



Report on typhoid fever in the city of Moorabbin, 1943

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STATE OF VICTORIA

DEPARTMENT OF PUBLIC HEALTH
COMMISSION OF PUBLIC HEALTH

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TYPHOID FEVER
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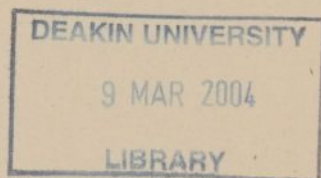
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REPORT ON TYPHOID FEVER IN THE CITY OF MOORABBIN, 1943.

I have the honour to present the accompanying report which deals with the outbreak of typhoid in Moorabbin City in March of this year.

The City* of Moorabbin found itself at that time with a very reduced health service due to enlistments for war service. Both the Medical Officer of Health and the Health Inspector were so engaged. The Acting Medical Officer is a very busy practitioner, and did not feel capable of allotting so much necessary time should the outbreak become as serious as he feared. The Acting Health Inspector, although well qualified and experienced in municipal health work, was holding a similar position for three other municipalities.

Further, the outbreak threatened to involve the neighbouring districts, and after several conferences the control of the outbreak was placed in my hands.

I may state here instead of at the usual place, that the success of this plan depended upon the complete co-operation of each municipal officer. In no instance was this withheld even at the expense of much hard work, great inconvenience, and often at the risk of prejudice to or even discredit to the municipality concerned.

Of the residents one cannot speak too highly. In every instance full co-operation was extended and submission to grave restraints and inconveniences was willing if not always cheerful. Perusal of the report will show how serious these interferences were, and it is remarkable that not one serious instance of obstruction has been reported.

I would call your attention to some discrepancy in figures. It will be noticed that, chapter to chapter, the figures do not agree. This is due to two causes.

For one thing each chapter was made independently of the other and at different times. The number of cases naturally varied as new cases occurred, some died and others were discharged as not typhoid.

The other reason is that some chapters deal with certain aspects and all the cases are not necessarily included. These chapters are of medical interest and were compiled either by "cross section" or deliberate selection, or from samples taken at random. Each method is explained in its appropriate place.

C. R. MERRILLEES, F.R.C.S.E., D.P.H.

District Health Officer.

1st August, 1943.

* A word of warning is necessary to those not familiar with Victorian local government. Throughout this report the word "city" occurs. This term is not used in its English sense, but merely denotes a local government district with a certain status of population and revenue. The other grades are towns and boroughs, and lastly, rural districts called "shires" which, however, may include quite sizeable townships. The City of Moorabbin is anomalous in being mostly rural and is in fact a shire which has been promoted to city status because of its rapid growth. One must also be careful to distinguish between the "City of Moorabbin" and "Moorabbin." The former applies to the whole municipal area, the latter to the postal area close to the railway station and village of that name.

PART 1.

CHAPTER I.

THE CITY OF MOORABBIN.

The City Area—Population—Topography—Soil—Climate—Drainage—Nightsoil—Vermin.

§ 1. The City Area.

The City of Moorabbin is a partly rural municipality at the south-eastern corner of the Melbourne suburban area (Maps 1 and 2). Four sections can be distinguished (Map 4).

Section 1.—The north-western corner: a closely built-up area:—a new suburb comprised of the districts of Bentleigh, McKinnon, and part of Ormond and of Moorabbin. It is continuous with Section 2.

Section 2.—Also a built-up area, but is not so dense as Section 1:—a narrow strip along the railway and the main highway (Point Nepean-road) wider and denser near the railway stations of Moorabbin, Highett, and Cheltenham, and is continued into the bayside urban area of Mentone (Mordialloc City).

Section 3.—That part of the municipal area east of Sections 1 and 2 occupied by market gardens, small farms, and golf courses, and including large institutions—a Benevolent Asylum, a Tuberculosis Sanatorium, and a Home for Young Women.

Section 4.—The small south-western corner:—sparsely built on and adjoining the open parts of the neighbouring municipalities of Brighton and Sandringham which are bayside suburbs closely built on up to with half a mile of the western municipal boundary.

The area affected was nearly the whole of Section 2, part of Section 3, and a small portion of Mentone (Map 8).

§ 2. Population.

In 1943 the population of the City of Moorabbin was 24,000, of which 4,500 lived in the affected area. The last census was made in 1933, and figures based on that are necessarily liable to gross error. A check, however, is made each year by a municipal census in connexion with the annual valuation. Dead reckoning on the census figures is fallacious in that two factors then operating, namely, a big fall in the birth rate and an almost complete stoppage of house building have since disappeared. A peculiarity of Moorabbin's population figures is the preponderance of young adults, due to the rapid expansion of the urban areas and the entrance of young married couples from other municipalities. This applies almost wholly to the Bentleigh portion. Since that time there has been a great revival of building and birth rate.

There is nothing striking in the industrial character of the city except a complete absence of large factories. The nearness to other industrial areas gives a certain amount of employment to residents, especially to the Bentleigh district which is, in fact, a dormitory suburb for commercial and industrial Melbourne. The population is thus midway between urban and rural in character, as is shown in the table which follows.

TABLE 1.

Comparison of Occupations of Residents of Moorabbin with Urban and Rural Victoria, in Percentages of Respective Populations. (1933 Census.)

| | Moorabbin. | Urban Victoria. | Rural Victoria. |
|---|------------|-----------------|-----------------|
| Primary industry | 5.1 | 1.2 | 17.9 |
| Manufacturing | 10.1 | 16.3 | 8.2 |
| Transport and communication | 2.8 | 3.1 | 18.0 |
| Commerce | 7.4 | 8.4 | 3.3 |
| Professional and administration | 2.9 | 3.6 | 2.0 |
| Entertainment | 0.5 | 0.4 | 0.1 |
| Personal service | 1.8 | 3.7 | 2.7 |
| Pensioners and independants | 7.3 | 7.1 | 4.8 |
| Home duty and dependants | 57.0 | 49.4 | 38.7 |
| Unemployed | 5.0 | 6.8 | 4.2 |

This is as would be expected, but it is worthy of note that home duties and pensioners provide a large proportion, due probably to prosperous conditions and to the numbers of retired persons who seek their final leisure here. On the other hand, note the low proportion engaged in personal and domestic service.

Since 1933 the general prosperity has practically abolished unemployment. Lately, owing to the need for labour in war industries, all the groups have tended to be lessened to swell the number grouped under "manufacturing."

A study of incomes, for which there is not space here,* will show in another way what I have desired to point out, namely, that there is no feature of occupation, monetary or social condition, to distinguish the population from a cross section sample of the general Victorian population, except that there are few "wealthy people," and practically none destitute. This applies particularly to the affected area which is shown in Map 3.

The Affected Area.—For this area, which closely corresponds with what is called the "Milk Zone," no exact detailed age and sex groups are available, but estimates have been prepared and approximately corrected by cross-section sampling.

The known residents in the affected area are believed to have been 4,504 in 1942.† This number is arrived at by street canvass in association with the annual valuation, the blanks being filled in by averaging, neighbour inquiry, allowance on previous return, or some such method *secundum artem*.

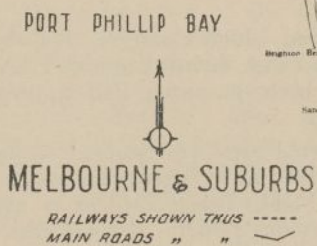
The age groups are not so reliable, but the probable error is not enough to spoil the value of the rates discussed elsewhere. (See Part II., Chapter I.)

* See figures, Australian Census 1933, and Year-Books.

† Moorabbin City population—estimate 1943—

| | |
|---|---------------|
| Northern portion, including Bentleigh and Ormond (part) | 15,930 |
| Southern Portion—Milk Zone | 4,573 |
| Other than Milk Zone | 3,348 |
| | <u>7,920</u> |
| Total | <u>23,850</u> |

Map 1.



§ 3. Topography, Soil, &c.

The whole of this bayside is a recent alluvial area. The soil is sandy, of various depths from a few inches to many feet. Dune formation is common, but has been modified by fresh sand deposits and erosion. The result is an undulating shelf rising very gently to the eastward. The bay shore is alternating sandy beach and low cliff.

The contours (Map 5) show the affected area practically level and almost wholly within the 100 feet contour. The undulations are gentle and seldom more than 25 feet. Broken contours are not common, and there are not more than three closed depressions. Owing to this gentle slope and the sandy soil there are no streams. The ground water level is low and except in the depressions which are not built on, is not a matter for consideration.

§ 4. Climate.

The climate is the usual Melbourne one, summer with hot north wind with sudden changes, winter mild and without snow and with few frosts. The rainfall is 20 to 25 inches, distributed on the average evenly through the year. This particular autumn was unusually dry and fine, temperatures were not extreme, and the usual oppressive hot north winds were noticeably absent. In short, it was a very pleasant season.

§ 5. Domestic Drainage.

As has been mentioned before, the greater part of Moorabbin City is rural in character. The houses in Sections 3 and 4 (Map 4) are scattered and mostly stand either in properties or are separated by vacant allotments (Map 12). The roads are metalled and mostly bitumened, but the side streets are on the whole unmade. This even applies to a large portion of Section 2, the built-up area, but not to Section 1, which is well paved and drained. There is no systematic drainage in Sections 3 and 4 and much of Section 2. Earth drains are the rule, but no nuisance is caused thereby because of the low concentration of houses and the absorbent nature of the soil.

§ 6. Nightsoil Service.

1. Sewerage.

Only a small part of the city area is sewered:—the whole of Section 1. This is part of the main metropolitan sewerage system (Melbourne and Metropolitan Board of Works). To the west of the city this system is prolonged southwards along the bayside through Brighton into Sandringham. Another finger comes southwards near Moorabbin as far as Highett (Map 6). South of Moorabbin City is the City of Mordialloc, which is a new sewerage area. This sewerage reaches the Moorabbin City boundary but does not extend into it except along a single road to serve the Benevolent Asylum and the Sanatorium.

2. Pan Service.

Except for a few houses served by private septic tanks, the rest of the city is provided with a weekly double-pan service. This is managed by the City by arrangement with the sewerage authority, and is carried out by a contractor. The closets are visited weekly and the used pan replaced by a clean one. The used pan is sealed and is taken to the Melbourne and Metropolitan Board of Works' depot just outside the affected area (Map 8). Here it is emptied and washed and returned

to the contractor. It is to be regretted that the above procedure describes more the terms of the contract than the performance. In spite of nearly desperate attempts by Council officers to enforce compliance with those terms, it was repeatedly stated that pans frequently were left unchanged, or emptied into another and replaced without being washed (topping). What was even worse was that to make room for this topping the liquid portion of the nightsoil was often poured away into the street or yard. Fear of being left without service at all was all that stopped the Council from terminating the contract, for, owing to the war, contractors are rare and good ones rarer still.

§ 7. Vermin.

The district being sandy, and the season warm, an almost rural area like this would be subject to three plagues, rats, flies, and fleas. The last is not considered to be a typhoid vector, but the other two certainly are.

Against this, rats were more plentiful in the northern part of the city area where on the edge of the built-up areas they seem to flourish.

Flies were very plentiful, both the common house fly and the bush fly. This was due to the warm season and the large quantities of horse dung imported for use as market garden manure.

It will be seen when we discuss the characteristics of the outbreak that it was explosive and over a wide but sharply defined area, just as severe in as out of the sewered areas, and in fact proportional in any affected area to the numbers of persons at risk. This is not the type of outbreak that can be spread by vermin, and although their prevalence did raise the fear of many secondary cases, this fear was not realized and vermin will not be discussed again.

CHAPTER II.

THE FOOD SUPPLY.

Water Supply—Metropolitan Reticulation—Food Supply Normal—Milk Zones—Government Control of Milk—Description of Zone—Branch Dairies—Production—Can Washing—Delivery—Serious Faults—Mrs. S....'s Milk Bar—Milk not Pasteurized.

§ 1. Water.

The whole of the city area is served with the Board's water reticulation (see Map 7). The water is collected in totally uninhabited areas, is subjected to long storage and settlement, and is distributed to service mains without other treatment. It is a high quality soft water and very closely protected.

§ 2. Food.

The food supply is a normal one. The supply is from the usual metropolitan markets and is distributed through the usual retail shops. Because of the war delivery is greatly restricted.

§ 3. Milk.

Up to 1943, the milk trade in Melbourne was "Free." It is now restricted by zoning. Milk is produced mostly in small dairy farms under Government supervision (Dairy Supervision Branch of the Department of Agriculture). The milk is collected and brought by

carters to dairies which are also licensed under the same Branch. In the affected area all the dairies had been absorbed by that one situated at Cheltenham.

As a war measure, to prevent waste in overlapping deliveries, the whole of Melbourne was recently divided into small areas called zones, and a zone was allotted to each dairyman so that, instead of several dairies operating in competition in any one place, there is now only one.

The supervision of the milk supply comes under two Acts and sets of regulations, so that there is considerable overlapping of authority and function. The following account is necessarily brief but will give a fair outline account of the working of the two Acts.

The Dairy Supervision Acts and Regulations are administered by the Dairy Supervision Branch of the Department of Agriculture. Inspectors (Dairy Supervisors) visit farms and dairies and criticize and advise owners on all matters of production (farming and care of milk). They control matters of structure and cleanliness of the farm, but not of disease in animals except those affecting the milk supply, such as mastitis and tuberculosis. This control extends to the retail dairies. The system has secured great improvements in the past years. Its obvious fault lies in insufficient powers, especially in respect to the personal and the domestic condition.

The Health Acts also apply to both dairy farms and dairies. These Acts and Regulations are administered by the local health authority (municipality) and by the Department of Public Health in a supervisory capacity.

The function of these health authorities is limited to cleanliness of premises and wholesomeness and freedom from infection of the milk. Except as is necessary for the sake of cleanliness, there is no power to deal with structure as such under the Health Act, but officers have a wider power in dealing with personal cleanliness and the actual living quarters, and, in fact, the whole premises are open to inspection and criticism if necessary.

The Dairy Supervisors enforce their requirements by cancellation of licence, which is weakened by its very strength. Few inspectors will destroy a man's living unless the failure is persistent and gross. The Health Inspectors, on the other hand, have no power of closure except in cases of infectious disease, but breaches of the Health Act may be punished by prosecution and fine.

A recent amendment to this scheme was brought about by the creation of the Milk Board. This is a nominated board to control the economic side of the industry. Its sanction is like that of the Dairy Supervisors (who also act for the Board), namely, the power to cancel its permission to trade.

The most recent measure, a war-time saving of labour, is the zoning previously mentioned, by which competition is eliminated in the allotted area, so far as delivery goes, though some competition persists through milk shops with a purely counter trade. It will be seen that the customer has no control of his milk supply. He cannot choose pasteurized or "tuberculin tested" milk, but must take what is available in the zone in which he lives. This has a close bearing on the outbreak.

§ 4.

The milk zone for this area (see Map 3) is roughly bounded—
 North—by South-road.
 East—by Moorabbin-road.
 South—by Balcombe-road, Latrobe-street, and Oak-avenue.
 West—by Reserve-road and the railway line.

This zone is an irregular rectangle 3 miles by 2 miles, and is astride Section 2 except at Highett, where the closely settled part west of the railway is not included. The main dairy for the zone is at Cheltenham, from which all deliveries are made. Delivery is in the early morning and is made to houses, depots, and shops. "Depots" were originally independent dairies but have been acquired by the Cheltenham Dairy and are used as shops for local trade over the counter. There are three which are known by the street in which each is situated, namely Jellicoe-street, Cheltenham, Charman-road, Mentone, and Marina-road, Mentone (Map 10 (Cases in Mentone)). "Shops" are independent businesses in which the sale of milk is not the main trade, but in which a few bottles of milk are kept for the convenience of customers. These shops also include "milk bars" and shops where milk drinks and ice cream are important, if not the sole article of trade. The shops in the milk area are also supplied from the Cheltenham Dairy, except one which is discussed later and is referred to as Mrs. S... 's Milk Bar.

Production by the dairy farmers and collection by the carters are distinct from the distribution by the retail dairymen, and care is required to avoid confusion between them. The producer is always referred to as the "dairy farmer" leaving the words "dairy" and "dairyman" to distinguish the retailer.

§ 5.

The general custom is for the farmers to produce milk under contract to the dairymen and deliver it to a carter who takes it with milk from other farms to the various dairies in his round. All milk is strained and cooled on the farm and placed in the farmers' cans of standard pattern, mostly 50-quart capacity, but with a few 40's. The cooling is done by passing the milk over an undulating surface cooled internally by farm water at natural temperature. It is carried in closed cans in a semi-closed truck, and after some hours on the road is delivered to the dairy twice a day at about 10.30 a.m. and 7 p.m. This delay is an obvious weakness in the system and especially dangerous in hot weather. On arrival at the dairy the milk is emptied to a sump and pumped over a "brine cooler" similar in principle to the farm cooler, but is cooled with refrigerator brine instead of water at natural temperature. From the cooler the milk is run into the same cans which usually have been rinsed. It is placed in the refrigerator and kept until delivery at a temperature about 32 deg. F.

§ 6.

Can washing is done by rinsing in cold water and hand scrubbing in hot lye. After another rinse the cans are steamed for three minutes, drained, cooled, and returned to the farmer for another supply. The weak points in this cleaning process are:—(i) its efficacy depends on that of each individual workman, and (ii) that the can lids may escape the careful attention that the cans receive, and it is probable that many

lids are not steamed at all and, further, are frequently soiled by falling from the draining rack to the floor.

Most of the milk is sold "loose" (bulk), although a small amount is bottled at the dairy for those who prefer it so, especially for shops.

§ 7.

This standard procedure was carried out in the affected dairy, and there is no reason to suspect any relaxation of this not very high standard of procedure. The dairy was undoubtedly well kept, and although faults could be found they were not serious. The daily turnover of this dairy is in the order of 1,200 quarts.

§ 8. Delivery Methods.

The usual method of delivery is practised. Horse carts with one driver carry the necessary quantity of milk in the farmer's cans. From time to time the driver's hand-can is replenished from the bulk cans. To prevent uneven distribution of the cream, the bulk cans are stirred and the temporary storage of this stirrer or "plunger," between withdrawals from the bulk can, creates a difficulty and provides a weak point where infection of the milk may occur. The driver ladles the milk from his hand can to the customer's jug. He uses a measure which hangs inside the can when not in use, so that the handle possibly soiled by the driver's hands may infect the whole of the can's contents. The driver is forbidden to carry water in his cart, and when it is considered that he is on his round for several hours another possibility of infection occurs from the lack of sanitary conveniences and of washing facilities for the driver's hands.

§ 9. Return Milk.

An important point is the disposal of excess milk from the delivery carts. This milk has been for several hours on the round and, although delivery must be made in the early morning, the milk has necessarily deteriorated by the time it is back at the dairy. This milk, however, was *not* carried over to the next day but was cooled and sold over the counter to those who wanted it. This is in contradiction of a repeated statement that milk was often kept for a day after being partly warmed on the delivery cart.

§ 10. Mrs. S....'s Milk Bar.

Mrs. S.... keeps a shop in Cheltenham which is of vital importance in the argument on the cause of the outbreak. This shop sold sweets, light refreshments, ices, and a large amount of milk drinks, up to 500 in a day. Although this shop is in the milk zone operated by the Cheltenham Dairy, an exception had been made and milk from other farms was supplied by another dairy.

§ 11. Pasteurization.

With the exception of one 50-gallon can of pasteurized milk for a special order none of the Cheltenham supply was pasteurized.

§ 12. Other Foods.

There is nothing significant in the supply or delivery of any other food. Meat, vegetables and fruit, groceries, dairy produce, bread, pastry, and sweets are served from small businesses throughout the area. Nothing is gained by examining them in detail except there might be at

some point in the production or delivery, a risk factor which would be common to the whole affected area. There are some bare possibilities which are worthy of discussion to enable them to be at once dismissed.

Meat.—Many retail shops, supplied from various abattoirs.

Bread.—Several bakers deliver their own produce.

Cakes and Pastry.—Several small makers. Wholesale cake makers supply the area but also the whole metropolis.

Ice Cream.—Ditto.

Confectionery.—Wholesale makers supply the area but also the whole metropolis.

Fruit and Vegetables.—From several sources.

Groceries.—From several sources.

Dairy Produce.—From several sources.

Ice.—From several sources.

It was possible that a packer in one of the large wholesalers was a carrier, but it is outside all possible coincidence that this area should receive the whole of the infected material. In other words, if the infection were food-borne, that is, by some common food, then only two foods were suspect:—(i) milk and local milk products, and (ii) water. The arguments against these two articles are discussed in detail in Chapter V.

CHAPTER III.

TYPHOID IN VICTORIA.

Victorian Health Administration—Typhoid in Victoria—Decline in Death Rate since Early Settlement—Coincidence of Sewerage Installation with Fall in Case Rate—False Conclusions drawn from Above—Analogous Coincidences—Case Rate in Sewered Areas as High as in Others—Typhoid Rates in Moorabbin—Similar to Other Districts.

§ 1. Health Administration.

Before describing the outbreak it is desirable to shortly explain the Victorian system of administration in relation to infectious disease.

The Health Acts provide for central and local health authorities with somewhat similar duties. The local authority, however, which is the municipal council, is charged with the whole of the work in this particular respect. It must receive and check notifications of infectious disease, provide treatment and accommodation where necessary, and carry out the instructions of its medical officer in respect to isolation, fumigation, &c. The central authority is the Public Health Department which acts usually in co-operation with and in supervision of the Council's activities. The policy of the Department is governed by the Commission of Public Health and by the Minister of Health, who has overriding powers in most cases. In a "State of Emergency" (and the Minister is the person who decides that a state of emergency exists) he may assume extraordinary powers necessary to meet a threatened danger from some infectious outbreak. Both the councils and the Department employ doctors and inspectors, though with one or two exceptions the municipal medical officer is a local practitioner who gives so many hours each day or week to the council's service. The officers of the Department serve whole time and are specialists in their various branches.

§ 2. Typhoid in Victoria.

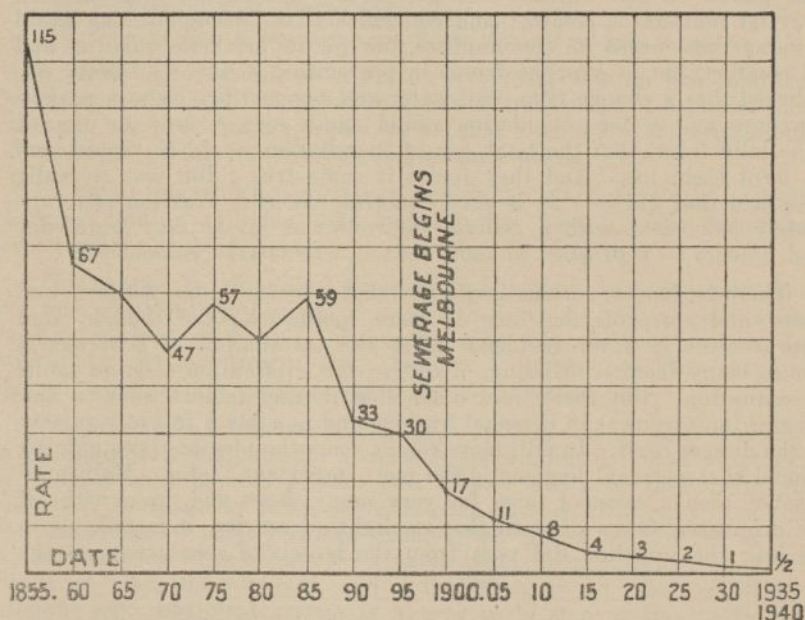
It is not proposed to enter into an exhaustive account, but some indication is necessary of what has been the trend of typhoid infection from our earliest times. For the twelve or thirteen years before the establishment of Victoria as a colony, records are not reliable, and for many years afterwards the disease itself was only vaguely recognized, so that possibly only classical types appear in the records. The death rate, however, is a fair indication of prevalence, and the next table shows that in earliest colonial times Typhoid Fever had already begun its downward course to become in this last twenty years a rare disease.

TABLE 2.
Typhoid Fever.

Annual Death Rate in Five-year Periods. Victorian Deaths per 100,000 Population.

| | | | | | | | | | |
|---------|----|----|----|------|------------------|----|----|----|------|
| 1853-59 | .. | .. | .. | 115 | 1900-04 | .. | .. | .. | 17.0 |
| 1860-64 | .. | .. | .. | 67 | 1905-09 | .. | .. | .. | 11 |
| 1865-69 | .. | .. | .. | 60 | 1910-14 | .. | .. | .. | 8 |
| 1870-74 | .. | .. | .. | 47 | 1915-19 | .. | .. | .. | 4 |
| 1875-79 | .. | .. | .. | 57 | 1920-24 | .. | .. | .. | 3 |
| 1880-84 | .. | .. | .. | 50 | 1925-29 | .. | .. | .. | 2 |
| 1885-89 | .. | .. | .. | 59 | 1930-34 | .. | .. | .. | 1 |
| 1890-94 | .. | .. | .. | 33 | 1935-39 | .. | .. | .. | 0.5 |
| 1895-99 | .. | .. | .. | 30.5 | 1940-42 (3-year) | .. | .. | .. | 0.13 |

GRAPH I



Showing the average annual death-rate from Typhoid Fever (: 100,000) for Victoria in five-year periods.

In 1890 Typhoid Fever was still one of the ever-present diseases, but from then the decline is so rapid as to excite comment (See Tables 2 and 3.) It happened that in this decade sewerage was begun (Port Melbourne, 1897) and inner Melbourne was in the course of the next fifteen years or so converted from a pan-service town to a most efficiently sewered one (Appendix IV.). The typhoid case rate during this period collapsed in Melbourne, and this coincidence set rise to a most stubbornly held tradition that sewerage wiped out Melbourne's typhoid.* The history of Typhoid Fever in Victoria can next be followed in its relation to sewerage.

§ 3. Typhoid in Victoria in Relation to Sewerage.

Victoria on the whole has had a somewhat lighter experience than had the other Australian colonies, yet the history of Typhoid Fever is substantially the same in every country, namely, long periods of steady infection punctuated as it were by explosions when some food or a water service became involved. Victoria had its share of this, but explosive local outbreaks do not stand out when the level of cases runs into thousands in a year. It is only when the background level is low that explosions show up, such as the milk-borne outbreak of 40 cases in Chelsea twelve years ago, and the outbreak now under consideration. Towards the end of last century Victoria, in common with the rest of the world, experienced a marked turn for the better, which has continued to the present time.

For many years the disease has been recognized as a "filth disease" and seems to be associated with bad sanitation. Ideas centred around "drainage," which gained more and more credit until more importance was placed on the "drains" of prospective new homes than on such "trivial matters as comfort and convenience." Throughout the world sewerage was urged on communities, not for its aesthetic qualities and its comfort, but as a prime factor in prevention of disease. Every one believed that a change from well water and cesspool privies to a modern sewerage and water reticulation would cause such a drop in disease, especially fever, that the total cost of installation would be repaid, and in hard cash, too. And they found it come true. But was it really sewerage that did it? It is very doubtful, indeed. Was not sewerage merely coincident with a general improvement in sanitary knowledge and decency? I propose to show that it was merely coincidence.

There is danger, serious insistent danger, in connexion between well water and cesspools, but one is more inclined to the thought that improvement in fever incidence after the installation of sewerage is due to many factors including, of course, the elimination of gross faults in sanitation. But there were other contributing factors, such as the general improvement in personal hygiene and possibly a fall in virulence of the disease itself. In still more recent years the idea has been gaining ground that personal hygiene is the most important factor. Melbourne has not been a cesspool town for very many years and, even with all the disgusting faults of a single-pan nightsoil service, it is difficult to see how the infection did pass from the bowels of one person to the

* It has been urged, mostly by interested persons, that insanitary conditions were the cause of this outbreak. So dangerous is such an idea that I am dealing in detail with the connexion between Victorian typhoid and sewerage, with the hope that the almost superstitious reverence given to sewerage may be reduced to a more rational level.

stomach of the next victim, except it were by soiled fingers or perhaps by flies. The next table (Table 3) shows the enormous rate of the 1890-94 period beginning to fall and progressively doing so as sewerage was introduced into Melbourne.

TABLE 3.

Victorian Average Yearly Incidence. Rates per 1,000 persons from 1890 to 1939.

| Year Groups. | Metro- politan. | Extra Metropolitan. | | | | | Moor- abbin. |
|---------------|---------------------|--------------------------------------|---------------------|---------------------|---------------------|--|-----------------|
| | | Total Extra Metro- politan. | Ballarat. | Bendigo. | Geelong. | Rest of Extra Metro- politan. | |
| 1890-94 | 3.46 | 2.01 | .. | .. | .. | .. | .. |
| 1895-99 | 3.02 ⁽¹⁾ | 2.90 | .. | .. | .. | .. | .. |
| 1900-04 | 1.33 | 2.19 | .. | .. | .. | .. | .. |
| 1905-09 | 0.83 ⁽²⁾ | 1.77 | .. | .. | .. | .. | .. |
| 1910-14 | 0.61 | 1.36 | 1.99 | 2.85 | 1.56 ⁽³⁾ | 1.48 | .. |
| 1915-19 | 0.18 | 0.60 | 0.84 | 0.89 | 0.27 | 0.59 | .. |
| 1920-24 | 0.13 | 0.40 | 0.57 ⁽⁵⁾ | 0.53 ⁽⁴⁾ | 0.23 | 0.35 | 0.11 |
| 1925-29 | 0.07 | 0.20 | 0.19 | 0.08 | 0.06 | 0.21 ⁽⁶⁾ | 0.08 |
| 1930-34 | 0.04 | 0.08 | .. | .. | .. | .. | 0.20 |
| 1935-39 | 0.02 | 0.04 | .. | .. | .. | .. | 0.08 |

(1) Sewerage begun in Melbourne 1897.

(2) Sewerage substantially completed in this half decade.

(3) Sewerage begun in Geelong 1911.

(4) Sewerage begun in Bendigo 1921.

(5) Sewerage begun in Ballarat 1924.

(6) Sewerage begun in first small town (Colac) 1927, and two more towns 1930.

Superficially it would seem that sewerage installation was followed by and was the cause of a fall in typhoid incidence, but examine this table and the previous graph and we see that long before the beginnings of sewerage the fall in each case had already begun.

So far as this evidence goes (and this is the evidence mostly quoted) there is nothing to show that sewerage has been a main factor in reduction of Typhoid Fever.

This chapter is not against sewerage in any way. It merely asks that the true relationship between sewage and fever be remembered when reading the rest of Part I. It merely asks that the true position be not hidden by stressing obvious but, as I propose to show in this respect, unimportant sanitary faults in the affected area.

The insanitary conditions which are usually abolished when sewerage is introduced are undoubtedly a cause of spread, but not of an outbreak, of typhoid such as this present one. There are many factors in an outbreak, of which the main one is not the absence of sewerage but the contamination of some common food, either direct by the carrier or patient, or even by sewerage itself (note D.G.'s farm, Chapter V., § 3). Sewerage needs no advocacy, and it is obvious to all that a carefully planned and controlled system is a very early step in improving the health of a community by removing the dangers involved in other systems (see Appendix IX.).

§ 4.

Looking at Map 6 we see that the cases are scattered over a definite area in which there are different nightsoil systems:—

- (a) Moorabbin and Highett—sewered.
- (b) The rest of the milk zone—weekly double-pan removal.
- (c) The extra-zone area in Mentone—sewered.

Note in Map 11 the concentration of cases around Highett where every house is sewerred, and note also that there were a number of visitors living outside the area altogether who were infected during a few minutes' stay at Highett (Table 13).

I do not think that any search will disclose a causal connexion between the nightsoil service, bad as it was, and the outbreak, and in any case we know that the cause was infected milk.

§ 5.

Moorabbin has not a high typhoid rate. Typhoid has always been a little more common in this bayside area than in some other places. This is usually accounted for, and reasonably, too, by a large number of holiday shacks and houses outside sanitary areas but near enough to neighbours to make insanitary habits a danger. There have been recently extra risks from nearby outbreaks:—Mordialloc (37 cases) in 1923, and Chelsea (41 cases) in 1931. Both these were caused by milk-borne infection. The figures for 23 years are given in Table 4.

TABLE 4.

Moorabbin Typhoid Cases 1920 to 1942.

| | | | | | | | | | |
|------|-----|------|-----|------|-----|------|-----|-------|-----|
| 1920 | Nil | 1925 | Nil | 1930 | 3 | 1935 | 1 | 1940 | Nil |
| 1921 | 1 | 1926 | Nil | 1931 | Nil | 1936 | Nil | 1941 | Nil |
| 1922 | Nil | 1927 | 1 | 1932 | 1 | 1937 | Nil | 1942 | Nil |
| 1923 | Nil | 1928 | Nil | 1933 | Nil | 1938 | 1 | .. | .. |
| 1924 | Nil | 1929 | Nil | 1934 | Nil | 1939 | Nil | Total | .. |
| | | | | | | | | 23 | |
| | | | | | | | | years | 8 |

In spite of the unreliability of comparative rate-figures, the next table *does* compare this municipality with its three bayside neighbours, and save for giving this assurance that these places *are* comparable I shall not stress this point further.

TABLE 5.

Rates per 1,000 in Four Adjoining Municipalities.

| 5-Year Period. | | | | City of Moorabbin. | City of Brighton. | City of Mordialloc. | City of Sandringham. |
|----------------|----|----|----|--------------------|-------------------|---------------------|----------------------|
| 1920-24 | .. | .. | .. | 0·11 | 0·45 | 5·32* | 2·65 |
| 1925-29 | .. | .. | .. | 0·08 | 0·16 | 0·25 | 0·31 |
| 1930-34 | .. | .. | .. | 0·20 | 0·30 | 0·12 | 0·10 |
| 1935-39 | .. | .. | .. | 0·08 | 0·00 | 0·00 | 0·05 |

* Including outbreak (37 cases) in 1923.

A point to be noted is that of the eight cases in Moorabbin City reported between 1920 and 1942, not less than five and probably seven were cases outside the present affected area.

§ 6.

And lastly, this is no new idea. More than 60 years ago when "drainage" seemed a royal road to sanitary perfection and bacteriology was as yet embryonic, there was a sound core of medical opinion which rejected the "sewer" theory and insisted that typhoid was contagious and due mainly to infected persons, and only in small part to filth, the cause of so many other troubles. Let me quote—

"A lowered fatality by typhoid in several larger towns in England appeared to follow thorough drainage; but concurrently, there was infinitely more attention paid to the now better known laws of disease.

The latter Knowledge produced the result, the former Fancy obtained the credit."

CHAPTER IV.

THE OUTBREAK.

Early Cases—Health Department called in—Milk Suspected—Doctors and Citizens Warned—Plan of Campaign—Collection of Specimens—All Negative—Second Series Negative—Widals Negative except Three—One Suggestive—Later Shown to be a Carrier—Problem of Accommodation—Queen's Memorial Infectious Diseases Hospital co-ordinated Hospitals and Victorian Civil Ambulance—Estimation of Probable Cases—Inspection of Houses and Contacts—Disinfectant to be Chiefly Fly Repellent—Search for Infector—Other Sources than Water and Milk Eliminated—Precautions about Milk—The Course of Outbreak—The End of Outbreak.

§ 1. The First Cases.

Early in March a case was reported. This patient, a middle-aged man, had also active pulmonary tuberculosis. His probable onset date has been placed about the 14th February. During this time another patient was being treated at another hospital. He had been sick since early December, and on the 22nd February he was admitted as an in-patient and Typhoid Fever was diagnosed by blood culture on the 2nd March. See Appendix V. These cases were notified on 6th March and 14th March respectively. No alarm was felt until on 15th March four new cases were reported. See graph 2 at end of this chapter (page 23). The City Health Officers consulted the Health Department, and after conference the Departmental officers assumed advisory control of the outbreak. The reasons for this step were, firstly, the local medical practitioners were extremely busy and could not spare so much time as might be necessary, and, secondly, the dispersion of cases was so wide than an acute and widespread infection was feared which might lead to an explosive outbreak.

§ 2.

A general survey was made on the 16th March. All the patients up to this received their milk from the same dairyman. This was, however, barely, if at all, significant, because this dairyman, under the milk-zoning scheme, was the sole supplier (see Chapter II.), and even if the infection were not milk borne it would have pointed just as strongly to the dairyman because, no matter how the disease was caused, all the patients were his customers.

§ 3. The Campaign.

The first day was spent in inspection and organizing the campaign, but on our return to headquarters it was learned that 30 cases had been reported. The explosive outbreak had arrived, and it was obvious that emergency measures were necessary. Medical practitioners were advised of the outbreak and the people warned of the danger. Advice to citizens was published by the newspapers, and the Moorabbin City Council circulated leaflets advising the boiling of all milk, exclusion of flies and dust from food, and the usual precautions against faecal and other contaminations, and the need to seek medical advice on the barest suspicion of infection (see Appendix III.). Arrangements were made to deal with various matters, namely:—

- Specimens of faeces, blood, &c., to be collected and examined;
- Provision for accommodation of the sick;
- Inspection and instruction in respect to “infected” premises by medical officers, nurses, and inspectors;
- Supply of disinfectants; and
- General search for source of infection.

On the 16th it was evident that the cases (39 in all) had one common factor at least—the milk. Without ignoring others, it was urgent that milk should receive an intensive investigation, the results of which are set out in the next chapter.

§ 4. Faeces Specimens.*

These were managed in “waves.” Owing to the “war shortage” of labour, not more than 30 or 40 specimens could be handled at one time by the laboratory (University). The first objective must be, therefore, to investigate those persons known to be handling the milk before its distribution to the retail delivery carts—(i) the dairyman and his employees and family, (ii) the carters, and (iii) the dairy farmers and their families.

All results were negative.

While awaiting the results of the first wave, the second wave was put in operation, namely, examination of specimens from the subsidiary dairy personnel, drivers, depot keepers, shopkeepers, and families, in case there had been an earlier undetected outbreak with many carriers or, and what was more likely, a carrier in this group who had access to milk before its dispersal from the main dairy. These were also negative.

While this was going on the first series of suspects was begun again and, as an additional help, a series of Widal blood tests was arranged and 50 specimens collected from those implicated. The results of the blood examination lent support to the probability of milk infection. A woman (the wife of a dairy farm operator) had a mild Widal reaction ($H = \frac{1}{160}$ to $\frac{1}{320}$; $O = \frac{1}{20}$), and a man (an elderly employee on another farm) had a “history” of Typhoid Fever 50 years ago and a very mild +ve. Widal.

* Urine was not collected. It is not easy to collect and keep specimens, and the long distances involved made it impossible with the little help available to call more than once a day.

The second series of faeces specimens disappointingly gave negative findings in every case. For reasons to be afterwards discussed, suspicion was concentrated on the woman with the suggestive *Widal*, and it was later shown that she was indeed a faecal carrier, and what is more, no other carrier, whether with the opportunity to infect the milk supply or not, was discovered in spite of repeated searches, until the usual crop of convalescent-carriers arrived.

The cases reported were now on the 200 mark, and by this time an inescapable conclusion had been reached that the milk and the milk only was implicated.

§ 5. Provision for Accommodation.

The hospital authorities and the municipal council were faced with the apparently insoluble problem of providing beds, nursing staff, supplies, and transport, most of which was already taxed by the war, but the various Government and public bodies concerned quickly set under way a scheme by which the Town Clerk should forward to the Superintendent of the Infectious Diseases Hospital all calls for beds, and the latter should then allot, according to the information supplied by the other hospitals which were making beds available, the more urgent cases first and so on, until all patients and serious suspects were accommodated.

The transport of patients was organized and carried out by the Victorian Civil Ambulance most efficiently, with the aid of volunteer help from men who had been trained for similar A.R.P. duties. In spite of the ever-growing list no serious delay occurred throughout, and very rarely was a patient left at home for more than one day. There is no creditable method of estimating with any certainty the number of beds required, although we endeavoured to do so,* and, further, the decline in the number of cases reported for a few days after the first explosion gave the wrong impression that all we were in for was a single explosive infection, and that a hundred or so beds would be ample.

The Town Clerk and I examined the situation and, taking into consideration the number at risk, that the outbreak was "milk borne," and that infection had ceased on the 16th of March, formed an opinion that 250 beds would be required in the first two weeks, with possibly another 100 to 200 later, according to the number of secondary cases. It was not until it was clear that the infection was not a single explosion that the estimate was put forward with much emphasis, and the hospital authorities rightly did not think they would have to provide for such a number, 420, in fact, within a month.

It is hoped that the outbreak will give some data to enable later investigators to make a more accurate estimate, but such estimates are in the order of guesses, inspired guesses perhaps, but still unreliable. For instance, had the S.... Milk Bar† been supplied from the common milk service the number of cases might have been nearly doubled.

§ 6. Inspection of Premises

The health organization of the Moorabbin City includes only one part-time medical officer and a health inspector who is shared with three other councils. The Acting Medical Officer of Health was a medical gentleman with a large local practice, and owing to man-power shortage was already fully taxed without the abnormal increase in work

* See Part 2, Chapter VI.

† See Chapter II. § 10.

which the outbreak brought to him and his colleagues. The Health Department, therefore, supplied a medical officer (myself), a specially trained nurse (Miss Lindsay), and a technician (Mr. D'Arcy), and the other municipalities freed the Acting Inspector (Mr. Opie) from his part-time duties with them so that he was able to give whole-time attention to the outbreak. The neighbouring municipalities also allowed their respective inspectors to assist, especially in the border areas, so that arrears were soon overtaken and an efficient inspection service maintained.

Instruction on lines similar to the Council's leaflet was given on the disposal of excreta, on the cleansing of bedding, utensils, &c., on the use of "disinfectant," on flies, closets, and generally on the avoidance of further infection. Inquiries were also made into incubation periods, possible sources of infection, and the usual routine in any such epidemic.

§ 7. Disinfectants, &c.

It was early decided that any attempt at germicidal effect by chemicals was too uncertain a matter to be entrusted to lay people. It was, therefore, decided that the chief function sought in any disinfectant in this outbreak would be a psychic effect of something smelling of cresol together with the really important property of fly repulsion. Again the war-shortages interfered, but sufficient material was released to enable the Council to issue at depots supplies to householders. The material chosen was an emulsion of phenyle and kerosene (1:2:12) (Appendix III.). Sanitary pans from infected houses were removed to the depot and marked with red paint to indicate that more careful disposal and washing were necessary. No secondary cases have been attributed to this factor.

§ 8. Search for Sources of Infection.

Although at first it was thought that the allotment of an area to one dairyman would hinder the fixing of the responsibility, it was fairly easy to eliminate other factors than milk and water. Bread, meat, ice, ice cream, fruit, vegetables, butter, cream, and in fact all other foods were obviously not a common factor in more than a small proportion of cases and were quickly eliminated. Water was more closely suspect, especially as the area of mains seemed to coincide with the area of cases. More careful search showed that unless a most improbable series of coincidences was allowed which would cause infection to one portion and leave another free, water must also be excluded from suspicion.

§ 9. Precautions About Milk.

The case against milk being so strong, the Minister of Health, on the recommendation of the Advisory Committee* took the step unprecedented in Victoria of closing the affected dairy and all the

* The Advisory Committee was appointed by the Hon. the Minister on the 18th March and met on the 19th March and subsequently. Its function was to consider reports of Departmental officers and to advise the Minister in matters of policy. It comprised:—

H. N. Featonby, M.B., B.S., D.P.H., Chief Health Officer (Chairman).
H. E. Albiston, D.V.Sc., Director, Veterinary Research Institute.
F. M. Burnet, M.B., B.S., Ph.D., F.R.S., Director, Walter and Eliza Hall Institute of Research.
J. Dale, O.B.E., M.D., B.Sc. (Pub. Health), Medical Officer of Health, City of Melbourne.
J. A. McIntosh, M.C.E., Acting Engineer of Sewerage, Melbourne and Metropolitan Board of Works.
F. V. G. Scholes, C.M.G., M.D., B.S., D.P.H., F.R.A.C.P., Medical Superintendent, Queen's Memorial Infectious Diseases Hospital

farms supplying it. This was done on the 19th March. Although I felt that the infection had already ceased, I also felt that this action was welcome to the Moorabbin Council and to the public generally. No attempt was made to save the suspected milk, and it was destroyed daily on the farms. It was an unfortunate waste of milk during an acute shortage and with a less anxious public could have been pasteurized and safely distributed for general use. The nearby dairies outside the zone were allowed by the Milk Board to deliver milk for the closed Cheltenham dairy.

Employees of the closed dairy were forbidden to handle the milk, but they at first acted as drivers and guides. Some of these became patients but nothing untoward occurred as a consequence of their infection. This possibility, simple as it is, was overlooked and I suggest that in similar circumstances a close surveillance be exercised on all such persons.

In any case the consumption in Cheltenham of liquid milk had fallen away. It is only now re-establishing itself, and that because dried milk is becoming scarce and scarcer. A case also occurred in the dairy itself so that before the end of the month the Cheltenham dairy and all its branches were closed for two reasons—on account of the emergency closing order and by the ordinary course because a case had occurred in each of the premises.

§ 10. The Course of the Outbreak.

The course of the outbreak is very simply told. It has been mentioned that the explosion occurred on the 16th March when between 30 and 40 cases were reported. This was the day that the infected milk went out of use except for some oddments in private houses and a small amount left over at the dairy.

We have seen that if there were only one carrier involved the last date of possible infection was the 17th March. New cases could be expected to occur for three weeks or so, ceasing, not suddenly, but slowly over an extended period, a sort of lysis as in the course of the disease itself, but very marked about the end of the month. This stringing-out is on account of the indefinite incubation period, so that although most of the cases would develop in 12 to 15 days, a few would occur up to 20 or 25 days later (Chapter II., Part 2). There are complicating factors, however, which tend to extend the period:—

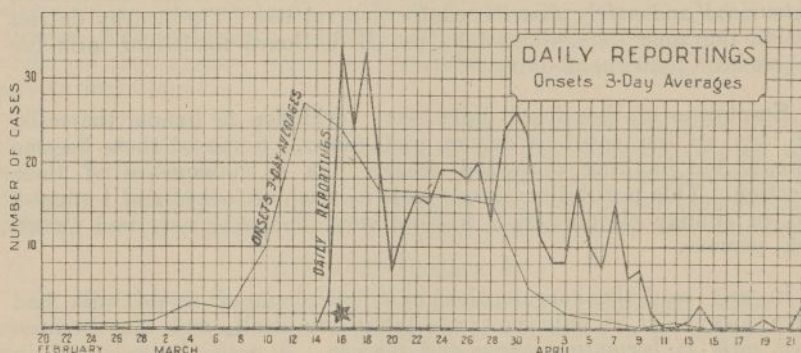
- (1) Secondary cases would be occurring.
- (2) The longer the outbreak continues, the more doubtful cases, abnormal incubators and ambulators will appear.

This, as forecast, did in fact occur. What happened was that cases occurred right up to the extreme incubation period, but in a steady decreasing number, faded out about the 6th and 7th of April for ordinary cases, to smoulder with an occasional long incubator or ambulant, but ceased in fact before the end of April as secondaries were extraordinarily few. This is more clearly set out in the next graph.

GRAPH 2.

Graph Showing the Daily Notifications and Three-day Average of Onsets.

GRAPH II



The star indicates the cessation of primary infection.

§ 11. The End of Outbreak.

Writing at the end of July we can get a fairly clear picture of the outbreak as a whole. The figures are now as accurate as may be expected for many months, until when the fate of our convalescents and carriers will not be known. This is the position on the 1st August.

TABLE 6.

Analysis of Cases Reported 1st March–31st July.

| — | Number of Cases Reported. | Not Typhoid | Net Total. | Discharged. | | | Still in Hospital. | | | | |
|--|---------------------------|-------------|------------|-------------|-------|-----------|--------------------|-----|-----|-----|--------|
| | | | | Well. | Died. | Carriers. | (a) | (b) | (c) | (d) | Total. |
| City of Moorabbin .. | 420 | 23 | 397 | 358 | 21 | 11 | 2 | 1 | 1 | 3 | 7 |
| City of Mordialloc .. | 18 | 2 | 16 | 12 | 2 | 1 | 0 | 1 | 0 | 0 | 1 |
| Elsewhere (connected with outbreak) .. | 21 | 1 | 20 | 18 | 0 | 1 | 1 | 0 | 0 | 0 | 1 |
| Total for outbreak | 459 | 26 | 433 | 388 | 23 | 13 | 3 | 2 | 1 | 3 | 9 |
| Rest of State (not known to be connected with outbreak) .. | 27 | 7 | 20 | 19 | 0 | 1 | .. | .. | .. | .. | 0 |
| Total for State .. | 486 | 33 | 453 | 407 | 23 | 14 | 3 | 2 | 1 | 3 | 9 |

* (a) Still sick with Typhoid Fever.

(b) Detained for carrier state.

(c) Convalescent and awaiting discharge.

(d) Detained with complications or intercurrent disease.

CHAPTER V.

THE CASE AGAINST WATER AND THE CASE AGAINST MILK.

A. The Case Against Water.

Water from Moorabbin Road Mains—Apparent Coincidence of Water and Case Areas—Nearby Nightsoil Depot—Drainage of Depot—Opening of Pipes in Dangerous Area—Suspicion against Water Resolved—Chief Evidence:—

- (a) *Cases before opening of pipe; and*
- (b) *This main supplies other areas but with no cases.*

§ 1.

The water supply of the affected area is from one of two large mains in Moorabbin-road which is the eastern boundary of the milk zone. These mains are high pressure and low pressure respectively, and it is the former which was the one suspected. Map 7 shows this main and the areas served by it.

At first sight it seemed that the water area and the affected area coincided and the apparently explosive nature of the outbreak strengthened the idea that water might be the vehicle of infection. There was, moreover, an opportunity for contamination to have occurred.

To the east of Moorabbin-road just east of the milk zone is a large nightsoil depot controlled by the Melbourne and Metropolitan Board of Works, which also controls the water supply. See Maps 8 and 9. The depot is on the slopes of an isolated hill (165) and three lines of natural drainage run south-easterly, southerly, south-westerly, respectively, and one north-west to a closed depression. As has been mentioned the soil is sandy on a variable clay. To establish the danger of this situation it would need two other conditions:—

- (i) Drainage must actually flow down the south-western gully; and
- (ii) Opportunity to enter the pipe must be afforded.

Both were shown to have been possible, the former by the very fact that the slopes and soil were suitable, and the latter by the fact that there was a 4-in. main which had been cut on 26th February, 1943 in Keys-road, and perforations* had been repaired on the high-pressure main on 27th February, and on 9th March, and 18th March.

§ 2.

Against this assumption of possibility of infection a large array of arguments is available.†

- I. Nightsoil was not being buried on the south-west slope of hill 165 which forms the head of this gully.
- II. Even after heavy rain no instances of escape of foul surface or ground water has been seen in this direction. A large sand pit is being worked in the direct bed of the original stream (now subsoil) just south of Keys-road. Any escape of foul drainage into this sand would have been at once remarked.

* "Perforations" are small holes which in this case were repaired under pressure.

† Immediately on the appearance of the outbreak, the Engineer of Water Supply, Mr. F. M. Lee, caused a bacteriological survey to be made of the area water supply. The University Laboratory reported an unusually high standard of bacteriological purity and an absence of any specific organisms.

- III. The soil though sandy is well charged with humus and no appropriate drifts or faults have been discovered which might allow a freer ground-water flow than by percolation.
- IV. In other areas where drifts do occur they are much lower than the level of the pipe which was being repaired.
- V. The usual drainage from hill 165 is by underground flow in other gullies:—
- (a) Westerly to a pan (140) which overflows only in very wet weather, such as we have not had this season.
 - (b) South-easterly to appear later as part of a small winter stream and in which no foul impurities have been detected.
- VI. The 4-in. pipe was open for a matter of hours only so that the possibility of infection was confined to one single instance when the flow in the mains was re-established. Contamination by the perforations was scarcely possible.
- VII. The 4-in. pipe connects at each end with much larger mains at high pressure. It is itself much drawn upon for market garden use, especially this dry season so that contamination of either of these larger mains, let alone the 30-in. one, is hardly a matter of practicability.
- VIII. Cases had begun before this date (22nd February, 1943), which appears final.
- IX. By the time that the above had been established, other facts had been discovered. The mains suspected supplied not only the milk zone area but also two areas not affected:—
- (a) A strip of $\frac{1}{2}$ to 1 mile north of South-road
 - (b) The whole of the closely-populated area between the zone and the beach (Map 8).

B. The Case Against Milk.

The Cheltenham Milk Supply—Sources—three clean—two not so clean—one filthy—Carrier discovered—Farm closed on 15th March—Infection deemed to have ceased 16th or 17th March—The Case against Milk set out and summarized.

§3. The Cheltenham Milk Supply.

Except as has been mentioned in the case of S.....'s Milk Bar and a few "own cow's," the whole supply was drawn from the Cheltenham dairy. The dairy drew its milk from seven sources:—six dairy farms for the main bulk of the supply, and a large milk factory for one 50-quart can of pasteurized milk, 1,200 quarts in all.

The milk was collected by two carters, C and D. Carter C from milk factory CL (50 quarts of pasteurized) and from farms CR, CT, and CW. Carter D from farms DC, DD, and DG. (See Appendix I., Diagram 1.)

Examination of the farms showed striking differences in cleanliness.

TABLE 7.

| DC, DD .. | .. | Farm satisfactory | .. | Domestic condition satisfactory | |
|-----------|----|-------------------|----|---------------------------------|--------------------|
| DG .. | .. | .. unsatisfactory | .. | .. | .. |
| CR .. | .. | .. bad | .. | .. | poor (flies**) |
| CT .. | .. | .. satisfactory | .. | .. | poor |
| CW .. | .. | .. bad | .. | .. | very bad (flies**) |

The carters were unlikely to handle the milk and were not seriously considered. The farms then—

DC and DD were thought unlikely.

DG's farm had been contaminated with sewage effluent.

CR.—The standard of the farm and its sanitation were low and the risk of infecting milk on account of this low standard and the obvious economic circumstances of the occupants was high.

CT.—In spite of difficulties from want of facilities and labour, possibly economic, the observed habits of the occupants did not suggest great danger.

CW.—This was bad in every way and if a carrier existed on the farm contamination of the milk was a practical certainty.

CL.—The milk from this place was pasteurized, moreover it was used for a limited customer area and was not a common factor for the main outbreak.

Farms DC and DD and factory CL were therefore temporarily eliminated.* On farm DG, in spite of the sewage contamination, which in itself was most unlikely to be infected†, we found the cleanliness of the farm and its occupants excellent, and classed it with the former two as unlikely to cause infection. Farm CT was hesitatingly put in this same group and first line suspicion concentrated on farm CW and less so on CR. No carrier had so far been discovered, but blood reactions independently pointed to CW and less so to CR.‡

The adverse criticisms must not be taken to mean that the farmers were essentially dirty people. There are many factors involved, of which the chief are the want of facilities for cleanliness and the will and energy to overcome the lack of them. In these cases "cleanliness" is assessed as to the likelihood to contaminate or allow contamination of the milk directly or indirectly with, to put it bluntly, faeces or urine.

§ 4. Discovery of a Significant Carrier.

Not until just within a fortnight was a carrier discovered, on farm CW too, as had been feared. The wife of the occupier was shown to have her faeces culture typhoid-positive. Repeated tests have failed to discover any other significant carrier.

The position so far is that if the outbreak were due to milk borne infection we had found one source of infection at least of whatever sources there may have been. We now had a carrier, a woman, an actual milker, who from her surroundings and habits had the means and opportunity to be the cause of the whole infection.

The following dates are important. This family had left the farm on the 15th March. The new occupants, who were dissatisfied with the want of cleanliness and facilities to ensure it, left it two days later. Thus the farm was both technically and voluntarily closed and vacated on the 17th March. The campaign was based, therefore, on the fact

* It was also discovered that milk from all three "D" farms over a significant period had milk diverted to other retailers with no resultant cases (see Appendix I.).

† Dandenong sewage. Activated sludge plant with pasture treatment of effluent. Most unlikely to be infected over any length of time as was required in this instance.

‡ (i) Wife of C.W. Widal H = 1/320. 0 = 1/80. No history of typhoid. (ii) Employee of CR (typhoid 50 years previously), Widal H = 1/160. Child of CR, H = 1/80.

that farm CW was infected but had ceased production of infected milk on the 15th, and that infection ceased in the area on the 16th or perhaps 17th.

§ 5. The Case Stated.

It is not enough to discover the *possible* sources of infection by milk. We must show that infection *did* occur through the milk supply. I do not think that disinterested opinion will reject the following arguments nor that the case against milk is so strong that it would be quite unreasonable to consider any other conditions as a source of infection, and that even if the carrier had not been discovered the milk would still have been considered to be the food at fault.

- I. The milk zone, excepting in some at first apparently anomalous cases, coincides exactly with the area in which the local cases occurred. Map 11 shows this quite plainly. One must note some cases (the apparently anomalous ones) just outside the area. All these patients are nevertheless known to have been consumers of suspected milk. See "Outside cases," Appendix VI.
- II. The milk zone does not coincide with the densely-populated area of the district. In other words, there were plenty of people to be infected outside the zone had they been at risk. Map 8 shows this well.
- III. All the early patients were consumers of milk. In the next table supplied by Miss Lindsay there is a significant excess of cases amongst those said by their friends to be "fond of milk," with a corresponding scarcity of cases amongst those who took less, such as "only in tea" (see Tables 8 and 9). This includes many visitors to the district who were affected (see Appendix VI.).

TABLE 8.
Milk Consumption in 25 Families Selected at Random.

| No. in Family. | Fond of Milk. | | Not Fond of Milk. | | No. in Family. | Fond of Milk. | | Not Fond of Milk. | |
|----------------|---------------|---------------|-------------------|---------------|----------------|---------------|---------------|-------------------|---------------|
| | Number. | No. of Cases. | Number. | No. of Cases. | | Number. | No. of Cases. | Number. | No. of Cases. |
| 3 | 1 | 1 | 2 | 0 | 4 | 1 | 1 | 3 | 3 |
| 3 | 1 | 1 | 2 | 0 | 5 | 1 | 0 | 4 | 1 |
| 3 | 2 | 0 | 1 | 1 | 5 | 2 | 2 | 3 | 0 |
| 3 | 2 | 1 | 1 | 0 | 5 | 1 | 1 | 4 | 0 |
| 4 | 2 | 2 | 2 | 0 | 5 | 1 | 1 | 4 | 0 |
| 4 | 2 | 0 | 2 | 1 | 5 | 1 | 1 | 4 | 0 |
| 4 | 1 | 0 | 3 | 1 | 6 | 2 | 2 | 4 | 0 |
| 4 | 1 | 1 | 3 | 0 | 6 | 1 | 1 | 5 | 2 |
| 4 | 1 | 1 | 3 | 0 | 6 | 4 | 1 | 2 | 1 |
| 4 | 1 | 1 | 3 | 0 | 7 | 1 | 1 | 6 | 2 |
| 4 | 1 | 1 | 3 | 0 | 8 | 2 | 2 | 6 | 1 |
| 4 | 2 | 0 | 2 | 1 | 9 | 2 | 2 | 7 | 0 |
| 4 | 1 | 0 | 3 | 1 | | | | | |
| | | | | | Total | | | | |
| | | | | | 119 | 37 | 24 | 82 | 15 |

TABLE 9.
Analysis of Table 8.

| | Number. | Number of Cases. | Number Not-Cases. | Percentage of Cases. | Proportion of Cases to Not-Cases. |
|---------------------|---------|---------------------|----------------------|-------------------------|---|
| Fond of Milk | 37 | 24 | 13 | 62 | % 185 |
| Not fond of Milk .. | 82 | 15 | 67 | 18 | 22 |
| Total | 119 | 39 | 80 | 33 | 49 |

NOTE.—These tables understate the case somewhat as a number of “not fond” who contracted the disease were secondary cases to a sib or parent who was.

IV. Conversely no person known to have been protected by using other supplies alone has been infected. These include:—

- (a) Family and neighbour groups with “own cow.”
- (b) The large Methodist Children’s Home with an independent supply.
- (c) Visitors to Cheltenham who took milk but who were served at S.....’s milk bar, which does not draw milk from the Cheltenham supply. The number of persons served at this bar cannot be discovered, but from 1,000 to 3,000 drinks per week have been served, of which a large proportion was sold to visitors from other districts (contrast the next paragraph).

V. Most of the cases elsewhere in Victoria were connected with the milk supply either as occasional customers while on visit or as residents on a visit elsewhere during their incubation period. (Appendix VI., list of visitors, &c.)

VI. No other probable cause has been discovered.

§ 6. Summary of the Case against Milk.

All early patients in zone and most of those elsewhere were known to have consumed suspected milk.

No suspect milk was served in any area other than that which provided the cases.

Most of the “cases” were large users of milk.

Visitors and passengers who took suspect milk *en route* provided a proportionate share of cases.

Visitors and passengers who took only S....’s milk escaped.

Residents with own cows, &c., escaped.

Other possible causes were eliminated and a significant carrier was discovered connected with the milk supply.

§ 7.

It is of interest to note that two “milk” outbreaks in Kew and Essendon were reported to the Board of Health in 1874, but were rejected as such by the Board of Health because it was believed that typhoid was not a contagious disease (*vide* Report 187 on Typhoid, Dr. W. Thomson).

PART 2.
CHAPTER I.
DISTRIBUTION.

The Age Incidence of Cases—Freedom of Infants and Aged—The Houses and Cases—More Persons than Houses Affected.

§ 1. Age Incidence.

The incidence at the various ages in this outbreak is that observed almost universally. This is set out in the following table.

TABLE 10.

| | Number of Persons. | Cases. | | Deaths. | | |
|----------------------|--------------------|------------------|-------------|-------------------|--------------------------------|--------------------------------------|
| | | Number of Cases. | Percentage. | Number of Deaths. | Mortality Percentage of Cases. | Death Rate Percentage of Population. |
| | | * | | * | | |
| Under 1 | 105 | 0 | .. | .. | .. | .. |
| 1 to 4 (Pre-school) | 400 | 44 | 11.0 | 0 | .. | .. |
| 5 to 14 (School age) | 859 | 150 | 17.5 | 3 | 2.0 | 0.35 |
| 15 to 24 .. | 850 | 96 | 11.3 | 6 | 6.25 | 0.7 |
| 25 to 34 .. | 736 | 57 | 7.7 | 1 | 0.9 | 0.13 |
| 35 to 44 .. | 659 | 39 | 5.0 | 2 | 5.0 | 0.3 |
| 45 to 54 .. | 539 | 27 | 5.0 | 3 | 11.1 | 0.55 |
| 55 to 64 .. | 283 | 15 | 5.3 | 2 | 13.3 | 0.7 |
| 65 to 74 .. | 157 | 8 | 5.1 | 5 | 60.0 | 3.2 |
| 75 to 84 .. | 74 | 4 | 5.4 | 1 | 25.0 | 1.35 |
| Over 85 | 10 | 0 | .. | .. | .. | .. |
| Total | 4,672 | 440 | 9.5 | 22 | 5.0 | 0.47 |

It is evident that infants under twelve months were either immune to or protected against infection, but from then on to 25 or so there is marked susceptibility, with an exaggerated peak during school ages. The rate is constant about 5 per cent. from middle age, but appears to drop to nothing in extreme age, most probably because the population has itself run out.

Deaths show a different proportion altogether. There is a slight peak after school age and a drop towards middle age, but from then the rates rise steeply.

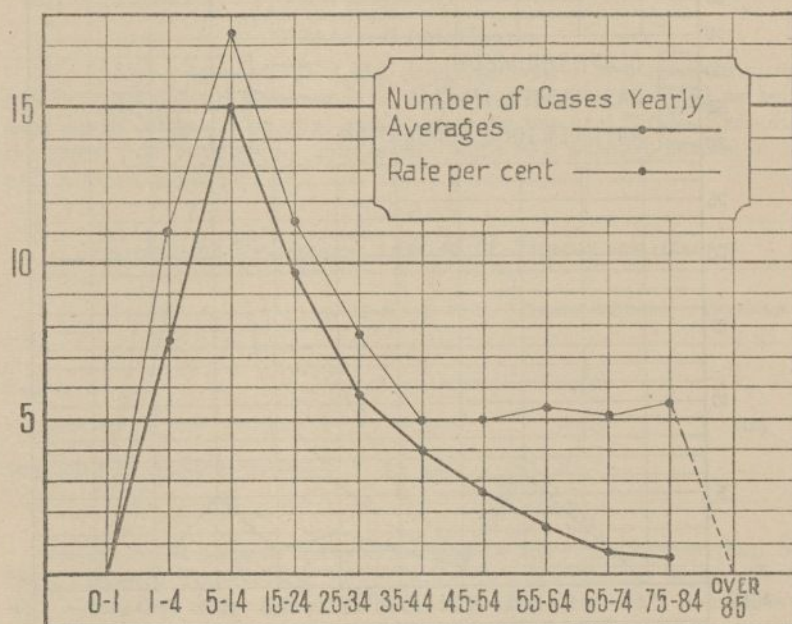
In dealing with so few cases, statistical figures are misleading, but the conclusion is unavoidable that, although after early manhood the risk of infection is much less, the risk of death is more than correspondingly greater. The following two graphs make this somewhat plainer.

* This differs from the figures of the early 1870's when of the deaths from typhoid 25 per cent. were "under five years" and 5 per cent. "under twelve months."

GRAPH 3.

The Numbers of Cases and Rates Per Cent. of Age Groups, Expressed in Yearly Averages.

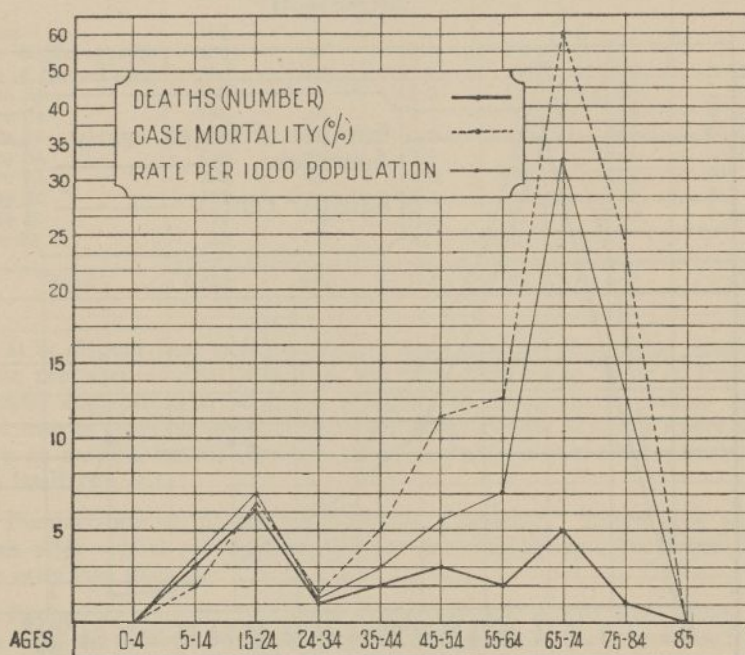
GRAPH III



GRAPH 4.

The Numbers of Fatal Cases in Age Groups; The Case Mortality (%) and Rate per 1,000 Age-Population.

GRAPH IV



§ 2. The Locality of Cases.

It is sometimes of interest to see the actual distribution of cases throughout the several localities so as to compare the incidence in relation to factors not operating over the whole area. This has been already done in respect to water, sewage, and other things. This additional note deals with the relation of cases to houses.

At the end of May (two and a half months) 434 local cases had been reported, of which some were diagnosed later* as "not typhoid."

Map 11 shows how the cases were well distributed over the zone. Four areas particularly suffered. These were by no means related to any common factor of sewerage, drainage, social standing, &c. There is an uncorroborated statement that these areas and some more particular streets were served with a larger proportion of milk from farm CW (the carrier farm) than the others, but my own inquiry makes it doubtful.

Multiple cases in a family were common.

§ 3. Cases and Houses.

The milk zone contains 1,212 dwellings and a few shop-dwellings, but it is not known how many of the shops may be included as being used as dwellings. The total could safely be put at 1,230.† Excluding the cases just outside the zone, there were 257 affected houses in the area (20 per cent. +).

TABLE 11.

Showing the Proportion Affected of Persons and Houses.

| — | | | | Number in Zone. | Number Affected. | Percentage. |
|---------------------------------|----|----|----|-----------------|------------------|-------------|
| Persons | .. | .. | .. | 4,500 to 5,000 | 409 | 8 to 9 |
| Houses | .. | .. | .. | 1,230 | 270 | 22½ |
| Proportion of houses to persons | | | | 1 : 4+ | 1 : 2— | .. |

It is evident that in many houses there were more cases than one. This has been exaggerated, however, by two institutions being affected and supplying many cases. The next table shows how houses were affected. The figures are obtained after correction for absent residents (see also Map 12 and Appendix VIII.).

* This occurred more often towards the end of the outbreak, especially in cases elsewhere than the affected area, and in multiple-case families.

† This does not include the large institutions which kept their own cows and so were virtually outside the zone.

TABLE 12.
Distribution of Cases in Houses.

Showing number of houses affected and numbers of cases in one house. Figures compared between milk zone and rest of State.

| Number of Cases in House. | Milk Zone. | | Rest of State. | | Total. | |
|------------------------------|----------------------|-----------------|----------------------|-----------------|----------------------|-----------------|
| | Number of Houses. | Total Cases. | Number of Houses. | Total Cases. | Number of Houses. | Total Cases. |
| 1 | 188 | 188 | 52 | 52 | 240 | 240 |
| 2 | 58 | 116 | 1 | 2 | 59 | 118 |
| 3 | 17 | 51 | 1 | 3 | 18 | 54 |
| 4 | 4 | 16 | .. | .. | 4 | 16 |
| 5 | 1 | 5 | .. | .. | 1 | 5 |
| Over 5* | 2 | 33 | 1 | 9 | 3 | 42 |
| Total .. | 270 | 409 | 55 | 66 | 325 | 475† |

The probable reason for so few multiple-case houses outside the zone is that many outside cases were those of single patients who had been infected while passing through the affected area, and whose house-fellows had not been at risk.

CHAPTER II.

INFECTION, INCUBATION, AND ONSET.

INFECTION: *The Morbid Dose may be Infinitesimal—A Secondary Case—Infection in Spite of Care—Fate of Bacillus in Bowel—Patient may be Infective although Never Invaded.* INCUBATION: *Difficulty in fixing Period—Other Indispositions in Incubation Period—Examples of Known Dates, Probable Period 10-21 Days.* ONSET: *Various Symptoms Discussed—No positive Syndrome Known.*

§ 1. Infection.

This is not the place to discuss the pathology of invasion. It is sufficient to know that Typhoid Fever is contracted as a result of ingesting infected food, especially foods which allow the bacilli to multiply or at least are not harmful to them.

In this outbreak it is definitely established that one such ingestion can bring about an attack and that persons whose only consumption of milk was that taken in tea were attacked.

§ 2. Minimum Dose.

Although this is quite unknown, we have evidence, but not at all accurate, that a larger dose of infecting material more often caused clinical disease. This boils down to the bald statement that of those questioned most patients were larger consumers of milk than other members of their families, but each attempt to get more accurate information was unsuccessful. The following is submitted, therefore, on general principles rather, and not on any exact information, namely, that the amount of infective material necessary to set up a clinical attack is probably minute (see page 27, Tables 8 and 9).

* Institutions.

† Latest figures increased by eleven.

Although the *Bacillus Typhosus* is pathogenic for other animals, it is only in man that any disease comparable to Typhoid Fever can be produced. For that reason most of the research in this disease is perforce confined to clinical observation, to the biology of the organism itself and to reactions between patients and the organism. One does not know the morbid dose nor what happens when it reaches the stomach, but some further scraps of information have been gathered which point towards a very small dose indeed.

§ 3.

First of all, the infecting material itself. In the case of water we have evidence, such as in the Croydon (Surrey) outbreak, that one man may infect a whole water supply, and Croydon is not a small village, and moreover little or no multiplication occurs in natural waters. Then the milk epidemics. We know how difficult it is to recover the *Bacillus Typhosus* from raw milk and how sensitive it is to the increasing acidity of staling milk. There is much room for research here. But more definite ideas can be got from secondary infections such as from patient-to-nurse and patient-to-doctor. The outbreak has given four such cases. Take for example one patient-to-doctor infection. There is no question of contaminated food so that the transference of infected material must have been direct. You are therefore asked to imagine the amount of infecting matter that could be conveyed to the doctor's mouth.* The quantity of infected matter taken on the hands must be small, and even if no washing at all were done only an extremely small proportion of this already tiny quantity could be swallowed.

§ 4.

Then again we really know nothing about the fate of the organisms actually ingested, do they multiply in the stomach, or is there a period in the acid contents of the stomach in which they may diminish? There seems little to refute the suggestion that once in the duodenum there is nothing likely to interfere with their growth, or at least nothing actively harmful to them. We do know that bacilli released from the bile duct are still vigorous and active after their journey of hours in the digestive canal, and are found under suitable conditions in faeces many weeks old. One must insist that, until definite information is available to the contrary, the Medical Officer of Health shall act as if one single bacillus were a sufficient infecting dose.

There is probably some connexion between number or quantity of the infecting material and the development of a clinical attack, but as there is practically nothing but general principles to act upon, we must regard a grain of infected dust or one live house fly as being capable of setting up an infection.

Indeed, there is a logical corollary which is disconcerting. Is it possible that an immune person may eat infected food and, without suffering any ill whatever, incubate the bacillus in the duodenum or elsewhere and discharge it, greatly multiplied, in the faeces?

* It is known that a complete ritual of washing was carried out, and although we have no faith in the efficacy of diluted disinfectants it is difficult to imagine even, how more than an odd bacillus could escape soap, water, and towel and be so ingested.

Pressure of work prevented any investigations on these lines, but on a previous occasion (Warburton) a closet pan was found to be infected, although no trace of case or carrier could be found in the household, the supposition being that a temporarily infested person had ceased to be such.

§ 5. Incubation Period.

Before discussing the data available in this outbreak; it is as well to consider the question "What is an incubation period?" Without going into the finer points of definition, one may reasonably state that it is the time elapsing between the ingestion of infective dose and the onset of the disease.

Taking the latter point first, we have the almost insuperable difficulty in deciding when the disease did in fact begin. In some diseases the clinical condition is merely a complication of a mild disease such as in cerebro-spinal meningitis. In this disease the onset of meningeal conditions may be so long delayed that we once had the absurd position of a child for months in isolation as a virulent carrier, at length succumbing to a frank clinical meningitis. In a case of Typhoid Fever the onset of the disease is so insidious that we are faced with a necessity of arbitrarily choosing some date on which the symptoms obtruded themselves on the notice of the patient or his family.

§ 6.

Let us consider two patients, No. 2 (R.R.) and No. 1 (W.G.G.). No. 2 is a lad who took sick, was literally sick for months, and whose case is shortly set out in the note supplied by Dr. Conway Dyté (Appendix V.). The other was a man whose typhoid infection was superimposed on a chronic pulmonary tuberculosis. At some unknown time in their sickness each was infected and developed the disease, for it is absurd to back date the typhoid onset to some sickness months past unless a quite new view of Typhoid Fever is to be taken. To a lesser degree the same difficulty occurs throughout the outbreak; and we are continually asking to which of some vague sicknesses must we date back the onset. With an incubation period extending into the fourth week there is ample time for several minor ailments to occur. Some writers, notably Osler, get over their difficulty by dating the onset to the time of taking to bed, but some of our patients did not take to bed at all.

§ 7.

I propose to show that these long incubation periods are strongly suspect and must be searchingly inquired into, as was done in our cases, for in no patient other than the two already quoted has been any evidence for an incubation longer than the fourth week. Fortunately for our purpose, there have been cases with one or two isolated "contacts," by which I mean that some patients drank infected milk on one or two known dates, and that careful inquiry has failed to disclose any other opportunity of infection or any distracting minor sicknesses. These cases are those who are not residents of the area but visited friends or who stopped for a drink at a milk bar on some occasion of passing through the district. The next table gives us the known intervals between the taking of milk and the first sickness.

TABLE 13.
Cases with One Infection Date.

| Patient's Number. | Incubation in Days. | Patient's Number. | Incubation in Days. | Patient's Number. | Incubation in Days. |
|-------------------|---------------------|-------------------|---------------------|-------------------|---------------------|
| 025 | 10 | 031 | 14 | 037 | 20 |
| 039 | 13 | 235 | 16 | 042 | 20 |
| 234 | 13 | 017 | 17 | .. | .. |

Compare this with Table 14, which sets out for eight patients two known possible dates of infection.

TABLE 14.
Cases with Two Possible Infected Dates.

| Patient's Number. | Incubation in Days. | Patient's Number. | Incubation in Days. |
|-------------------|---------------------|-------------------|---------------------|
| 072 | 4 and 12 | 018 | 12 and 19 |
| 046 | 5 and 12 | 014 | 16 and 18 |
| 041 | 7 and 19 | 050 | 17 and 23 |
| 058 | 9 and 17 | 051 | 18 and 23 |

§ 8.

It was hoped that information would be obtained from country patients who left Cheltenham for another district during their incubation. Only five were known for certain and these were disappointing. The next table shows the last possible time of infection, which ranges from three to fourteen days.

TABLE 15.

| Time Away before Taking Sick. | Number. | Time Away before Taking Sick. | Number. |
|-------------------------------|---------|-------------------------------|---------|
| Over 3 days | 1 | Over 11 days | 1 |
| Over 6 days | 1 | Over 14 days | 2 |
| Over 8 days | 1 | | |

These few figures are, of course, not conclusive by any means, but it is clear that

- (i) In Table 13 the incubation period is seen to lie between 10 and 20 days, and is balanced about the 15th day.
- (ii) Tables 14 and 15 are compatible with this.
- (iii) Tables 14 and 15 disclose alternative short periods as low as 3 days.

Until one can collect figures in some enormous epidemic, we are unlikely to get any better idea than the old one, that the incubation period is one to three weeks. I am inclined, however, to extend it somewhat, and say from 7 to 24 days, but most commonly from the 10th to 20th day.

§ 9. Onset of Disease.

The speed of diagnosis asked for in a typhoid outbreak is incompatible with accuracy in identification of the disease. Symptoms often do run in certain lines for each outbreak, so 200 odd cases were carefully checked to see what could be expected. The result was negative; the symptoms were too varied. The next table (Table 16), which sets out the result of the inquiry, is followed by a short comment on the more salient points. What was more readily noticed, perhaps, was the incidence of headache in the adolescent group both total and as an initial symptom. It must be remembered that this last refers only to those symptoms shown before diagnosis and is mostly a picture of the first few days. This whole section is submitted not with the hope of its being conclusive but to conform with custom and to provide material for investigators who want it.

TABLE 16.
Symptoms Noted Before Diagnosis of Typhoid.
In age groups.

| Symptoms, &c. | 72 Cases under 10. | | 68 Cases 10 to 19. | | 39 Cases 20 to 39. | | 25 Cases over 40. | | Total— 204 Cases. | |
|---------------------------|-----------------------|----|-----------------------|----|-----------------------|----|----------------------|----|----------------------|----|
| | a | b | a | b | a | b | a | b | a | b |
| Malaise .. | 62 | 35 | 48 | 15 | 39 | 14 | 21 | 12 | 170 | 76 |
| Fever .. | 55 | 10 | 52 | 1 | 20 | 3 | 21 | 0 | 148 | 14 |
| Headache .. | 36 | 12 | 60 | 38 | 27 | 14 | 21 | 8 | 144 | 72 |
| Bellyache .. | 15 | 4 | 12 | 2 | 22 | 4 | 12 | 4 | 61 | 14 |
| Nausea and vomiting | 18 | 1 | 12 | 0 | 7 | 0 | 8 | 0 | 45 | 1 |
| Constipation | 5 | 0 | 0 | .. | 2 | 0 | 0 | .. | 7 | 0 |
| Diarrhoea .. | 18 | 6 | 7 | 1 | 7 | 1 | 3 | 1 | 35 | 9 |
| Eyeache .. | 3 | 1 | 8 | 4 | 4 | 0 | 0 | .. | 15 | 5 |
| Neck, back, &c., aches | 5 | 0 | 5 | 0 | 5 | 0 | 4 | 0 | 19 | 0 |
| Nose bleed | 5 | 1 | 8 | 2 | 3 | 1 | 0 | .. | 16 | 4 |
| Sore throat | 1 | 0 | 1 | 0 | 3 | 0 | 0 | .. | 5 | 0 |
| Sweats .. | 1 | 0 | 6 | 1 | 0 | .. | 0 | .. | 7 | 1 |
| Shivers .. | 4 | 2 | 5 | 3 | 6 | 2 | 0 | .. | 15 | 7 |
| Giddiness .. | 1 | 0 | 3 | 1 | 2 | 0 | 2 | 0 | 8 | 1 |

a = No. of cases in which symptom observed.

b = No. of cases in which symptom was that first seen.

§ 10.

Malaise.—This was a listlessness and physical depression out of proportion to the general condition, and in the extremes of age was very striking indeed. In spite of this, the patient often appeared bright enough unless other things, such as pain or vomiting, were present. This general out-of-sorts state often lasted for a noticeable time before the onset of any other symptom.

Fever.—When present, and especially when coupled with the unusual mental brightness previously mentioned, it was a useful guide. The chart was usually classical: that is, a rising temperature with increasing morning remission; the “sierra” or rising zig-zag type. In young people only was it an important initial symptom, and in children in about 20 per cent. of its total incidence it was the first and only indication of the child’s condition. What is more remarkable is that in at least 25 per cent. of the cases fever was not present or at least not noted by the patient or friends, and in three did not, to the best of our knowledge, develop at any time.

Headache.—A mild headache was very common. In young adults and adolescents especially it was severe and constituted the chief initial symptom. It conformed to no locality or character type, but was just a “bad headache.”

Digestive tract.—Nausea, vomiting, constipation or diarrhoea and bellyache, especially in children, are seen to be not infrequent. Victoria had just passed through a widespread epidemic of gastro-enteritis in all ages, usually mild and lasting a few days. The early cases, therefore, were not recognized if showing this syndrome. But when the outbreak was recognized such symptoms were immediately suspect.

Eyeache.—This system showed no peculiarity. It was the usual pain of developing feverish condition. Photophobia was not common, but was seen on several occasions.

Other aches.—This includes cramps, which were sometimes marked. Backache, &c., was not common nor severe, and was of no diagnostic value at all.

Nose bleed, sore throat, giddiness, and mild sweats, were occasionally seen. It is regretted that no specimen swabs were taken from inflamed fauces.

General onset.—In the great majority of cases the onset was gradual and insidious, but in sixteen of the group the onset was severe and sudden, and led to diagnosis of other diseases such as appendicitis (two operations), pneumonia and rheumatic fever.

§ 11.

I am informed by medical practitioners that it was the alert appearance of the patient which caused suspicion. It is clear that some such symptom or want of one may be a valuable aid in epidemic period diagnosis.

It is curious that neither foul breath, dark-coated tongue, nor the peculiar “typhoid” smell, which were so noticeable to me, were observed by patients or friends. It would appear that family tongues are not looked at nor is the pulse examined.

No symptom or syndrome appeared more likely than any other to be “confirmed as typhoid” by laboratory examination.

CHAPTER III.

ACCURACY IN DIAGNOSIS AND LABORATORY CONFIRMATION.

DIAGNOSIS: *Accurate Diagnosis Essential—Laboratory Aid not a First Line Weapon—Standard Definition of Typhoid Infection—Laboratory Diagnosis Too Slow—Inoculation Caused Anomalies—Proportions of Wrong Diagnosis—Speed of Diagnosis Vital—The Two Compared—Missed Case—Mild Cases.* LABORATORY FINDINGS: *Tabulated +ve Results—Comparisons Not Possible—Hospital Procedure—Real Value of Laboratory Findings—Times of Appearance—Fallacies—Need for Accurate Observations.*

§ 1. Accuracy of Diagnosis.

In planning a campaign against an outbreak of Typhoid Fever one must guard against faulty diagnosis, especially in key cases.

The first aim, of course, is to discover and cut off the source of infection, and it is obvious that missed cases or, what is worse, inclusion of cases of other diseases, could easily mask the real position.

The aid of the laboratory will in the end determine the diagnosis of doubtful cases and even detect the infection in persons suspected on circumstantial evidence in the absence of clinical signs, for instance, Case No. 313 (P.L.)*. Another patient, 069 (J.S.), suffering from no more than an ephemeral mild malaise, developed a positive blood culture after all symptoms had ceased (see Appendix V.).

In spite of the ultimate importance of missed cases, it is more important at the outset to be able to exclude as many non-typhoid cases as possible from the picture.

§ 2.

A standard of accuracy must be adopted early and all cases which do not reach standard must be held in suspicion for the time being. A working standard was adopted which defined a typhoid case as one which either—

- (i) is definitely clinically a case, or
- (ii) gives a positive blood culture, or
- (iii) is clinically suspect and which is supported by appropriate laboratory findings.

To exclude carriers a fourth class was added—

- (iv) Persons *without* significant clinical signs, but with positive faeces-culture supported by rising Widal figures, especially in "O" titres, not associated with an otherwise diagnosable febrile condition (Case 313, described above).

* This case was that of a child who had the opportunity (was in fact a carrier) to set up a secondary focus and who later did so. Her age and her living and personal conditions all made her suspect, but she was in no way sick nor had there been any suggestion of a positive typhoid history. Her rising Widal was followed by a positive faeces culture, so that Typhoid Fever was actually "diagnosed" before the onset of the disease which occurred a week or so later, in hospital.

Under this definition the first 300 cases were classified as follows:—

| | | |
|--|-------|-----|
| (i) clinically definite (no lab. confirmation) | .. | 19 |
| (ii) blood culture +ve | | 188 |
| (iii) doubtful clinically with— | | |
| (a) +ve Widal 80 | } | 87 |
| (b) +ve faeces culture 7 | | |
| (iv) no clinical signs but lab. reports +ve | .. | 3 |
| (v) doubtful, no +ve lab. reports | | 3 |
| | | 300 |

§ 3.

Later, as the number of persons who were being inoculated increased, a typhoid Widal figure became ambiguous. Advantage was taken, however, of the fact that all the inoculations were being done with T.A.B., and that rising titres for A and B could be expected, parallel to the Ty. titres. At Dr. McLorinan's suggestion numbers (iii) and (iv) were modified to exclude cases which developed shortly after inoculation with T.A.B. and gave A and B titres in the same order as the Ty's. Owing to difficulties explained elsewhere, VI, reactions were not sought and a valuable diagnostic aid had to be done without.

§ 4.

It is obvious that laboratory confirmation of diagnosis cannot be awaited by the impatient field officer. He needs something quick and that as accurate as possible, but with any probable fallacy appreciated. He must, therefore, rely upon clinical observation. In this outbreak we were helped beyond all expectation. It is my experience that the local physicians who bear the burden of this need for quick diagnosis respond remarkably well—in this case it was extraordinary.

§ 5.

It was the custom to send to hospital all likely cases, and every day or so to make inquiries to find what definite diagnosis, if any, had been reached, and how. The next table shows what was the state of things as the outbreak progressed.

TABLE 17.

Showing in Approximate Figures the Proportions of Cases Wrongly Diagnosed.

| Cases. | 1st Week. | 2nd Week. | 3rd Week. | 4th Week. | 5th Week. | Onward. |
|--|-----------|-----------|-----------|-----------|-----------|---------|
| Number of cases reported .. | 150 | 125 | 100 | 30 | 6 | 14 |
| Number wrongly diagnosed (including doubtful) .. | 3 | 1 | 6 | 9 | 2 | 4 |
| Percentage* | 2 | 0·8 | 6 | 30 | 33 | 29 |

* Of the total 435 cases reported in this area 25 (or 6 per cent.) were wrongly diagnosed. Compare this with the 16 per cent. wrongly diagnosed of those cases occurring elsewhere. I make no attempt to explain this. The important point is that in this, as in other outbreaks, the diagnosis of early local cases is usually steady and reliable.

§ 6.

Besides knowing what is the likely total error, the Health Officer should have an idea of what is the individual doctor's error rate. This can be very quickly found in an outbreak like this, but one must not interpret any such error as indicating incompetence. For one thing it must be assessed against speed, and if one is to get astride of things speed was vital. The infection already had fourteen days' start.

§ 7.

The speed of diagnosis by various doctors was found to vary, and I attempted, as is shown in the next table, to compare these speeds by averaging the times elapsing between onset and provisional diagnosis in three groups of physicians. Note the regularity throughout.

TABLE 18.

Average Times Elapsing between Onset and Diagnosis for Three Groups of Physicians.

| Group. | | Average Period in Days for All Cases Including Doubtful Cases. | | | | | | | | | |
|--------|----|--|----|-----------|-----|-----------|-----|-----------|------|-----------|------|
| | | 1st Week. | | 2nd Week. | | 3rd Week. | | 4th Week. | | 5th Week. | |
| | | a | b | a | b | a | b | a | b | a | b |
| A | .. | 3.3 | .. | 4.0 | 4.9 | 5.0 | 5.3 | 5.6 | 8.3 | 5.5 | 12.5 |
| B | .. | 5.0 | .. | 5.3 | 6.4 | 5.3 | 7.0 | 5.8 | 8.3 | 3.7 | 7.0 |
| C | .. | 4.3 | .. | 8.3 | 8.6 | 5.7 | 9.3 | 6.6 | 11.8 | .. | .. |

a = cases excluding long-standing cases.
b = cases including long-standing cases.

§ 8.

It is interesting to compare what these doctors have called their "happy mistakes," that is, the cases wrongly diagnosed as Typhoid Fever, together with their speeds in making them.

TABLE 19.

The Number of Wrong Diagnoses for the Same Three Groups of Physicians with Average Time in Days between Onset and Diagnosis, NOT including doubtfuls.

| Group. | | 1st Week. | | 2nd Week. | | 3rd Week. | | 4th Week. | | 5th and Over. | | Total. | |
|--------|----|-----------|-------|-----------|-------|-----------|-------|-----------|-------|---------------|-------|--------|-------|
| | | No. | Time. | No. | Time. | No. | Time. | No. | Time. | No. | Time. | No. | Time. |
| A | .. | 1 | 3 | 2* | 4 | 4 | 2.7 | 3 | 4.6 | 2 | 10.0 | 12 | 4.3 |
| B | .. | 2 | 4 | .. | .. | .. | .. | .. | .. | 1 | 8 | 3 | 5.3 |
| C | .. | .. | .. | .. | .. | 3 | 7.3 | 3 | 7.3 | 2 | 4½ | 8 | 6.5 |

* Excluding very long-standing cases.

§ 9.

The value of exploiting this personal element is obvious, but it is beyond me to decide whether the investigator to whom every hour is more than precious should desire speed above all else or wait an extra day or two to obtain the greater accuracy. I am inclined to the view that, as the error was so small in any case, the extra speed was most valuable and desirable.

§ 10. Missed Cases.

The number of missed cases is naturally unknown, but inquiry suggested strongly that during the month of the outbreak nearly every case of indisposition was investigated. The number of missed cases must, therefore, be very small, and must comprise only those who have deliberately concealed sickness and those whose sickness was too slight to attract attention, but several have come to light through secondary cases. The most disconcerting discovery was the fact that persons even obviously not sick could show unmistakably laboratory signs of typhoid infection. Three striking examples presented themselves, two of which have been quoted before:—

069 (J.S.).—Little evidence of sickness. Blood Culture +ve.

313 (P.L.).—No indication of sickness. Widal H $\frac{1}{80}$, O $\frac{1}{20}$.

Faeces Culture +ve.

This latter case developed a mild clinical disease at least ten days after the first suspicion.

432 (A.S.).—Had a passing indisposition, but being a house contact of two cases was placed under surveillance. Faeces

+ve. Widal + $\frac{1}{160}$.

The point in all this is that in two cases the faeces was +ve and that each would be gravely dangerous in appropriate circumstances. An illustration of this is given by 313 (P.L.) mentioned in §1. This child, aged two, lives with her parent, the manager of a milk depot. Gross hygienic faults were reported, the child was isolated, and the worst expected, but not realized. Only two cases (man +ve and wife suspect) can be attributed to infection by this baby.

§ 11.

It was evident, however, that a number of mild cases existed, and our half dozen or so technical cases show that typhoid, like other diseases, does not depend on chronic carriers but, contrary to general opinion, the germ may be excreted during a non-clinical infection, in the sense that the patient's reaction is too slight to be detected even after suspicion has been aroused.*

§ 12. Value of Laboratory Results.

It was desirable to get a clear idea of the value of laboratory findings to the health officer, but an attempt has been made with results that are disappointing.

* The above suggests too limited a view. There is no evidence against the possibility of the bacillus multiplying in the bowel without any actual invasion, so that an "infested" person may be temporarily a true carrier but never "suffer" from the disease in any way.

The worst obstacle is the dissimilarity of procedure in various hospitals. Five of the leading Melbourne hospitals have been good enough to supply the data for this, and have been put to some trouble in doing so. Two hundred cases have been selected from a random sample from four hospitals by rejecting those cases of patients too sick for investigation, and, at the other extreme, carriers and technical cases. The next table shows the laboratory findings in each of these hospitals. It is hoped that the findings in the fifth and the other hospitals will be published by their own pathologists.

TABLE 20.

Hospital Laboratory Results in 200 Cases (Selected), Showing Positive Results of Specimen Examination:—(a) Total Occurrences; (b) Occurrences with all Other Tests Negative.

| Hospital. | | No. of Cases. | + ve Ty. Culture. | | | | | | Widal. | | Nil. |
|-----------|----|---------------------|-------------------|-------------------|----------|-------------------|----------|----------|----------|----------|-------------------|
| | | | Blood. | | Faeces. | | Urine. | | | | |
| | | | <i>a</i> | <i>b</i> | <i>a</i> | <i>b</i> | <i>a</i> | <i>b</i> | <i>a</i> | <i>b</i> | |
| H (c) | .. | 36 | 22 | 10 | 21 | 1 | 13 | 0 | 19 | 6 | 1 |
| H (p) | .. | 24 | 5 | 2 | 11 | 2 | 3 | 0 | 19 | 10 | 1 |
| I (a) | .. | 50 | 42 | 16 ⁽¹⁾ | 10 | 0 | 6 | 0 | 33 | 8 | 1 |
| I (d) | .. | 90 | 14 | 3 | 44 | 17 ⁽²⁾ | 7 | 2 | 38 | 8 | 16 ⁽²⁾ |

A better criticism might have been possible if an examination had been made of results in those cases only in which all four tests were done, but even then such figures would have been misleading, because each hospital followed a different procedure, used different technique, and varied this freely to suit individual requirements, so that no two hospitals had comparable results.

The general routine at these hospitals was as follows:—

Hospital H(c).—Thirty-six cases. Blood culture attempted 27 cases (22 +ve), from three to eight days after admission (average five days). Widal: Nineteen cases, only six of which had blood cultures (one the day before, one the same day, three in two days, and one 20 days after the blood culture day). The remainder were taken from one to thirteen days after admission (average 7). In this hospital the Widal and blood culture are alternative, not co-confirmatory. Faeces and urine-culture were taken later (one week to a month or more after admission) the object apparently being to ascertain when the patient had become “negative.”

Hospital H(p).—Blood culture was attempted in nearly every case from five to fifteen days after admission (average six), but for some reason only five positives were obtained. Widal's were done ten days after admission. Faeces and urine later.

Hospital I(a).—Blood culture was regular and early, with very few exceptions on the day of admission (average one day). Widal's a few days later. Faeces and urine chiefly for purposes of discharge.

(1) In eleven of these no “Widal” was done.

(2) In many patients in this hospital neither blood culture nor “Widal” was done.

Hospital I(d).—No early reliance of laboratory findings was in evidence here. One gathered that the pathologists thought clinical observation the more reliable (and these figures would support that idea). Laboratory aid was concentrated on difficult diagnostic cases.

§ 12.

It would seem, also, that although blood culture seems to offer the quickest results, culture methods are critically delicate and liable to many fallacies, not the least of which is the uncertainty of each technique, so much so that different results are obtained by different institutions and even by various methods in the one laboratory. The Health Officer who wants speed in diagnosis must therefore chiefly rely upon the clinician who will use laboratory facilities as he needs them. This does not mean by any means that laboratory investigation is of such insufficient value that it might be abandoned. Such an absurdity would leave us without some invaluable aids—detection of carriers and technical cases, data for discharge from isolation and moral support in dealing with obstructive, or at least non co-operative persons, and, of not the least importance, legal evidence of infection.

§ 13. Times of Appearance and Disappearance.

At the beginning of an outbreak, laboratory findings do not replace clinical opinion, but it was hoped that some light could be thrown on the subject if we knew the earliest and the latest appearance or disappearance of any such phenomenon. Unfortunately, the results are indefinite, and the next table shows what wide variation is possible in each case.

TABLE 21.

Times of Appearance and Disappearance of Laboratory Finding.

| | Appearance. | | Disappearance. |
|-------------------|---------------------------------------|---------------------|--------------------------|
| | Earliest range from— | Average between— | |
| Blood Culture .. | 1st to 58th day | 8th and 13th | 1 week to never |
| Faeces Culture .. | 6th before onset to 64th day after | 21st and 28th .. | |
| Urine Culture .. | 8th to 75th day* .. | 39th and 48th .. | 2 weeks to never |
| Widal .. | 7th to 44th day .. | 11th and 24th .. | Slowly over the years |

* We are indebted to Dr. Hilda Gardner (Royal Melbourne Hospital) for one case in which a urine positive result appeared on the 100th day of sickness.

§ 14.

From this table we see much that would be of value to the Health Officer, even if negatively, if only it were reliable.

One difficulty must be resolved. In many cases the particular test was done late in the disease, and it is quite possible that a positive finding would have been made much earlier had the attempt been made. I have included those cases only in which a successful first attempt was made within a few days of the onset and those in which a negative state had been indicated by one or more tests before the positive state had

been established. There are no figures available at present about the disappearance of the blood culture. In the second column I have used only those cases with previous negative tests so that the so-called average is most likely much too late. Had tests been done daily from the beginning, the particular tests almost certainly would have been positive much earlier. This applies particularly to blood culture and faeces culture. It would be interesting in the event of another outbreak to take specimens from a cross section of the persons at risk, as in this outbreak we have found positive blood results on the first day and, in the case of faeces, six days before onset. Urine culture and Widal test do not appear to be positive so early. There are cases of urine cultures being negative over the whole acute sickness and appearing positive in convalescence.*

* See footnote to Table 21, previous page.

Notes on Laboratory Results.

Blood Culture.—In one case, blood taken on the day of onset (the case being a member of hospital staff) gave a definite growth of *B. Ty.* and there is nothing to prevent discovery of an even earlier invasion of the blood stream, except the fact that patients are rarely seen before the fourth or fifth day. Against that we have cases in which a negative state was found for weeks until at last the attempt at culture succeeded. I put it this way to suggest that it was the attempt to culture that failed and not that the *B. Ty.* was necessarily absent. This throws light on the "long incubation cases" which had little or no clinical upset.

Faeces Culture and Urine Culture.—There is more information about faeces than either blood or urine cultures, but still not enough to make it a reliable guide. Notably—we have instances of positive results before the onset of the sickness (which was invariably mild). At the other extreme we have repeated searches with negative results and then positive results appearing for the first time as late as the 64th day for faeces and the 100th for urine.

Widals.—There is more agreement on this than most other questions about typhoid. The earliest noted positive Widal (H/160) was on the seventh day. The longest period of negative finding was 41 days, the specimen of the 44th day being positive (H/160 O/80). Very few cases failed to give some reaction if persisted in, but it was not the custom to persevere unless confirmation was required for a doubtful case. In those cases when persistent search failed to discover a significant agglutination it was common to have no laboratory positive findings at all in undoubted clinical cases. Several difficult cases were solved after discharge from hospital when blood titres gradually rose.

The almost regular response to vaccine is in sharp contrast to this, and it is difficult to explain the significance of a Widal except as a coincident phenomenon when we consider those rare cases where patients with a definite clinical syndrome and various positive cultures enjoyed an uneventful recovery without showing the slightest increase in Widal titres throughout the disease or convalescence.

Nevertheless, the Widal has proved a most reliable signpost in suspected carrier and mild clinical cases, and in spite of the prevalence of T.A.B. inoculations (see Appendix VII).

CHAPTER IV

EFFECTS OF INOCULATION.

Mass Inoculation not Advised—Advised for Certain Individuals—People Familiar with Inoculation and Demanded it—Attack seemed to be Precipitated but Mild—Old and New Inoculation both Protect—Widal Reactions Rapidly Developed—Value of Widal Reaction—Inoculation Causes Uncertainty—Two Widal Reactions—Quick Development—T.A.B. Reactions—Significance of Presence of A and B Reactions.

§ 1. Effects of Inoculation.

It was frequently asked why mass inoculation was not adopted as an early measure, as very few will dispute the protection value of inoculation even to the individual and certainly in mass.

The answer is—"Because of want of information about its efficacy in patients already infected." During this outbreak it was likely that many persons were incubating Typhoid Fever and it was feared that untimely inoculation might increase the severity of the disease actually

developing. A quick decision had to be made, and after hurried discussion and requests for advice it was decided not to advise mass inoculation but to encourage each person to consult a private physician or to bring the problem to us to be judged on its merits.

§ 2.

Inoculation was advised for individual cases in the following classes:—

- (a) Newcomers under one week—at once.
- (b) Families with a member already a patient—to wait for 14 to 21 days and try to be completed with at least two doses well before the discharge of the patient.
- (c) Persons at continued risk, those attending the sick or handling infected material (such as sanitary personnel)—at once.
- (d) Others—advised against inoculation unless necessary for some social reason, such as the allaying of fears of customers or neighbours.

§ 3.

When the Advisory Committee met on the 19th March, the question was at once raised but it was not settled on account of want of information on the subject, but the classes (b) and (c) were strongly advised to submit to inoculation at the appropriate time. On the whole our advice was not taken, for most people demanded inoculation at once. There are a large number of persons nowadays who have personal experience of inoculations and believe not only in their efficacy but in their harmlessness. Besides this there are a large number of old returned soldiers (well over 200 as estimated by the Town Clerk's office), many service men and women already inoculated against several diseases, and many more families familiar, more or less, with the subject through the experiences of their absent members in the various forces and through local diphtheria campaigns. The demand for inoculation was accordingly strong, and many persons were inoculated with T.A.B. who, according to our advice, should have waited. The numbers are not obtainable, but some of the coincident occurrences are known.

§ 4.

It will be remembered that it was believed that primary infection ceased on the 16th March, or, at the latest, the 17th, and that the numbers of cases after, say, the 30th should be quite small, because both secondary cases and long incubating cases were not common. This indeed proved to be the case. In the last fortnight, from the 24th March to the 3rd April, there were 95 "onsets." Of these, thirteen were known to have received one or more doses of inoculation. In nine of these (70 per cent.) there were what may be interpreted from the patients' descriptions as "severe reactions" from which the patient did not quite recover, but which slid into the clinical stage. Two others took sick after the second dose, so that of these thirteen cases who had been inoculated, no less than eleven (90 per cent.) had what is best described as coincident onset and inoculation reaction. None of these eleven had severe attacks, and it is thus quite reasonable to believe that inoculation may have (1) precipitated and aggravated an attack which

may or may not have otherwise occurred, or, on the other hand, (2) mitigated an inevitable attack which might otherwise have been serious. No information is available, naturally, as to how many inoculated persons did not get typhoid nor how many were at risk.

§ 5.

Three other non-conclusive facts have been observed which tend to suggest not only that (1) recent inoculation in three doses is a reasonable preventive, but that (2) its effects last for many more years than is believed, and that (3) the reaction to inoculation is much quicker than was expected. These facts are—

- (1) Members of the Forces subject to the same civil risk as their neighbours did not contract the disease. There were many false alarms but only two real cases. (There is a striking exception to this in the group of service women at a local station who contracted the disease but had not been inoculated or had just begun it.)
- (2) No returned soldier (1914-18) contracted the disease although there were over 200 at risk. These inoculations would be at least 25 years old.
- (3) No newcomers who had begun treatment within a week of their arrival nor any person who had completed treatment contracted a clinical disease (37 known at risk and none discovered amongst the cases).

§ 6.

The Widal reactions, as we have shown, do not appear to have any sure relation to either blood or faeces culture findings. For instance, the case which gave a series of positive blood cultures passed through a classic course and recovered without any significant rise in Typhoid (H. & O.) titres. But it is reasonable to expect that the sharp rise in both H and O titres after inoculation is somewhat parallel or at least heading in the same general direction as the desired immunity, and we do find that three patients who had been inoculated shortly before, if not at the onset of disease, had both an early rise in Widal figures and a mild attack.

§ 7. Diagnosis in the Inoculated.

In the earlier stage of the outbreak, the doctors had many cases of mild sickness to diagnose, and I have told elsewhere the really wonderful job they made of it, in fact, the speed and accuracy of the general practitioner's work in this respect is one of the highlights of the epidemic. They did, however, enlist the aid of the laboratory in many doubtful cases, chiefly in the examination of faeces and the investigation of the Widal figures. It was soon found that faeces culture was a broken reed because of the time taken to prove a positive result, the unreliability of a negative result, and latterly, the doubt that even a positive result would indicate a clinical invasion. The speed and reliability of blood culture were not generally recognized, and reliance was given to the Widal as the first line of investigation.

§ 8.

As inoculation became more common the help given by the Widal was apparently denied us until it was grasped that its very objections themselves showed as sure a way as before. The problem is simply stated. Does a positive Widal and indeed a rising figure in a recently-inoculated sick person indicate a clinical infection? Put in this way the answer is definitely "No." But the modern laboratory does not report so baldly as that. Much more information is usually available. I have not space nor the knowledge to fully go into this, but a general outline (E. & O.E.) is necessary for the understanding by those like myself whose knowledge on the subject is non-specialized.

§ 9.

Three common Widal reactions are dealt with: H., O., and VI., which respectively refer to antigens attributed to the flagella, to the body of the germ, and to an invasive quality indicating the reaction to a living organism. (This last, the VI., was not done in Victoria as a routine on account of technical difficulties connected with supply and our distance from the centres of Old World research.) The reactions are selective and a high figure, especially a rising one, is most suggestive. Such reactions were frequently found within a week after inoculation, and reference to Appendix VII. will show that in clinical cases the same reaction develops from the seventh day onwards; that is, artificial inoculation is inclined to produce a quicker result than natural infection.

§ 10.

Suppose, then, that in a suspected patient who had *not* been inoculated, we found a growing figure for the reactions H and O, and especially the latter, the case for a diagnosis of Typhoid Fever would be strengthened to almost a certainty. This is especially true if both H and O rise together, but allowance must be made for the many abnormal cases which react for H and not for O, and vice versa. In an inoculated person this rising titre is expected anyhow, but as the vaccine used is not a simple one but is a mixture of typhoid vaccine and vaccines of paratyphoids A and B, &c., we should expect other reactions, which, in fact, we obtain.

Those inoculated with T.A.B. not only gave the usual Widal figures, but gave quite high figures for A and B, and in the great majority of cases much higher than those for B. Typhoid. Thus, if in a suspected patient recently inoculated with T.A.B. we found a high and rising Typhoid figure, with an A or B following later, we diagnosed it as a mild clinical case. This occurred three times and each was supported by continued sickness and later other laboratory results.

The more important aspect, however, was that when the A and B results so outbalanced the Typhoid or were at least equal to it, we were justified in holding the case in suspense, which was followed in nine out of ten cases of P.U.O. by nothing further to suggest infection. The other case proved to be a mild attack, with faeces-culture +ve.

CHAPTER V.

THE CARRIER STATE AND SECONDARY CASES.

General bacteriological requirements for release from hospital—Not all carriers dangerous—Carriers released under surveillance—Conditions of release—List of carriers—Standards of risk—Instructions to carriers—Reliance on education—Danger with children and housewives—Search for unknown carriers—Faeces specimens—Widal test useful—A positive result is encouraging—Some carrier Widal—Significance. SECONDARY CASES: Few cases—Some doubtful Council's action effective—Citizens co-operative.

§ 1. General.

It is a desirable rule that no patient be finally discharged unless three consecutive bacteriological examinations of both faeces and urine are negative. It was early obvious that much embarrassment would arise from convalescents' returning home before it was certain that they had ceased to be infective.

I have stressed earlier my belief that the carrier state although potentially dangerous is not in fact so unless there be other conditions, namely, (1) habits which make infection of others likely, and (2) the opportunity to infect. In brief it means that a carrier who is dirty can infect others, especially if in contact with food. But it is well known that return cases of typhoid are rare. It is known that many carriers are living normal lives without infecting others and it is extremely probable that many others are carriers and quite unaware of it. At the most they may cause a few sporadic cases which are of no importance whatever in public health except that they keep the reservoir of potential infection comfortably full and await the coincidence of the other two factors, dirtiness and participation in food production, to cause an outbreak.

It was decided early that convalescence-carriers could not be isolated indefinitely but would be discharged to home life as soon as certain requirements were able to be satisfied. Up to the end of June twelve such persons were under consideration.

§ 2.

As there is no authority on this point the question had to be settled dogmatically. The principles to be relied on were laid down on somewhat the following lines:—

- (1) The general hospitals urgently needed the beds for sick people.
- (2) The Infectious Diseases Hospital could not hold carrier cases indefinitely and the municipality had no other facilities whatever for isolation.
- (3) The best of them could be discharged to their homes temporarily at least, to see if they would clear up, namely, those who—
 - (a) were intelligent and co-operative,
 - (b) did not handle any food supply,
 - (c) had a private home to go to and the conditions of the homes were suitable, and
 - (d) above all, were habitually clean.

The conditions required at home were—

House must be sanitary, not crowded and not associated with any public food supply.

House must be a single private one, not divided into flats nor yet a boarding house.

The drainage and sanitary service must be effective.

All the inmates must submit to supervision and co-operate with the patient and the health authority.

This meant that very few adults indeed who had homes to go to would be detained in hospital, but infancy, senility, and subnormal mentality would be a very serious bar, though not an absolute one. In fact, except for such things as the home's being a "food premises," no condition was thought to be an absolute bar. For instance, a young child was discharged to home with Ty. + ve faeces. The risk was small, however, as the home was an isolated dwelling well in the country where the other inmates were already protected and the patient could be kept under surveillance.

At the end of July there had already been fourteen such persons discharged to home.

TABLE 22.

Patients Discharged to Homes as Carriers.

| — | Age. | Sex. | Occupation. | Days Sick. | Days in Hospital. | Urine or Faeces. | Remarks. |
|---------|------|------|----------------|------------|-------------------|------------------|---------------------|
| BE 1 .. | 69 | M. | Nil .. | 93 | 90 | F. | |
| A 1 .. | 78 | M. | Nil .. | 82 | 78 | U. | Since —ve |
| AB 5 .. | 42 | M. | Postal Officer | 93 | 83 | F. | |
| AG 5 .. | 22 | F. | Home Duties | 101 | 95 | F. | Six months pregnant |
| AD 6 .. | 39 | M. | Foreman .. | 87 | 84 | F. | Since —ve |
| CC 7 .. | 63 | M. | Clergyman .. | 85 | 66 | F. | |
| AC 8 .. | 60 | M. | Printer .. | 90 | 84 | F. | Since —ve |
| AO 9 .. | 45 | F. | Home Duties | 101 | 95 | F. | |
| AF 0 .. | 60 | F. | Home Duties | 86 | 83 | F. | |
| O CD .. | 2 | F. | Nil .. | 85 | 65 | F. | |
| O 58 .. | 35 | F. | Home Duties | 98 | 92 | F. | |
| DC 2 .. | 42 | M. | | .. | 76 | F. | Technical case |
| BG 9 .. | 52 | F. | Home Duties | 95 | 92 | F. | |
| BG 0 .. | 12 | M. | Scholar .. | 104 | 96 | F. | |

NOTE.—Since the above was written it has been discovered that some carriers who had been negative for four or more specimens have reverted to the positive state. The epidemiological value of this is obvious.

§ 3.

In assessing the risk, that is, the likelihood of the carrier's carelessness or want of understanding, one must take into consideration the opinion of the hospital resident and one's own observation of the character of the patient, the state of his home, family, clothing, and in some instances the views of the patient's employer or workmates. For instance, No. 7 CC, a clergyman, clean, intelligent and anxious to learn, was released without question, but another patient, somewhat sub-mental who, although willing to please, showed incapacity to grasp the meaning of the ritual of cleanliness was persuaded to have a cholecystectomy done, with the result that both her duodenal and faecal bacteriological examination results became persistently negative and she has since been discharged.

The carriers released on this probation are kept under surveillance and frequent examinations are made of faeces and urine. Should these persistently show positive the position will be reviewed in say three to six months and other treatment advised or not according to the opinion of the consultants.

§ 4.

The instructions are simple. The carrier on discharge is placed "under surveillance" under the Health Act and written instructions are given to him according to the particulars of his case. The general instructions are:—

He shall—

- (i) handle no food cooked or raw, except for his own use. This applies also to wrappings and kitchen and eating utensils;
 - (ii) send no personal or bed linen to a public laundry;
 - (iii) after urination, defaecation or handling clothing or other article liable to have been soiled (such as underclothing) carefully wash his hands in soap and water;
 - (iv) use as far as possible only a sanitary convenience and if a urinary carrier, preferably not a slab or trough urinal, taking care to clean any accidental soilings as well as circumstances permit;
 - (v) as far as possible, himself empty and clean bedroom urinals and dispose of the contents and washings in the sanitary convenience; and
 - (vi) not leave the district without consulting the Health Officer.
- The rest is education.

§ 5.

When he is settled in his home the inspector calls to collect weekly specimens and, above all, give encouragement and advice and continue the instruction so that the restrictions on his life that the above naturally imposes will become habitual and not irksome.

§ 6.

The trouble is going to show itself in children and housewives. The former because of their want of understanding and careless sanitary habits, and the housewife because of the necessity of her preparing the family food. For this reason one of the terms of the release agreement is that all the members of the household be inoculated against typhoid. This has not been refused so far. If after some period the patient be still "positive" it is proposed to release suitable persons from the obligations of surveillance, except to keep the Department informed of any change of residence and to trust to their cleanliness, either natural or acquired, to prevent infection. It is likely also that the recently reported treatment by Opacol will be tried.*

§ 7. The Infective Stage.

Much has been written on this point, but it is usually confusing because of the uncertainty already existing—(a) what is the date of onset? and (b) is the investigator certain that his methods were the best possible for determining the presence of the bacillus? One

* Dr. Allen, M.O.H., informs me that all our carriers are being treated with this drug. Its action is awaited with interest. So far the reports from the University are uniformly disappointing.

must confess that in general the incubation period and date of onset have never been properly settled and that whatever technique were employed by the investigator there has always been a better one just around the corner and awaiting discovery.

In Chapter III. I pointed out that a case may be infective from the moment faeces is passed after infection, up to an indefinite time after recovery and, in some cases, throughout the remaining life of the patient. There is at least one definite case and probably four more in which positive faeces cultures were obtained before any suspicion of sickness. The child, PL, was admitted to hospital without any indication of infection, except her carrier state. This child was not a chronic carrier and I submit that if the bacilli isolated before her sickness were not excreted from some lesion then they were of the saprophytic nature discussed above. Another patient, BG, provides a similar case but one is unsure that there had not been a vague minor sickness two days earlier. It may be that the disease had already begun. But it certainly did not last, for this child was discharged within a few weeks having been free from all signs and symptoms.

In any case the beginning of the infective stage is much earlier than has been believed and may begin actually before the clinical onset. As the prolonged period of infectivity after convalescence is so well known and expected, it need not be stressed here.

§ 8. Unrecognized Cases.

There is grave danger to be feared from missed cases. This outbreak has shown the great need for careful investigation of convalescents with respect to their possible carrier state, but it has also shown that the disease can exist in all degrees of severity from an overwhelming toxic disaster (276 N.M., 083 B.P., and 304 N.R.) down to a trivial, barely noticed, indisposition (432 A.S.). In fact the patient (432 A.S.) was certain that his whole sickness was merely an anxiety about another member of the family and had no physical basis. This person threatened to become a chronic carrier but has since yielded two negative specimens. (This might have been a case of a chronic carrier's being detected by accident, but that is unlikely from the fact that a significant Widal figure has recently developed.)

No matter how careful we may be in respect to detecting and educating chronic carriers among the convalescents there is an absolute certainty that some carriers will escape discovery because they never have been patients.

A proper examination of the whole 4,500 population is too costly and impracticable. One must, therefore, hope to educate in time the whole population into sufficiently clean habits to minimize the risk from undetected carriers. This outbreak shows we have signally failed so far; we owe this outbreak to a previously undetected carrier working on a dairy farm and with not even the rudiments of hygiene.

§9. Widal Test in Carrier Investigation.

The Health Officer is faced with the task of tracking down the responsible carrier, and quickly too. I have indicated my opinion that when he reasonably suspects a common article of food as being the vehicle of infection he should explore two fields; the discovery of persons who, from their habits and opportunities, are likely to be infectors, and

at the same time to proceed with routine laboratory and clinical examination. Faeces specimens are usually freely and honestly given so that so long as instructions are understood any person may do the collection and take them to the laboratory. In this way one may chance quickly on an active carrier as was done in a previous outbreak. At the same time blood should be collected for Widal examination. This unfortunately requires a highly skilled technique and, unless a large staff of trained officers is available, will take a long time and at the best will not do more than indicate where the carrier may be found.

§ 10.

If, as in this instance, the first round of faeces examination gives negative results, the results of the blood examinations may indicate one or more persons on whom it would be wise to concentrate. It must always be remembered that the suspect has rights as well as have his fellow citizens who want him detected and shut up. I have said that the suspect usually co-operates in respect to faeces examinations, but he frequently jibs at blood taking, especially if the idea be new to him. It requires persuasion and it seems that it is best done by the medical officer who can sympathize with his reluctance, explain his difficulties, and generally obtain his co-operation and even his enthusiasm in the matter. All this takes time but the results pay if only that they help to confirm negative results.

But when a positive Widal is found it encourages the medical officer to persist in attempting to obtain a positive result from faeces or urine culture, which is the only indicator of the carrier state which our Courts would recognize if it came to legal enforcement..

§ 11.

There does not appear to be a great deal of work done on carriers, especially in respect to intermittently active ones, but we have been fortunate in having a few proved cases under observation. It is well known that the chronic carrier state may persist indefinitely after an attack of typhoid, but it is not known if the Widal reaction of the blood is influenced by the persistence of the living bacillus or whether it be more a residuum from the clinical attack, or in other words, does a Widal positive reaction indicate "carrier" or merely "old patient"? Three cases not connected with this outbreak illustrate this problem.

| | | |
|--|----------------------|---|
| A.—Typhoid 12 years previously | Widal 1/150 .. | Widal 15 days after $\frac{1}{2}$ cc. T.A.B.; Ty. = 1/800 |
| B.—Typhoid 3 years previously | Widal H/160, 0/20 .. | Widal during attack of P.U.O. H/160, 0/160 |
| C.—Date of attack not known; believed to be 25 years ago | Widal H/320, 0/20 + | No other readings available |

All these were carriers and all were discovered on account of the Widal pointing the way.

§ 12.

This also indicates the known tendency of the "O" figures to fade more quickly than the "H" (they return under any sort of febrile attack). Any such figure therefore should be suggestive and it will repay concentration on such persons even if another carrier has already been discovered. There may easily be two. In the present outbreak, as will be remembered* (Part I., Chapter V., see also Appendix I.), in spite of failure to demonstrate a +ve faeces culture and the complete absence of any history of typhoid or any similar sickness, the presence of a Widal reaction very similar to that of C above enabled the carrier state to be demonstrated.

§ 13. Secondary Cases.

I have much relief in reporting the remarkably small number of definitely secondary cases, but there are many that could be either primary or secondary.

The period of infection before the outbreak was so long that many cases had developed before the first became known. The milk infection ceased on the 16th or 17th, but many onsets have been dated well before that time, in fact, 177 cases had already occurred which were certainly not diagnosed and possibly not even suspected. It seemed most likely that many secondary cases would occur and possibly they did but, if they did, they fell within the primary incubation period and there were no obvious circumstances suggesting a secondary nature. But when a case occurred so long after the stopping of the milk that milk infection might be in doubt a more careful inquiry was made. The results are that only five cases* can be said to be undoubtedly secondary, three family cases and two neighbour infections. Four more were doubtful, that is, they may have been primary milk-infected cases but more probably were family or neighbour infections.

There is no possible control of secondary cases before the outbreak is discovered and the source of infection is disclosed. There is no practical purpose to be served in spending time on them, except again to stress the want of any connexion between the outbreak and local sanitation. It is a different story when the supposed cause has been disclosed and stopped. After that any secondary infection is due to some carelessness, culpable or inadvertent.

It is thus with much pleasure that I again bring to your notice the activity of the Council and officers of Moorabbin City and the co-operation of the citizens. Their calmness and freedom from panic in spite of what promised to be a devastating outbreak is very gratifying.

* Not including four hospital staff cases.

CHAPTER VI.

DURATION OF SICKNESS AND FORECASTING.

Attempt to predict number of cases, beds, time, &c.—Length of sickness period—Unknown factors—Deaths—Length of stay in hospital—Formula for predicting number of cases—Deaths and carriers.

§ 1. Duration of Sickness.

An attempt has been made to indicate what might be looked for not only in the numbers of beds necessary but the number of days each bed will be required. The age of the patient may have effect on this, as is shown in Table 23 and the accompanying Graph 5.

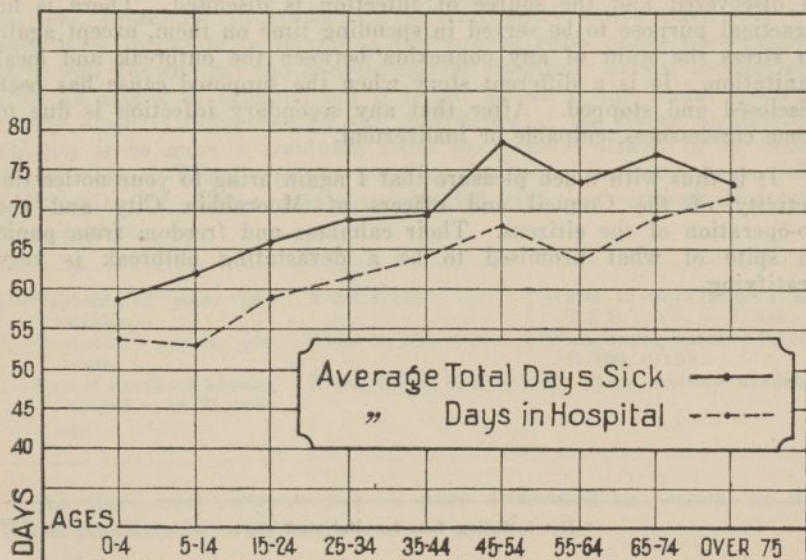
TABLE 23.

The Number of Days of Sickness and the Number Spent in Hospital in Age Groups of 400 Consecutive Patients.

| Ages. | Number of Cases. | Days Sick. | | Days in Hospital. | |
|-----------------------------|------------------|------------|----------|-------------------|----------|
| | | Total. | Average. | Total. | Average. |
| 1 to 4 | 45 | 2,762 | 59.4 | 2,410 | 53.6 |
| 5 to 14 | 128 | 7,854 | 61.4 | 6,745 | 52.7 |
| 15 to 24 | 81 | 5,300 | 65.4 | 4,823 | 59.5 |
| 25 to 34 | 54 | 3,704 | 68.6 | 3,276 | 60.7 |
| 35 to 44 | 37 | 2,560 | 69.2 | 2,304 | 64.3 |
| 45 to 54 | 28 | 2,176 | 77.7 | 1,908 | 68.1 |
| 55 to 64 | 8 | 588 | 73.5 | 514 | 64.5 |
| 65 to 74 | 4 | 305 | 76.2 | 278 | 69.5 |
| Over 75 | 3 | 223 | 74.3 | 215 | 71.6 |
| Total | 388 | 25,472 | 65.6 | 22,475 | 57.9 |
| In hospital 1st July, 1943* | 2 | 203 | 101.5 | 197 | 98.5 |

* There were others still in hospital which would raise these figures.

GRAPH V



Although the figures are small there can be no doubt whatever that the number of days both of average total-sickness-time and average time-spent-in-hospital rises more or less steadily as age progresses. The total number of bed-days to be provided for of course is = *number of patients* \times *average time* as is shown in Graph 5.

§ 2.

Prognostication unfortunately is liable to be falsified by an indeterminable number of complications tending to prolong the bed-duration. These are notably in three classes—

- (i) The carrier state;
- (ii) debility and effects of other infirmities such as Bright's or diabetes; and
- (iii) direct complications such as bone affection.

The carrier state has been discussed elsewhere and general debility of course is a feature of old age, but apart from this we have found in this outbreak a dozen or so patients who when quite recovered from the Typhoid Fever attack were suffering from such things as broncho-pneumonia, nephritis, pleurisy, cardiac disease, bed sores and diabetes. Two other patients will be in hospital for a long time with typhoid spine disease and there is one patient with a suspicious involvement of the great trochanter. I can find no reliable guide in estimating such delay in discharge, for the paradox appears that the more skilful the attention given the more likely these patients are to survive, and by a long sickness and recovery raise the total number of bed-days to an unpredictable figure.

§ 3. Deaths.

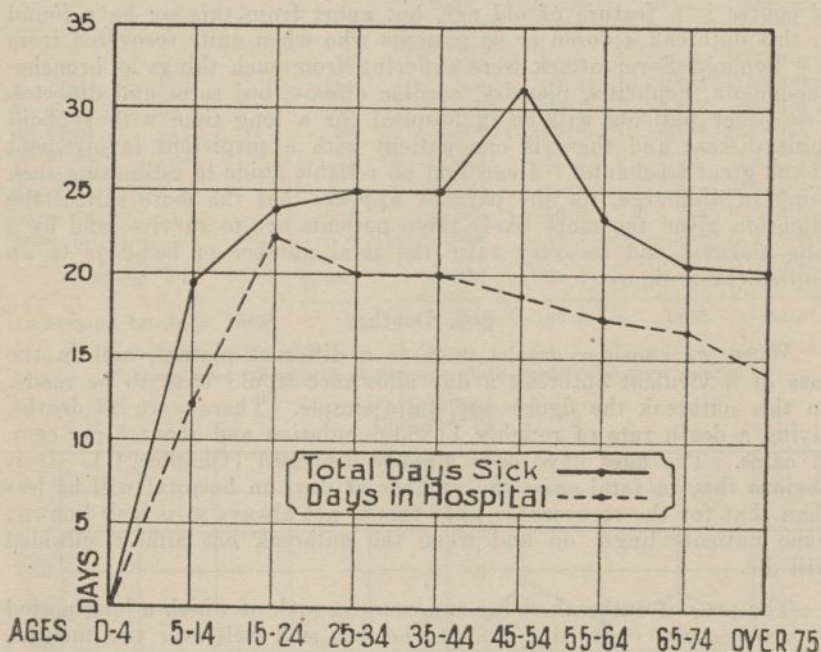
When we consider deaths there is a different picture, and in the case of a virulent outbreak a due allowance would have to be made. In this outbreak the figures are quite simple. There were 23 deaths, giving a death rate of roughly 1:200-population and about 5 per cent. of cases. The ages have been already discussed (Chapter I.). It is obvious that in fatal cases the number of days in hospital will be less than that for the recovered. That this is not always so is well known; some patients linger on and when the outbreak has almost subsided will die.

The present outbreak shows two cases in each of which a long period of sickness was endured:—No. 1, who was sick well over two months, and No. 9 for roughly three months. As an intercurrent disease was ultimately suspected of being the cause of death in each case, I am removing them in this particular discussion from the list of deaths but not classing them with the non-fatal. Compare the days involved in Table 24 and Graph 6 with the former (Table 23, Graph 5). It would appear that middle age resists the fatal attack longer than each extreme.

TABLE 24.
Fatal Cases.
Average Duration of Sickness and Time Spent in Hospital.

| Ages. | Average Time in Days. | | Ages. | Average Time in Days. | |
|-------------|-----------------------|--------------|------------|-----------------------|--------------|
| | Sick. | In Hospital. | | Sick. | In Hospital. |
| 5 to 14 .. | 19½ | 12 | 45 | 31½ | 19 |
| 15 to 24 .. | 24 | 23½ | 55 | 23 | 18 |
| 25 to 34 .. | 25 | 20 | 65 | 20½ | 17½ |
| 35 to 44 .. | 25½ | 20 | Over 75 .. | 20 | 14 |
| | | | Total .. | 23½ | 17½ |

GRAPH VI



It is worthy of note that the old idea that the fatal period is about three to four weeks strikingly holds true in these cases.

Causes of death do not come into a report of this nature and are dealt with by other officers.

§ 4. Forecasting the Course of an Epidemic.

It would be of inestimable value if at the beginning of an outbreak one could foretell the number of cases, the beds required, the deaths, the number of carriers, and the length of time before new cases ceased to occur, but there are so many unknown factors that any figure given in advance must be closely related to a guess. But so long

as this is understood one is able to narrow the extent of the field a little and place the estimate, still somewhat of a guess, within some reasonable bounds.

The length of time the outbreak will last depends mainly on two factors: (1) the time elapsing before the discovery of the carrier with the consequent removal of risk, and (2) the incubation period. The outbreak should show signs of ceasing, therefore, about 14 days after the risk is removed and should be completely in hand in 20 to 25 days, provided, and a big proviso it is, that everyone has co-operated, patients have been isolated, and the Health Officer's instructions carried out in an attempt to prevent secondary cases, and later to try to avoid return cases by inoculation and by a vigorous search for convalescent carriers.

An estimate of the number of cases is the next task. There is no rule nor can there be any that will bear scientific scrutiny; but there are some empiric aids which make our guess a little more reasonable. The simplest is that used by the late Dr. Claude Ker, of Edinburgh:

The number of cases = $K \times (\text{number at risk} \times \text{number of days of risk})$.

He suggested that K should be about 0.25 per cent., which should be varied to suit circumstances—small in outbreaks in districts accustomed to typhoid, and larger in those running wild in a virgin field, i.e., from $\frac{20}{10,000}$ say to $\frac{40}{10,000}$.

It is plain that this irrational formula does not demand nor yield great accuracy.

Applying this on the third day of the outbreak we compromised with a constant of 0.35 per cent. (Moorabbin being "nearly virgin"), the population at 5,000 and the period of risk three weeks. Thus:—

$$\text{Number of cases} = 5,000 \times 21 \times \frac{3.5}{1,000} = 367 \text{ or say between}$$

350 and 400 of which 250 were expected in the first fortnight.

The actual figure was nearer 475 which was accounted for, to our satisfaction, by the supposition that the area was more nearly virgin than we thought and by the later discovered fact that cases had been occurring earlier, that is, the days of risk were more numerous than at first believed. In a previous outbreak the position was reversed; 60 cases were expected and 50 odd occurred.

Other calculations were easier and errors began to cancel out.

§ 5.

Case mortality rates are said to vary from 6 to 10 per cent. and over. Seven per cent. seemed a fair Victorian figure and from 18 to 30 deaths were expected—twenty-three have occurred and not more than two others dangerously sick.*

§ 6.

Chronic carriers are usually expected in the proportion of about 5 per cent., of which twelve are now under observation and six still in hospital.† The average stay in hospital is roughly stated eight weeks to three months and so on. This is not advanced with any pretention to accuracy. As estimate must be made and although merely a stab in the dark our formula at least indicates the approximate direction for the thrust.

* 1st August—all recovering.

† See end of Chapter IV., Part 1.

PART 3.

SUMMARY.

I. In March, 1943, a serious outbreak of Typhoid Fever began at Cheltenham, a part of the City of Moorabbin. The City of Moorabbin is a part rural, part suburban municipality on the edge of the closely built up metropolis. The population is midway in character between urban and country, and in 1943 is estimated to be just under 24,000, only a portion of which was affected, namely, about 4,500.

Age distribution is normal except for an excess of young married couples and young babies.

Soil: sandy and undulating. Vegetation: principally tea-tree and heaths. Cultivation: mostly market gardening. Climate: warm temperate, few frosts. Rainfall: 20 to 25 inches.

Sanitation—

Drainage.—Normal in north-west not affected area. This area is sewered.

In affected area: patchy and mostly unpaved (nature of soil has so far prevented nuisance).

Nightsoil Service.—Double-pan weekly. There have been many complaints of dirty practices, topping pans, tipping fluids in streets, and not clearing closets at proper times.

Vermin, flies, and rats.—Plentiful, but type of outbreak not compatible with vermin as cause.

II. Water Supply.—Melbourne and Metropolitan Board of Works reticulation service, good and of high quality.

Food Supply.—Food is the normal urban type; ample, with no shortages except possibly Vitamin B groups.

Milk.—Delivery “zoned,” one supplier for whole of affected area. Farms and retailers trade under licence of Department of Agriculture. Councils and Health Department also supervise matters of cleanliness and disease.

Zoning eliminates competition and prevents customers choosing pasteurized milk.

Dairy for milk zone affected is at Cheltenham. Proprietor has two depots outside the zone in Mentone.

Dairy farmers strain and water-cool milk. Milk is collected by carters who deliver it to dairies under contract to farmers. The cooling is imperfect and the milk may be many hours on the road.

Dairy milk is brine cooled and stored at 32 deg. F.

Can washing is done by scrubbing in hot water and soda. The cans are then rinsed, drained, and steamed. The lids sometimes are not cleaned.

Most of the milk is “loose,” some is bottled. Loose milk liable to contamination from the stirrer and from the dipper.

The driver has no access to sanitary convenience or washing facilities.

Return milk does not go on the round again. It is sold over the counter at the dairy.

There is a shop in Cheltenham, an exception to the zone rule. This shop is a milk bar with a big turnover. Its supply is derived from another dairy and is not a part of the Cheltenham zone supply.

Excepting one 50-gallon can the milk was not pasteurized.

Other foods were eliminated, the only suspects were water and milk.

The farmer stopped supplying milk on 15th March, 1943, so that the 16th or 17th is the last date of infection by that farm.

III. The Municipal Council administers the Health Acts. The Commission of Public Health has all the powers of a council and is supervisory. The Minister of Health has the powers of both Commission and Council. The Health Department is the executive branch and carries out the policy laid down by the Commission and the Minister.

Typhoid Fever has steadily declined in Victoria from earliest times. The credit of this decline is not attributable to installation of sewerage.

The typhoid incidence in Moorabbin City in the past has not been high, and that of the affected area has been as low as any neighbouring district.

IV. *The Outbreak.*—There were two early cases, both anomalous. No alarm was felt. Four scattered cases were reported on 15th March. The Health Department was consulted, and at request of the Medical Officer of Health took over supervision of the outbreak.

All patients were customers of one dairy. This is not significant as one dairy supplied the whole area or zone.

The next day 30 cases were reported, all in milk zone.

Investigation of farmers, carters, &c., was begun and specimens of faeces were collected.

Warnings were issued to local physicians and advice to citizens.

First specimens were all negative, second specimens ditto. Blood examination revealed one suggestive person, the wife of a dairy farmer, and who later was shown to be a carrier (+ve faeces).

Accommodation.—Beds and staff were insufficient, being already taxed by war effort. General hospitals allotted beds and Queen's Memorial Infectious Diseases Hospital acted as co-ordinator. No serious delay in finding beds occurred, although cases were being reported up to 30 in one day. Provisional estimate of total cases was from 350 to 400.

Inspection.—Health Department supplemented Council's part-time officers. Neighboring Councils also assisted. House to house inspection was inaugurated.

Disinfectants were not relied upon. Psychic effect of smell and fly-repulsion were the qualities demanded. Phenyle-kerosene emulsion (1:2:12) supplied these.

Infected sanitary pans were marked with red to indicate need for special treatment.

Search for infection eliminated everything from suspicion except water and milk. All dairies and farms connected with the supply were closed and the milk destroyed for four weeks.

The outbreak virtually ceased at end of first week in April; a few secondaries occurred later.

V. Water was strongly suspect. The case-area and water-area appeared to coincide.

A large nightsoil depot is at the head of a gully in which a water service pipe was cut on a significant date. Many facts against this idea are known:—No nightsoil on this slope; no actual discharge of foul drainage known to flow this way; pipes opened and emptied skilfully; some cases occurred before the date of cutting pipe; and the main supplied another well populated area which has had no cases.

Milk was supplied in two groups, C and D. Inspection of C and D sources of supply showed all D group good, and C group unsatisfactory—one poor, one bad, and one filthy. D group milk had also been used in other areas with no cases. Finally, after two failures a carrier was found on the farm above labelled “filthy.”

The farmer stopped supplying milk on 15th March, 1943, so that the 16th or 17th is the last date of infection by that farm.

The case against milk apart from the known presence of a carrier is—

Milk zone coincides with affected area but not with the densely populated area, the water area nor the sewerage areas.

All patients were consumers of suspected milk and no person not using suspected milk was infected. (*Note.*—Especially customers of a large milk bar using other milk.)

Visitors from other districts who used milk even on one occasion were infected.

No other cause can be discovered.

PART II.

1. Ages conform to orthodox ideas. The incidence is greatest in school ages and somewhat lower in pre-school age children and young adults. The rate for ages from 35 years upwards remains constant. No cases occurred in infants under twelve months. No cases occurred in the very aged but only ten were at risk.

Deaths, on the other hand, show a slight peak in young adults and rise sharply after middle age. No deaths occurred in pre-school age children.

Locality distribution is normal.

2. It is of extreme importance to the medical officer to know if the amount of infecting material need be small. There is evidence that it is very small. This might be because the bacillus multiplies after ingestion. There is even the possibility that infection may be passed from person to person in a saprophytic manner. Incubation is discussed.

The difficulties are want of definite times for infection and the vague insidious onset. Several cases are available which give definite dates. The conclusion reached is that 10 to 24 days is the normal period, of which 12 to 17 or 18 is most common. A few may occur earlier or later, but anything much earlier or later is suspect. The onset is also discussed and symptoms tabulated. The conclusions are indefinite. No particular syndrome pointed to Typhoid Fever except a mental brightness not usual with the physical condition of the patient and his temperature.

3. Accuracy in diagnosis is essential in early stages. It is important to exclude other sicknesses, and a rigid definition or standard of typhoid infection was adopted to exclude other diseases and non-clinical chronic carriers. Laboratory findings were subordinated to clinical observation because the speed of the latter was much greater and usually just as, if not more, accurate. Several undoubted cases gave no laboratory confirmation at all and, on the other hand, several laboratory technical cases had no appropriate clinical condition.

Speed and accuracy are not compatible, but the error, although greater in the quick diagnoses, was small. The accuracy in the early part of the outbreak was remarkable.

4. Inoculation was not advised in mass for fear of aggravating or precipitating an attack. People, nowadays familiar with procedure, demanded it, and a large number of inoculated persons caused a depreciation of value of Widal test in diagnosis. Inoculation seemed to precipitate the attack which was then, however, of a mild nature. Inoculation, even of very recent date, seemed to protect as did 25-year-old inoculation in 1914-18 veterans. Inoculation with TAB was the usual method, and A and B reactions served to distinguish Widal reactions due to clinical disease from those due to inoculations.

5. Patients when well were discharged after three negative culture attempts. Carriers, if co-operative and intelligent, were released under surveillance with instructions about washing, handling food, and disposal of excreta. The Widal test is useful in searching for carriers. It is in no way conclusive, but strongly encouraging to persist in search. There have been very few secondary cases and a few doubtfuls, a good position due to activity of the local Council and co-operation of citizens. Latest results show liability of apparently cured carriers to relapse.

6. Length of stay in hospital up to date averages 65-66 days. An attempt was made to foretell the progress of the epidemic, and although accuracy cannot be reached a fair indication is possible.

CONCLUSIONS AND RECOMMENDATIONS.

The Moorabbin outbreak was typically milk borne. There were few secondary cases, and most of these, if not all, were directly or indirectly due to sanitary faults which were serious, especially in connexion with the collection and removal of excreta.

A carrier who could have been the cause of every case was discovered and removed to hospital, and the outbreak died a natural death.

But the sanitary faults, and especially the want of sewerage system, had no influence in causing the outbreak and little in its spread. Want of sewerage can cause many troubles but an explosive typhoid outbreak is not one of them.

The outbreak followed the usual lines of one which has been interrupted by the removal of the carrier.

It presented few new facts beyond some confirmation of old ideas on age-incidence, incubation period, and length of sickness.

On the whole it was not a mild outbreak, but appeared to be mild because modern scientific knowledge enabled us to detect many mild cases and so lower the average of severity.

The lessons to be learned are not many but are clearly indicated.

1. Production of milk at a profit and the supply of safe milk to a town should not be supervised by the same individual or set of individuals. Each is a separate industry and liable to find its interests just or otherwise at variance with the others.
2. The sanitation of a community so closely settled as this one should be as nearly perfect as possible. Sewerage, drainage, water supply, and all the modern aids to housekeeping should be extended to as many parts of the State as the finances of the people will permit.
3. The health staff should be adequate in each community or a large reserve of trained persons should be available either by united municipal action or by the Health Department. Although the war did aggravate the bad position, it would have been little better in peace time. As it was, the Department could spare the necessary officers by neglecting other important but less pressing matters, and this only at the risk of a serious breakdown of the organization should any one of the officers, State or municipal, have taken sick.
4. This is not a new lesson but one that is repeated at every outbreak—

Farms must be clean, milk must be clean, pure, and unsophisticated and above all pasteurized.

I would therefore beg to recommend that—

1. Full-time officers be employed in all health services. If the community be too small to achieve this, it is suggested that a health service be arranged to serve several communities; such a service as is suggested in the Greater Melbourne proposals.
2. The "amenity services," such as roads, water supply, lighting and drainage, be pushed on, as soon as circumstances permit, into every portion of the State.
3. In particular, the larger suburban areas of Melbourne, namely, Cheltenham, Chelsea, Ringwood, and possibly Belgrave, Croydon, Ferntree Gully, and Frankston, be considered areas urgently needing sewerage systems and in one case a water service.
4. The milk supply for towns throughout the State be re-organized. This is too big a subject to be dealt with in detail, and I must be content with mere outline, which I have set out separately.

Recommendations on Milk Supply.

Although I recommend that re-organization be first applied to Melbourne, that is only because this outbreak has centred attention on this area. The principle is the same for every town in the State.

namely the present system leaves any community, clean or otherwise, open to the same disastrous risks that applied to Moorabbin City. My recommendations are—

1. Experts shall supervise the production of milk, to educate and assist the farmer as is the present practice.
2. A public body, not the same as the first, shall control the treatment and delivery of the milk to the consumer. This is preferably the consumers themselves, through their representatives, as is now the case in respect to water and sewerage and to roads and drainage.
3. All milk shall comply with standards of purity, cleanliness, and quality, as is now required, and if so far satisfactory shall be pasteurized. If not satisfactory it shall be rejected.
4. The pasteurization shall be controlled, not merely supervised, by a public body, preferably the consumers as mentioned in paragraph 2.

Pasteurization by private persons, even under supervision of occasionally visiting officers, is liable to be unsatisfactory, and maybe an even greater danger than no pasteurization at all.

5. The milk once rendered safe by pasteurization shall be packed without human contact, that is, automatically bottled or canned, and delivered in that package unopened to the user. Bulk deliveries of pasteurized milk are excessively dangerous.

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APPENDIX I.

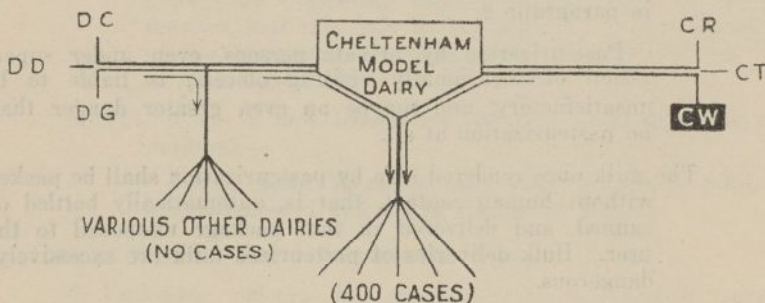
ELIMINATION OF CERTAIN DAIRIES FROM SUSPICION.

Group D (no carriers suspected).

Milk from farmers D.C., D.D. and D.G. was carted by Carter D to the Cheltenham dairy twice daily. According to the contract the dairy had the right to refuse milk a specified number of days per month. In the cases of these three farmers, this right was exercised freely and the carter was able to divert this unwanted milk to other dairies who wanted an extra supply or, as it is termed in the trade, "accommodation milk." Throughout February large quantities sometimes daily were thus diverted from Cheltenham dairy to others in Brighton, Sandringham, South Melbourne, and St. Kilda (see Appendix II.). No cases have been reported in any customers of the dairies receiving this "accommodation" milk.

The following diagram illustrates this point:—

Diagram 1.

DIAGRAM ILLUSTRATING DIVERSION OF MILK FROM
"D" FARMS.*Group C (suspect carrier group).*

A careful attempt was made to discover any similar diversion to other dairies of the milk produced on the other three farms, C.R., C.T., and C.W. (Carter C). No instance was discovered and all the records show that the total yield from these farms was received at the Cheltenham dairy.

A possible instance was found in a re-sale of large amounts of milk from the Cheltenham dairy (up to 300 quarts in one instance) to a retailer in Sandringham, among whose customers no cases occurred. Should it have been shown that Group C milk had gone to this Sandringham dairy it would have had a most important bearing on the matter of incubation periods or even have disproved the "milk-borne" hypothesis. Unfortunately, or fortunately, as one looks at it, it was shown that there was an extreme unlikelihood that any milk from Group C was included in this or any other diversion from the regular disposal within the milk zone. Thus, "D" milk went to other areas and caused no cases, "C" milk all went to Cheltenham, and if an incubation period of about fourteen days be accepted, then in spite of the fact that one farm in the D Group (D.G.) was contaminated with sewage effluent, it would seem that all three farms of Group D (D.C., D.D., and D.G.) must be eliminated. This leaves us only the farms C.R., C.T. and C.W. under suspicion. Inspection showed the following conditions:—

C.W.—Inspected on the 16th March and 18th March. Managed by a couple who had taken over the day previously. Personal habits good. Domestic condition very dirty. This was due to dirt left by previous manager. House filthy and actually smelled of stale human habitation, in spite of obvious strenuous efforts by the new occupants to clean up. Several deposits of child faeces seen near the house. No children in the new family. Closet dilapidated

and foul, its pan contents suggested it was not much used as a receptacle for urine. On the 16th C.W., the former occupants, had moved to a house nearby. This C.W. family consisted of a man, wife, and four children aged 8/12 to 7 years. On the 17th the house they had occupied for two days only was dirty and smelly. The wife was dirty and untidy, the children were filthy. The wife was sickly looking, but denied any possibility of any of the family's having had typhoid fever. The state of the home and conversation of the wife showed *complete* indifference to ordinary sanitary decency. Her mental age appeared about 8-10 years. If this person had any dealings with cows it was highly probable that the milk would be contaminated. Her obvious physical condition prompted direct questioning which elicited a history of periodic attacks of "stomach trouble" with some looseness of the bowels. She became at once Suspect No. 1.

C.T.—This farm was managed by C.T., who was also the proprietor of C.W. farm. The household consisted of C.T., his housekeeper, and her infant. Although domestic conditions were very poor, the personal cleanliness did not suggest a likely contamination. Hands and clothing were clean, although the want of facilities together with overwork tended to a low standard of house cleanliness and comfort.

C.R.—This farm, *qua* dairy farm, was very low in standard of technical equipment and facilities for maintaining cleanliness. The household consisted of a man, wife, four children (eldest aged 12-13), and an elderly man employed as a helper. Again it was evident that overwork and probably shortage of capital prevented both an efficient farm and a high standard of domestic cleanliness and comfort. Although it could not in any way be compared with C.W. in the matter of dirtiness, it was in no way a clean farm or household. The elderly employee, moreover, had had typhoid in early boyhood.

None of these Group C farms, therefore, could be freed from suspicion.

Both groups (families included) were subjected to a bacteriological investigation. The results were interesting and are better tabulated.

TABLE 25.

| Farm. | Faeces (First Specimen). | | Faeces (Second Specimen.) | | Blood H. | Blood O. |
|---------|-----------------------------|----|----------------------------------|----|---|-----------------------|
| D.C. .. | All -ve | .. | All -ve | .. | All -ve .. | All -ve |
| D.D. .. | " | .. | " | .. | " .. | " |
| D.G. .. | " | .. | " | .. | " .. | " |
| C.W. .. | " | .. | { Wife +ve .. Remainder -ve.. | .. | Wife 1/300 .. Rest -ve .. | Wife 1/20 Rest -ve |
| C.T. .. | " | .. | All -ve | { | Housekeeper 1/80 Rest -ve .. | } All -ve |
| C.R. .. | " | .. | " | { | Employee 1/160 Daughter 1/20 .. Rest -ve .. | } All -ve |

C.W. seemed to supply the carrier, but it was nearly a fortnight before confirmation could be obtained.

The wife of C.W. and the elderly employee of C.R. were admitted to hospital where the above finding was confirmed, namely, the wife of C.W. a biliary excreter and the man not a carrier. The woman has submitted to operation for this condition, and she was discharged on 13th June, 1943, well and cured of her carrier state.

APPENDIX II.

TABLE 26.

Diversion of Milk 1943.

| Quantity Diverted (Quarts.) | | | Farm of Origin. | | District of Consumption. | | | Date. |
|--------------------------------|----|----|-----------------|----|--------------------------|----|----|---------------------|
| Nil | .. | .. | | | .. | .. | .. | 1st to 7th February |
| 78 | .. | .. | D.C. | .. | Brighton | .. | .. | 8th February |
| 98 | .. | .. | D.D. | .. | St. Kilda | .. | .. | 9th February |
| 100 | .. | .. | D.G. | .. | St. Kilda | .. | .. | 9th February |
| 67 | .. | .. | D.C. | .. | Brighton | .. | .. | 10th February |
| 96 | .. | .. | D.G. | .. | South Melbourne | .. | .. | 11th February |
| 100 | .. | .. | D.D. | .. | Brighton | .. | .. | 12th February |
| Nil | .. | .. | | | .. | .. | .. | 13th February |
| 110 | .. | .. | D.G. | .. | Brighton | .. | .. | 14th February |
| 92 | .. | .. | D.C. | .. | Brighton | .. | .. | 15th February |
| 50 | .. | .. | D.D. | .. | Brighton | .. | .. | 15th February |
| 72 | .. | .. | D.C. | .. | Brighton | .. | .. | 16th February |
| 70 | .. | .. | D.D. | .. | Brighton | .. | .. | 16th February |
| 100 | .. | .. | D.G. | .. | Brighton | .. | .. | 16th February |
| 150 | .. | .. | D.G. | .. | Brighton | .. | .. | 17th February |
| 50 | .. | .. | D.D. | .. | Brighton | .. | .. | 18th February |
| 100 | .. | .. | D.G. | .. | Brighton | .. | .. | 18th February |
| 100 | .. | .. | D.G. | .. | Brighton | .. | .. | 19th February |
| Nil | .. | .. | | | .. | .. | .. | 20th February |
| 50 | .. | .. | D.D. | .. | Brighton | .. | .. | 21st February |
| Nil | .. | .. | | | .. | .. | .. | 22nd February |
| 100 | .. | .. | D.D. | .. | Brighton | .. | .. | 23rd February |
| 72 | .. | .. | D.C. | .. | Brighton | .. | .. | 23rd February |
| 100 | .. | .. | D.G. | .. | Brighton | .. | .. | 23rd February |
| Nil | .. | .. | | | .. | .. | .. | 24th February |
| Nil | .. | .. | | | .. | .. | .. | 25th February |
| 107 | .. | .. | D.G. | .. | Brighton | .. | .. | 26th February |
| 50 | .. | .. | D.G. | .. | Brighton | .. | .. | 27th February |
| 40 | .. | .. | D.G. | .. | Brighton | .. | .. | 27th February |
| 90 | .. | .. | D.G. | .. | Brighton | .. | .. | 28th February |
| 100 | .. | .. | D.G. | .. | Brighton | .. | .. | 1st March |
| 100 | .. | .. | D.D. | .. | South Melbourne | .. | .. | 2nd March |
| Nil | .. | .. | | | .. | .. | .. | 3rd March |
| Nil | .. | .. | | | .. | .. | .. | 4th March |
| Nil | .. | .. | | | .. | .. | .. | 5th March |
| 50 | .. | .. | D.C. | .. | Brighton | .. | .. | 6th March |
| 25 | .. | .. | D.C. | .. | Brighton | .. | .. | 6th March |
| Nil | .. | .. | | | .. | .. | .. | 7th March |
| Nil | .. | .. | | | .. | .. | .. | 8th March |
| Nil | .. | .. | | | .. | .. | .. | 9th March |
| 100 | .. | .. | D.C. | .. | South Melbourne | .. | .. | 10th March |
| 100 | .. | .. | D.D. | .. | Ormond | .. | .. | 11th March |
| 100 | .. | .. | D.D. | .. | Ormond | .. | .. | 12th March |
| Nil | .. | .. | | | .. | .. | .. | 13th March |
| Nil | .. | .. | | | .. | .. | .. | 14th March |
| Nil | .. | .. | | | .. | .. | .. | 15th March |
| 20 | .. | .. | D.D. | .. | Brighton | .. | .. | 16th March |
| 20 | .. | .. | D.D. | .. | Brighton | .. | .. | 17th March |
| Nil | .. | .. | | | .. | .. | .. | 18th March |
| Nil | .. | .. | | | .. | .. | .. | 19th March |

APPENDIX III.

CITY OF MOORABBIN.

TYPHOID FEVER OUTBREAK.

To Householders in the Infected Area.

The first stage of the Typhoid Fever outbreak in the Cheltenham, Highett, and Moorabbin districts is now passing, and subsequent cases may reasonably be attributed to faults in public and private cleanliness and hygiene.

Typhoid can only be contracted by the swallowing of infected food or drink. The infection occurs by contamination from the excreta or urine of a human patient or carrier.

It is unfortunately true that a person may be a carrier, and be utterly unaware of the fact, so that for the present emergency every person should help by considering himself a possible carrier.

Persons are therefore urged to take the trouble to properly deal with all bowel motions and urine in order to obviate any chance of such infection.

The usual methods of conveyance to food are by soiled hands and clothing, by dust, and, above all, flies.

These may be dealt with as follows:—

(a) After visiting the closet hands should be well washed with soap and water. *No place other than a closet* should be used as a convenience.

(b) Flies must be denied access to excreta by making the closet pan-*stead* fly proof, and seeing that the seat lid is closed at once.

The liberal use of disinfectant is strongly recommended.

“DISINFECTANT” FOR PAN CLOSETS.

Phenyle 1 part, kerosene 2 parts, well shaken, makes the stock. Take one part of stock and add three parts of water. Shake well before use. Pour two tablespoonsful in the pan after any kind of use.

PROTECTION OF FOODS.

Flies must be kept from any access whatsoever to foods. Should accidental access be allowed the food should be again boiled or destroyed. Boiling, however, is quite effective.

A like precaution must be taken against contamination of foods by dust and by unnecessary handling.

This applies especially to bread, cheese, butter, and all foods that may not be boiled.

Salad vegetables should be thoroughly washed in running water before use.

MILK SHOULD BE PASTEURIZED OR BOILED.

The disease is an insidious one and may begin with the vaguest “off colour” symptoms, usually with headache, feverishness, and an abdominal upset, such as diarrhoea or constipation.

Medical advice is urgently necessary in any suspicious case.

WHAT TO DO IF A CASE OCCURS.

Thoroughly disinfect all patients’ excreta, according to your doctor’s instructions.

The safest way is to place all such matter in a tin or bucket, stir with a stick and boil over a fire in the yard. Then burn the stick and empty the boiled faeces into the sanitary pan.

Clothing should be boiled if suitable, if not it should be soaked in lysol (2 per cent.) or germicide of similar action and washed in soapy water.

Blankets—contrary to the usual opinion—may be safely brought to the boil if all soap has been rinsed. No wringing whatever is to be done.

Mattresses.—If unsoiled should be well exposed to sunlight for four or five days. If soiled they are best destroyed by burning.

If necessary, consult the City Officers regarding this matter.

Bed utensils and slop pails should be boiled in the copper after having been well washed in a soapy lysol solution.

After attending to a suspected case, or soiled bedclothes or utensils, the hands should be carefully washed in 2 per cent. lysol or similar germicidal solution.

The Council is arranging for the Government to release disinfectants and germicides, and these will be supplied to householders from central depots. Full particulars will be announced in the daily press.

K. A. STEPHENSON, M.B., B.S.,
Acting Medical Officer of Health for the City of Moorabbin.

APPENDIX IV.

DATES OF CONNEXIONS TO SEWERS IN METROPOLITAN AREAS.

| Year. | | | | — | — |
|-------|----|----|----|--|-------------|
| 1897 | .. | .. | .. | Port Melbourne South Melbourne Melbourne Prahran Footscray | 17th August |
| 1898 | .. | .. | .. | North Melbourne Carlton | |
| 1899 | .. | .. | .. | St. Kilda Richmond Fitzroy Flemington Kensington | |
| 1900 | | | | | |
| 1901 | .. | .. | .. | Collingwood Caulfield | |
| 1902 | .. | .. | .. | Malvern | |
| 1903 | .. | .. | .. | Essendon | |
| 1904 | .. | .. | .. | Williamstown Kew | |

From this time onwards the progress was rapid, spreading outwards, and additions were continually being made during the years to districts already begun.

APPENDIX V.

I am indebted to Dr. Conway Dyte (Medical Superintendent, Alfred Hospital), and to Dr. Russell Sherwin (Medical Superintendent, Prince Henry's Hospital), for the short accounts of two puzzling cases.

No. 2 (R.R.).—This boy was an early ambulant case with either—(1) an unduly long prodromal period; (2) a remission after a fortnight's spell; or (3) a superimposed infection on some undiagnosed sickness.

The above-named first attended the Out-patients' Department of this hospital on 9th February, 1943, complaining of tiredness for several months, and thirst. Apparently he was not losing weight, and his appetite was normal. No dysuria. No sore throat.

Past History: No previous illnesses.

Family History: Mother and father alive and well. Two brothers alive and well. Two sisters alive and well.

His next attendance at Out-patients was on 12th February, 1943, when his 6.30 a.m. urine was N.A.D. His 11.30 a.m. urine had a trace of sugar.

On 22nd February, 1943, he was admitted to hospital, accompanied by a letter from Dr. Hudson, of Cheltenham, who had seen him eleven days previously. He had history of feeling off colour for three months and of having both sugar and albumen in his urine. His temperature was 101.4 deg., otherwise nothing abnormal was detected, and he was admitted for investigation.

On examination: His heart, abdomen, and central nervous system were clinically clear. He had some discrete glands in the axillae. His urine contained albumen but no sugar.

The following investigations were carried out:—

23rd February, 1943.—X-ray of chest N.A.D.

24th February, 1943.—Wassermann negative.

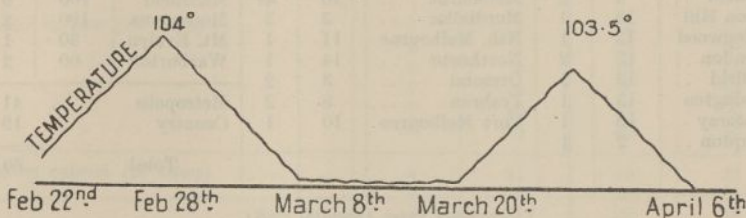
26th February, 1943.—Agglutination with B. Typhosis 1-160. No agglutination with B. Paratyphosis A. or B., B. Abortus, B. Proteus.

2nd March, 1943.—Blood culture positive for Ty.

5th March, 1943.—Urine negative. Faeces—B. Typhosis cultured (19th April, 1943, faeces negative).

The following is a rough diagram taken from his temperature chart.

Diagram 2.



069 (J.S.).—This patient was admitted on 7th April, 1943. She gave a history of ten days giddy turns, with an associated frontal headache. Seven days before she had had an epistaxis, which had recurred 24 hours before admission. Nine days before she had upper abdominal pain with nausea, but no vomiting. Her bowels had been regular, she had had occasional shivers and sweats. On admission her temperature was normal, and for the duration of her stay in hospital never rose above 99.4. Clinically she appeared perfectly well and had no complaints or clinical evidence of typhoid. Blood culture taken four days before admission was positive B. Typhosum, but two subsequent cultures were negative. Widal test was negative on two occasions—B. Typhosum was never cultured from her urine or faeces.

APPENDIX VI.

CASES JUST OUTSIDE THE MILK ZONE.

These cases have been grouped for convenience (see Maps 10 and 11):—

Groups 1, 2, and 3.—Six cases, all known to have been at risk either in the area or by milk brought from the area.

Group 4.—The Mentone cases (see below) (Map 10).

Group 5.—Two cases, one a secondary case and one a frequent visitor to the zone where milk was often taken.

Group 6. Two cases. One, an early case with no certain connexion but several possibilities, e.g., visitor to house of relative of case and who had mild undiagnosed symptoms. The other case well connected.

The Mentone cases, fourteen in all. These were not in the delivery area, but were among the 64 customers of either of the depots or branch dairies in Charman-road and Marina-road. Map 10 shows, as a point of interest, that all the patients lived within easy distance of these implicated dairies, but the areas around other dairies show no cases.

There were other cases further afield. At first it appeared that many cases which could not be connected with the Cheltenham Dairy were occurring outside the affected areas. These, however, were found to be not all typhoid cases. Tables 27, 28, and 29, in which these cases have been analysed, show that 33 are definitely part of the outbreak, three are doubtful, nine due to another discovered focus, and ten not traced; 60 all told. (This number has since been increased. See Table 6.)

Now in spite of the very small case rate for typhoid in Victoria some cases do occur, but it is striking that as many as 33 cases can be definitely traced to consumption of Cheltenham milk, and many of them at definite known dates which have been discussed in Chapter II., Part 2 (Incubation),

TABLE 27.
Cases Occurring Elsewhere than in or near Milk Zone.

| Place. | Dis- tance. | No. | Place. | Dis- tance. | No. | Place. | Dis- tance. | No. |
|--------------------|----------------|-----|--------------------|----------------|-----|-----------------|----------------|-----|
| <i>Metropolis.</i> | Miles. | | <i>Metropolis.</i> | Miles. | | <i>Country.</i> | Miles. | |
| Ascot Vale | 14 | 2 | Hawthorn .. | 8 | 2 | Clematis .. | 26 | 1 |
| Bentleigh .. | 4 | 1 | Kensington .. | 13 | 1 | Chiltern .. | 150 | 1 |
| Brighton .. | 4 | 1 | Kew .. | 10 | 1 | Croydon .. | 20 | 1 |
| Brunswick | 15 | 3 | Malvern .. | 6 | 1 | Daylesford | 100 | 2 |
| Caulfield .. | 4 | 2 | Melbourne .. | 10 | 4* | Mansfield | 100 | 9 |
| Clifton Hill | 15 | 1 | Mordialloc .. | 3 | 3 | Mooroopna | 100 | 2 |
| Collingwood | 13 | 1 | Nth. Melbourne | 11 | 1 | Mt. Evelyn | 30 | 1 |
| Essendon .. | 15 | 2 | Northcote .. | 14 | 1 | Warburton | 60 | 2 |
| Fairfield .. | 15 | 1 | Ormond .. | 3 | 2 | | | |
| Flemington | 13 | 1 | Prahran .. | 8 | 2 | Metropolis | .. | 41 |
| Footscray | 15 | 1 | Port Melbourne | 10 | 1 | Country | .. | 19 |
| Hampton .. | 2 | 1 | | | | Total | .. | 60 |

* Secondary cases (hospital staff).

TABLE 28.
How These Outside Cases were Infected.

| — | Visitor to Cheltenham. | Cheltenham Resident on Holiday. | Secondary. | Traced Elsewhere. | Not Traced. | Doubtful. | Total. |
|---------------|---------------------------|---------------------------------------|------------|----------------------|----------------|-----------|--------|
| Metropolis .. | 19 | 6 | 7 | Nil | 6 | 3 | 41 |
| Country .. | 1 | 5 | Nil | 9 | 4 | Nil | 19 |
| Total .. | 20 | 11 | 7 | 9 | 10 | 3 | 60 |

TABLE 29.
Relations of Persons Mentioned in Table 27 to Infected Area (See Map 1).

Visitors 21* from—

| | | | |
|--------------|-------------|------------|-----------|
| Ascot Vale | Bentleigh | Brighton | Caulfield |
| Clifton Hill | Essendon | Flemington | Footscray |
| Hawthorn | Kensington | Mordialloc | Northcote |
| Ormond | Sandringham | St. Kilda | Clematis |

Zone-residents 13* (staying at)—

| | | | |
|------------|-----------|------------|-----------|
| Brunswick | Caulfield | Essendon | Hampton |
| Fairfield | Prahran | Daylesford | Mooroopna |
| Mt. Evelyn | | | |

Secondary Cases (6)*—

| | | | |
|-------------|---------|-----------------|----------------|
| Collingwood | Malvern | North Melbourne | Port Melbourne |
|-------------|---------|-----------------|----------------|

Traced Elsewhere (9)—Mansfield

Not Traced (10)—

| | | | |
|------------|-----------|-----------|-----------------|
| Ascot Vale | Brunswick | Kew | South Melbourne |
| Croydon | Chiltern | Warburton | |

* Including doubtful connexion cases.

APPENDIX VII.

BLOOD, FAECES, AND URINE CULTURE AND WIDAL TESTS. TIMES OF APPEARANCE OF POSITIVE FINDINGS.

The following numbers (Table 30) express the duration of the disease in days at the time of taking the respective specimens:—

TABLE 30.

| | Duration of Disease in Days. | | Duration of Disease in Days. | |
|--|------------------------------|------------------------|------------------------------|------------------------|
| | Last Negative Result. | First Positive Result. | Last Negative Result. | First Positive Result. |
| Blood culture (12 cases) | 2 | 3 | 9 | 12 |
| | 3 | 8 | 12 | 13 |
| | 6 | 9 | 12 | 14 |
| | 7 | 8 | 15 | 16 |
| | 7 | 10 | 35 | 38 |
| | 9 | 10 | 49 | 56 |
| Faeces culture (26 cases) | 4 | 11 | 19 | 22 |
| | 4 | 14 | 20 | 24 |
| | 7 | 11 | 20 | 34 |
| | 7 | 15 | 23 | 27 |
| | 9 | 10 | 25 | 28 |
| | 9 | 13 | 25 | 28 |
| | 9 | 20 | 26 | 52 |
| | 10 | 12 | 30 | 37 |
| | 12 | 16 | 32 | 37 |
| | 12 | 22 | 44 | 48 |
| | 13 | 17 | 47 | 53 |
| | 15 | 20 | 60 | 64 |
| | 17 | 27 | 62 | 66 |
| Urine culture (10 cases) | 9 | 13 | 43 | 44 |
| | 18 | 31 | 50 | 54 |
| | 30 | 35 | 56 | 57 |
| | 35 | 37 | 60 | 75 |
| | 40 | 48 | 66 | 71 |
| Widal test (H = 1/160 or higher (8 cases)) | 7 | 8 | 10 | 15 |
| | 8 | 9 | 11 | 19 |
| | 8 | 15 | 11 | 29 |
| | 8 | 19 | 24 | 28 |

APPENDIX VIII.

MULTIPLE-CASE FAMILIES.

TABLE 31.

| Number of Cases in Family. | Each Number is the Case Number of First in his Family to be Affected. Names of others in Index. |
|----------------------------|---|
| 2 | 1, 12, 14, 22, 26, 38, 39, 40, 41, 48, 50, 54, 64, 69, 71, 87, 99, 101, 102, 103, 106, 111, 112, 115, 121, 125, 135, 144, 145, 154, 155, 158, 164, 171, 175, 179, 181, 189, 198, 209, 214, 218, 221, 233, 234, 248, 262, 263, 268, 281, 304, 311, 324, 334, 353, 357, 367, 377, 034 |
| 3 .. | 30, 35, 63, 85, 100, 104, 148, 152, 166, 183, 191, 194, 238, 256, 258, 302, 370, 400 |
| 4 .. | 9, 23, 52, 136 |
| 5 .. | 72 |
| Over 5 .. | House of Mercy, Cheltenham, 26; Naval Wireless Station, Moorabbin, 7; Hospital, Mansfield, 9 (not connected with outbreak). |

APPENDIX IX.

WHY TYPHOID FEVER WAS COMMON IN 1870.

(Collated from various contemporary sources.)

Sanitary and other practices respecting nightsoil in Melbourne and suburbs in 1860-70.

Cess Pits.—(a) Watertight; emptied by private enterprise;
(b) Others; abandoned when full and another taken into use.

Pails, chambers, &c.—Emptied into cess pits, gutters, middens, or the back yard, according to the sanitary status of householder. It was not an offence to use the dung pit for disposal of human faeces.

Removal.—(1) Private.—Contractors collected nightsoil in tanks (not inspected or standardized) from better class houses and removed it to private disposal places.

(2) Community.—Services similar, but in some cases the carts were standardized or approved and inspected.

Complaints of that time show that spilling and leaking were so common as to be a constant danger to health and a menace to ordinary decent cleanliness.

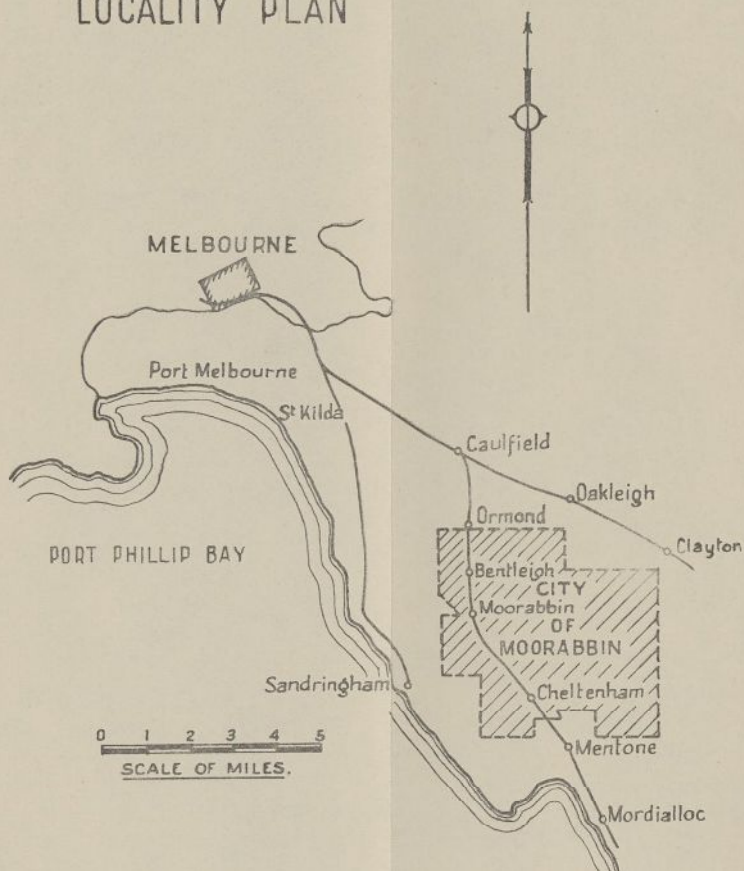
Disposal.—Some contractors and others used private disposal areas, mostly market gardens near the places served, others tipped the nightsoil into pits or into various streams, especially the Moonee Ponds Creek, Merri Creek, Kooyongkoot Creek (the name indicates a smelly sewer), and the Yarra itself, from which much of the town water was drawn (Yan Yean did not at the time serve the whole metropolis).

Septic Tanks.—A few existed, mostly at institutions. Some large hospitals discharged all this kind of refuse, including tissue fragments and drainage from postmortems direct to the street.

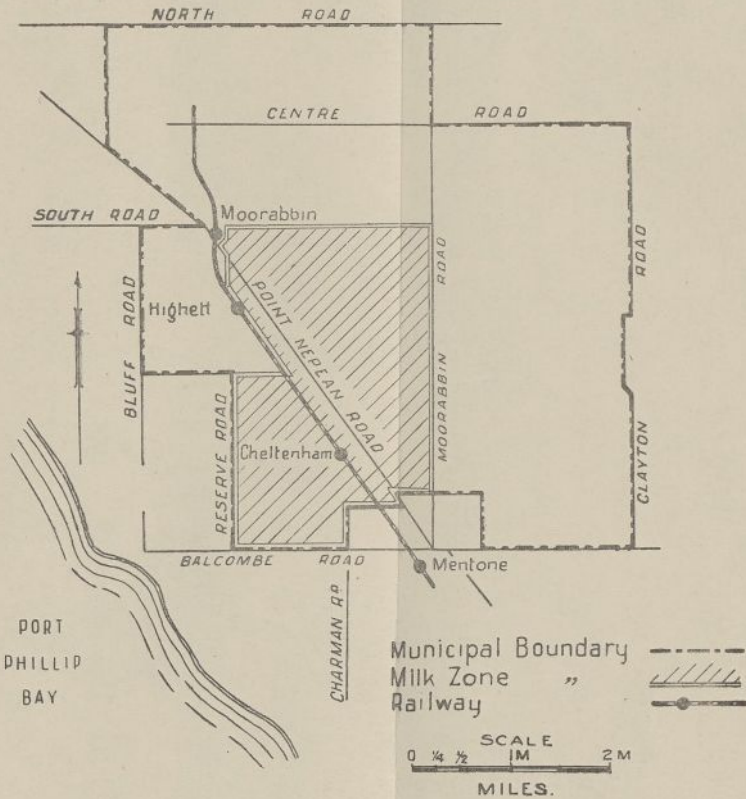
NOTE.—In defence of the community which permitted these things, it must be realized that typhoid and other fevers were at that time not thought to be communicable.

Map 2.

LOCALITY PLAN

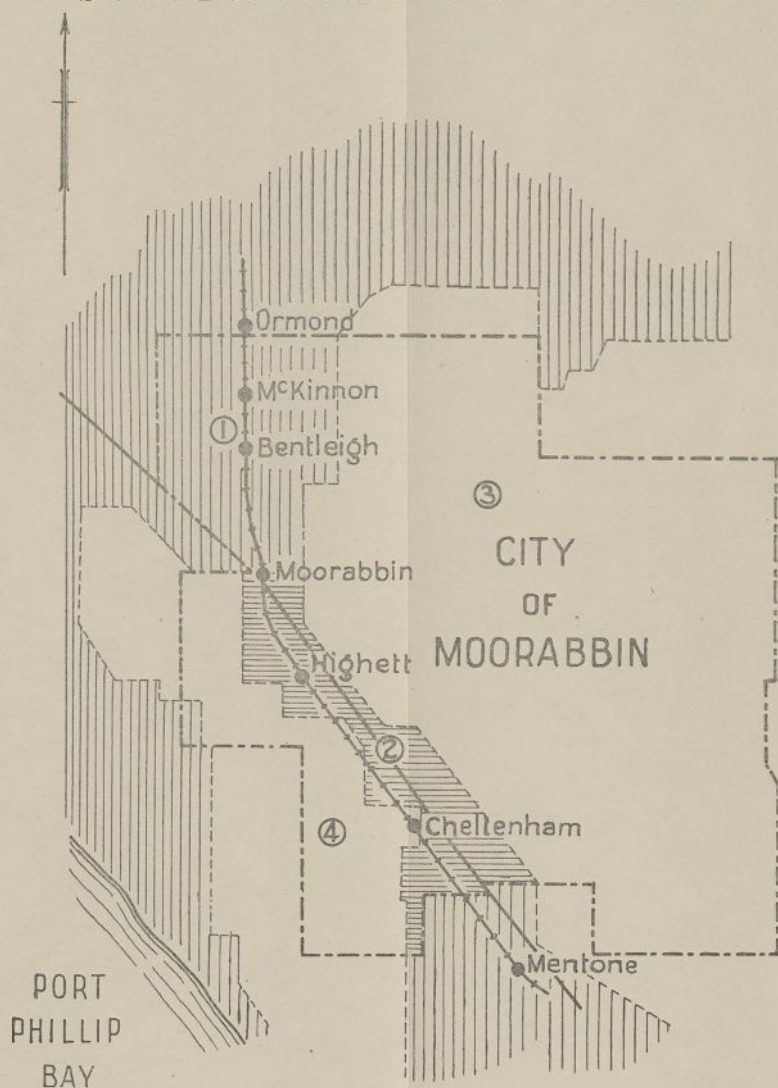


Map 3.
CITY OF MOORABBIN
AND
CHELTENHAM-MOORABBIN MILK ZONE.
(THE AFFECTED AREA.)

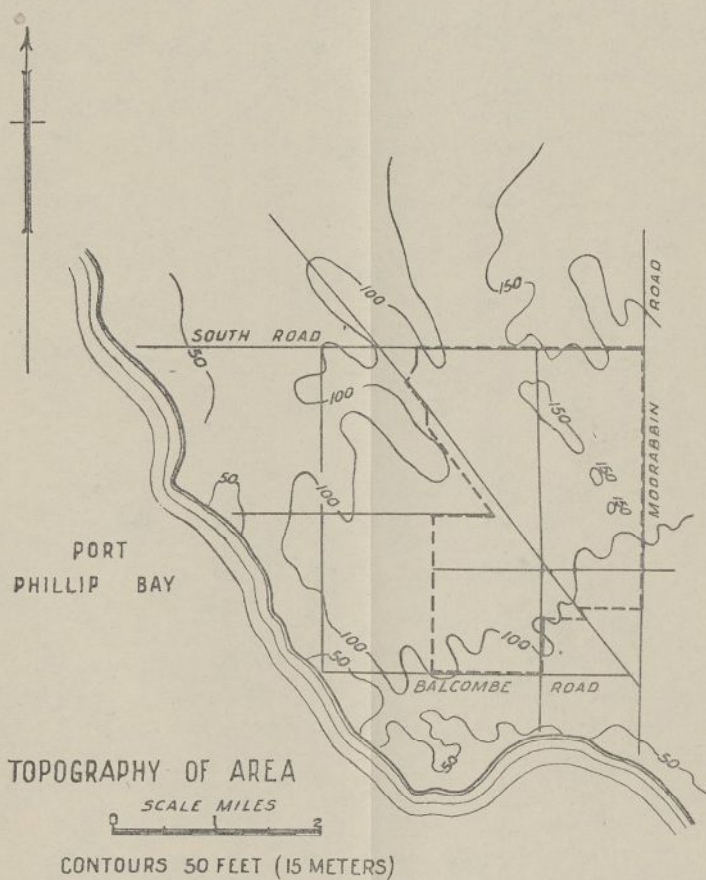


Map 4.

SKETCH PLAN, CITY OF MOORABBIN
SHOWING DIVISIONS INTO RURAL AND URBAN AREAS.

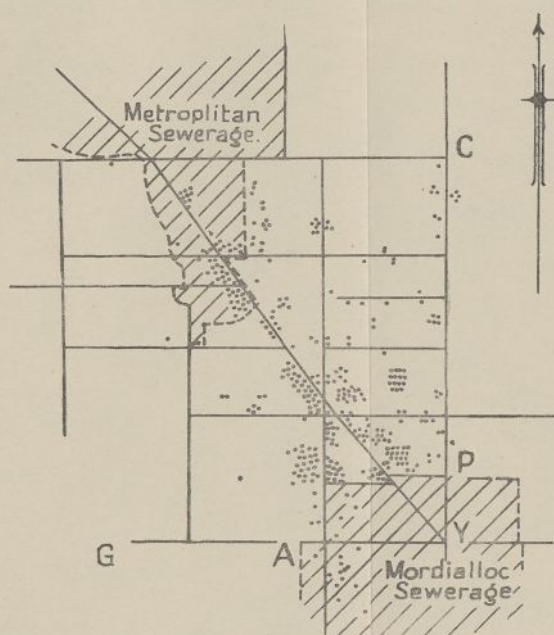


Map 5.



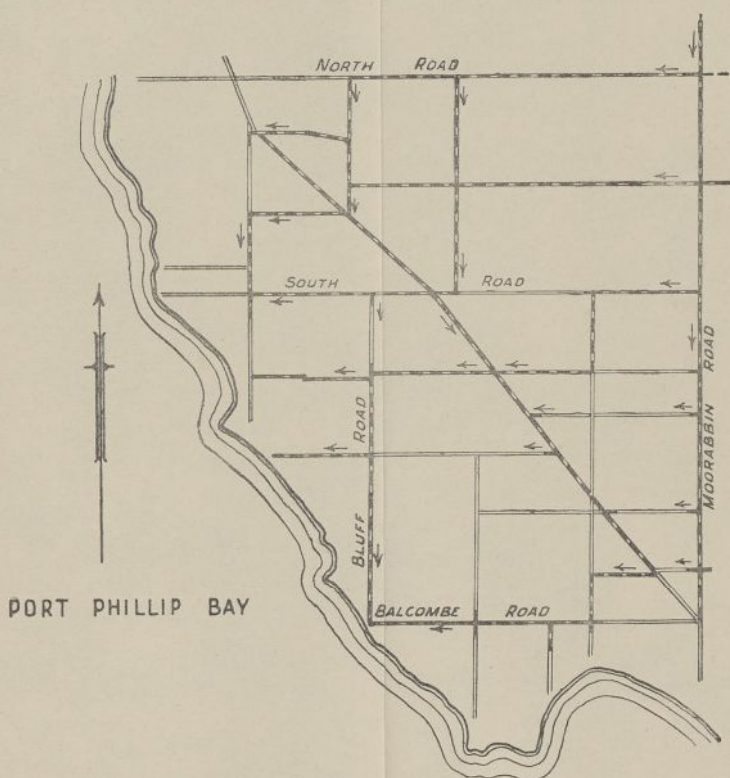
Map 6.

PLAN SHOWING CASES INCIDENCE IN RELATION TO
SEWERED AREAS.

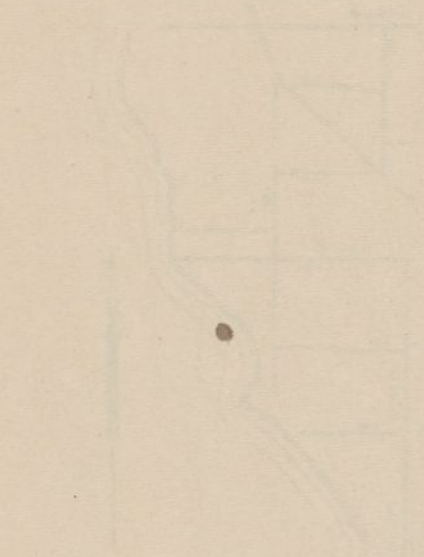


Note concentration in Northern Sewered Area

Map 7.
THE WATER MAINS.



The arrows indicate the general flow of water in the mains serving the Milk Zone and surrounding areas.



EAST PHILIP RAY

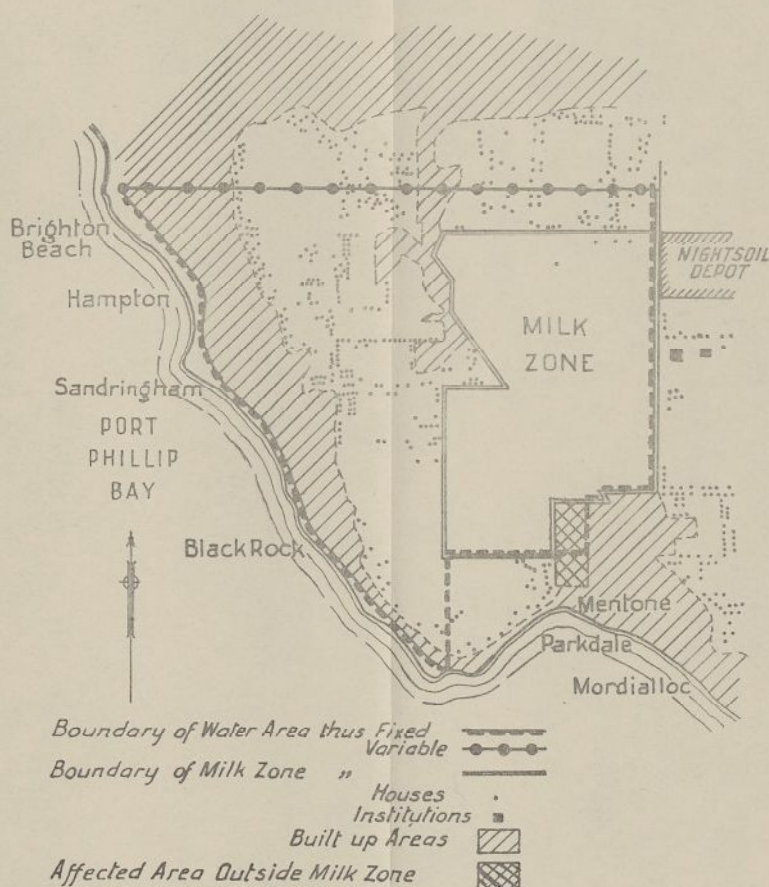
THE GULF OF MEXICO
FROM THE NORTH

Map 8.

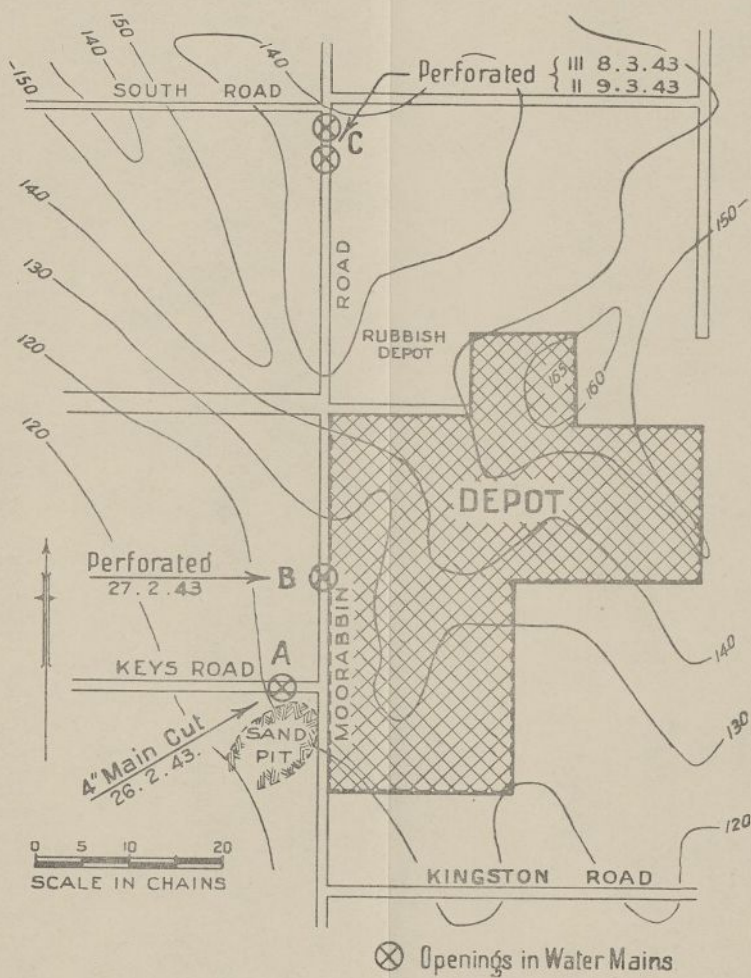
BAYSIDE DISTRICT.

PART OF BRIGHTON, SANDRINGHAM, MOORABBIN, AND
MORDIALLOC CITIES.

Map Showing Built-up Areas and Isolated Houses outside Milk Zone.

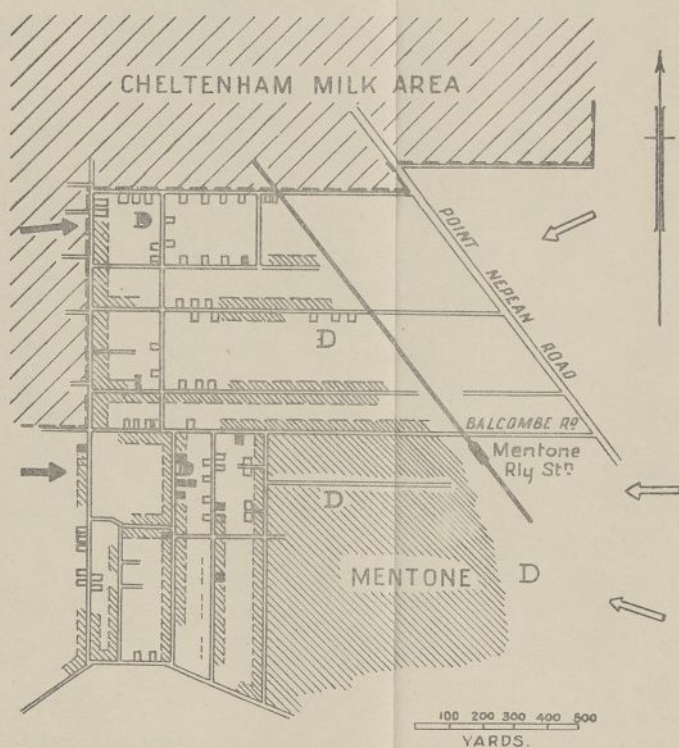


Map 9.
NORTH-EASTERN CORNER OF ZONE
AND
NIGHTSOIL DEPOT.



Map 10.

THE MENTONE CASES.



Boundary of Cheltenham Milk Area

Mentone Cases Outside " "

Isolated Houses

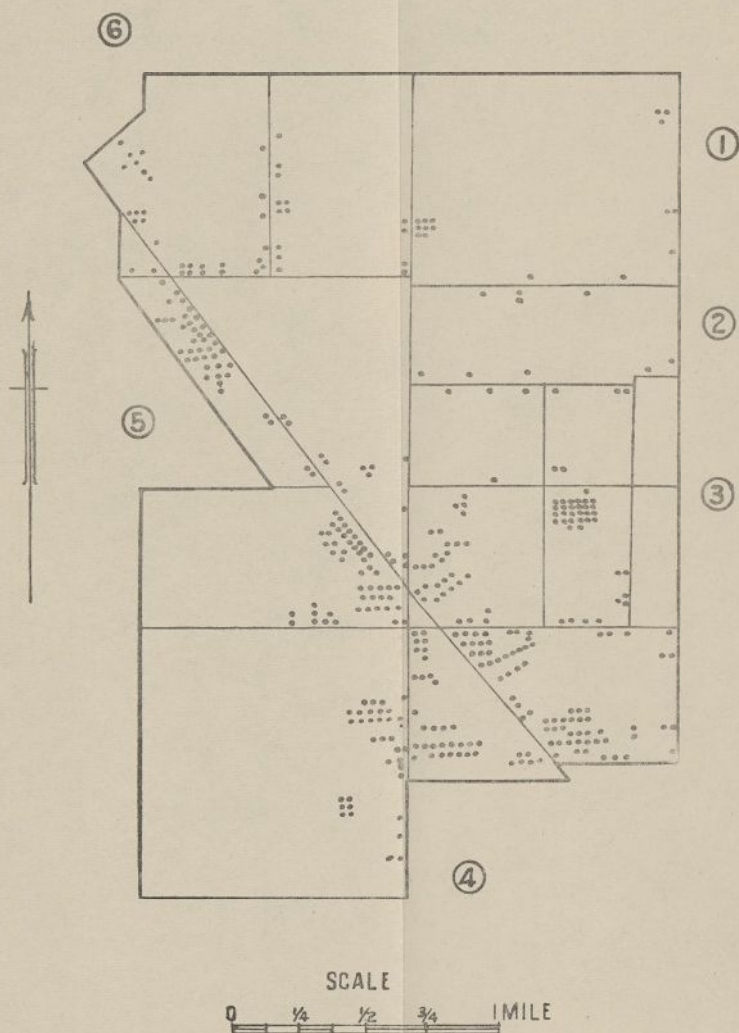
Continuous "

Note Relation to Branch Cheltenham Dairies "D" Other Dairies "D"

Map 11.

CASE DISTRIBUTION IN AND NEAR MILK ZONE.

(Numbers referred to in text.)



Map 12.

INFECTED HOUSES IN AND NEAR MILK ZONE.

