Sanitation and education in sanitation and the application of sanitary laws and regulations, and sanitary surroundings are of great importance in Tuberculosis as in Malaria and Plague and all other communicable diseases. Every preventive measure should be availed of and all milk should be boiled.

THE ETIOLOGY OF TUBERCULOSIS.

The etiology of Tuberculosis in Bombay is one of the most complex problems: poverty, ignorance, and neglect, the social customs and habits of the people and the over-crowded and insanitary conditions at home ensuring to a great extent the progress of the disease.

Most of these conditions have been accentuated by the prevalence of high prices, high rents, and acute scarcity of house accommodation. It may be added that the Influenza epidemic of 1918, and the out-breaks of subsequent years, have left us a legacy of Tuberculosis.

Over-crowding is one of the principal causes contributing to the spread of Tuberculosis. It tends to increase the opportunities for personal contact and infection, to hinder the possibility of free ventilation, and to lower the vitality and power of resistance of the people. The mere statement of the average number of persons per acre in a town is often misguiding. Thus the average population per acre in Bombay is 67, whilst the thickly populated areas give 638 persons per acre. Much depends on the number of persons residing in each room. By careful planning of the houses erected, it is possible to accommodate a larger number of people in a certain area without over-crowding. In Bombay about 80 % of the population dwell in one-room tenements. The evils resulting from over-crowding are far greater in the northern parts of India than the southern, as in the former the intense cold induces the people to shut themselves up closely in their houses, and thereby greatly hinders free ventilation.

Tuberculosis is both the parent and child of poverty. Certain people, through pecuniary difficulties, due to unemployment are forced to curtail expenses and live in insanitary quarters where the conditions are such as to easily open the way to Tubercle. The tuberculous, on the other hand, rendered helpless by the enormous financial drain involved by the disease for treatment, extra food, etc., and inability to work, are compelled to shift to cheaper rooms in insanitary localities.

Certain social customs among women in India are a potent factor in the causation of this disease and account for the fact that in many cities of India more than twice as many women as men suffer from Tuberculosis. The "purdah" system amongst the Mohamedans is directly responsible for the large incidence of the disease amongst the females of that community. The women are generally secluded in one of the hind rooms, which is not a very sanitary part of the house, with no attempt to ensure fresh air and light.

In public these women use a veil or "burqa," which is a white cotton garment which completely covers the body and face. Since more than one member of a family often use the same "burqa", the serious danger of infection resulting from this practice will be realised, especially when some members of the family are already suffering from Phthisis. The incidence of the disease is greater in those cities where the purdah system is followed either amongst Hindus or Mussalmans.

The early marriage system, the sexual excess at premature age, and the crude methods adopted in the management of child-births are some of the causes which produce considerable mental depression and physical strain on the young girls during the early days of married life, and thus open the door to the Tubercle bacillus. From an inquiry made by the King George V Anti-Tuberculosis League it was

revealed that 25% of tubercular cases amongst women occurred after confinement.

The habit of indiscriminate spitting is largely conducive in India to the spread of Tuberculosis. The Tubercle bacillus thrives and retains its vitality for a long time in dirt in the absence of fresh air and sunlight. It has been found that Tubercle bacilli in sputum, when exposed to direct sun-light, die after 8 hours, and to diffused day-light in 8 days, but when kept in darkness they are alive and virulent even after 309 days. A careless consumptive who is passing millions of Tubercle bacilli in his sputum would be a great menace, therefore, if he were to spit indiscriminately on the floor and walls of his room, the spit would dry up and be distributed in the dust and any person inhaling the vitiated air, specially if his vitality has been already lowered, will fall a victim to the disease. The practice amongst the poor of wiping their mouth with the end of their garment, or the lappet of the shirt is objectionable and attended with risks of infection. At home the people should spit into a spittoon or into an open vessel containing some disinfectant like carbolic lotion (1 in 20) or izal (1 in 50). A tray containing ashes or bits of rags or paper contained in a receptacle will do, provided it is emptied from time to time into the fire. For out-door use, a pocket flask spittoon is advisable.

TRADES AND OCCUPATIONS.

There are several occupations which levy a high toll. In India, however, there are not so many industrial occupations as in England in which vitiated dust is inhaled and in which labourers are exposed to great variations of temperature and pressure. Moreover, most of the Indian labourers work less in crowded workshops, but more in the open air and in private houses, depending more on hand power than on machinery.

There are several occupations carried on in small ill-ventilated rooms for long hours at a stretch which necessitate the workmen sitting down in a recumbent position for a long time and which levy a large toll. Tailors, shoemakers, clerks, shop-servants and weavers suffer very frequently. Special reference must be made to the "bidi" makers (cigarette makers) in Kamatipura in Bombay. The workers, chiefly women, are crowded together in dark ill-ventilated hovels for several hours in making bidis. They spit promiscuously on the floor and unwittingly help in the disease being conveyed from one to the other. An idea of the over-crowding and unhealthiness in the bidi shops can be realised from the fact that 20 to 30 women are usually huddled together in a small room in which there is no fresh air and sun-light and which abuts on foul smelling passages. If one of these workers has already contracted the disease, the chances of spreading infection are very great. In view of the insanitary conditions at present prevailing in places where indigenous cigarettes are made and the danger of such places becoming centres of tubercular infection, it is proposed to bring such places under Municipal control, by requiring that they shall be licensed. This measure will serve to improve the sanitary condition of the rooms by alterations being enforced so as to afford better light and ventilation and larger floor area before granting a license.

There are certain industries which involve the constant breathing of air charged with irritating particles and in which the workers suffer to a large extent from Tuberculosis. These are cotton ginning mills, jute factories, rice cleaning mills, quartz crushing mills, coal mines and the like.

As the number of hair-dressing saloons in the City is increasing rapidly and in many cases no attempt is made to keep the premises or the implements used in a clean and proper condition, it is proposed to bring this trade under

Municipal control to prevent the spread of infectious diseases.

DISTRIBUTION OF TUBERCULOSIS IN INDIA.

It is difficult to gauge the magnitude of the evil caused by Tuberculosis on account of the unreliableness of the little information that is available. The vital statistics in India are inevitably very inaccurate, as the verification of cause of death is done by ignorant and lazy "chowkidars" even in many of the larger cities. Moreover, in the Report of the Sanitary Commissioner of India, Phthisis is not classified under a separate heading, but is included under respiratory diseases, many of the deaths from Tuberculosis being registered under "Fevers" and "All Causes." The Tubercular death-rates of the cities of India are, therefore, not sufficiently accurate.

Classification of Indian Cities, according to estimated prevalence of Tuberculosis (from Lankester.)

CLASS I. Death-rates less than 2·0 per Mille.	CLASS II. Death-rates from 2·0 to 3·0 per Mille.	CLASS III. Death-rates over 3·0 per Mille.
Aligarh, Allahabad, Amroati, Aurangabad, Berhampur, Cuttack, Ellore, Ferozpore, Gorakpore, Jalna, Kohat, Syallpur, Muttra, Montgomery, Muzaffarpur, Nainital, Nowshera, Pakhoku, Ranchi, Rawalpindi, Saigang, Salem, Shillong, Simla, Taru-Taran, Vellore, Waltair, Warangal, Wardha.	Ahmednagar, Bangalore, Bannu, Bareilly, Bhagalpore, Bharatpur, Gwalior, Indore, Jabbalpur, Jhansi, Jodpur, Karachi, Ludhiana, Moradabad, Moulmein, Meerut, Mysore, Nagpur, Patiala, Prome, Puri, Secunderabad, Sialkote, Tanjore, Tinnevelly, Trichinopoly, Udaipur, Vizagapatam, Wazirabad.	Agra, Ahmedabad, Ajmere, Amritsar, Benares, Bhopal, Bombay, Broach, Calcutta, Calicut, Cawnpore, Dacca, Delhi, Gaya, Hyderabad (Sind), Hyderabad (Deccan), Jaipur, Lahore, Lucknow, Madras, Madura, Mandalay, Multan, Patna, Peshawar, Poona, Rangoon, Srinagar, Surat.

The distribution of Tuberculosis in India is dependent upon the varying climatic conditions of the country and the social customs of the people. Dr. Lankester in his book on "Tuberculosis in India" says that the plateaux of India with (except during the monsoon) their small rainfall, low relative humidity, dry clear atmosphere and high mean temperature are the most favourable regions, Tuberculosis being the least prevalent. Thus the high table-lands of Rajputana, Central India, the Central Provinces, the Deccan, and Mysore plain are very favourable in comparison with other parts of India, both as regards the general prevalence of Tuberculosis, and as to the effect of their climate, in the treatment of sufferers from the disease.

Dr. Lankester places the following areas as more or less intermediate as regards the prevalence of the disease. The Sindh desert, the south-western portion of the Punjab, the north-east corner of the United Provinces around Gorakhpur, with the adjacent parts of Bihar, north of the Ganges; the whole of Orissa and the whole of the Madras Presidency with the exception of the Malabar coast and the southern hills.

The remaining parts of India appear to be most unfavourable, Tuberculosis being very prevalent. These comprise the delta of Bengal, the eastern and western Indo-Gangetic plain including the whole of the Punjab except the south-western corner; the valleys of the North-Western Frontier Province and lastly Gujerat and the western littoral, specially the Malabar coast.

The mortality from Tubercular diseases is very much greater in cities than in villages; the villages on the outskirts of the city suffering more than those more distantly situated.

The migration of people from villages into the city for employment specially during the times of famine, and the

increased facilities of communication afforded by the network of railways in India have been largely conducive to the increase of Tuberculosis in Indian cities. On the other hand, people contracting Tuberculosis in the cities go over to the villages and carry and spread infection there.

The social factors are even more important than the climatic in deciding the incidence of Tuberculosis, as in certain cities in Rajputana and the Deccan, *e.g.*, Agra, Hyderabad, the prevalance of the disease is very great, being over 3 per mille. But such cities though unfavourable as regards incidence are very favourable for the treatment of Tuberculosis on account of the climatic conditions. It has been the experience that people emigrating from places where the incidence of Tuberculosis is very low or negligible into cities which are the hot-beds of the disease easily fall victims as they are not sufficiently immuned. Thus, for instance, the Gurkhas and Pathans who come from the hilly regions in the north of India, where Tuberculosis is practically absent, are very susceptible to the disease when they migrate into the large cities of India.

PRACTICAL PRECAUTIONS AND MEASURES.

To undertake thoroughly the work of controlling and exterminating Tuberculosis in a community, much time, trouble and energy are required, with a perfect organization and thorough control, and suitable bylaws and regulations. To attain any measure of success, however, the Medical profession, the public, the Sanitary and Municipal Authorities and the Government must co-operate. The various measures may be classified as follows :—

1. Compulsory notification.
2. Tuberculosis dispensaries.
3. Sanatoria and village colonies.
4. Open air schools.
5. Hospital for advanced cases.

6. General sanitary measures including the house problem.
7. Special preventive measures.
8. Educational measures.
9. Food control.

COMPULSORY NOTIFICATION.

The advantage of a compulsory system of notification is not merely to enable to despatch to a Hospital the cases that come under observation and to disinfect their homes, but also to ensure that the hitherto unrecognized cases are detected and insanitary conditions in domestic and industrial life are discovered and removed. The usual rule all over India is the voluntary notification of the disease, and it is only recently that it is being made compulsory in large towns. The success of compulsory notification depends on the amount of medical relief that is available. A sufficient staff of skilled health visitors for giving instructions, and an adequate provision of beds for advanced cases, and accommodation in sanatoria for early ones will be required. Medical inspection of factories, workshops and infected houses should be made, regular forms should be kept, and a register made of all cases visited and action taken. Early notification :—On receipt of a notification or information of a case or of a certificate of death from Phthisis, or as the result of examination of sputum sent to the Laboratory, the Sanitary Officer should visit the house, making inquiries into the duration of the case and its surroundings. Instructions should be given, printed and oral, and the case, if possible, removed to the Hospital for Consumptives. He should then proceed to disinfect the room and bedding. The Esmarch process of rubbing the walls, ceiling, and floors with dough to collect the infected dust might be adopted in suitable houses, as it would not be practicable in all Indian dwellings ; the dough should afterwards be burnt ; on no account should

the room be swept with a brush or duster, as the infected material may be dispersed in the air and inhaled by the operatives.

Formalin spray or 2 per cent. solution of chloride of lime or izal (1–30) may be used for washing the floor, walls and ceilings. The furniture should be washed with a damp cloth soaked in izal. The linen and bedding should be passed through a steam sterilizer. A room occupied by a Phthisical patient should be thus treated every 6 months.

TUBERCULOSIS DISPENSARY.

The "Tuberculosis dispensary", which has come to be recognised as an important factor in an Anti-Tuberculosis campaign, owes its initiation to Sir R.W. Phillips who opened the first of its kind in Edinburgh in 1900. Since then, several hundreds of such have been opened up on the same lines all over the world. His idea that no one method of dealing with the disease could be effective in combating every aspect of the problem, culminated in the growth of the dispensary which was destined by him to verify and co-ordinate all the various agencies endeavouring to fight the disease. In general the functions of the Tuberculosis dispensary are to serve as a :—

1. Receiving house and centre of diagnosis.
2. Clearing house and centre of observation.
3. Centre of curative treatment.
4. Centre for the search of incipient cases.
5. Centre of after-care.
6. Information bureau and educational centre.

The dispensary is not merely one in the usual sense of the word, but a great "clearing house" where various types of the disease are sorted out and sent to the various institutions most suited to the particular stage of the disease. Thus the medical officer has to be in close touch with the private practitioners, and the directors of numerous institutions affording treatment, *e.g.*, Sanatoria, Hospitals, Open Air

Schools, etc. The staff usually consists of a medical officer with nurses and health visitors whose duty it is to pay domiciliary visits to the patients attending the dispensary with a view of instructing them in elementary sanitation and finding out early cases. The King George V Anti-Tuberculosis League Dispensary at Bombay, opened in 1912, was the first of its kind in India and has served as a model for similar dispensaries opened up in many of the larger cities and towns of India. In large towns of India it would be advisable to have independent Tuberculosis dispensaries, one for every 100,000 people, and they should be so situated as to be easily accessible to the working classes.

SANATORIA.

The sanatorium serves as a curative and prophylactic measure of great importance. Modern experience has pressed for the necessity of providing for every community sanatoria in which early cases can be treated and cured by removing them from the haunts of infection to suitable situations where their life can be regulated under medical control. From an educational point of view, it serves to impress upon the patient and his relations the nature of the disease and its mode of spread so as to enable them to continue the same care on his return home.

Whilst admitting of easy administration, the structure and surroundings should be inexpensive, yet hygienically as perfect as possible, and so built as to command the maximum of fresh air and sunlight. The question of locality and site has several inherent difficulties. In India it is preferable to establish sanatoria on the plains rather than at some hill stations. The plains have a number of advantages in India which are of great importance in deciding their value. They are easily accessible to the poor and, as the climate would conform more or less with that in their own country, it would be possible for the patient to safely return to his home

without in any way feeling any change. A trip to the hills entails much expense and thus the poor are debarred from going to such places. The site should be healthy and within the reach of the district it is intended to serve, the ideal position being a place 2 or 3 miles from a railway station. The principal desiderata in judging the value of a place are a southerly aspect, low rainfall, protection from sun and wind, and free circulation of air round the sanatorium so as to ensure a maximum of sunshine. Ample water supply without great expense is essential. The soil should be dry and porous with extensive lands round about planted preferably with pine trees. Amongst the other needs are freedom from heavy rains and dust, and ample space for further development. The amount of accommodation required for sanatorium treatment is estimated by the Departmental Committee on Tuberculosis as one bed for every 5,000 inhabitants in addition to hospital beds for advanced cases. They also recommend that a sanatorium should not contain fewer than 100 beds. Amongst the principal sanatoria in India may be mentioned :—

1. Bhoiwada Sanatorium, Parel, Bombay.
2. Bahadurji's Sanatorium at Deolali.
3. King Edward Sanatorium at Bhowali (Kumon Hills).
4. Bell Sanatorium at Punchagani.
5. King Edward VII Sanatorium at Dharampur.
6. Mission Sanatorium at Almora and Madanpalli.
7. Hindu Sanatorium at Karla.

The Departmental Committee have divided cases of Pulmonary Tuberculosis into six classes :—

(1) Cases in which the disease can be diagnosed or is strongly suspected, but in which there is no evident impairment of the working capacity.

(2) Cases of recent onset, with some impairment of the working capacity, but without marked evidence of ill-health.

(3) Cases of recent onset, with evidence of acute illness.

(4) Cases of a longer history of illness. In some of these cases permanent arrest of the disease may be hoped for, but in the majority, restoration to full working capacity for more than a short period is not to be expected.

(5) Cases in which there is a permanent loss of working capacity. Many of these patients live for a considerable period in a condition of chronic ill-health.

(6) Cases in which a fatal termination within six months is probable.

Treatment in sanatoria will be chiefly necessary for cases falling within classes 2, 3 and 4, and for a small proportion of cases within classes 1 and 5.

VILLAGE COLONIES.

The establishment of open air colonies in Europe has been considered necessary to prevent a relapse in the large proportion of those who though discharged as "arrested" from the sanatorium have had to return to their insanitary homes and dusty occupations. Muthu has recommended for India a system of village colonies where consumptives can go to with their families and live an open air life and at the same time engage themselves in some occupations like gardening, small industries, carpentering, etc. Such colonies would be model villages possessing many activities and becoming a centre of education and training. If successful, they could be self-supporting or at least partly so. The persons fit for transfer to the colonies should be those free from constitutional taint, with no rise of temperature, and with arrested local manifestations.

Such could easily work for three to four hours a day and produce work which could make the colonies self-supporting. For various reasons village colonies if adopted in India should

thrive, land being easily available. The colonies should consist of groups of cottages with large gardens and containing accommodation for a hospital sanatorium, school for children, farm, dairy, laundry, etc.

Hospital for Advanced Cases.

The far advanced cases constitute the greatest source of infection and unless these are segregated, the chances of spread of the disease are multiplied. Hospital accommodation should be provided by the State, or Municipality or charitable persons. Upto now not even in the Presidency towns are there any hospitals for advanced cases with the exception of a few beds in the general hospitals and the result is that it is difficult to find accommodation for them in the last stages of the disease. The open cases of Phthisis pass millions of Tubercle bacilli in their sputum. The careless habit of such patients of spitting indiscriminately and the personal contact at home with relations and friends greatly increase the risk of spreading infection. The most practical way in which medical relief could be afforded to the poor is by the creation of separate Tuberculosis wards, where those who are lower down in the scale of life and who would be a source of infection at home could be nursed and be treated free of charge. Open air shelter, lean-to shelter, consisting of a verandah, could be added to almost any hospital.

General Sanitary Methods.

This part of the subject has a wide scope, for it includes the laying out of streets, the provision of improved roads of communication, the construction of dwellings and work-shops so as to ensure sufficient air-space, free ventilation, and abundant sun-light, the cleansing of streets and alleys, the avoidance of dampness, the removal of filth and dust, &c. The provision of more suitable houses for living than

what the people possess and a domestic condition in which the physical health, the morals as well as the social conditions can be improved is the pressing need of the day. It has often been expressed and quite rightly too that the true solution of the Tuberculosis problem lies in the opening up of broad roads and so ensuring abundant air, light and ventilation in each and every room of the building. The question, therefore, of improving congested and insanitary areas by a systematic town planning, and of granting extended powers to local authorities to deal with such areas is one which merits the earnest consideration of Government. The building bylaws regulating the open space round houses and floor space require revision in most cities.

OPEN AIR SCHOOLS.

A large part of the work of prevention of Tuberculosis can be most effectively carried out through the school.

The Government of Bombay in a Resolution have intimated the necessity of :—

(*a*) Giving definite instructions in the schools in large towns on the dangers of Tuberculosis.

(*b*) The establishment of special classes for tubercular children who should be segregated from their fellows.

(*c*) The opening of open air schools for children who are in a poor condition and likely to become tubercular.

In India where the exigencies of the climate, except perhaps during the monsoon, are not such as to prevent the holding of classes in the open air, the need of such open air schools is all the more felt. A regular and systematic school medical inspection of school children and school premises should be carried out by medical men and health visitors at the instance of Government or Municipality. Many students and some school masters in various educational institutions suffer from Phthisis and are therefore a great

menace to the innumerable children that come in contact with them. Children in boarding schools, orphanages and foundling homes are largely prone to the disease. Great care has to be taken in the planning of school buildings, so as to provide the maximum of fresh air and sunlight in the dormitories and school rooms, and great discretion has to be exercised in framing the school dietary and the curriculum of the students.

SPECIAL SANITARY MEASURES.

The Phthisical patient must be taught not to spit promiscuously on the floor and walls or in the streets and foot-paths. Notices as to spitting should be widely circulated in all public places, workshops, factories, railways, tram-cars, etc. A consumptive should be instructed to always spit into a vessel containing a disinfectant or into a pocket glass which can be cleansed or into a paper spittoon which can be burnt. Phthisical patients should use their own spoons, forks, cups, glasses, etc. They should not sleep together with others. They should hold a handkerchief to the mouth whilst coughing or sneezing, and they should avoid kissing children. No dust should be allowed on the floors, walls, etc., and the latter should therefore be cleaned from time to time with a damp cloth. Free ventilation is of the greatest importance for the health of the patients and unaffected members of the family, and therefore the windows should always be kept open.

EDUCATIONAL MEASURES.

Education of the people and most specially of the children of to-day must be co-ordinated with the efforts of sanitary authorities to improve the surroundings of dwellings. The Bombay Sanitary Association has done much useful work in this direction by organizing several public lectures in institutions and schools, by cinematographic shows and by

publishing several leaflets, posters and literature on the subject for the benefit of laymen. The Anti-Tuberculosis League of Bombay has struck a new note by organizing a properly equipped Museum and Information Bureau. The Museum is provided with various kinds of spittoons, paper goods, placards, photographs, pathological specimens and automatic devices. The Information Bureau has supplied information to laymen and to several Municipalities and to the sister Leagues at Surat, Broach, Lucknow, etc.

MEASURES FOR THE PROTECTION OF FOOD.

Inspection of meat and milk, dairies, cow-sheds, slaughter houses should be systematically carried out. All milch cattle should be tested with tuberculin and such as react to the test should be removed. Legislation should be adopted for compensation and slaughter of infected animals. All infected animals should be cast and destroyed. Complete control of the milk supply by the State is necessary ensuring the removal of dairies from centres of large towns and cities, cleanliness in the collection of milk and the transmission of it from the dairy to the consumer. The indifference of the average Indian to protect his food from the invasion of flies may lead to the contamination of milk or any other foodstuffs in more ways than one.

MEASURES CARRIED OUT IN BOMBAY.

Leaflets in English and vernaculars are freely circulated and lectures delivered and notices against spitting issued to all schools and public places.

Cases of Phthisis are notified to the Health Officer, and the houses are disinfected and lime-washed; 1,767 cases were notified and 1,118 houses disinfected on account of the disease in 1920.

The King George V Anti-Tuberculosis League has founded a Tuberculosis Dispensary and a Bureau of Information—both in conjunction with the Health Department, also a

Sanatorium for the treatment of early cases. The building is situated in the north of the island on a small hillock, with extensive open grounds.

Plan of campaign.—The League proposes to restrict its efforts to measures for the prevention of Tuberculosis in its varied manifestations, and with this view, it has devised the following plan of campaign, (which is subject to modification as required), as the best suited to local conditions and most likely to ensure early and adequate results :—

(1) Notification of the disease.
(2) Tuberculosis dispensaries.
(3) Education of the people.
(4) Medical inspection of school children.
(5) Supervision of milk & food supplies.
(6) Special fund to relieve distress.
(7) Arousing public interest in Tuberculosis.

(1) *Notification of disease*—

The cordial co-operation of the Department of Public Health and medical practitioners in the City, by notifying cases of Consumption and thereby placing the poor and needy in touch with the dispensaries, is essential for the purpose of preventing the dissemination of infection.

(2) *Education of the people*—

Education of the general public and the working classes, with a view to the better understanding of the nature of Consumption, the risks from infection, the methods of guarding against the same, etc., and their practical demonstration form the principal basis of preventive and educative work. This is being done by domiciliary visits of the medical officers and nurses attached to the dispensaries, and, if possible, by the co-operation of a Ladies' Committee of voluntary workers, as in London and Dublin, who will also help and supplement the work of the paid staff.

Cholera.

Cholera is an acute infectious disease characterised by profuse purging and vomiting of a colourless serous material, muscular cramps, suppression of urine and collapse, and a high mortality, a special bacterium—Koch's Comma vibrio—being present in the intestines and discharges from the bowels. Cholera is usually considered a water-borne disease, due to water having become infected with the Cholera organism by some person suffering from the disease. But the personal and direct infection are seriously to be considered.

CHOLERA IN BOMBAY, CALCUTTA AND BRITISH INDIA COMPARED.

In the following statement is compared the mortality from Cholera during 1901–1919 in the cities of Bombay and Calcutta and in British India; the death-rates per 1,000 of population are inserted :—

YEAR.	BOMBAY.		CALCUTTA.		BRITISH INDIA.	
	No. of deaths from Cholera.	Death-rate per 1,000 of population.	No. of deaths from Cholera.	Death-rate per 1,000 of population.	No. of deaths from Cholera.	Death-rate per 1,000 of population.
1901	198	·25	1,720	2·02	271,210	1·21
1902	75	·09	2,716	3·20	224,136	0·99
1903	17	·02	1,990	2·34	312,854	1·38
1904	219	·28	2,056	2·42	192,835	0·85
1905	26	·03	2,323	2·74	441,786	1·96
1906	1,241	1·26	2,504	2·95	690,519	3·05
1907	439	·44	3,803	4·48	408,102	1·81
1908	95	·09	3,694	4·35	591,725	2·61
1909	727	·74	2,022	2·38	239,429	1·06
1910	107	·10	1,901	2·4	430,451	1·90
1911	123	·12	1,860	2·1	154,005	1·90
1912	1,790	1·82	2,244	2·5	407,769	1·71
1913	125	·12	1,764	1·9	294,815	1·24
1914	221	·22	1,983	2·2	280,730	1·18
1915	61	·01	1,612	1·8	....	....
1916	141	·14	1,335	1·5	288,047	1·21
1917	16	·06	866	·96	267,002	1·12
1918	1,682	1·69	1,526	1·7	560,802	2·35
1919	8,455	8·63	3,888	4·1	....	....
Total (1901—1919) ..	15,758	....	41,607	....	1,115,851	....
Annual average ..	829	....	3,189	....	58,729	....

ETIOLOGY OF CHOLERA.

Cholera is now almost universally accepted as being due to a living contagium—Koch's Cholera bacillus which, growing in the intestines of the patient, causes death partly by the effect of the toxins produced by it and partly by the profuse purging which it sets up. The further etiology of the disease resolves itself into two factors: first, the means by which the microbe gains access to the body; second, the conditions which render the body susceptible to the microbe. Of the first of these we know much, of the second little.

Mode of access:—It is certain that Cholera is not contagious in the ordinary sense of the word as Small-pox, Scarlet Fever, Measles. Nurses and those who attend to the sick are often affected in larger proportion than others; but this is readily explained by the fact that, unless constant care is exercised in regard to cleanliness of hands and utensils, they are much more exposed than are others to the known and recognised mode of infection, which is by the mouth. All evidence goes to show that the infection of Cholera to take effect must be swallowed.

As in all zymotic diseases, the *materies morbi*—the *contagium vivum*—greatly increases within the body of the patient during the progress of his malady. During the disease a minute amount of infectious material grows into an amount capable of giving the infection to thousands and, in the case of Cholera, this infectious material finds its exit from the patient's body in the discharges caused by the disease.

The study of the etiology of Cholera, then, is to a large extent a study of the steps by which matter, that has left one patient, so gains access to some article of food as to be swallowed by some one else.

It is conceivable that, in the presence of a great abundance of the infection, it might be inhaled in the form of dust; of this, however, there is no evidence.

It is with food and drink that it commonly gains access to the human body. Well-authenticated instances are related in which flies have appeared to carry the infection from Cholera dejecta to milk and various articles of diet; and Haffkine detected Cholera bacilli in specimens of sterilised milk, exposed in new vessels, to which flies were permitted free access during an attack of Cholera. The use of Cholera-infected water for washing cooking utensils and articles used in the preparation of food is another mode of local distribution. In the cases of nurses and those who attend to the sick, or have charge of the dead, the Cholera poison may as a result of want of strict cleanliness, be transferred to the mouth by the fingers, either directly or by means of food.

It has been universally accepted that the great, the persistent and the almost universal mode by which the Cholera germ gains access to the body is through the drinking water. This is now so well recognised that it is unnecessary to go again over the evidence by which this has been proved to demonstration. It is unnecessary here to refer to the classical examples of this mode of Cholera distribution.

This, however, is not the only mode by which the disease is spread in the larger cities of India. When a wholesome supply of drinking water is provided, the ignorance and carelessness of the people in preventing the pollution of the domestic supply, the storing of water in dirty vessels and the constant use of well and tank water to which infection may be conveyed must be an important factor.

The habits of the people, the customs with regard to the dead, the modes of preparing and consumption of food, the insanitary condition of their houses, the proximity of privies and bathing places to living rooms, and the opportunity given to food and milk to become infected by personal contact and flies during an epidemic must provide an enormous source of danger.

There is a good deal of evidence to show that water does not act as a mere diluent and distributor of the Cholera-

poison, but that, under certain conditions, the Cholera bacilli grow and for a short time increase in virulence during their sojourn in this medium. The persistence of Cholera in a district is indicative of more than a single pollution of the water-supply, and generally points to a persistence of some insanitary conditions which favour repeated infection.

It is not always the case, however, that the infection is conveyed directly from man to man by means of water. Where we find sudden outbursts of the disease affecting large numbers of people drawing their water-supply from a common source, some direct and wholesale fouling of the supply is generally the cause of the mischief. But much more commonly, especially near its endemic home in India, Cholera does not occur in great outbursts ; small local epidemics arise, die down and then recur. The Cholera bacillus existing, as we must presume, in the foul soil is now and again washed into the wells, and so sets up disease in those that draw their water from them. The key, then, to this side of the etiology of Cholera is to be found in the habits of the people and the degree of care or want of care they exercise in the protection of their water supply.

Individual susceptibility.—The etiology of Cholera is not, however, completely explained by the statement that it depends on the ingestion of Cholera-infected water ; another condition is also necessary, namely, the susceptibility of the individual. Considerable differences exist in the habits of the various members of every community : thus, it often happens that even where the habits of the majority are foul, a few are protected from receiving the infection by the greater cleanliness and propriety of their lives. Yet many fail to sicken, although they are known to have swallowed the very infective matter which at the same time is producing Cholera in others. We have proof of this in every widespread water epidemic ; the number of those who swallow the poison must in these cases vastly exceed the number of those who are

attacked by the disease. Macnamara gives an instance in which a vessel of drinking water was accidentally polluted with fresh Cholera excreta, and after being exposed to the sun all day, the water was partaken of by nineteen persons ; of these, five only subsequently suffered from Cholera. It seems clear that the inhabitants of the areas in which Cholera is frequently present, notwithstanding habits which expose them continually to chances of infection, are much less frequently attacked than new arrivals in the districts, much less, for instance, than Europeans although, when attacked, they succumb more readily.

Dissemination by human intercourse.—There can no longer be any doubt that Cholera is disseminated by human intercourse. The march of Cholera coincides with the march of man, and it is carried from place to place either by infected man or by Cholera-tainted clothing. The part played by pilgrimages, *e.g.*, the pilgrimage to Mecca, is well known, and severe outbreaks and wide dispersion have often followed on such movements of large bodies of men. There seems no practical limit to the distance to which it would be possible to transmit the infection in a bundle of imperfectly dried rags soiled by Cholera excreta ; man, however, can but carry the disease so far as he is able to travel between receiving the infection and being laid low. What we find, then, on comparing the march of the earlier epidemics of Cholera with those that have occurred in more recent years, is that whereas when travel was slow the disease swept steadily forwards, occupying the land as it advanced, in later times it has bounded forward with long strides, occupying outposts far ahead of infected areas, by means of railway and steamboat communication, and then, from these outlying foci of infection, has spread in both directions coalescing perhaps at a much later date with the main body of the epidemic which has slowly advanced across the country from earlier centres.

Certain as it is, however, that man is the porter by whom Cholera is introduced to any place, it must not be forgotten

that its development in that place depends on insanitary circumstances, the chief condition necessary being the liability of the drinking water to be contaminated by infected excreta. There are probably other but more obscure conditions still unknown to us.

Even amidst the conditions of soil and climate most favourable or most inimical to Cholera, its prevalence largely depends upon the habits of the people : however largely present its contagium may be, it is harmless unless swallowed. Thus, among all the influences making for Cholera, the most important are those habits of carelessness as to the cleanliness of food and drink, which make it easy for either the one or the other to be tainted with fæcal material.

BACTERIOLOGY OF CHOLERA.

The bacteriology of Cholera has provided the subject for an enormous amount of work. Koch, who discovered the Comma bacillus vibrio, visited India in 1883 and was followed by Klein and Gibbes in 1885 and later by Haffkine.

It is unnecessary to repeat the investigations of eminent observers and the enormous amount of work done in the bacteriology of Cholera which have brought us to our present knowledge. It is accepted, rightly or wrongly, that the vibrio called the Comma vibrio of Koch is associated with Cholera ; that the organism exists in the stools of Cholera patients, that it can be isolated and can exist in water ; that the stools of Cholera patients, either directly from the body or from the clothes and discharges, can infect water and food and milk and thereby convey the disease.

There is an enormous field for further scientific research in the bacteriology and epidemiology of Cholera.

With the improved technique of the laboratory and the opportunities now given for research work in tropical diseases, the investigations into the bacteriology and epidemiology of Cholera should be considered of the first importance.

A great deal of work has been done with the Cholera vibrio * and the laboratory methods and technique are delicate and uncertain.

INVESTIGATION INTO POSSIBLE CAUSES OF OUT-BREAK.

On the appearance of Cholera in any part of a city, the methods adopted for the investigation of its causes are as follows :—

The name, age, sex, occupation, place of work and length of residence at present address are inquired into ; and the information sent daily to the Head Office by the Health Officer of districts.

The food-supply, milk-supply and water-supply and the possibility of infection from a former case either in the city or outside form the subject of inquiry.

If a case existed in the premises the water is examined, and if a well or tank exists, it is treated with permanganate of potash as a precaution. Each case is followed up, and the

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* In order that those who are not familiar with bacteriological terms may not be misled by the statement that "*Cholera-like vibrios*" have been found in water, it is desirable to explain what is meant by the term "*Cholera-like vibrio.*"

The germ associated with Cholera, generally known as "*the true Cholera vibrio*," belongs to a group of organisms which are fairly frequently met with in nature. This group of organisms have certain features in common ; they are very minute microscopic vegetable organisms which grow and multiply in a particular manner and have a form likened to the shape of a comma. All the organisms of this group are able to move about actively in water or other liquid medium ; they are furnished with certain very minute hair-like structures called flagellæ, by the movement of which they can swim. Little would have been known about these organisms, were it not that Cholera is caused by one of them, and in certain circumstances the organisms which are not the "true Cholera vibrios" but are known as "Cholera-like vibrios" may be mistaken for that harmful germ. The "Cholera-like vibrios" never cause Cholera ; they are, as far as we know, perfectly harmless germs. Those who are not sufficiently acquainted with bacteriology have sometimes asserted that under favourable circumstances these "Cholera-like vibrios" may be converted into "true Cholera vibrios." There is not a scrap of evidence that this is ever the case.

connection with a previous case ascertained, if possible, and all precautions are taken to prevent the spread of the disease.

Spot maps should be made showing each attack and death.

THE BACTERIOLOGY OF CHOLERA AND ITS RELATION TO THE SPREAD OF THE DISEASE FROM THE POINT OF VIEW OF THE HEALTH OFFICER.

The following notes may be of interest in the very difficult question of the relation of the Cholera vibrio of Koch to the spread of Cholera :—

Experiments were carried out during the 1912 out-break of Cholera in Bombay, June—August, 1912. From these investigations, the following conclusions were drawn :—

(1) That the Comma vibrio is present in the excreta of persons dying or suffering from Cholera.

(2) That the vibrio persists until sometime after the patient is convalescent but not indefinitely.

(3) That in times of a Cholera epidemic, the vibrio is found in waters, wells, tanks, vessels, etc., but that it does not retain its morphological and cultural characteristics or its virulence for any length of time.

(4) That an out-break of Cholera depends on :—

a. The strength and quantity of the dose of the virus received.

b. The condition of the infected material which gains access to the intestine.

c. The physical condition of the patient and his power of resistance.

d. Certain climatic conditions.

e. Sanitary surroundings of the people ; water, food, drainage and refuse disposal and the habits of the people.

(5) That when the vibrio leaves the infected person it loses its virulence in direct ratio to the time and conditions to which it is subjected.

From investigations by daily visits of inspection to the infected houses, streets, wells and tanks in B Ward and from bacteriological examinations carried on during a severe outbreak of Cholera in Bombay, there is sufficient evidence to assume that the water had been polluted directly or indirectly from Cholera cases.

In order to ascertain the probable cause of the outbreak, in addition to the epidemiological investigations, many samples of water from wells, tanks, open vessels and tap water were examined as well as *post-mortem* examination made of intestines and the fæces of patients dying of the disease.

During January to August, 114 samples of Municipal waters were examined in the Laboratory; 257 samples of other waters, 16 of milk and food stuffs and 18 of excreta of Cholera patients. These examinations were conducted until September and the fæces of 62 patients examined.

During visits of inspection, attention was drawn to the following:—

(1) To provide water for the people, large earthen vessels were placed in the streets; they were filled with water by *bhistis* from tanks, stand-pipes and wells.

(2) During certain hours of the day and night, the Municipal water-supply was shut off owing to the scarcity of supply and *bhistis* were providing water to the houses.

(3) Stand-pipes in the City were used as bathing places and for washing clothes and utensils.

(4) *Bhistis* filled their *mashaks* at these stand-pipes immediately before, after or, if possible, at the time people were washing their bodies and clothes.

(5) The large reservoir at Pydhoni adjoining the Police Station was a favourite place for this purpose, and although there is a notice pointing out that these stand-pipes were not meant for washing bodies and clothes and although it adjoins the Police Station,

dozens of people were to be seen daily fighting for water and washing their clothes. This was pointed out to the Police who temporarily stopped it.

(6) *Bhistis*, when they cannot get a supply of water from stand-pipes, get water from tanks and wells at mosques and other places, and carry the water to private houses, where it is stored in various kinds of tubs, earthenware pots, etc.

The possibility of conveying infection through water is apparent.

The *bhistis' mashaks* during the outbreak were washed with lime and permanganate solution.

Now supposing that water is contaminated with material from an infected house, person or clothes, it is not unreasonable to assume the probability of the disease being spread in this way.

Samples from open vessels in the streets and houses, tanks and wells in the mosques were examined. It was found from the results of the analysis of the many samples that were sent, that the majority of the waters were contaminated with fæcal matter, and in some instances an organism having cultural characteristics of the Cholera vibrio was detected.

Although a vibrio was present in many samples, it was not until a sample from a well in a mosque in Kazi Syed Street was examined that what appeared to be the real Cholera vibrio was found. The well is inside the mosque and adjoining it, a tank and a place where dead bodies are washed in the mosque. Three deaths from Cholera occurred here and many dead bodies were washed in a place close to the well and tank. Outside the mosques are galvanised vessels filled with water for the use of the passers by.

As has been pointed out, to obtain a pure culture of the Cholera vibrio in a well or tank water is not easy, especially in India where many other vibrios exist.

Water is much fouled with organic matter, and the presence of other bacteria to a certain extent smothers the Cholera vibrio.

The bacteriological tests which were used in the Municipal Laboratory are as follows :—

(1) 90 c. c. of the water to be examined was put in a narrow mouthed flask with 10 c. c. of an alkaline concentrated peptone solution and incubated for 24 hours.

(2) This was then examined microscopically and after staining with carbol fuchsin, if vibrios were present.

(3) A loop full of the peptone solution was inoculated into a sterile broth culture medium.

(4) A sub-culture was immediately made in agar slant tube.

(5) Further dilutions were made in another broth tube.

(6) A further sub-culture was made into slant agar tubes and incubated for 24 hours, and then examined microscopically as in (2).

(7) Colonies from the agar were then further sub-cultured on agar and subjected to other tests.

Another method.—48 hours' peptone cultures were plated out on agar petri dishes and incubated for 24 hours and the colonies were examined.

Pure cultures were then examined as follows :—

Microscopically, stained as before, motility, Cholera red re-action, Nitroso-indol, Ehrlich Rosindol reaction—staining for flagella—agglutination and Pfeiffer's test.

All the tests mentioned above, with the exception of the Pfeiffer test, were applied to the vibrio isolated from this well water in the Municipal Laboratory and found to be positive.

Now, if there is any organism that varies in its cultural, morphological and pathogenic properties, it is the Cholera vibrio, and from the latest investigations, with the most modern bacteriological technique, it is stated that "the power of anti-Cholera serum to agglutinate the vibrio is very variable."

That because either agglutination or Pfeiffer's test is negative, it does not follow that in the presence of an epidemic a vibrio, not responding to these tests, should not be considered to be a Cholera vibrio for all practical purposes.

Under the circumstances, from these investigations, it is proved that this well water was infected with material from

Cholera patient, and that it was possible many other wells and tanks and water-vessels were infected in a similar way.

This is as far as any observers have ever got in the bacteriology of the disease, and until we know more we must assume that Cholera is spread in this way.

For the practical sanitarian this is enough to work upon. Given an outbreak of Cholera, whether imported or indigenous, any sample of water, from which a pure culture of the Comma vibrio is obtained, is sufficient evidence for active preventive measures.

The Cholera vibrio, after it leaves the human body, undergoes such rapid modifications in water, milk, food, soil, or even on the soiled clothes and discharges of the suffering person as to render it almost unrecognisable. The organism, fortunately for the human race, is very faintly resistant to external influences;* and it is for this reason, that when an outbreak occurs, prompt sanitary measures can control it.

How far, and how long, a Cholera vibrio can retain its virulence externally to the human body and how far the other organisms in water affect it are still subjects for further investigation. How the attenuated organism, found in water, can again regain its virulence when entering the body of its former host is what we want to know. Until then the practical sanitarian must consider all water containing a Comma vibrio, in the presence of a Cholera outbreak, a danger which by all the means in his power should be attacked.

Without entering into the bacteriology of the innumerable Cholera-like vibrios found in water and fæces, the presence of a Comma vibrio in water during a Cholera epidemic is evidence of probable contamination from a case of Cholera, though, as already pointed out, it is held that infected water is always the cause of the spread of Cholera, and that personal contact has little to do with the spread of the disease.

PERSONAL ELEMENT IN THE SPREAD OF CHOLERA.

It is impossible to analyse the evidence collected during the outbreak in Bombay without coming to the conclusion that the personal element has a great deal to do with the spread of Cholera in India. Without labouring too much on the habits and customs of the people, there is no doubt that the spread of Cholera is greatly due to direct infection from person to person by means of the discharges, contaminated hands, food, vessels, milk and water, and flies.

The filthy privy baskets, overflowing into open drains and thus soaking into sub-soil or storm-water drains, the position of the water and sewer pipes and the common washing places are a constant danger at any time, but in the presence of Cholera must contribute to a large extent to the circumstances favouring the spread of the disease.

For example, on visiting a person suffering from the disease, he or she will be surrounded with relatives and friends handling the patient. Many will be found occupying the same room, sleeping on the floor; they all use the same privy and washing place, eat from the same vessels; the water is stored in wooden, iron, earthenware or other vessels, in the living room, cook-room or *nahani*, for days together. The friends and relatives will wash the dead body and take it to the burial ground or burning *ghat* and afterwards wash in the nearest tank or bathing place—without any disinfectant precautions.

Any one familiar with the homes of thepoor can easily understand how Cholera is thus spread :—

The following are some instances :—

A man, Hindu, living in a well-built *chawl*, the servants' quarters of a large bungalow on Malabar Hill, occupied a room by himself; he had his meals with a man and woman in an adjoining room. No case of Cholera had occurred in the neighbourhood. He visited the *Bazar* one day, came home and took ill with vomiting and Diarrhœa; he was nursed, fed and attended to by a woman in the adjoining room. This man was removed to hospital that evening in a collapsed condition and died two hours afterwards. Next day, the woman, who had attended him, took ill with

Diarrhœa and vomiting, and after some difficulty was persuaded to go to hospital, and she recovered.

House No. 2, C. Street, three deaths occurred on the ground and first floors occupied by the same family—well-to-do Mahomedans. The first case occurred on the 12th, the second on the 13th, the third on the 14th. The house is situated back to back to another separated by a narrow sweeper's passage or gully from a house in B. Street, where seven deaths occurred, four on the 11th.

From house No. 25, friends and relatives visited house No. 2, where the three cases were suffering; three deaths occurred at house No. 25—one on the 14th, and two on the 19th.

From house No. 25, a suffering case was taken to house No. 1-3, M. Street, and died there.

At house No. 25, a lady came to visit and remained there some days, took ill, was taken to No. 207, A. O. Street in C Ward, and died there.

A number of similar instances could be given.

This is nothing new in the epidemiology of Cholera, as witness the fairs held in India.

Large crowds of people assemble, Cholera breaks out and is only checked when the fair is over, or the proper sanitary precautions have been taken to prevent the pollution of the water-supply, and other sanitary precautions observed with regard to food and cleanliness of the camps and destruction of all infected material.

Many persons leaving the fair perfectly well are attacked or die on their way home or recover and return to their homes convalescent, thus becoming a focus to spread the disease elsewhere.

Facilities of transit are so many that the disease may be carried hundreds of miles in a few hours.

Bombay City is a very small unit of the Indian Empire or even of the Bombay Presidency, but it is the haven of refuge for the destitute as well as the prosperous in times of famine and sickness in the neighbouring districts and thus pays the penalty of its position.

The difficulties of obtaining information from the friends and relatives of infected people and the passive resistance to any sanitary measures make it extremely difficult to trace cases of infectious disease or to adopt measures for their control.

Indifference and carelessness on the part of the poor people to accept any advice adds to the difficulties of control, while the ignorance of any measures of personal hygiene and the rooted objection to any innovation in their domestic arrangements form obstacles difficult to overcome.

The following routine method was used in the examination of the samples for Cholera in the Municipal Laboratory :—

For samples of water—

I.—90 c. c. of the water was transferred to a narrow mouthed sterile flask containing 10 c. c. of concentrated peptone

solution. This was placed in the incubator at 37° C. for 24 hours.

II.—Smears were then made and examined microscopically after staining with 1-10 Carbofuchsin. If the smears showed any Cholera-like organisms, then one of the following methods was followed in isolating the pure culture of Cholera vibrio.

III.—*Method A.*—

(*a*) One loopful was removed from flask (1) containing 24 hours culture on peptone and put in a broth tube. This was labelled (2).

(*b*) A sub-culture was immediately made on slant agar (2*a*).

(*c*) Further dilution was now made by taking a loopful from (2) and putting it in a broth tube labelled (3).

(*d*) An immediate sub-culture was made from (3) into slant agar (3*a*). The tubes were then incubated at 37° C. for 24 hours.

(*e*) At the end of 24 hours, several suspicious-looking colonies were selected from (2*a*) and (3*a*) and examined in the usual way microscopically.

(*f*) Such isolated colonies were again sub-cultured on agar for 24 hours, after which they were subjected to other tests for Cholera vibrio (*q. v.*).

Method B. for isolation of Cholera vibrio.—

In this method 48 hours' old peptone cultures were plated on petri dishes and incubated at 37° C. for 24 hours. Several colonies were picked up from these and examined in the usual way.

IV.—*The pure sub-cultures obtained by method A were then examined as follows:*—

(1) Morphology.

(2) Motility.

(3) Cholera red reaction—

(*a*) Nitroso-indol reaction with sulphuric acid (this was tried in 24 and 48 hours).

(*b*) Ehrlich's Rosindol reaction with Paradi-methylami-dobenzaldehyde. This was also tried in 24 and 48 hours.

V.—*Staining for flagella*—

Stephens' stain was used on a fresh sub-culture (under 24 hours).

VI.—*Agglutination test*—

This was tried with serum usually obtained from the Bombay Bacteriological Laboratory, Parel.

VII.—*Method for examining samples of fæces from Cholera patients.*

These were either passed through peptone water and isolated on slant agar or diluted through broth and immediately inoculated on slant agar. The rest of the method was the same as in the case of water.

The method of examining samples other than those of waters or of fæces does not differ materially from method No. 1 (*q. v.*), excepting that a smaller amount of peptone water is used up.

PFEIFFER'S REACTION AND GROWTH ON SUGAR MEDIA.

In this investigation the main difficulty was felt in the isolation of a pure culture of Cholera-like bacilli from all the other organisms present in the water. This is the main difficulty usually experienced by most bacteriologists. After trying various methods, we were fortunate enough to isolate a pure culture by method A., as described above. This method is simple, quick, and there is no risk of external contamination.

Method B., although used by many bacteriologists, was not found so satisfactory. Besides, in method B. there are many chances of external contamination during the manipulations.

The isolated organisms were typically comma-shaped with marked curve, actively motile, with one terminal flagellum, gave the "Cholera red" reaction within 24 and 48 hours, showed complete or partial agglutination and gave acid but no gas in sugar media.

The agglutination test was not positive in all cases, and this may have been perhaps due to the serum not being homologous to the organisms isolated by us.

Out of the 370 samples of waters examined for Cholera vibrio, it was detected only in two samples of well waters—(1) well at No. 34-36, Mount Road, and (2) well at Bohras' Mosque, No. 10, Cazi Sayyed Street—with positive results, both microscopically and culturally. Beside, comma-like bacilli were seen microscopically in 16 samples with negative results for cultural tests as follows :—

5 well waters, 6 tap waters, 3 tank waters, 1 water from earthen pot, and not classed.

Sanitation in India.

Cholera Carriers.

The following is an extract from a report prepared by Dr. Crendiropoulo, Director of the Bacteriological Laboratory of Chatby, Alexandria, published by the Conseil Sanitaire Maritime and Quarantenaire of Egypt, upon an examination of the stools of travellers coming from countries infected with Cholera. The investigation was started owing to the following incident :—On August 16th, 1911, a Belgian steamer arrived at Alexandria from Smyrna, where Cholera was present. On the fifth day of the period of quarantine, a little girl, five years of age, died with symptoms suggestive of Cholera. At the necropsy the characteristic lesions of this disease were not found, but bacteriological examination revealed the presence of abundant vibrios, and cultures made from them were powerfully agglutinated by Cholera serum. Examination of the stools of all the other persons on board the steamer showed that one woman, a servant in the family to which the dead child belonged, was a carrier of an agglutinating vibrio. Other incidents of similar nature occurring within a few days showed the danger these carriers represented for Egypt, and the Conseil Quarantenaire, on the proposition of Dr. Armand Ruffer, authorized the quarantine authorities to carry out bacteriological examinations as part of their visit in all cases where they considered it necessary. In consequence, between the dates of August 17th, 1911, and January 31st, 1912, the passengers and crews of 297 vessels were submitted to an examination of the stools as part of the routine examination for quarantine. The total number of stools examined was 34,461, and of these 14,553 were obtained from the crews and 19,908 from passengers, mostly from those of the poor class, although in some instances every person on the boat was examined. Vibrios were found in 63 cases, and of these 23 possessed agglutinating properties with Cholera serum, while 40 did not. Of the 23 agglutinating vibrios, only 2 came from members of the crews, while of the

40 non-agglutinating, 12 were found in members of the crews. The percentage of agglutinating vibrios was, therefore, about 0·07, but it was found that in the 44 days from August 17th to September 30th, during which the epidemic was at its height, there were ten times more carriers than during the remainder of the period. In general, Dr. Crendiropoulo finds that agglutinating vibrios are only found in travellers from infected countries and only when an epidemic is at its height. During the decline of an epidemic, carriers become extremely rare. It is interesting to note that the greater number of carriers were found in passengers and that the crews were but rarely affected. All the carriers were kept in quarantine until the disappearance of their vibrios which took place in most cases within five days, though in one case they persisted for eight days. Dr. Crendiropoulo is careful to point out, however, that the limit of five to eight days must not be taken as the ordinary time of persistence of the vibrios, since they had probably been present for some time before they were discovered. In regard to the non-agglutinating vibrios, their frequency is found to be in inverse proportion to that of the agglutinating. They become more abundant as the carriers of true Cholera vibrios become fewer, but both of them cease altogether when the epidemic comes to an end. Dr. Crendiropoulo gives an interesting and exhaustive account of the bacteriological characters of the vibrios obtained, including their virulence for the pigeon, liquefaction of gelatin, coagulation of milk, the production of hæmolysis and the indol reaction; and he concludes that none of them can be relied upon as a criterion for the diagnosis of the Cholera vibrios. Even the fixation of complement and the agglutination reactions are not free from doubt. As a result of his observations, he suggests that every carrier of vibrios, whether agglutinating or not who comes from a place where the disease is epidemic, should be held as a suspect.

PRECAUTIONS TO BE TAKEN BEFORE AND AFTER A VILLAGE HAS BECOME INFECTED.

Fairs, feasts and festivals are very common in India, and pilgrims from all parts of the Empire flock to them at certain times. Holy cities and villages thus become suddenly overcrowded with people who have to live under the most insanitary conditions, and it frequently happens that Cholera breaks out and is rapidly spread, not only amongst the pilgrims but wherever they go, and on returning to their homes they convey the disease. Railway communication fosters the spread of the disease to distant places which may become a focus and thus Cholera may be rapidly spread over a very large area. Previous to the arrival of the pilgrims, huts should be erected, properly laid out in blocks, with suitable sanitary conveniences so as to render supervision easy. The majority of the pilgrims are entirely ignorant and absolutely callous as regards pollution of streams, rivers and tanks. Thousands may be seen bathing and washing their clothes in the water they have to use for drinking. The river banks and the river itself are polluted with human excretions.

When a village or place visited by pilgrims has become infected with Cholera, special precautions should be taken to protect the water-supply and bathing places; a strict and efficient system of conservancy should be adopted and guards placed in charge of the water-supply and the conservancy system. The authorities in the adjoining village and town and places through which returning pilgrims pass should be daily informed of the progress of the epidemic. The latrines should be built of temporary structures, well away from the huts or dwelling places, and should be inspected twice daily and the receptacles properly disinfected; the contents treated with izal 5 per cent. or chloride of lime, and burnt or buried two feet deep well away from the camp to the leeward side. A proper system of disposal of the excreta is most important.

All bathing places should be kept separate from the river or drinking supply, and disinfected twice daily. If a river supplies the drinking water, no bathing should be allowed above the source of supply and proper channels should be cut to get rid of polluted water in the bed of the river.

Over-crowding in the huts and common lodging houses should be prevented and strict medical supervision enforced; every case notified and isolated, and a temporary incinerator and disinfector erected for the burning of refuse and disinfection of clothes. All vehicles and railway carriages should be regularly disinfected, and the railway authorities instructed to notify cases of deaths occurring in the carriages or coming to their knowledge. Railway stations to which pilgrims return from Cholera-infected places should be inspected and all cases removed to hospital, and the names and addresses of the relatives or persons taken down so that they could be visited at their homes.

The *measures for the prevention of the spread* of the disease are :—to early notify the disease, isolate the patient, disinfect or burn the stools and infected clothing, disinfect all utensils, boil milk and water, provide a pure supply of water and milk and food; to protect the food from flies, disinfect houses and latrines, trace the cause of the disease, isolate convalescent cases, protect the water and milk supplies, immediately remove all refuse and issue printed instructions.

Fresh chlorinated lime or powder in the proportion of two tablespoonsful to a pint of Cholera discharge is effective in 25 minutes. Strong izal 5 per cent. and carbolic acid 1-10 can be used for completely covering the discharges. For lime-washing rooms, $\frac{1}{2}$ lb. of chlorinated lime (bleaching powder) should be added to 7 gallons of lime wash.

INSTRUCTIONS FOR THE PREVENTION OF CHOLERA.

Origin of Cholera.—Cholera results from swallowing, with food or drink, minute organisms or germs which, developing

in the intestine, excrete a poison and give rise to the characteristic symptoms of the disease.

Spread of Cholera.—The germ of Cholera does not naturally exist in articles of food or in water, but gains access to them through the agency of infected persons. These germs are found in large numbers in the stools of the Cholera-stricken, and it is thus easy to understand how infection clings around a person sick with Cholera. Beds, bedding and clothing become soiled with the evacuations. The floor around the bed, or on which a sick person lies, the patients' own hands, and also the hands, feet and clothes of the attendant are all liable to infection from the same source. The patient infects everything he handles, and vessels used by him may convey disease to other members of the family. The attendant who cooks food or draws water may carry infection to these articles.

Again, if evacuations of a patient are thrown carelessly outside the house, flies settle on the filth and returning to the house carry Cholera germs to food and water which may be exposed.

There are thus many ways in which infection is spread in a household, and by which Cholera attacks one after another of a family.

But Cholera also attacks several families at once in a village, and this is because the water in the well, tank or stream has become infected and many persons drink the water. The evacuations of the Cholera-stricken, if thrown on to the ground, may get washed during the rainy season into any of these sources of water ; dirty pots, soiled clothing washed in the tank or stream, or near a well, will foul the water, or dirty infected water pots used for drawing water will spread infection. In one or other of these ways, Cholera germs get into the water used by the village ; they multiply and give rise to a general outbreak.

Fortunately, the Cholera germ is a delicate organism easily destroyed by heat and disinfectants. Disinfectants

may not always be obtainable, but fire is always ready to hand. On the first appearance of Cholera in the village, steps should be taken which will destroy germs and thus prevent its spread.

Cleanliness in the house and the removal of refuse and filth from the vicinity will help to keep away flies, and thus lessen the risk of the introduction of infection through their agency. All water of the house should be boiled for 5 minutes and allowed to cool before use. This will kill any germs in the water. Only freshly cooked food should be eaten. This also will lessen the risk of infection from flies, which readily settle on food left exposed.

Sweetmeats or other food exposed in shops, swarming with flies, should not be eaten.

Raw vegetables, or unripe or over-ripe fruits, should be avoided as they are apt to cause Diarrhœa, and Diarrhœa predisposes to Cholera.

Any symptoms of Diarrhœa should receive prompt treatment.

The above are measures which can be adopted in every household. In addition, there is an important preventive measure affecting a whole community in the disinfection of all sources of water by permanganate of potassium. This is a crystalline powder which, dissolved in water, colours it pink, the colour lasting for several hours. It is quite harmless to those using the water, but by destroying germs it prevents the spread of Cholera. The permanganate should be used according to the directions which follow. Bearing in mind the danger of contaminated water, and the risk of infection being carried by flies, special efforts should be made to keep the village site clean; people should be urged to go outside the village site for natural purposes, and away from tanks or streams. Warning should also be issued against washing soiled clothes near wells, or in tanks or streams from which household water is drawn.

PRECAUTIONS TO BE ADOPTED IN AN INFECTED HOUSEHOLD.

On the first appearance of Cholera, the *Patel* of the village should send to the *taluka* head-quarters for Cholera mixture, permanganate of potassium and phenyle.

The sick person should, as far as possible, be kept apart from the rest of the family.

All articles, such as bedding, clothing, drinking vessels and dishes for food, which are used by the patient, should remain in the sick-room and kept for his use only.

The evacuations should be received in an earthenware vessel, *gumla*, or chatty, in which some phenyle is always to be kept, and should be buried, not thrown on the ground.

The floor around the sick person and under the bed should be washed once a day with izal or phenyle solution, 1-20.

A solution of phenyle should always be kept ready with which attendants should carefully wash their hands after each act of tending the sick. Cholera mixture for the patient and phenyle for makinng a disinfecting solution should be asked for from the *Patel* of the village.

The disinfecting solution is made by taking one part of the strong phenyle and adding to it 50 parts of water, when a thick liquid is obtained.

If phenyle or other disinfectant is not obtainable, the attendant should use all the more care in burying all evacuations and in washing the hands frequently with clean water, and wherever the floor around the sick person gets soiled, he should sprinkle hot wood ashes.

Precautions to be adopted after the death or recovery of a patient.—Every article of bedding and clothing, the tapes or coir of the charpoy, the feeding and drinking vessels should be boiled for half an hour before allowing them to be washed, so as to destroy all germs. The floor and walls of the sick-room should be washed down with phenyle solution before being smeared with cowdung or limewashed.

Cremation or burial of those dying of Cholera should not be carried out near any source of water. Cremation should be most thorough, and burial at least 6 feet under ground.

Summary.—Cholera results from swallowing living organisms with food or drink. These organisms are easily killed by heat, and therefore freshly cooked hot food and boiled water can be safely used.

When Cholera is prevalent in an infected household, isolation of the sick, strict cleanliness and the free use of phenyle by the attendants, and disinfection by steam or burning of all infected articles will best prevent Cholera attacking other members of a family.

In an infected village, in addition to these precautions, disinfection of wells by potassium permanganate will check the outbreak.

DIRECTIONS FOR THE USE OF POTASSIUM PERMANGANATE IN DISINFECTING WELLS, ETC.

Put two ounces of permanganate in the solid state into a *dol* or bucket that has been filled with water from the well about to be treated. Stir it up and pour the red solution thus produced into the well, leaving the portion of permanganate that is not yet dissolved at the bottom of the *dol*. Lower the *dol* into the well, fill it with water, draw it up, pour back the water as before. Repeat the process till all the permanganate has been dissolved. After half an hour draw up some of the water and examine it. If a red colour is still present, enough has been added. If the red colour has disappeared, then more permanganate should be added to the water in the well. In all cases enough permanganate should be added to produce a red colour lasting 24 hours.

If the water in the well is bad, more permanganate will be necessary. In such a case it will be found that the strong red colour at first produced slowly changes to brown and then fades away. This is because permanganate and dirt

destroy each other. Therefore more permanganate must be added in order to produce a lasting colour. If the water in the well is clean, a smaller quantity of permanganate will be found to be sufficient; from one to eight ounces of solid permanganate will be found to be sufficient for ordinary wells. If possible, the permanganate should be added at night in order to leave the wells undisturbed as long as possible. The water will be fit to drink on the following morning. If at this time the water has a red colour, it will have a slightly unpleasant taste, but it is perfectly harmless. If the inhabitants do not like the taste, they should be instructed to pump out the water until the colour vanishes.

TREATMENT OF CHOLERA BY PERMANGANATE OF POTASH.

Whenever Cholera makes its appearance in a village, the water-supplies are purified by permanganate of potash. Permanganate destroys the germs which cause Cholera, and thus prevents the spread of the disease. Now it occurred to certain investigators that if permanganate could prevent Cholera by destroying Cholera germs in water, it might also cure Cholera by destroying the germs in a patient actually sick of the disease. It has been proved that if the drug is given properly, it has very good effects. For several years past, the Government of Bombay has issued tabloids of permanganate free of charge for use in villages. Hitherto the tabloids have been dissolved in a *seer* of water. The patient receives only a small portion of the drug in relation to the amount of liquid swallowed, and as the stomach is very intolerant during Cholera, he often cannot retain it. Moreover, the drug has to do its work in the intestines and not the stomach, and for this purpose a pill is preferable to a soluble tabloid. The Sanitary Commissioner, therefore, has recently recommended that in future the drug should be stored in the shape of pills in all localities subject to

epidemics, and promptly issued at the first appearance of the disease. He also recommended that the pills should be issued in 'treatments', similar to the quinine treatments which have become so popular. Government have accordingly issued orders that the Civil Surgeons of districts and the Deputy Sanitary Commissioners should keep suitable stocks of permanganate made up into treatments of 12 pills, and these officers will supply them to Mamlatdars for issue, free of charge, in Cholera-infected localities. It will therefore be most important for village officers to report immediately to their Mamlatdars the first case of Cholera in their village and to obtain a supply of treatments for distribution. The Governor in Council trusts that they and all persons of education and influence will put forward their best efforts to popularize the use of the treatments and thus save many valuable lives. *Government Order, General Department, No.* 4289 *of* 25*th May*, 1915.

INSTRUCTIONS AGAINST CHOLERA IN TOWNS.

In Bombay, the Inspectors must ascertain in every case whether all the personal clothing worn by the patient and all the bedding and any article of attire which may have been soiled by vomited matter or fæcal discharge has been collected and dealt with by the District Registrar or his staff on his preliminary visit. The District Registrar has instructions to immerse all such articles in *perchloride solution* pending the arrival of the disinfecting staff. The Disinfecting Sub-Inspector must remove all infected clothing for steam sterilization. It is of the utmost importance that no infected article be overlooked, and it is considered a very serious neglect of duty if any instance of such is detected.

2. *All water taps* must be carefully washed with freshly prepared permanganate solution and the water allowed to flow freely for a few minutes afterwards.

3. Careful search must be made to see if *any well* exists on the premises; if so, it must be treated with permanganate

solution. A solution of the crystals must be made first and then added to the well water till the latter remains pinked for about half hour.

4. *Every privy seat* should be carefully scrubbed with a brush, using plenty of water with some izal solution in it. The walls and floor of the privy must also be well washed with the same solution. If necessary, *pesterine may be applied subsequently.*

6. As far as possible all drinking utensils, plates, knives, &c., and all "chatties" should be well washed in a *solution of izal* and subsequently washed in clean tap water.

6. *The rooms* should be carefully swept (all furniture being removed) and then disinfected with perchloride solution or izal. The furniture should be well rubbed with a cloth soaked in izal solution and any table or article of furniture that will permit washing should be so treated.

7. The members of the family should be informed that it is essential to observe the greatest strictness in regard to cleanliness of their hands and utensils when taking food.

8. The privy floor and receptacle and also the trap door, if present, and the walls should be most carefully cleansed under the personal supervision of the Sub-Inspector. After thorough cleansing, the whole trap should be treated with pesterine. The object of so doing is to lessen the risk of conveyance of the disease by the agency of flies, and it is most important that the work be carried out in a conscientious and thorough manner.

On inquiry into the cause of an outbreak of Cholera and Enteric, and the spread of these diseases, many points will have to be considered and many things inquired into in the cities and villages in India—which are opposed to all the elementary teachings of sanitation.

The milk supply may be from the buffalo or cow direct, brought to the house door or kept in the compound. If the milking process is supervised by a reliable servant, the milk may be as pure as the animals can give it, but the *gowli*

or milkman, his vessels, his family and domestic surroundings require the strictest attention, if pure milk is expected. The milk may be from a dairy, or collection of milch cattle, and the conditions under which they are kept and milked require all the supervision the authorities can provide. The milk may be from a small shop to which it has been brought and its composition and quality is likely to suffer during transit, or before distribution; this can be ascertained only by analysis; the water with which it is adulterated may be contaminated; the milk may come from a so-called up-to-date dairy in a large city, sent out in sealed cans or bottles; a periodic examination of even this supply and the dairy itself is necessary. The milk may come from a distance, by train or carried on the head of a cooly in open brass vessels, or by a bullock cart, and may have to pass through many vicissitudes before arriving at its destination. All this points to a pollution of the milk before being consumed, and boiling is always advisable.

The following instructions have been issued to taluka officers in the Bombay Presidency, for guidance on the outbreak of Cholera:—

(*Accompaniment to Government Order, General Dept., No.* 2290 *of* 18-3-1919).

DUTIES OF THE MAMLATDAR DURING A CHOLERA EPIDEMIC.

1. Notification of infected villages to other villages in the taluka and to Mamlatdars of neighbouring talukas.

2. Send reports to Sub-Divisional Officer, Deputy Sanitary Commissioner and Collector.

3. Arrange, if possible, to go to the village with the Sub-Assistant Surgeon or send one of the Head Karkuns or some other senior Karkun if that is not possible.

4. Send out *at once*, by special messenger, if necessary, a stock of Cholera treatments.

5. Arrange for a trained man to go to the village at once to disinfect the wells, if well water is used for drinking.

CHOLERA INSTRUCTIONS FOR VILLAGE OFFICERS.

A. Explanatory remarks :—

1. The poison of Cholera is a very minute living organism: so minute that many lakhs of them could be placed on a silver two-anna piece.

2. This living organism multiplies in the body of the person suffering from Cholera, and leaves the body in the vomit and dejecta. The vomit and dejecta are therefore full of the poison of Cholera: *it is by them that the infection is carried from person to person.*

3. A person can only be attacked by Cholera if he swallows in his food and drink some living Cholera organisms.

4. Food, including milk, is contaminated by flies settling on it, or by the soiled hands of those who prepare it for use, or otherwise handle it.

Water in a river or tank is usually infected *by the washing of soiled clothes in it*; or by persons with soiled hands or feet washing in it or entering with cattle.

Water in a well is usually infected by soiled vessels being dipped in it or by washing clothes in the neighbourhood, so that some of the soiled water can trickle back into the well.

5. Cholera organisms are delicate and are *killed by heat or by* certain disinfectants such as permanganate of potash and cholorogen. *Hence,* during a Cholera epidemic, people who drink only water or milk which has been boiled, and eat only freshly cooked food while it is still hot, will not get Cholera. *If food is allowed to get cold before eating, it may be re-infected by flies settling on it.* Flies sit on dejecta and vomit, and so carry filth directly to food.

6. The digestive juice of the stomach in its healthy state is slightly acid and destroys the germs of Cholera: but the eating of too much fruit, or of any under-ripe or over-ripe fruit may destroy this natural power of resisting Cholera. *Hence,* during a Cholera epidemic *do not eat fruit of any kind,* and avoid sherbets.

B. What you can do to prevent your village from being infected?

Do not allow any person from an infected village to enter your village. If this be impossible, do not allow any visitor from any village to go near any well or tank or river from which drinking water is taken. Arrange for some villager to draw water for the visitor and then pour it into his water vessel. Allow no visitor or traveller to wash clothes in the village except in a selected place.

2. *Advise* all villagers to boil all water and milk, and to eat only freshly cooked food while it is still hot, and to avoid fruit and sherbets.

3. Get the wells disinfected with potassium permanganate or chlorogen once a week, or as often as may be practicable.

C. What to do when cases occur in your village to prevent the infection spreading?

1. See that the sources of infection—the vomit and dejecta—are properly disposed of. The only safe way is to burn or boil all the vomit and dejecta.

(*a*) In some houses people may find it convenient to catch the dejecta in shallow earthenware vessels. In this case a vessel such as a kerosine oil tin should be kept on the fire with a little water in the bottom. The contents of the pan should be thrown into this. After a few minutes boiling the contents will be harmless and can be buried.

(*b*) If earthenware pans are not available or cannot be conveniently used, dry grass, dry leaves, sawdust or rags should be placed below the sufferer, and near his mouth. The soiled grass, etc., should be removed and burnt on a fire outside.

(*c*) In every case a wide mouthed vessel of boiling water such as a kerosine oil tin should be kept on the fire, and all soiled clothes should be thrown into it, and boiled for 15 minutes before they are taken to be washed in the ordinary way with cold water.

(*d*) The soiled ground below the patient can be disinfected with a strong disinfectant like phenyle. If no such disinfectant is available, soak the soiled ground with kerosine oil, crude oil or pesterine. This will prevent flies from settling on it. Then scrape away the soiled earth and throw the scrapings on the fire.

2. Allow no one from an infected house to go near the village sources of water for any purpose whatsoever.

3. Make arrangements to supply such persons with water. *The water must not be drawn with vessels belonging to them*, but with vessels kept for the purpose and should then be poured into their own vessels.

4. Allow no one to wash his mouth, body or clothes near any water which is used for drinking.

5. *Close temporarily all steps* to step-wells.

6. *In the case of draw-wells :—*

(*a*) If possible keep separate vessels for drawing water, and do not allow people to use their own.

7. Select some wells for drinking water supply if there are many, and arrange for their regular disinfection : *once a day* while cases of Cholera occur if possible.

8. Advise people daily to use the selected wells, and have these wells carefully watched so that no one can wash himself or his clothes near them.

9. *When water is taken from a river :—*

(*a*) Select one place for drawing drinking water or dig special budkis in the river bed.

(*b*) Allow no one to wash himself or his clothes, water cattle, or perform funeral ceremonies near this place or upstream from it. Arrange for these matters being done down-stream.

(*c*) Keep a watchman to see that these rules are obeyed.

10. Arrange for a man with a tomtom to go round the village daily to advise people to boil all drinking water.

11. Arrange, if possible, for the supply to houses from which cases have been reported of earthenware vessels, grass, vessels for boiling water and fuel for boiling water or burning dejecta, soiled grass, etc.

12. Send a special mahar *at once*, even if it is in the middle of the night to report the first case to the Mamlatdar.

The reasons for this immediate report are :—

(*a*) The Mamlatdar can inform other villages, so that they may take timely precautions to protect themselves

(*b*) The Mamlatdar can arrange for some one with more knowledge and experience to visit the village for the treatment of the sufferers, and the prevention of the spread of infection.

(*c*) A large stock of medicines cannot be kept in every village. A small amount can be stocked for the first few cases, but the main supply must be stored at taluka headquarters. From this store more treatments can be sent to a village at once if a prompt report is sent to the Mamlatdar as soon as the first case occurs.

D. How to treat the sufferer?

1. *Medicine.*—Give the friends at once a bottle containing potassium permanganate pills. Each bottle contains 2 pills made up to the prescription of a doctor with very great experience in the treatment of Cholera.

One pill should be given every 15 minutes so long as the sufferer can swallow. The pills can do no harm if given at any state of the disease: they will do good if the stomach can retain them. Give the pills as early as possible: they are most valuable in the early stages. So advise people to report as soon as Diarrhœa commences.

2. *Diet* must be light: it should consist of milk and water or a conjee made of rice, jawari, or bajri. This liquid diet should be given in small quantities—a mouthful or two at a time, and frequently—that is about every 30 minutes.

This weak diet should be continued *for some days after apparent recovery*; fatal relapses are often caused by an injudicious and premature return to ordinary food.

3. *Drinks.*—The thirst in Cholera is usually very great: try to alleviate this by giving small quantities of cold boiled water, cold barley water, cold arrowroot water, or aerated water.

If ice is available, small pieces of ice may be given to the sufferer to suck.

Do not let the sufferer drink a large quantity at one time. A large draught excites vomiting and increases the thirst. Frequent sips will relieve thirst, large draughts will not.

4. *Pain.*—Try to relieve the painful cramps by hot fomentations and gentle massage.

5. If a hospital is near at hand arrange to remove the sufferer there at once.

CHOLERA LEAFLET FOR VILLAGE HOUSEHOLDERS.

A. Explanatory remarks:—

1. The poison of Cholera is a very minute living organism: so minute that many lakhs of them could be placed on a silver two-anna piece.

2. This living organism multiplies in the body of the person suffering from Cholera, and leaves the body in the vomit and dejecta. The vomit and dejecta are therefore full of the poison of Cholera: *it is by them that the infection is* carried from person to person.

3. A person can only be attacked by Cholera if he swallows in his food and drink some living Cholera organisms.

4. Food, including milk, is contaminated by flies settling on it, or by the soiled hands of those who prepare it for use, or otherwise handle it.

Water in a river or tank is usually infected by *the washing of soiled clothes in it*; or by persons with soiled hands or feet washing in it, or entering with cattle.

Water in a well is usually infected by soiled vessels being dipped in it; or by washing clothes in the neighbourhood, so that some of the soiled water can trickle back into the well.

5. Cholera organisms are delicate and are *killed by heat* or by certain disinfectants such as permanganate of potash and chlorogen. *Hence* during a Cholera epidemic, people who drink only water or milk which has been boiled, and eat only freshly cooked food while it is still hot will not get Cholera. *If food is allowed to get cold before eating, it may be reinfected by flies settling on it.* Flies sit on dejecta and vomit and so carry filth directly to food.

6. The digestive juice of the stomach in its healthy state is slightly acid and destroys the germs of Cholera; but the eating of too much fruit, or of any under-ripe or over-ripe fruit may destroy this natural power of resisting Cholera. *Hence*, during a Cholera epidemic *do not eat fruit of any kind*, and avoid sherbets.

B. How to protect yourself from Cholera?

1. Never drink any water which has not been boiled.

2. Store boiled water in vessels which are cleaned every day by rinsing them with boiling water. Keep the vessels carefully covered.

3. Allow no one to dip cups in the vessels for storing water. If cups are used for drinking, they should be filled by pouring water from the storage vessels.

4. Never drink unboiled milk.

5. Do not lower your power of resisting infection by eating fruit or drinking sherbets.

6. Eat only freshly cooked hot food. Do not eat sweets and dried fruits bought in the bazar, and which may have been infected by flies. Every one must have seen the swarms of flies on sweets and other articles of food exposed for sale in shops.

7. Never eat uncooked vegetables.

8. Wash your hands carefully before eating.

9. Do not enter a house in which there is a case of Cholera.

10. Inform the Patel at once if you see an inmate of a house in which there is a case of Cholera near the source of the village drinking water-supply.

C. If you hear of a case of Cholera or Diarrhœa in the village inform the Patel at once.

D. What to do when a member of your house is attacked?

1. Inform the Patel at once.

2. Ask the Patel for a bottle of Cholera treatments, and start giving the pills to the sufferer at once.

Act in the same way even if you think it is only Diarrhœa. The pills will do good even if it is simple Diarrhœa: for Cholera they are the best treatment possible if the patient cannot go to hospital or cannot obtain the constant advice of a doctor.

3. Keep all members of the household, except those actually required to attend the sick person, in a separate room or outside the house.

4. Every attendant on a sick person should be very careful to scrub his hands with soap and hot water every time he touches the sick person or anything soiled by him.

E. How to treat the sufferer?

1. Each bottle of Cholera treatments contains 24 pills made up to the prescription of a doctor with very great experience in the treatment of Cholera.

One pill should be given every 15 minutes so long as the sufferer can swallow. The pills can do no harm if given at any stage of the disease: they will do good if the stomach can retain them. Give the pills as early as possible: they are most valuable in the early stages. So advise people to report as soon as Diarrhœa commences.

2. *Diet* must be light: it should consist of milk and water or a conjee made of rice, jawari or bajri. This liquid diet should be given in small quantities—a mouthful or two at a time, and frequently—that is about every 30 minutes.

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4. *Pain.*—Try to relieve the painful cramps by hot fomentations and gentle massage

5. If a hospital is near at hand, arrange to remove the sufferer there at once.

Small-pox and Vaccination.

History.—The origin of Small-pox is involved in much obscurity. It is supposed to have had its origin in the East; certain it is that this very loathsome and fatal disease has been known in India for a long time. It was a disease from which almost every person born had to suffer and from

which a large number of persons died or were disfigured terribly.

Small-pox.—Three most important aids to correct diagnosis are the :—(1) premonitory symptoms, (2) the character of the rash and (3) the distribution of the rash.

(1) Fever, headache, vomiting, *backache* (lumber and sacral regions) and rigors.

(2) Eruptions appear two days after the onset of the backache ; *hard* and *shotty* to the tough ; rash, pimple, vesicle, pustule.

(3) Face and forehead first, then on wrists and ankles, then on the back (least on the chest and abdomen). When the rash comes out the temperature falls.

Inoculation.—The experience of the disease had shown that a person was not seized with it twice, that in a large percentage of cases one attack was protective against future attacks. In this experience is to be found the origin of the inoculation of Small-pox, a method consisting in inoculating the variolous matter into a wound on the body of a person previously untouched by Small-pox and thus giving him immunity from an attack of the natural disease. Who invented this method of protective inoculation, it is difficult to say. But the inoculated disease was found to be much milder than the natural disease and was therefore very willingly resorted to by the countries which suffered from Small-pox.

According to tradition, inoculation was a most ancient custom in India. It was practised by a particular tribe of Brahmins who, Mr. Holwell informs us, " were delegated from the different colleges of Bindoobund, Beneras, etc., over all the provinces. These divided themselves into small batches and arranged their circuits in such manner as to arrive at their respective places of destination some weeks before the usual return of the disease." The Brahmins operated at the door, refusing to inoculate any who had not observed previously for a month the preparatory course of

abstinence from fish, etc. Friction with a piece of dry cloth was made on the forearm or other part intended for inoculation; slight scratches with a fine sharp instrument were then made, but scarcely deep enough to draw blood; on this was bandaged a moistened pledget of cotton saturated with matter from the inoculated pustules of the previous year. The pledget was allowed to remain for six hours, after which the bandage was removed and the pledget left to fall of itself. The inoculated person was frequently douched with cold water over the head and shoulders upto the time of eruptive fever and the douches were resumed on the appearance of the pustules.

But inoculation had its own drawbacks. The method was not as safe as one could have wished and proved fatal in some cases; worse still, the inoculated disease was as infectious to the unprotected as the natural disease. It was, however, the milder of the two evils and continued to be practised in India till late.

Vaccination.—In 1798 Edward Jenner published his inquiry into the causes and effects of variolæ vaccinæ and proved that a person who had the Cow-pox, either accidentally or intentionally, was not susceptible to inoculation of Small-pox and consequently was safe from the natural disease. He proved that it was possible to propagate the Cow-pox by inoculation after the manner of Small-pox inoculation, first from cow to man and subsequently from one human subject to another.

VACCINATION IN BOMBAY.

The earliest record of vaccination available in Bombay pertains to the year 1849. But there is no doubt that vaccination was introduced into Bombay half a century earlier. History tells us that Jenner was very anxious about the introduction of vaccination in India. In 1799, about the end of the year, he sent copies of his works and a quantity of

vaccine on board the " Queen, " an East Indiaman, but the vessel was unfortunately wrecked on the outward voyage and the object was frustrated. Jenner renewed his attempt ; but the lymph was transmitted on lancet points or by means of threads soaked in the virus ; but the length of the voyage and vicissitudes of climate for a time rendered futile all attempts to diffuse vaccination to the East. Eventually, the genius of Jenner triumphed ; for he secured the services of series of volunteers who were successively vaccinated during the voyage. Cow-pox was thus transmitted from arm-to-arm until it reached Ceylon and India. In the meantime, a supply of lymph had entered India from another source through Bombay ; for in the spring of 1799, Dr. Pearson sent to Dr. Decarro, a Genoese by birth, then settled in Vienna, a supply of lymph upon threads. Decarro vaccinated successfully with it and in turn sent some of his lymph to Thomas Bruce, Earl of Elgin, who was then British Ambassador at Constantinople. He, with the courage of a Wortley Montague, first vaccinated his own son and then transmitted some of the lymph to Bombay, where the practice spread. The new method was at first opposed by the inhabitants, but their objection was in part overcome by a " pious fraud." Mr. Ellis of Madras composed a short Sanskrit poem on the subject of vaccination. It was inscribed on old paper to give it an air of antiquity. In the Bombay Presidency, impetus to the work was given by the Honourable Mountstuart Elphinstone, Governor of Bombay, 1819-1827. The province was divided into four divisions, a European vaccinator being in charge of each division. Arm-to-arm vaccination was practised in Bombay till 1869, when it was replaced by animal vaccination.

The Bombay Vaccination Act of 1877 requires every Bombay-born child to be vaccinated within six months of its birth and every outborn person under 14 years within three months of his arrival in Bombay. Bombay was the first City in India to make vaccination compulsory.

The Registrar of Births sends a notice to the parent or guardian of the child directing his attention to the Vaccination Act, which requires the vaccination to be done within six months of birth, and mentioning the place and hour where vaccination is done free of charge on a certain day of the week. He also submits to the Superintendent of Vaccination, through the Executive Health Officer, a list of the births registered by him.

Bombay is divided into six vaccination districts, each under a vaccinator. He is assisted by 3 or 4 karkuns under him, whose chief duty is to find out children for vaccination.

Each district has two public Vaccine Stations, where vaccination is done free of charge once a week. Every vaccinated child has to be brought at the same station next week for inspection by the Superintendent or the Assistant Superintendent, when a certificate of successful vaccination is given. The date of vaccination of each Bombay-born child is put against its name in the register and notices are served against the rest as soon as they reach the age of six months.

CALF INOCULATION.

Calf inoculation was started in Bombay in 1869, and the lymph was cultivated from calf to calf. The stock of lymph was at times renewed from the English lymph supplied by the Secretary of State and at times by retro-vaccination.

In Bombay cow-calves are used for lymph. But a buffalo-calf or a horse or an ass may also be used for the cultivation of lymphs

Race.—Many vaccine institutes give much importance to the race of cow-calf used. Calves are supplied by a contractor who brings them mostly from Ahmednagar District. This is a poor race and does not give much lymph.

Age.—The calves are easily manageable only when they are young; from 9 months to 18 months is a suitable age-limit. In some places older animals are used.

Veterinary Examination.—All calves are examined by a qualified veterinary graduate after admission to the depôt; emaciated or diseased calves are rejected and returned to the contractor.

Tuberculin Test.—Calves are tested for tubercle before their use for vaccination purposes.

Isolation and Feeding.—Every batch is isolated by itself for at least 15 days before it is allowed to mix with the old stock. The infectious diseases likely to be brought in the depôt by the new calves are Foot and Mouth Disease (very common), Rinderpest, Paraplasmosis and Anthrax. Much attention has to be given to the feeding of these calves, as generally they are received in a poor condition. On an average, a calf gets enough quantity of good dry hay daily, in addition to half a pound of the mixture of the following articles :—A pounded mixture of equal parts of gram, *toor*, and oil-cake mixed with an equal weight of cotton seed. Salt is mixed at the rate of one *tola* to one pound.

Calves which are well fed and without any high temperature are selected for the operation of vaccination and shaved. In this depôt, only the lower part of the abdomen from umbilicus and a portion of the inner side of thighs is shaved. In some institutions the whole of the abdomen and even the thorax are used. The shaved area is well washed with soap and water, and coated with a mixture of glycerine and carbolic acid 5 per cent. in case the part is abraded by a razor. The calf is then stabled in a separate place till it is actually required for use.

Just before the operation, the temperature of the calf is taken, and if the animal has a temperature below 102°, it is selected for inoculation. The shaved part is again washed with soap and sterile water and the calf is then kept on a "tilting" table in such a way that the mouth of the calf would come on the right hand side of the operator. The part is again washed by sterile water by the operator

himself. The instruments and appliances to be used for inoculation are previously sterilized in the hot chamber.

Inoculation of the calf.—The calf is inoculated either (*a*) direct from calf, or (*b*) from preserved glycerinated vaccine.

(*a*) The lymph used for inoculation purposes is from 96 to 120 hours well-developed vesicles. Typical well-developed vesicles should be selected; this can be done with a little practice. The selected vesicle is then squeezed by the expression forceps, when the lymph oozes out in the form of fine pure droplets. Care should be taken to remove the blood that comes out first.

(*b*) In the latter method, the tube is to be cut at both ends by a file and the contents taken on a scalpel point.

In both cases the lymph is taken on the point of a scalpel and then introduced into the skin by making parallel linear incisions by the scalpel. The incisions should be deep, and care should be taken not to allow the calf to bleed too much, as this is likely to wash off the lymph used.

Calves are inoculated for two purposes, either for vaccinating children direct (from calf to arm), or for scraping the growth and preserving the lymph in glycerine as is described hereafter. For the first purpose, the calf is inoculated—(1) by punctures, or (2) by incisions of about half to one inch long. The development of punctures is slower than that of incisions and the calf can, therefore, be conveniently utilised on the 5th and 6th day for vaccination. For the second purpose, the calf is inoculated by long continued incisions about 4 to 5 inches in length and one inch apart from each other.

In both the cases, the lymph should be distributed evenly along the line. The calf is kept in the same position on the table for about 5 minutes after the operation is over.

After-care of the calf.—The calf is then tethered in a clean stable in such a way as to prevent any injury to the vaccinated part. Aprons are used to cover the inoculated area, but it will be better to arrange the stalls in such a way as to prevent the calf from licking the operated part. After 48 hours, the temperature of the calf is taken morning and evening and the operated area inspected from day to day, marking the development of vesicles.

Preparation of glycerinated vaccine.—Nearly at the completion of 120 hours, most of the vesicles mature. This is the time for the collection of the lymph, and the animal is again placed on the operation table in the same position as described above. The inoculated surface is thoroughly washed with neutral soap and sterilized water and gently rubbed over by clean hands of the operator. The process is repeated till the part is completely clean. A towel soaked with water is then placed on the inoculated part for about ten minutes to moisten and soften the part. The growth is then collected by scraping with a sterilized spoon. The pulp obtained is received into a stoppered glass box and is then weighed. It is mixed with

four times its weight of sterilized mixture of 50 per cent. pure glycerine in distilled water. The emulsion is prepared in mortar and pestle by hand rotation. In order to secure the thorough and complete pounding of the pulp with the above mixture of glycerine and water, two-and-half hours are required. The first, second and third doses of the above mixture equal to the weight of pulp are added at the interval of about 40 minutes and the last dose of n ixture is added at the interval of half an hour. The emulsion is then poured into a tube-filling machine (Baird and Tatlock's), worked with water pressure. The arrangement of the machine is very simple and every part of the machine can be easily separated and sterilized. The tubes are hermetically sealed at both ends on a gas flame, care being taken to prevent the heating of the lymph. The tubes are then kept in an Ice Chamber at a temperature of 40° to 50° F.

Testing of lymph.—The contents of the tube are then examined bacteriologically by the Municipal Analyst after four weeks and tested repeatedly till found sterile.

The potency of the lymph is afterwards tested on a calf and, if the results are satisfactory, the lymph is issued to the vaccinators for use on children for primary and re-vaccination. The activity of the lymph depends upon the quality of lymph when collected and the temperature under which it is kept.

GLYCERINATED CALF LYMPH.

The glycerine serves to preserve the lymph, without in any way interfering with its activity, and it destroys extraneous organisms.

The calves are previously tested with tuberculin.

In Paris, the lymph is diluted with an equal bulk of glycerine. In Brussels, twice the bulk of glycerine is added. In England 5 to 8 times its bulk or 40 or 50 per cent. pure glycerine is added.

If vaccination is performed, within 48 hours of the exposure to contagion, on a person who has already contracted Small-pox, vaccinia ensues and Small-pox is avoided. But if performed at a later date, Small-pox is contracted, modified if within 3 days, but unmodified if later.

Small-pox, as it occurs in the present day, may be divided into (1) Small-pox in the unvaccinated, and (2) Small-pox modified by vaccination. In both cases, after a person has contracted the disease, he may remain to all appearance

quite well for eleven or twelve days ; he then becomes feverish and sick, and complains of pain in the back for two or three days. Finally, the eruption comes out (usually first on the face), pimples which fill with clear lymph and then become pustules and form crusts. If the spots of the face run together, the disease is called *confluent*; if they remain separate on the face, the disease is called *discrete*.

Thus when a person has been exposed to infection, he should be quarantined for a clear fortnight. If he remains quite well, he may be regarded as safe. The *patient is infectious from the very first symptom till all the scabs are off.* However, a case is rarely notified until the eruption appears and if then properly isolated, the spread of the disease is generally prevented. It has been found that if Small-pox were modified by vaccination, a patient treated in hospital would be free from infection five weeks after the eruption began to appear ; if the disease were not modified, a patient (provided he recovered) would not be free from infection until eight weeks after the eruption began to appear. As the particles, by means of which the disease is spread, are stored up in the crusts, these should be kept oiled from the time they begin to form.

Cases in which the disease is modified by good vaccination are often so mild that the whole eruption may not amount to a dozen spots. Such cases are particularly liable to escape attention. The head of the household may know nothing about them, and there is little likelihood of a doctor being called in. Yet disease communicated from such a patient, if the receiver be unvaccinated, may be as severe as possible.

DURATION OF SMALL-POX IMMUNITY CONFERRED BY SUCCESSFUL VACCINATION.

There are two means of judging the duration of Small-pox immunity conferred by a successful vaccination. The first is through observation of those, who having had a successful

vaccination, are later exposed to Small-pox and the second, the duration of immunity to vaccination with vaccine.

It is well known that an occasional individual responds only slightly to immunizing agents ; the degree of immunity established varies with the individual. The variable period that different individuals retain immunizing substances is also evident in all infectious diseases. This peculiarity is present for all anti-bodies. The enormous experience now gathered indicates that it is wise for any one exposed to Small-pox to be re-vaccinated, if a successful vaccination has not been obtained within nine months. The general population should be vaccinated about every five years, when Small-pox is at all prevalent. Even when the disease is absent, it is necessary that all persons be vaccinated in infancy and again in childhood so as to keep the population moderately immune and so prevent a sudden development of an epidemic.

The protection vaccination affords against Small-pox may be stated as follows :—

(1) That it diminishes the liability to be attacked by the disease.

(2) That it modifies the character of the disease and renders it less fatal and of a less severe type.

(3) That the protection it affords against attacks of the disease is greatest during the years immediately succeeding the operation of vaccination. A *child must be vaccinated* within six months of its birth *unless*.—

(1) the parent obtains a certificate of exemption or (2) the child dies or (3) is attacked by Small-pox within that period or (4) three or more unsuccessful attempts at vaccination have been made or (5) a medical certificate of postponement is given on ground of ill-health. (Royal Commission on Vaccination, 1896.)

How very severe Small-pox may be, those who have had long experience in connection with the disease can testify. There are two forms in particular that occur—the so-called "*black Small-pox*," where the eruption becomes dark from innumerable small hæmorrhages, and the *variolæ sine variolis*, where the disease is so malignant that there is no eruption but the skin is thickened and somewhat livid.

When a case of Small-pox is notified and the Health Officer has satisfied himself that it is really Small-pox, there are four steps to be taken, and all as promptly as possible—

(1) The patient must be isolated.

(2) Vaccination (or re-vaccination) must be offered to and pressed on those in the same house as the patient and persons ascertained to have been recently in contact with him.

(3) The patient's wearing apparel, bedding, &c., must be efficiently disinfected or destroyed, and his room thoroughly cleaned out.

(4) The origin of the case must be investigated. No pains should be spared in searching out the source of infection, especially if the case notified be the first in an outbreak. If the investigation be carefully made, the officer undertaking it will ordinarily ascertain the source. He must not abandon the search too soon, and be content with the lame conclusion that the disease reached the district ærially.

The necessity of a Health Officer satisfying himself that a case notified as Small-pox is really Small-pox is obvious. Not only are cases of Chicken-pox frequently reported as Small-pox, but also cases of Eczema and other skin diseases. Indeed, in one instance a man suffering from secondary Syphilis only was sent to Birkenhead Hospital as a case of Small-pox.

The incubation period of Small-pox is 12 days but may vary from 9 to 15. Duration of infectiveness is from 3 to 4 weeks.

The contagion is most active and the infectivity greatest during the period of maturation and crusting of the pustules. The virus is contained in the mouth and throat secretions and the skin eruptions, and may be conveyed through the air in the dried epithelial scales and pus cells from the crusted pocks for considerable distances.

LOCAL GOVERNMENT BOARD REGULATIONS, ENGLAND.

A Small-pox Hospital should not be erected—

(1) on any site where it would have within a quarter of a mile of it as a centre, either a hospital, whether for infectious diseases or not, or a workhouse, or any similar establishment, or a population of 150 to 200 persons; and

(2) on any site where it would have within half a mile of it as a centre a population of 500 to 600 persons, whether in one or more institutions or in dwelling houses.

Cases in which there is any considerable collection of inhabitants just beyond the half-mile zone should always call for special consideration.

Small-pox arises solely from infection from a previous case.

Vaccination depends largely upon the efficiency of the operation and the number and character of the resulting scars. The protective influence wears away with the lapse of time, and re-vaccination at or before the age of puberty is necessary.

In London, there is a 'conscience' clause. In Germany, vaccination and re-vaccination are compulsory.

OBJECTION TO VACCINATION.

The Indian community as a whole does not object to vaccination. Their indolence and apathy, however, come in the way of their getting children vaccinated early, unless the Vaccination Department compels it. This compulsion the Act allows to be applied. There are, however, a few

prejudices connected with vaccination which it is worth while noting. Of these, the first is the religious aspect given to vaccination. The ceremony performed is the same as is gone through when a person gets the Small-pox. It consists in what is known as "naming" the disease, which is done when the vaccine vesicles appear. On this day a worship is commenced in a certain form with the burning of incense, a swing is provided with a number of neemb-leaf strings hanging above it and ladies of the house and neighbours and friends sit on the swing and sing in praise of God. This ceremony goes on for 9 days when the "vibhuti" ceremony is performed. This consists in applying "abir" to the pustules; the friends and relations of the family send presents of sweets and fruits to the child. From this day the disease is said to be on the decline, but the worship referred to above continues till the 21st day when the child is given a bath and taken to the temple of goddess Shitalà, where the worship of the goddess is performed with great pomp and *éclat*. On the same day, friends and relations are invited to dine at the place. This ceremony is either much curtailed or even omitted by the higher classes of the Hindu community, but is still followed in detail among Khatris, Kolis, etc. All this means expense and consequent delay in the vaccination of children. Second, a superstition generally noticed among Kolis is that no vaccination is allowed to be done in the locality where there are cases of Small-pox, as thereby goddess Shitalà is believed to be much enraged. Evidently, this must refer to the inoculation days, when, probably, during an epidemic, persons undergoing inoculation got the disease in much severer form than usual.

EFFECT OF VACCINATION ON SMALL-POX.

The effect of vaccination on Small-pox will be seen by the comparison of the figures of mortality from Small-pox before and after 1877, the year when vaccination was made