonah.

At the time of his inspection, Mr. Mason obtained a list of the dairy farms from which Benjafield obtained his milk: they were Messrs. Firth and Lucas's, at Kingston, Dr. Benjafield's, at Moonah, and Mr. Piesse's, at Green Point, Bridgewater. The Secretary of the Central Board, as before reported, wrote on the 7th February to the Local Boards of the districts in which these farms are situated, asking that an immediate inspection and report might be made. On the 10th February the report was received of the inspections made at Kingston, and it is given in Appendix B. The report on the farm at Moonah is also given in the same Appendix. But, as some delay occurred in obtaining it, Dr. Barnard and the Secretary went on the 11th February and inspected it. They found the condition of the farm and buildings very much as described by Inspector Bateman in his report given in the Appendix. The people employed were all reported, and appeared to be, in good health, and the milch kine, with one exception, were also in fair condition and health. The exception was a cow with some affection of one of the teats. It was driven to the milking shed, and a sample of milk taken, and instructions given to prevent any use being made of the milk of this cow. It has not been considered necessary to give a detailed report of the examination of this milk, as, in default of having properly sterilized receptacles for the milk taken, it is probable that it might have been subjected to infection by airborne micro-organisms, and as, notwithstanding this probable infection, no bacilli of diphtheria were found after examination and cultivation as hereafter described. It may be incidentally mentioned, though outside the special object of the examination, that so far as the cultures were proceeded with, no example of the bacillus of tuberculosis was found.

Bridgewater.

On the 12th February, Dr. Barnard and the Secretary went to the farm at Green Point, Bridgewater. The people employed and the cows were in good health, the milking-sheds and yards in fairly clean condition, and the milk-cans properly cleansed and scoured. The drinking water on the runs was said to be good, but the drinking-places near the house would be improved by paving or other means of preventing the cattle from treading and working up the mud of the waterholes.

THE BONNET FARM, RURAL QUEENBOROUGH.

On the 11th February, Dr. Benjafield informed the Secretary that he had learnt that Benjafield at the dairy had since the 26th January been also getting milk from the Bonnet Farm; that he had had the can of milk that arrived the previous evening put aside to be given up for examination, that he had tested it with his lactometer, which showed that it had been adulterated with about 25 per cent. of water, and that he had ordered the cessation of all supply of milk from the farm mentioned. This information threw a new light upon the whole matter, for, as you will remember, at your meeting of the 10th February, the Secretary reported to you, "that in "connection with a fatal case of diphtheria that had been sent (on the 5th January) to the "Hobart General Hospital from the Bonnet Farm, he was making all the inquiries in his "power. Thus far he had ascertained that the patient, a boy, whose parents lived in the Oatlands "district, had left home in good health a little before Christmas, and had come on a visit to the "farm, staying a short time at Risdon on his way. While at the Bonnet Farm he had been once or "twice at Kingston, and had once visited at Mackay's farm, which adjoins. The Inspector at "Oatlands has reported that the parents, their family, house, premises, and cattle are all in good "health and condition. The Engineering Inspector of the Board had visited the Bonnet and "neighbouring farms, the families living at which were all declared to be in good health; the "premises were clean and proper, and the water supply apparently good. The cows had been "examined by the local Inspector, and found to be in good health. The only known fact that "might account for the boy's having taken diphtheria was his visit as above-mentioned to "Mackay's farm, whence, early in November last, a girl on a visit was taken to her home in "Clarence Plains suffering from diphtheria, and taken subsequently, on the 29th November,

No. 2 case, H.W.

"to the Hobart Hospital. At the Mackay's she had slept with the children, and after her "removal these children had suffered from sore throat, but had quickly recovered, and there had "been no further case of sickness there. But at Clarence Plains the disease spread among the "girl's family, and her brother had died at the Hospital. The enquiry was proceeding."

On receiving Dr. Benjafield's information Dr. Barnard and the Secretary at once proceeded to the Bonnet Farm to make further examination. The facts connected with the case of the 5th January were repeated without sensible variation. The whole premises were fairly clean. The water supply of the house was again said to be exclusively derived from rain-water tanks in which the water was found to be clean, and which were themselves free from sediment. The well in the yard was stated to be never used, and the statement was fully corroborated by the absence of all means of drawing the water, the windlass being broken, and there being no rope nor well-bucket. A spring at a distance from the house was pointed out as the cows' watering-place, and the water found fairly good when not muddied by the trampling of the kine; and directions were given for preventing this muddying. The cows themselves were again examined, and found healthy. A sample of their milk was taken for analysis and examined, as reported hereinafter, but with negative results. The occupier of the farm gave the most peremptory denial to the allegation that any addition of water had been made by him or any one belonging to him to the milk supplied to Benjafield's dairy. He produced, moreover, the milk-can which had been sent from the dairy, to show the unclean condition in which the cans were sent to him; and the can was certainly unfit in its then condition to carry milk to be used as human food, as the bottom and sides had much adherent hard curdled milk, and smelt sour.

On the same day, the 11th February, the Mackay's farm was also visited, but no fresh facts elicited.

The milk constituting the last supply to Benjafield's dairy from the Bonnet Farm, which, as above stated, was reserved by Dr. Benjafield for examination, was received from the dairy, and reports of its analytical and bacteriological examination are given in Appendix C.

On the 26th February a girl was admitted to the hospital from Kingston, suffering from diphtheria. She had been for a few days employed by day as a servant at the Bonnet Farm, but slept at her father's house at Kingston. She had nothing to do with the cows, but she drank large quantities of the milk. She attributed her illness to the bad smell arising from the well when the local inspector had on the 17th February thrown a large stone down it. A notice was served on the 26th on the proprietor of the farm to have the well filled up and closed. On the 29th February J. B.'s little brother, who used to sleep in the same bed with her, was also brought to the hospital with diphtheria. The usual examination of the parents' house at Kingston was made, and the place was found clean and well kept, and the only probable cause of this illness was the girl's connexion with Bonnet Farm. Case 33, J.B. Case 35, D. B.

On the last-mentioned day, the 29th February, a young man named W. B. came to the hospital for treatment, and was found to be suffering from diphtheritic paralysis. On inquiry it was found that he had been a farm servant at the Bonnet Farm during December and January, and that while there he had suffered from sore throat about New Year time. No doctor had seen it, but he apparently cured himself. He had never left his work for it, but continued milking cows and doing such like service till he left the farm on the 1st February. He then went into service in the Huon District, but was sent home on account of illness, and he then went to the hospital. Case No. 1, W. B.

At the various inquiries above-mentioned at the Bonnet farm as to the health of the inmates W. B.'s illness was never mentioned, and the occupier of the farm and his family still maintain that they never knew of his illness. Though cousins, J. B. and W. B. do not seem to have met during the period included within the dates above given.

In connexion with the well on the farm, information from several quarters was received that though the water was not used, the well itself was made the receptacle for the dead animals, calves, and fowls of the farm; and that both last year and this there had been considerable mortality among the fowls. This mortality is admitted by the farmer, who, however, denies knowledge of the throwing of the bodies into the well. But the nature of the malady causing the mortality has not been disclosed. Under the circumstances it was thought desirable to have the water examined, and therefore a sample of it was obtained, and the report of its examination is given hereinafter. (See Appendix C.)

Removal of Benjafield's Dairy Business.

It is mentioned in Inspector Mason's report given above that Benjafield's dairy at 216, Liverpool-street, had been "practically closed" before the giving of the order prohibiting the sale of the milk. He does not mention that the sale of the milk had been simply transferred from the shop in Liverpool-street to another in Barrack-street, where the sale of milk from the supply farms was continued by members of the Benjafield family. These members declare that all communication between the sick and those that were nursing them, and the healthy who were carrying on the

business entirely ceased. The business was transferred on the 3rd of February. It does not appear that the new premises were licensed for the sale of milk, nor that any supervision was exercised during the transfer as to the disinfection of the milk vessels taken from the infected house; and from Inspector Mason's report it appears that some of these vessels were at the old dairy on the 7th February. As a matter of fact it seems clear from the dates given in the list of cases in Appendix A. that the removal of the business in the manner in which it was carried out had no effect whatever upon the prevention of the dissemination of the disease by means of the milk sold, for if four or five days' interval be allowed for the infection in the milk to take effect, it would appear that of the 19 cases of diphtheria traceable to the dairy, nine were occasioned by milk sent from Liverpool-street, and ten by that sent from Barrack-street. It is therefore evident that a prohibition order against the sale of milk from a dairy is quite useless as a preventive of the propagation of disease if it can be virtually evaded by the transfer of the business in this manner from one set of premises to another. The attention of the Local Boards concerned should be called to this matter, as showing that in like circumstances the establishment of new dairies should be prevented until all the conditions imposed by the By-laws relating to milk supply have been strictly fulfilled. In this case such prevention would have saved several lives, as three of the above-mentioned ten cases that originated after the establishment of the new dairy were fatal. It is also to be greatly regretted that the Bonnet Farm was not mentioned on the 7th February as one of the sources of the milk supply, as by this omission the distribution of the infected milk went on for three days at least longer than would otherwise have been the case.

Cause of the Outbreak.

Immediate cause of the Hobart cases.

The following considerations of the facts above set forth, and of those given in Appendix A., show as conclusively as is possible in such a matter that, notwithstanding the negative results obtained from the examination of the milk, the immediate cause of the disease in the nineteen cases connected with Benjafield's dairies was the consumption of milk supplied from the Bonnet Farm :—

(1.) That no case of diphtheria occurred among Benjafield's customers while the milk supply was exclusively derived from sources other than the Bonnet Farm.

(2). That immediately upon the receipt of milk from the Bonnet Farm for the first time on the 26th January, and its distribution among customers on the 27th, diphtheria must have commenced to develop among them, as the proprietor and his son were taken ill on the 29th, and a case from a customer's house was taken to the hospital on the 31st.

(3.) That there was a *nidus* of infection existing on the Bonnet Farm during the whole month of January, as shown by the case of W. B., who remained at the farm during the whole month where he was engaged milking the cows, and by the case of H. W., who was removed thence to the hospital on the 5th January.

(4.) That, allowance being made for an incubatory period, immediately upon the discontinuance of the receipt of milk from the Bonnet Farm on the 10th of February there was a cessation of the occurrence of diphtheria among the customers of the dairy; and

(5.) That after the prohibition of sending out milk from the Bonnet Farm, one of the farm servants who had drunk large quantities of the milk was sent to the hospital on the 26th February suffering from diphtheria, showing the continued existence of the *nidus* of infection there during the greater part of February.

If the cogency of this reasoning be admitted—and it is hard to see how it could be more conclusive—the scope of the inquiry into the cause of the outbreak may now be limited to the consideration of everything connected with the milk sent out from the Bonnet Farm with the view of ascertaining, if possible, how the milk became infected.

The difficulties of this inquiry have no doubt been greatly increased by the fact that the occupiers of the farm have found that the result of the inquiry has so far resulted in the serious loss to them of their milk and butter trade, an immediate loss that, perhaps naturally, prevents them from appreciating the fact that they are more concerned than anyone else in discovering and removing the real cause that has necessitated the stopping of their trade.

Dissemination of Diphtheria by Milk.

The dissemination of diphtheria by milk is now universally admitted; but how the milk itself becomes infected is still a difficult question to answer, and is occasioning much controversy. If the infective milk is produced by a diseased cow, the malady is said to be invariably shown by an eruptive disease of the teats and udder, followed by scabs or crusts. This disease is contagious, and usually spreads more or less through the herd. It has been communicated to cows by inoculation with cultures from the diphtheritic membrane of the human throat, but no cases are recorded of transmission otherwise from the human subject to the cow. But there have been cases in which milk has been infected by fouling from a case of human diphtheria. The question in this case therefore is, Was the infected milk at the Bonnet Farm the product of diseased cows, or was it infected from a human subject?

The cows at Bonnet Farm.

As already mentioned, the cows at the Bonnet Farm were repeatedly examined. The lay inspectors were specially instructed to look out for the eruptive disease and the scabs, but neither

they nor Dr. Barnard found any trace of it. Therefore, unless the cows that were or had been suffering from it were carefully kept out of sight (though no previous notice was ever given of an intended inspection), it does not seem probable that the infective character of the milk was derived from diseased cows.

Cause of cases at the Bonnet Farm.

As to the causation of the human cases at the Bonnet Farm, it is more difficult to speak definitely. The farm itself seems to be the last place in the world where diphtheria would be originated. It occupies the summit of the last hill of the long spur of the Wellington Range that begins at the divide between the headwaters of the Wellington Rivulet and Brown's River, and runs by way of Mount Nelson to this little peak dominating Kingston and its bay. It is several hundred feet high, and within a mile of the sea. It is swept by every wind that blows, whether from the sea, the estuary of the Derwent, the valleys of Mount Wellington, or the plains and hills behind Kingston. The hill is of volcanic rock, and the surface is dry chocolate soil. The ground slopes every way from the house, which is cleanly and properly kept. The farm-yard is dry, and shows no accumulations of manure other than the current production of a few days of stable and cowshed dung. The only bad feature is the well, and any inspection of that would demonstrate that it had not been used as a water supply for months, and probably for years. It is forty or fifty feet deep, and had ten or twelve feet of water in it.

The farm had previously a good health record, the only reported case of infectious disease in any way connected with it was that of W.S. a farm servant, who had typhoid fever more than a year ago, but, in his case, while the farm was reported clean, a very foul cesspool was found at his own cottage in the township.

Before the facts connected with case No. 1 were ascertained, it was thought, as expressed in the Secretary's report to you on the 10th February, that H.W.'s case might be attributable to his visit to a neighbouring farm where a girl had fallen ill with a sore throat early in November last. Further inquiries have made it doubtful whether this girl had diphtheria at the time of her leaving the farm, as she apparently recovered from the sore throat while at home, and then her brother came home from the Sorell District, where a case of diphtheria had occurred. The boy soon developed the disease, and it was thought he had caught it from his sister. But it is quite possible that the sister, being convalescent from a throat affection, may have caught the disease from the brother, who may have been unconsciously the bearer of the infection. Both went to the hospital together. But, as it has been shown that the girl visited the Bonnet Farm, and had tea there before she fell ill, it is also possible that she contracted the sore throat at the time of this passing visit, which, if really then a case of diphtheria, would show that the *nidus* of infection was existent as long ago as in the beginning of November last. This case is here mentioned to put you in possession of all the facts we have ascertained, though we do not think it has any real connexion with the first of the cases recorded in Appendix A.

This first case, that of W.B., appears to be the origin of the infection at the farm. He went to live there about the middle of December. He had lived at home for some months previously. His father's cottage is in the bush, two miles from any other house, and is described as cleanly kept and in good condition, and having a good water supply. How W.B. himself was infected we have no means of ascertaining, but probably by some casual encounter of which he had no knowledge with some one who had a sore throat of the same kind as his certainly was. He probably communicated the disease to H.W., the second case, who was on a visit to the farm, and whose illness was certainly not caused by infected milk, for he disliked it and never partook of any, either alone or in his tea, or otherwise. As before stated, W.B. milked some of the cows night and morning during the whole month of January. Up till the 26th January the milk was churned, and, probably, was treated differently than when immediately sold, for it does not seem to have been infective, as no case of diphtheria was reported that could have been connected with the store to which the butter was sold. But when the milk itself was sold its infective nature became apparent in the disastrous manner described.

It is impossible to trace positively how the milk, or some of it, continued to be infective after W.B. left the farm, for it seems certain that it did so continue till the beginning of the illness of case No. 33. Probably, as the cows were milked in a yard, W.B., in his month's occupancy of his milking stool, had left enough sputum about to occasionally, when dry and disturbed by the cows' feet, pollute the milk in the pails during milking time.

With regard to the diseased fowls having been the source of infection, it has been already stated that no definite information could be obtained as to the nature of the disease from which they suffered; nor could any material, except the water in the well into which they were said to be thrown, be obtained to subject to examination. As to the water, it will be seen that it yielded no information upon the subject.

We have the honour to be,
Gentlemen,
Your obedient Servants,

C. E. BARNARD, *M.D.*
A. MAULT.

Hobart, 27th March, 1896.

Appendix A.

CASE LIST, Diphtheria in Hobart and neighbourhood, January 1st to March 5th, 1896.

Number of case.	Patient.				Date.				By whom notified.	Source of Milk Supply.	Treatment.			
											Serum used.		Serum not used.	
											Result.		Result.	
	Name.	Age.	Sex.	Residence.	First symptoms.	Admission to Hospital.	Notification to Local Board.	Notification to Central Board.						
1	W. B.*	20	M.	Kingston	1 Jan.	29 Feb.	...	...	Hospital	Bonnet Farm, Rural Queenborough	...	...	Convalescent	...
2	H. W.	14	M.	Rural Queenborough	2 or 3 Jan.	5 Jan.	12 Jan.	11 Jan.	Ditto	Ditto	...	...	...	Died
3	E. C.	13	F.	Hobart	...	31 Jan.	7 Feb.	7 Feb.	Ditto	Benjafield's Dairy, Hobart†	Cured	...	...	...
4	F. B.‡	12	M.	Ditto	29 Jan.	...	3 Feb.	5 Feb.	Dr. Benjafield	Ditto	...	...	...	Died
5	A. B.§	Adult.	M.	Ditto	29 Jan.	...	...	...	Ditto	Ditto	...	...	...	Died
6	M. H.	21	F.	Ditto	...	...	3 Feb.	5 Feb.	Dr. Oldmeadow	Ditto	...	...	...	Died
7	O. W.	13	F.	Ditto	...	5 Feb.	8 Feb.	8 Feb.	Dr. Wolfhagen	Ditto	Cured	...	...	...
8	A. N.	5	F.	Ditto	...	5 Feb.	10 Feb.	10 Feb.	Ditto	Ditto	...	...	Cured	...
9	— S.	18	F.	Ditto	...	...	6 Feb.	10 Feb.	Dr. Harvey	Ditto	Cured	...	...	...
10	E. S.	28	F.	Ditto	...	8 Feb.	10 Feb.	10 Feb.	Dr. Crowther	Ditto	Cured	...	...	...
11	W. H.	21	M.	H.M.S. *Ringarooma* ‖	...	8 Feb.	12 Feb.	12 Feb.	Dr. Gunn	Ditto	...	...	Cured	...
12	J. B.	6	M.	Glebetown	5 Feb.	...	...	29 Feb.	Dr. Naylor	Ditto	Cured	...	...	...
13	H. B.	12	M.	Ditto	5 Feb.	...	...	29 Feb.	Ditto	Ditto	Cured	...	...	...
14	W. T.	22	M.	H.M.S. *Waterwitch* ‖	...	10 Feb.	12 Feb.	12 Feb.	Dr. Capps	Ditto	Cured	...	...	...
15	E. L.	23	F.	Hobart	...	10 Feb.	12 Feb.	12 Feb.	Dr. Oldmeadow	Ditto	...	...	Cured	...
16	— B.	Adult.	F.	Ditto	...	...	...	11 Feb.	Dr. Benjafield	Ditto	...	...	Cured	...
17	H. O.	7	M.	Ditto	...	...	11 Feb.	...	Dr. Scott	Aymer's Dairy, Hobart	...	...	...	Died
18	— M.	2	M.	Ditto	...	...	12 Feb.	...	Dr. Gibson	Benjafield's Dairy, Hobart	...	...	Cured	...
19	— F.	5	M.	Ditto	...	...	12 Feb.	...	Ditto	Ditto	...	...	Cured	...
20	S. B.	18	M.	H.M.S. *Orlando* ‖	...	12 Feb.	14 Feb.	14 Feb.	Dr. Irvine	Ditto	...	Died	...	...
21	R. P.	25	M.	H.M.S. *Pylades* ‖	...	12 Feb.	14 Feb.	...	Dr. Andrews	Ditto	Cured	...	...	...
22	— G.	7	F.	Hobart	...	...	12 Feb.	...	Dr. Wolfhagen	Macaulay's Dairy, Hobart	...	...	Cured	...
23	E. G.	5	M.	Ditto	...	...	12 Feb.	...	Ditto	Ditto	...	Died	...	...
24	— N.	6	F.	Ditto	...	...	13 Feb.	...	Ditto	Ditto	...	...	Cured	...
25	— N.	5	F.	Ditto	...	...	13 Feb.	...	Ditto	Ditto	...	...	Cured	...
26	G. L.	2	M.	Ditto	...	...	14 Feb.	...	Dr. Walch	Benjafield's Dairy, Hobart	Cured	...	...	...
27	R. H.	4	F.	Queen's Domain	...	...	15 Feb.	19 Feb.	Dr. Oldmeadow	Ditto	...	...	Cured	...
28	A. Y.	3	F.	Hobart	...	15 Feb.	17 Feb.	17 Feb.	Dr. Maxwell	...	...	...	Cured	...
29	E. C.	5	F.	Ditto	...	15 Feb.	17 Feb.	17 Feb.	Ditto	...	Cured	...	...	...
30	A. C.	9	F.	Ditto	...	20 Feb.	22 Feb.	22 Feb.	Dr. Wolfhagen	Crow's Dairy, Hobart	Cured	...	...	...
31	C. J.	30	F.	Ditto	...	20 Feb.	22 Feb.	22 Feb.	Dr. Crowther	Barwick, Glenorchy	...	...	Cured	...
32	A. C.	2	F.	Ditto	...	23 Feb.	25 Feb.	25 Feb.	Hospital	Crow's Dairy	Cured	...	...	...
33	J. B.	16	F.	Kingston	20 Feb.	26 Feb.	29 Feb.	29 Feb.	Ditto	Bonnet Farm	Convalescent	...	...	...
34	M. S.	18	F.	Hobart	...	28 Feb.	2 March	2 March	Dr. Crowther	...	Cured	...	...	...
35	D. B.	7	M.	Kingston	...	29 Feb.	2 March	2 March	Hospital	...	Cured	...	...	...
36	M. G.	Adult.	F.	Hobart	...	...	4 March	...	Dr. Naylor.	Lewis's, Sandy Bay	Cured	...	...	...

* Admitted to Hospital on date mentioned suffering from Diphtheritic Paralysis; circumstances detailed in Report; date of first symptoms probably earlier.
† Milk sold at the dairy named procured from country farms—*See* Report. ‡ Son of proprietor of dairy. § Proprietor of dairy. ‖ Vessel lying in Harbour.

Appendix B.

LOCAL INSPECTORS' REPORTS.

Kingston, 10*th February*, 1896.

Sir,

Re annexed, I beg to inform you that I this afternoon inspected Mr. Ernest Lucas's milking cows (14), and found 12 of them without a blemish. Of the remaining two, one had marks on four of its teats caused by sun-scald, the other had one teat similarly marked, but I am certain that the marks were not caused by any eruption.

The persons that attend the above cows seemed to me to be healthy, but one of the milkers has a large boil on his left arm between the wrist and the elbow.

I have also examined 37 of Mr. J. T. Firth's milking cows, and found two out of the lot suffering, or rather marked, in a similar manner to those belonging to Mr. Lucas, but all the cows are in the very best of order, and as clean as they possibly can be in the skin,—in fact, the whole of the cattle I inspected this afternoon could not look healthier. All Mr. Firth's people seem in the best of health.

I am, &c.

R. NEWALL, *Inspector Board of Health.*

H. Jolliffe, *Esq.*, *Chairman Board of Health.*

Council Chambers, Glenorchy, 20*th February*, 1896.

To A. Mault, *Esq.*, *Secretary Central Board of Health.*

Sir,

In accordance with your request, I herewith forward you the following report *re* Dr. Benjafield's dairy farm, situate at Moonah. The cattle were out on the run at the time of my visit yesterday afternoon, therefore I did not see them, but I am credibly informed that the cattle are in a fairly good condition, and, to all appearances, are free from any disease. The water supplied to the cattle for drinking purposes is conveyed along the main line of railway through pipes from the New Town Creek until it reaches Dr. Benjafield's farm, a distance of about 200 yards. At this point it is further conveyed in an open drain a distance of 100 yards, and then empties into a pond within 30 yards of the dwelling-house. The water in the drain was mostly stagnant and of a greenish colour. The cowsheds are about six yards from pond. There are two doors in each end of cowshed, and when being swept out, which is done, I am informed, about twice a week, it is swept on to a dung-heap which is lying within six yards of the drinking-pond. There is a steep incline from the dung-heap to the pond, and all liquids contained therein must necessarily flow into the pond. The water in the pond is very much discoloured, there being no outlet for the water, and the drinking end not being paved, consequently there is a large amount of slush around it. The floors of the sheds are wood, and in a very dilapidated condition; the same may be said of the surroundings.

I am, &c.

W. BATEMAN, *Superintendent of Police.*

Appendix C.

DR. BARNARD'S BACTERIOLOGICAL EXAMINATIONS.

Milk from Benjafield's Dairy.

The can of milk obtained on the 12th February, 1896, from the premises in Barrack-street used as a temporary dairy by Mr. Benjafield, measured 172 quarts. It had a sour smell, and was in a curdled condition when received, showing that some amount of decomposition had already set in.

On the same day a portion of this milk was sent to Mr. Ward, Government Analyst, for analysis as regards its constituents, and he reported that the milk had been diluted with 18 per cent of water, and that it was in a partial state of decomposition.

In addition to this analysis I submitted the milk to microscopical examination, carefully noting the micro-organisms present, and then proceeded to the bacteriological cultivation on suitable nutritive media of small quantities of the thickened portion of the milk, taken from its surface. For this purpose several tubes of sterilised gelatine and agar-agar were inoculated with a platinum needle dipped into the milk. Some of these tubes of cultural material were rendered liquid before being inoculated; and after having been well shaken in order to distribute the micro-organisms, the mixture was poured on to glass plates and allowed to become set. During the whole examination every precaution was taken to prevent the cultures being exposed to any foreign influences whatever.

These tubes and plates were kept at a temperature of about 35° C., or blood heat, in order to allow of the development of the bacilli of diphtheria, if present, as these micro-organisms will not grow sufficiently rapid at the lower temperature to outpace the putrefactive organisms to be found in the milk. Great difficulty was experienced in keeping back the numerous putrefactive and non-pathogenic micro-organisms from overcrowding the plate and from liquefying the media. From day to day each tube and plate was

examined, and any small colony that appeared likely to be the one searched for was picked out for microscopical examination and for further sub-culture, so that any colonies of diphtheritic or other pathogenic bacilli, if present, would readily be detected.

By staining cover-glass preparations with suitable aniline dyes, several kinds of bacteria were noticeable under the microscope; those of them that in some measure resembled the Klebs-Löffler bacillus of diphtheria were carefully isolated and sub-cultured with a view to obtain "pure" cultures, and were examined from day to day, but so far no bacillus has been found presenting the distinguishing characteristics of the diphtheria bacillus.

The micro-organisms found were those mostly associated with decomposition of albuminous fluids, besides those appertaining to the souring of milk. Among them were four species of bacilli and three of micrococci.

Milk drawn direct from a cow by a clean and healthy person into a sterilised glass vessel under proper precautions should contain no microbes—certainly none of a pathogenic character. Should any of a pathogenic character be found it would certainly indicate that the cow was diseased, and that the bacilli had migrated into the milk from the system of the cow. This migration of bacilli has been often proved.

Saprophytic and septic bacilli such as those found, when in milk are mostly derived from the air or from the water that may have been added to the milk, or with which the cans have been washed—especially if the water is not pure and has not been previously boiled. As the milk sent for examination is found to be diluted with water to the extent of 18 per cent., there is every probability that the greater number of the micro-organisms found in it were derived from this contaminating source.

As the diphtheritic germs are extremely microscopic, not being longer than $\frac{6}{1000}$ths of a m.m., they may float anywhere and find their way into the milk, especially when this is exposed to the open air in cans. And as milk is a cultural medium of good nourishing power, they would at once proceed to grow and multiply, and so be able to infect a neighbourhood.

In the case of this present outbreak there is every probability of the milk in the first place, having been infected by W. B., who was suffering from a sore throat while he was milking the cows. Unfortunately, nothing was known then of the infectiousness of the complaint from which he was suffering, and as he is a young man of robust build, and was in vigorous health at the time, he was enabled by the strong resistant power of his tissue cells to throw off the disease without much difficulty; and yet the true diphtheritic nature of his malady is made manifest by the subsequent development of a throat paralysis, for which he has been treated in the General Hospital.

Well Water from the Bonnet Farm.

On 5th March Mr. Mault brought for bacteriological examination a Winchester quart of water which was obtained from the well at the Bonnet Farm. The water was turbid, deeply discoloured, and contained fragments of vegetable matter in abundance. It had an unpleasant smell. In order to obtain the solid particles in a more concentrated form it was filtered through a sterilised Berkfeld filter, which kept back all solid matters and micro-organisms, allowing only water to flow through. The filtered water still retained its discolouration, showing that this was due to infusion of the vegetable matter present. The filtrate was a thick muddy fluid containing all the debris brought in the water.

As was to be expected, this muddy fluid contained innumerable micro-organisms, and in order to separate them for classification as in the case of the milk, plate cultures were similarly used, thus enabling examination of the several colonies to take place as they appeared on the plates. From these colonies sub-cultures were made on agar-agar medium, in tubes.

As the search was more particularly for the diphtheritic bacillus, those micro-organisms were set on one side that had nothing in common with this bacillus; and so the eliminating process was gradually carried on until none were left that in any way showed the characteristics of the Klebs-Löffler bacillus.

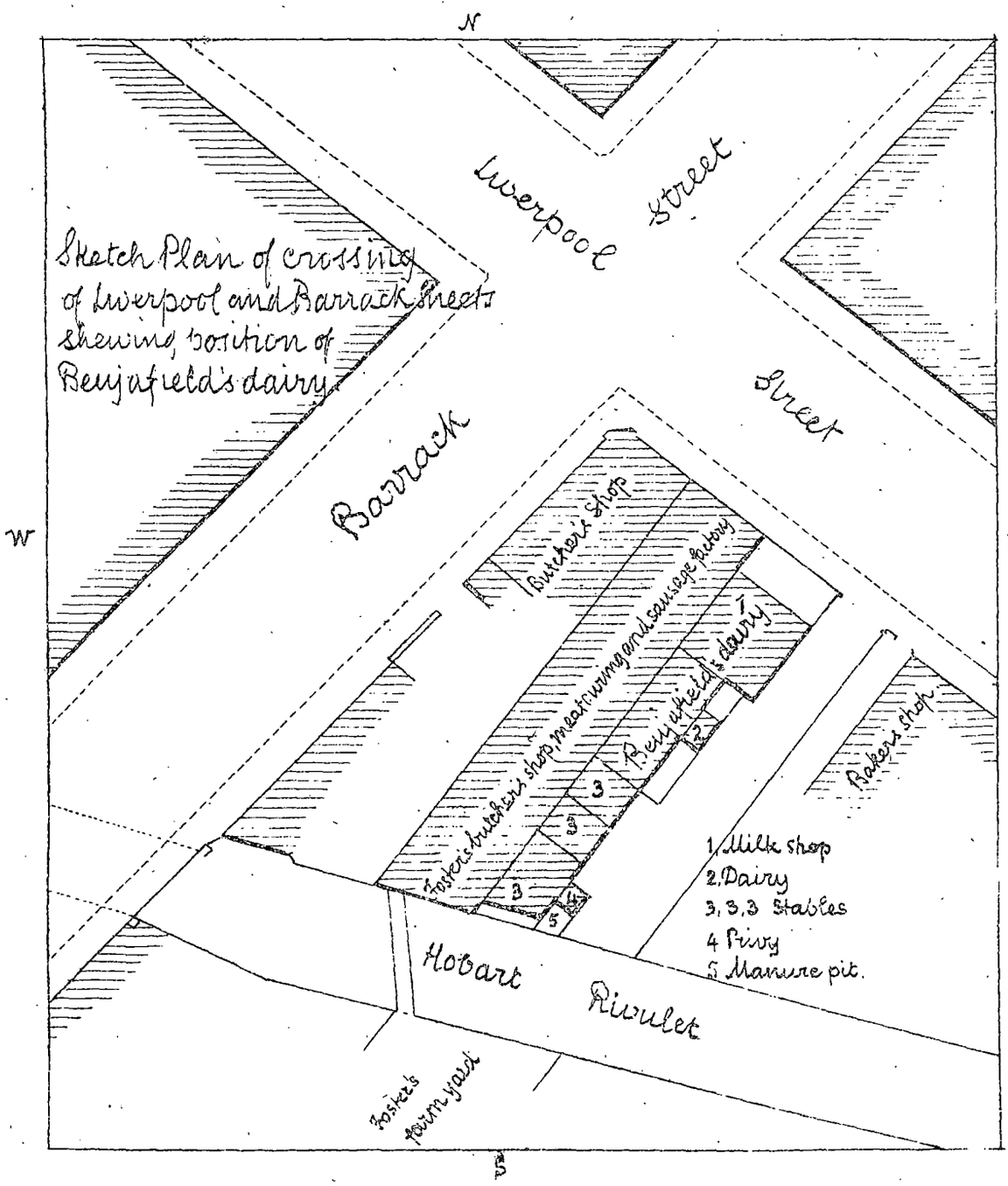
It cannot be thought strange that this bacillus was not discovered in the water when we consider its natural history so far as is known. Its particular habitat where it grows and multiplies is not water of any kind, but mucous surfaces, on which it flourishes in a marvellous degree: here it obtains all the elements needed for its growth—oxygen or air, warmth, moisture, and nutrition. When deprived of these essentials and protected from the light, it lies dormant and apparently inert, but the moment it lights on a mucous membrane it bursts forth into activity again. It has great tenacity of life, even under unfavourable conditions, and seems capable of germinating for some months, provided it be not exposed to very high temperatures. Hot water of about 150° F. kills its germinating power. Dry heat also destroys its vitality, but not so readily as moist heat.

In a dry state, then, the bacillus and its spores seem to be widely distributed, and may be present, lying in a dormant condition, even in such healthy situations as the Bonnet Farm. But when disturbed they may find their resting place in milk or on the mucous surface of some victim, and there set up (however healthy he may be) its specific disease. The disease once established is readily communicable, as is demonstrated by this outbreak.

C. E. BARNARD, *M.D.*

Hobart, 27th March, 1896.

WILLIAM GRAHAME, JUN.,
GOVERNMENT PRINTER, TASMANIA.


N
W
E
S
Liverpool Street
Barrack Street
Sketch Plan of crossing of Liverpool and Barrack Streets shewing position of Benjafield's dairy
Butcher's shop
Foster's butcher's shop, meat curing and sausage factory
Benjafield's dairy
Baker's shop
1
2
3
3
3
3
4
5
1, Milk shop
2, Dairy
3, 3, 3 Stables
4 Privy
5 Manure pit.
Hobart Rivulet
Hoskin's farm yard