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THE PLAGUE,

by

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THE PLAGUE.

EARLY HISTORY.

The earliest recorded notice of the disease which we now know as "the Plague" is that in the Bible. The prophet Samuel, (1240 B.C.) speaks of the plague of emerods and of mice (a) by which the Philistines were afflicted; and to-day still, wherever the malady appears, these two prominent accompaniments claim their numerous victims, and "mar the land". Our equivalent phraseology, ~~bubonic~~ inguinal bubos & mortality among rats, is wonderfully akin to this genetic account of the scourge.

(a) - 1 Sam V: 9-12, VI: 4-18.

That Syria may thus have been its primary home is rendered more probable by the record of its re-appearance there about a thousand years later. For, at the close of the third century B.C., Syria, with adjacent Egypt and Libya, was visited by an epidemic characterised by "pestilent buboes very fetid and acute" - "pestilentes bubones maxime letales et acuti" [a] - That this description by Oribasius refers to the Plague can, we think, scarcely be questioned.

None of the early Greek physicians give any account of it. Aretæus, however, is doubtless referring to it when he speaks of "pestilential buboes" / "βουβῶνες λοιμώδεις"] -

"The outbreaks which appeared in South

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[a] Oribasius - Collectanea, Lib. XLIV: Cap 17 - Œuvres Ed: Bussemaker et Daremberg, Paris, 1851. Vol. III, p. 607 -

Africa, about 542 A.D., and which later spread itself throughout Europe, attacking all classes of the people, including the Roman Emperor, as described by Procopius,[a] had all the leading features of our Twentieth Century Plague, and may be safely identified with it.

In 1348 A.D. the "Black Death" cut off more than a third of the population in England, and during the next fifty years it was equally fatal throughout the Continent. It is estimated that 25,000,000 died in Europe alone during its visitation, widely from its attack. The resulting desolation, and dislocation of societies from dread of it, are powerfully pictured by Boccaccio in his "Decameron". Some consider the "Black Death" to have been

(a) Procopius - De Bello Persico, II: 22, 23.

a malady wholly different from the Plague, and one which is now happily extinct. A few prominent lung symptoms, specially the violent pains in the chest, and the horribly offensive breath, perceivable at a distance remote from the sufferer, are special points of variance. Notwithstanding these discrepancies, others reckon it to have been but a modified form of our present visitant. In the view of it, the account of a modern observer, Giovanni Cabiadis, who tells of the Plague in Mesopotamia in 1873-74,[a] may be considered. He describes the petechiæ as varying in size from the dimensions of a millet-seed to those of a lentil; and as so numerous at times, and so thickly placed, that the skin assumed a livid hue, and

[a] See Trans. Epidem. Society, London, Vol IV., where Cabiadis' report is summarised by Dr. Dickson.

the corpses of such a blackened appearance. His mark, Leadle, is "so characteristic of "the disease that the malady might properly "have been called, even in this day, "Black "Death"".

Pepys, Defoe, and others give numerous details concerning the Great Plague of London, 1665; and which, the year following seemed to be stamped out by the Great Fire. The contagion is supposed to have been brought to London by those merchant-ships which traded with the Levant. Its identity with our present-day Plague is undoubted, & need not be enlarged upon. The pathos of the following incident recorded in Pepys' Diary (a) must touch all hearts: "Greenwich begins "apace to be sickly. x x x. A complaint was

(a). Pepys' Diary edited by Bright. Bickers & Sons, London, 6 Vols. 1879- Vol. VI. p. 103.

"brought up against one in the town for taking
"a child from London from an infected house.
"Alderman Forbes told us it was the child of a
"very able citizen in Gracious Street, a saddler,
"who had buried all the rest of his children of the
"Plague, and himself and wife now being shut
"up in despair of escaping, did desire to save
"only the life of this little child, and so prevailed
"to have it received stark naked into the arms
"of a friend, who brought it, (Having first it into
"new fresh cloths,) to Greenwich; whereupon,
"hearing the story, we did agree it should be per-
"mitted to be received and kept in the town."

Many of Defoe's details again are powerfully realistic, as in the following sketch:

"It is hardly credible to what excess the
"passions of men carried them in this extremity
"of the distemper; and this fact I think was as
"moving as the rest. What could affect a man

(a) Defoe's Journal of the Plague Year 1665. Ed. Brayley-
—published by Routledge, London, p. 221/3.

"in the full power of his reflection; and what could
"make deeper impressions on the soul, than to see
"a man almost naked, and got out of his house,
"or perhaps out of his bed, into the street, x x x,
"run dancing and singing, and making a
"thousand antic gestures, with five or six women
"and children running after him, crying & calling
"upon him, for the Lord's sake, to come back; and
"intreating the help of others to bring him back?—
"but all in vain, nobody daring to lay a hand
"upon him, or to come near him!"

"This was a most grievous & affecting thing to me,
"who saw it all from my own window; for all
"this while, the poor afflicted man was observed to
"lye there in the utmost agony of pain, having, as
"they said, two swellings upon him, which could not
"be brought to break, or to suppurate; but by
"laying strong caustics on them, the surgeons had,
"it seems, hopes to break them, which caustics were
"even then upon him, burning his flesh as with a hot iron.

"I cannot say what became of this poor man; but
"I think he continued roving about in that manner
"till he fell down and died."

Since the epidemic of 1665, England has been little troubled by this undesirable visitor. But, in other quarters of the globe it has since repeatedly been kindled into fierce activity, only to die down, when its fuel, so to speak, began to fail; and again, after a more or less prolonged smouldering, to break out afresh elsewhere, in all its customed virulence and power. Much useful information concerning anterior outbreaks is detailed in the Report of the Commission of the French Academy of Medicine, 1844. Particulars of such epidemics as have occurred subsequently are most fully given in the various Government Reports of those Countries which have suffered from its ravages, or have dreaded its approach. Interesting and valuable as many of these are, yet they all

dwindle into comparative insignificance when compared with the importance of the Japanese Government Report upon the outbreak of Plague in Hong Kong in 1894; and the French Government Report regarding the same epidemic. These two Reports mark an Epoch in our knowledge of the radical nature of the diseases.

DEFINITION. Before proceeding further we may define the Plague as: An Epidemic disease produced by the presence of a specific virus in the Lymphatics, blood, and viscera; communicable by contact, and by inoculation; accompanied by high fever, great prostration, and intense headache; and by varying local symptoms.

DISCOVERY OF THE BACILLUS.

The Hong Kong Epidemic of 1894, as we have said, led to special inquiries as to its nature and origin by the Governments of Japan and of France. The Japanese enquiry was conducted by Kitasato and Aoyama, and the French enquiry by Yersin. These researches were made independently and about the same time, and they were attended by the same result — the discovery of the Coco-bacillus which is the specific cause of the disease, and which we now know as the Bacillus Pestis. This discovery is one of the many recent triumphs won by the microscope in the field of medicine.

Kitasato has the honour of being the first to identify and isolate this bacillus as the immediate & efficient cause of the malady. Inasmuch as he found the bacillus in the buboes and blood of patients, and in the

organs and blood of rats and mice who were plague-smitten; and seeing that this was the one feature which seemed to be alone common to these foods, he assumed that its presence & action in the human body was the cause of the disease.

The subsequently oft-repeated inoculation of the lower animals, both with culture-forms of the bacillus, and with forms directly derived from the bodies of the plague-stricken, (under careful isolation both before and after inoculation against other forms of infection), and the fact that these experiments were in regular course invariably followed by the disease, irrefutably established his induction. And in this discovery the Occident may justly yield to the Orient its meed of praise for progress in science, a field which has so long been peculiarly its own.

Later on, Yersin, working on lines of his own, also identified the same bacillus.

As might have been expected in the case of two observers using somewhat different methods & different reagents in their preparations for the microscope, there is some discrepancy between their accounts, while at the same time there is a substantial identity.

Summarizing the accounts then & subsequently published, we append a short description of the characters and marks of this specific agent. The Bacillus Pestis is most readily found in the Lymphatic System of all those who are attacked by the Plague, and more especially in the buboes; and also in the sputa & pulmonary alveoli of such Pneumonic Cases as occur. It is found also present in the blood. Until recently the blood-forms were supposed to be sometimes absent; or, at least, that in the beginning of the attack they were rare. Recently, however, Calmette (a) has asserted that as long as the Plague fever continues it is possible to demonstrate

(a). Quoted by Montenegro in "Bubonic Plague" London. p. 68.

the presence of the microbe in the blood; and that when the fever disappears the bacilli also disappear, alike from the lymphatics, the blood, & all pathological products. In cases about to terminate fatally it has been noticed that the number of the blood-forms is largely increased. And after death they are always observed in profusion in the spleen, liver, and kidneys; and, in rapid cases at least, in the lungs and in the intestines.

In shape the bacillus is a short & thick cell-like body, having rounded ends, showing mobility (Kitasato), at a temp^re of 37°C; and, sometimes, endowed with one or two terminal flagella (Gaskin). Its size is from 1 μ to nearly 2 μ in length, and from 0.3 μ to 0.6 μ in width. It does not develop spores, and seems to be reproduced entirely by subdivision. The temperature most favorable to its development is from 35° to 37°C. (equal to 95° to 98.6°F.). It is killed in thirty minutes by a temperature of 77°C. (or 170°F.); and, in a few minutes

by the temperature of 100° C. / 212° F.).

The forms are readily stained by aniline dyes and more deeply at the ends than at the middle. It shows great affinity for all the three groups of stains. A 1 in 4 solution of Carbol fuchsin is a serviceable stain. It is important to note that when the stained bacillus is treated by Gram's method it is decolorized.

Removed directly from the human body it is most frequently observed in pairs, but cultivated in bouillon it generally manifests streptococcus-like chains containing five, six, or more bacilli with an angle or bend in the chain. The appearance of a capsule, often noticed, is supposed to result from the method of preparation. It can be cultivated anaërobically, but aërobic growth is the common method. It does not generate pus. Agar-agar and gelatine are the usual culture media, but in India gelatine is not to be trusted. The most favorable temp-

for culture, is about 37°C. (98.6°F.) It grows rapidly in blood serum; and in twenty four hours shows as a slightly elevated, moist, and cream-colored growth. When gelatine is used the culture medium is unliquified. Seen against the light, young colonies have a ground-glass appearance, but older colonies are more opaque, with a greater density in the centre. Fraser speaks of gelatine cultures as developing transparent colonies, which manifest iridescence at their borders.

Cultures from infected sputa are readily isolated, (Childe); but the beginner may have difficulty from the concurring presence of strepto-cocci and staphylo-cocci, pus-producing bacilli. The Bacillus Pestis however, at a low temperature, develops more quickly than these. Therefore, it may be isolated by removal of the growth-patches first appearing. Aseptic precautions are of course needful throughout

Streptococci and Staphylococci forms are also distinguished by the fact that they are stained by Gram's method, while the Bacillus Pestis is not.

Haffkine (a) has shown how to produce a special stalactite-form of the Bacillus Pestis, and the production of this form is the basis of his pro-phylactic fluid. It is also a great help to diag-nosis, as will be stated later on, because no other known bacillus, similarly treated, develops in the same fashion. His method is to pour a melted or goat's flesh broth medium into a little cocoa-nut or shin oil in a flask. This does not necessarily seal the broth below from the atmosphere of the flask above. After sterilisation, it is infested with pure microbe forms, and kept at the requisite temper-ature in an incubator, & studiously free from anything which could cause vibrations. In the course of about twelve hours a diffuse cloudiness

(a) - Indian Plague Commn. Report, 1900, Vol. I, Appx. V, p. 345.

appears; and later on this slenderness transforms itself into a stalactite-shaped growth depending from the oil-globule at the top. Left undisturbed these forms would ultimately occupy the whole inferior space. But very gentle shaking precipitates the growth in the form of a sweet-like powder. In the preparation of the prophylactic fluid this precipitation is induced every fourdays, to secure permanent minute sub-division favorable to rapid absorption when injected subcutaneously. The process is continued until new forms cease to appear. Then the microbes are killed by heating up to 70°C. Afterwards, under aseptic precautions, fluid & precipitate are sealed up in small flasks holding about 60 c.c.

Lustig & Galeotti[a] have fallen into error in stating that this stalactite-form is anaërobic, & so necessarily of attenuated virulence. For the oil used is not enough to seal off from the air above; and, even were it so, the dissolved atmospheric gases, renewed by shaking every four days, maintain a measured supply.

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[a] Indian Plague Commn. Report. 1900. 8vo. Appx VI. p. 347.

GENERAL CAUSATION.

The causes which either evolve or multiply the specific virus, and which aggravate the symptoms and tendency of the disease, are far-reaching & subtile in their working.

1, Neglect of Ventilation, and an ingrained hatred of fresh air, is perhaps the most decisive of all. This is a world-wide weakness among the poor, having perhaps its root-cause in under-feeding & craving after warmth. In the present Bombay epidemic, 1896-1901, it has been observed that the advent of chilly weather is followed by an increase of cases; and this is believed simply to arise from increase in indoor-living, and the stoppage of all ventilating apertures, "to keep out the cold". Europeans & Eurasians, being for the most part well-fed & living in clean and well-ventilated homes, are attacked but rarely.

So also is it with the richer class of Parsees, who are at once better-educated and better-housed than other native races.

Police-Ships when smitten by Plague outbreak have only a few sporadic cases arising from shore infection. The abundant ventilation, purity of the sea-air, and scrupulous cleanliness of life at sea, afford the disease no nidus, & if frequently does spread.

The same has been noticed on board Pilgrim-Ships, the travellers in which are even more uncleanly in their habits than the Police.

Boat-dwellers upon the great Chinese rivers and Canals, although moored alongside dense masses of Plague-smitten shore dwellings, suffer but little from the Scourge.

In the Canton Epidemic of 1894 it was remarked that about 250,000 people living in boat-houses, enjoyed almost complete immunity.

In Segregation Camps also, through Separation from the old Environment, and abundant Ventilation, the spread of the disease is always speedily arrested. The cases which do occur are from town-acquired Contagion, and these rarely or never beget new Camp Cases.

Now the attendants of Plague Hospitals, institutions whose perfect Ventilation is studiously secured, are rarely attacked. So much so that it has been remarked - The safest place during an epidemic is the atmosphere of a sanitary Plague Hospital.'

These manifold facts have but one thing in common, the presence of abundant fresh air: and the exclusion can scarcely be resisted - Perfect Ventilation by itself arrests & checks the progress of the Plague: and the converse necessarily holds true - Lack of fresh air promotes and favors its development.

2, Insanitary Dwellings also promote Plague evolution - whether from Lack of cleanliness, or faulty site, or hurtful surroundings.
Earthen floors, or floors of mixed Cow-dung & earth, prevail in the Lowest Class of houses in India. These, from the habits of the inmates, become saturated with food refuse & secreta from man & beast. The result is to establish a congenial shelter for the Plague Virus.
Then, by a parallel neglect of Sanitary Conditions unknown even in England, the floors are frequently lodged in houses built on alluvial or marshy soil, too low-lying to be effectually drained. Colvill describes such a village on the Lower Euphrates, in which the Plague Epidemic of 1874-1877 originated. He relates how it is erected on ground which is a foot or two lower than the surface of the river in Spring, and that the soil is saturated with water, so that

the refuse of the village is neither absorbed nor can be evaporated; for it always takes up fresh moisture from below, and the refuse acquires the form of a bluish-black oily fluid, which surrounds the huts, covers the paths, and stains the walls two feet from the ground. And in fact the village was in such a state of filth that it required to be seen to be believed. This dreadful picture of a "marsh-village" holds substantially true of not a few other villages in many other lands.

Then the swamps on every side, which are apt to appear suddenly in the rainy season in such localities, multiply ten-fold the innate insanitariness of these sunken abodes.

In other cases, dunghills at doors & windows, in heat and rain, act peculiarly. Custom blinds the judgment and cloth ties the hands against all change or improvement.

3, Overcrowding, embedded with effluvia from unclean bodies, lends their aid. In England from such an exciting cause typhus is apt to appear; in India and the East, the Plague. A striking instance is related by a Government Medical Officer. It was in the house of a jailor who lived contiguous to the prison. It had three large rooms & four small; had double rows of windows in front, rear, and sides; had clerestory windows above the abutment of the verandah roofs; and had no less than six large doors with fanlights above them. These abundant means of procuring fresh air were wholly ignored by the tenant, an ignorant & old-fashioned high-class Brahmin, quite unwilling to depart from traditions. He himself, his wife, his mother-in-law, six children, 6 buffaloes and 3 buffalo calves "practically occupied the same bed in the central room", with every door and window closed, & every opening for fresh air blocked-up! At length the Plague appeared. And need we wonder?

4, Underfeeding, and consequent cachectic type of constitution. This predisposing cause, very frequently, as in famine seasons, no benevolence or foresight can wholly avert. The Plague indeed has been termed the "Pestis Morbus", or the Poor Man's Disease, a name first used during the great London Epidemic in 1665.

5, House vermin. Ectozoa, flies, mice, & rats are all capable of becoming infected with the Plague, and of carrying the contagion from house to house, and from district to district. Birds, dogs, cats, sheep, goats, swine, & horses are happily not susceptible, but most of them manifest marked reactionary fever under Inoculation.

Body-fleas and house-flies however are comparatively unimportant disseminators; so also are ants and bugs (Hankin). The mouse is somewhat less susceptible than the rat.

Rats however are so susceptible, except the musk rat, of Rat the Plague has been defined as: A disease of rats communicable to man.

The gregarious habits of rats and mice, their preference for human dwellings, and their well-nigh irrepressible migrations are well known. When infested their presence & movements are looked upon with justifiable alarm. In the work of cleansing & disinfesting Plague-stricken houses dead rats & mice are sometimes found under the floors, in the roof, or elsewhere. That the rats as a rule are the infected and not the infected, is inferred from numerous observations. Where outbreaks in towns and villages have frequently been observed to be preceded by the bodies of dead rats in some special house or compound. Later on, the first declared case of Plague appears in that dwelling. Then from it as a centre, the next occurring cases radiated in succession, the more remote in space being also the more

remote in time of development. Such was the history of the 1897 Epidemic at Kholápur, and of the outbreak of 1898 at Khánápur; and of other places too numerous to mention.

Disinfecting & Sanitary measures in an infested locality will drive the rats & mice to the dwellings next adjacent, & they necessarily carry the disease with them. At other times some as yet unmastered instinct, it is supposed of self-preservation, would seem to impel them to migrate. This phenomenon, in the early part of the Bombay Epidemic, attracted much attention; and the "Rat-Progress", as it was termed, was somewhat sensationally described. One account says: "armies of rats which had first infested, "and then were in turn infested by, the locality "in which they found themselves, fled from East "to West, and from West to North. In the wake "of these fleeing armies of vermin followed the "deadly pestilence". Further details may be

Earned in the account by Mr. Snow, the Municipal Commissioner of Bombay, 1896-97; and in that by Mr. Logan, Collector at Thana).

In China, Japan, and elsewhere the same phenomenon has been observed. Kitasato, in a great report[a] describes how two separate epidemics in Japan, the one at Kobé (± 30,000. inhabitants) and the other at Osaka (760,000. inhabitants) &c. in Dec. 1899 and Jan. 1900, were preceded by the appearance in the streets of numerous dead rats. The two municipalities took alarm, & offered 10 Centimes a head for all rats dead or alive. Before the end of Jan. 20,000. rats were taken at Kobé, and 15,000. at Osaka. When these were examined it was found that at Kobé 1 rat in 5, and in Osaka 1 rat in 10, were infected by the Bacillus Pestis. That is, 4,000. in the one, and 1,500. in the other were capable of originating the disease wherever they went! And these, it must

[a] British Medical Journal, 27 Oct. 1900, p. 1268.

be remembered, were but a small part of the whole number of this most difficultly irradicable agent.

Between the months of Sept. 1896, and end of 1897, it was found that 54 grain and flour sellers, millers, and grain-handlers in Bombay, had died of Plague. This fact put in wide circulation created great uneasiness. Many alarmist rumours were spread as to the effects producible by infested rats and mice upon the various grains and other objects of human food. It was however quickly pointed out that the 54 deaths among this class had occurred in infested localities; and further, that special experimental enquiry, conducted by Mr Hankin, had proved that any infection of grain that could occur died out between 4 and 6 days, as a rule, & that nothing destroyed germ vitality.

This enquiry had also an important bearing upon the question of grain export.

MARKED TYPES, AND GENERAL SYMPTOMS.

As far back as the Fourteenth Century, when the Papal Chair was stationed at Avignon, an epidemic of the Plague appeared there; and de Chauliac gives a terse summary of its symptoms and character. He says:

"This plague began among us in the month of January, (1348), and lasted for seven months. It presented two types: the first appearing lasted during two months, with continued fever and spitting of blood, and those died within three days; the second type lasted for the rest of the time, (five months), also with continued fever, apostems, & carbuncles, on the external parts, especially in the neck, arm-pits, & groins; and those died within five days. It was so contagious, especially

(a)- Guy de Chauliac, La Grande Chirurgie - Ed. Nisard, Paris, 1890, p. 167 -

"when it was attended by spitting of blood,
"did not merely by living with the patient,
"but even by looking at him, one person caught
"it from another. Thus men died without at-
"tendants, and were buried without priests;
"the father did not visit the son, nor the son
"the father; charity itself was dead, and
"hope extinct."

This brief description, written five hundred and fifty years ago, contains the essential marks of what we now call, & fitly call, "The Bubonic" and "The Pneumonic" varieties of the malady. And all observation since has but established the fact that these two modifications of the scourge are at once the most characteristic, and the most frequent. A third well-defined type has received from some modern observers (a) the name, "Septicaemic". But as this word in

(a) Childe, Plague Commn. Report Vol I. Appendix XIII.
Cantlie, British Medical Journal, 27 Oct. 1900, &c.

its widest meaning may be fully ascribed to all the types of the Plague, it is, we think, a mistake to narrow it down to designate one variety. The term, "Laminant", used by other writers for practically the same type, is much less open to objection. For, (like the names, "Bubonic", and "Pneumonic"), it indicates unmistakeably the dominant feature of the variety, and helps definite conception.

These three modifications of the Plague have now received a wide general acceptation. Recent literature however has sought to introduce additional types in which, so far as we can judge, the essential features constituting a variety have been overlooked, so that a confused rather than a clear account of the malady has been the result. In November last, for example, Dr. Hossack of Calcutta [a] writes: "The types recognised are

[a] - "The Lancet", 24th Nov. 1900, p. 1487.

as follows: 1, the Bubonic; 2, the Pneumonic; 3, the Septic; 4, the Intestinal; 5, the Meningeal; and 6, the Carbuncular. Speaking in detail concerning the last four groups he says under 3, the Septic: "This type of Plague is best "described as Plague where neither glands, "bubos, nor pneumonia can be detected." As this description necessarily embraces, besides his Septic examples, the Intestinal, Meningeal, & Carbuncular cases, we are at a loss to see its adequateness. Under 4, the Intestinal group he estimates the cases as less than five per cent of those investigated; & these, he adds, "were generally registered as cholera". Under 6, the Meningeal group, his brief account leaves the impression that the majority of cases diagnosed as such were found in the post-mortem room to be without men-ingeal or cerebral lesions. "Sometimes, however," he adds, "distinct signs of meningitis are present."

Under 6, The Carbuncular type, he states its rarity; and that our knowledge of it is deficient.

An attentive consideration of the full definitions and descriptions as given by the author leads us to believe that his four last types are not likely to obtain permanent recognition. The first two, as we have already seen, have long been fully defined and established.

All cases of Plague have in common some characteristic marks. Three among these, High fever, Great prostration, and Intense headache - are more outstanding than the others. A French writer terms them - "La triade sémiotique pathognomique de la peste" - and this, if somewhat strained, is at least a useful synopsis of leading signs.

1, High fever. The temperature rises rapidly. Within two days of first declared signs it may reach 104° F, while 107.6° F has been noticed. Its greatest

height is early attained. A spontaneous remission, apart from anti-pyretic treatment, is frequent between the Second and Third days, and a further fall to normal, or sub-normal, between the Sixth and Seventh days. On account of this feature it has often been mistaken for Remittent Fever. An exacerbation on the Seventh day may arise from Secondary Pneumonia, or other Complication, and is an unfavorable Sign. In the Pulmonic form of the Malady the temperature may not rise above 102°F.; and therefore high temperature must not be considered as the only, nor yet as the chief, sign of gravity.

With the rise of temperature the Pulse is quickened and also the Respiratory movements.

In some severe cases a sudden depression to Sub-normal has been noticed. A descent to 93.2°F. has been recorded in one case. When such a fall occurs it is commonly accompanied by a profuse perspiration.

2, Great prostration. The degree of prostration is the best index of gravity. It arises chiefly from the toxic power of the virus. When fully developed the action of the poison in the system produces a marked mental dulness & absent-mindedness. The expression of the features is listless & vacant; the aspect anxious and haggard; and the eyes congested and retracted. Some consider this facial aspect diagnostic. The tongue at first is dry and covered with a white fur, while the tip and edges remain moist and red. Later, the fur becomes brown & more dry, while sordes appear on lips and teeth. The tongue is also swollen, and the articulation obscured.

Diarrhoea is uncommon; but melaena & hæmaturia may occur. The urine becomes scanty, strongly acid, & slightly albuminous. A staggering gait at the commencement of the trouble is frequent, and arises from loss of co-ordinative power as much as muscular debility.

3, Intense Headache. It is described as "splitting" and is specially felt in the forehead & temples. It may be accompanied by rigors, fainting, or vomiting. In children convulsions may mark the onset, followed later by great restlessness and delirium. The hearing is dulled, and the mental faculties blunted. Questions need frequently to be repeated. About 90 per cent of all cases are attended by severe headache, at the beginning, or during the course of the illness.

Other signs, whether essential or accidental, will be best noticed under a sketch of the leading features of each of the three types.

I, Bubonic Plague. This form is by far the most frequent, and best known. Until quite recently the term "Bubonic Plague", was used as a general name for all cases of the disease. This is so no longer. It expresses

simply a group of cases. This group however embraces about two-thirds of the whole. While epidemics vary much as to the prominence of certain types yet in general the bubonic cases always predominate. We must here notice briefly Abortive, or Larval Plague. It is an ailment wholly lacking in the grave septicaemic symptoms which characterise true Plague. In abortive Plague buboes appear in the groin, axilla, or neck, but their appearance is never accompanied by either fever or local pain. In short the subjects of this attack walks about as if in perfect health, and gradually the buboes subside and disappear. Now cases, it has been remarked, frequently mark the outbreak, or follow in the wake, of an epidemic of true Plague. It was so in the Epidemic of 1873-1877 in Mesopotamia. The exact relationship which such cases bear to true Plague has not been determined. But as their occurrence has an important bearing upon Statistics, such abnormal forms must be

identified and excluded. It will readily be seen that any estimate of the curative value of a special method will be largely vitiated if such cases were to be included as cases of true Plague.

Epidemics of Plague vary much in character and prevalence of type, yet in all of them Bubonic Cases predominate. The mortality on an average roughly at 70 per cent. The bubo develops most frequently in the groin, next in the axilla, and least frequently of all in the upper cervical region. The groin cases are about 75 per cent. of the whole; the axillary 15 per cent. and the cervical less than 10 per cent.

As buboes are possible wherever glands occur, some erratic situations have been noted, as the epitrochlear region of elbow, and the popliteal space. Buboes may be single or multiple; unilateral or bi-lateral. The site of each bubo is probably determined by the site of infective spot. Some minute & unnoticed abrasion of skin is, it is believed, the ordinary channel; or more

rarely, of the mucous membrane. In the case of groin buboes the abrasion would be in the foot or leg; of axillary buboes in the hand or arm; and of cervical buboes in the face or mouth. But no local lymphangitis, or very rarely, even marks the infection aperture. The abrasion is probably too minute to attract notice. The Russian physician, Zabalotny, found experimentally that he could infect a monkey with the Plague by simply touching its palm once by a needle dipped in Plague culture. After four days a bubo developed in the axilla, & the infecting puncture was then quite indiscernable. The use of the limbs in walking and working, one can readily see, would produce infection most frequently first in the groin & next in the axilla. For the virus travelling by the lymphatics would seem to begin local action at the first glandular beyond the aperture receiving the infection.

Usually the bubo shews upon the second or third day of the fever, but the swelling & pain

may attract notice as early as the first day. The tumour is elastic & resilient to the touch, while the tension inducing the pain causes the sufferer to flex the limb & hold it motionless, specially in the leg. The size of the bubo varies from that of a filbert to that of a hen-egg. Later, the surrounding tissues are also infiltrated by the morbid action. Suppuration occurs but slowly, & fatal cases rarely suppurate. A chronic abscess is known as a hospital sign. The pus is thin, ill-smelling, overlayed with the specific bacilli; & its discharge is followed by sloughing, & the persistance for weeks of a gaping unhealthy-looking sore. If the glands adjacent or above, become infected, a rise of temperature indicates the increased lesion. In some cases of severe resolution of the local swelling occurs, but this is much less common; in others, during a tedious convalescence of months the effected glands will remain hard & indurated.

II, Pneumonic Plague: As we have seen, the type here meant was first indicated by de Chauliac in 1384; and was again described as a distinct form, in 1812, by White, during the epidemic which then appeared in Cutch. He says: "The characteristic symptoms of this variety are "slight rigor, pain of the chest, & haemorrhage "from the mouth, attended with fever, but no "buboes." Childe, in 1896, has the merit of re-identifying the variety, and of placing its pathology on a firm basis, viz., primary infection of the lungs by the specific virus. Niblock & Cornwall, I.M.S., estimated primary pneumonic plague cases encountered in the Sind epidemic, 1896-1897, to be 15 per cent of the whole. Others observers estimate the numbers much higher, & others much lower. Probably, the average estimate of 20 per cent is near the truth?

(a) Trans. Bombay Medical & Physical Society, 1898, July, p. 148.

Besides the general symptoms this type is attended by cough, dyspnœa, and a profuse watery sputum, crowded with the specific bacilli. From the first, or after the first day, the sputum is streaked with blood, but free from the putty look, & characteristic viscidity, of ordinary pneumonia. Hæmoptysis of a free, or profuse character is not infrequent. Respirations become frequent, 40 to 60 per minute sometimes. Percussion reveals dull patches, inconstant as to position & transitory as to duration. Their site shifts & varies from day to day, as also do their size & degree of dulness. The most frequent sites are the lower lobes posteriorly; but any part of the lungs may be attacked. Moist râles, with moderate dulness & resonance, are the chief signs over the affected areas. Tubular breathing is rarely heard; or it is singularly evanescent. The breathing becomes more hurried towards the close; and a muttering delirium sets in, the fatal result being reached between the

4th and 6th days generally.

It is the most infectious of all the types, & the sputa should be carefully destroyed. A spark of sepetoration received into the eye of a nurse, (Montenegro, p. 19), developed parotid bubo ending in death.

This type has been often induced experimentally on the lower animals, by rubbing infected matter on the mucous membrane of the nostrils. It is a fact which greatly strengthens the view that in the human subject, this type is determined by infection through the respiratory tract, with or without abrasion. Simple aërial infection is very probable from the crowding together, and the deeply vitiated air of native huts.

Capt. Crons [a] has advanced the theory that Pneumonic Plague is "due to infection from the blood, rather "than from the air-passages - that is to say, that the Pneu- "monia is simply the expression of a septicaemia".

This supposition is certainly not borne out by the

[a]. Quoted by Dr. Strassburg in "Lancet", 24 Nov. 1900, p. 1488.

Enormous numbers of Plague bacilli in the air-cells, and their Comparative paucity in the blood-vessels, as seen in post-mortems. Captain Childe (a) indeed remarks Ref. the blood-forms in Pneumonic cases "are not in large numbers."

In the Pneumonic type the deep bronchial & deep cervical glands are intensely congested. But affection of the Lymphatic System in other regions of the body may concurrently appear. In Ref. a Primary Pneumonia & Bubos are sometimes seen in one patient. But the Lung symptoms as a rule predominate. Again, a Secondary Pneumonic form is not uncommon. After the development of the marked signs of another type, Lung Symptoms appear. Chicklock (b), I.M.S., states Ref. in the Surat Epidemic the Secondary Cases of Pneumonia were 11 per cent, and the Case mortality among these 6 per cent, or a little higher than the mortality of Hospital Cases.

(a). "Bombay Plague", Bombay, 1900, Report by Childe, p. 99.

(b). Surat Epidemic, Bombay Med. & Phys. Soc., July 1898 p. 48.

III, Fulminant Plague. This variety averages less than 10 per cent of all the Cases investigated. The crushing effect of its onset is due to the virulence of the infection and its rapid diffusion through the body. The manner of this diffusion so far has not been clearly expressed. One remark by the Bombay Plague Research Committee is indeed somewhat mis-leading. Their words are (a):-

"The microbe grows in the blood, hence it
"has been called Septicaemic Plague: in the
"other it grows in the lungs, giving rise to Prim-
"-ary Plague Pneumonia."

As far as the first clause of this sentence indicates a theory of action of the imported virus of Septicaemic / Fulminant Plague, it is not borne out by the evidence of the Morbid Anatomy. The post mortem details which are given by Surgeon. Capt: Childe, in a later part of the Lancet report (b), indeed go directly against it.

(a). "Bombay Plague", Capt: Enclen, 1900, Research Rept. p. 76.
(b). Do. Do. p. 97.

Speaking of the distribution of the Plague Bacillus in this variety he says:-

"Specimens taken from the inguinal, iliac, and
"axillary glands of both sides showed enormous
"numbers of distinct Plague-bacilli, which
"took the stain well; specimens of the lum-
"-bar and mesenteric glands showed the
"same appearance. The cervical glands
"showed them also, but in less numbers;
"and the bronchial, supra-trochlear, and
"popliteal glands still less. A large number
"of specimens, to show the bacilli, was made
"from the glands of each region; and, as a
"general rule, those glands which were largest
"and most distinctly altered showed the
"greatest number of Plague-bacilli."
"Specimens of the Spleen contained many
"of the bacilli, but less in number than the
"Plague-glands. The Liver & kidneys showed
"plenty, but fewer than the Spleen, and

"the lungs still fewer. The blood contained
"a fair number, about as many as in the
"lung."

This account certainly does not support the view that "the microbe grows in the blood".

We venture to indicate a theory of the intra-corporal growth & diffusion of the bacilli which agrees with these post-mortem facts, and is not contradicted by the data acquired by clinical observation. It is that:

The Lymphatic System is first widely and generally infested; and that consequently many sets of glands simultaneously became centres for the development of the microbe and its toxins.

Next, that those rapidly developed & numerous bacilli, and their toxic products, reach the blood & viscera secondarily chiefly through the Thoracic Duct.

Lastly, the toxic products & the bacilli re-

-ceived into the general blood circulation, and into the viscera, not by profoundly depressing the great nerve centres.

However this theory may be received, this much at least is clear: Unless we regard the affection of the blood as a wholly secondary result, the post mortem facts regarding the Lymphatic System are inexplicable.

And if it be granted that the blood condition is secondary, then our preference for the title, "Fulminant," instead of "Septicaemic," is amply justified.

While there is no tubo manifest, there is yet "a general involvement of nearly all the Lymph-atic glands." In the case described by Childe above, he found bacilli & morbid action in inguinal, iliac, & axillary glands on both sides; in the Lumbar and mesenteric glands as well; & ~~do~~ in the cervical, bronchial, supra-trochlear, and popliteal in addition. The intense en-

-gorgement seen in the Bubonic gland of-
-festin is absent; and the disorganisation and
effusion are also less.

During life the muscular prostration and
the threatening of Cardiac Collapse are the most
prominent symptoms. The sufferer has indeed
the semblance of one indirectly smitten by
lightening; or of one struggling under a
dose of deadly poison. This state
may end in delirium or Coma, with
death upon the second day, or even on
the first. Life may be prolonged to fourth day.
A high fever, rarely attends the onset. It may be
104°F. and rise quickly to 107°F. A rise
of temperature sometimes precedes the fatal
end; more rarely, there is apyrexia.
In other cases, but these are uncommon,
the pyrexia persists during some hours
after death. This has been ascertained
by postal thermometric observation.

Haematemesis is not infrequent in this variety; and from the frequency of the symptom it is sometimes, popularly, termed, "Black Vomit." Epistaxis may replace the haematemesis, or accompany it. In other cases the blood escape is incurred as Melaena, or Haematuria.

In the Pirie epidemic 1896-1897 old people seemed to be more susceptible to attack by this type than the young.

As already stated mixed types occur. The characteristic marks in special types are sometimes obscured by Lupus-added symptoms; and, in diagnosing, this must be remembered. But generally the signs of one type predominate, and, by a little care, can be elucidated.

It is a more difficult matter when other diseases occur; for the obscuration is necessarily greater. Phthisis, Leprosy,

Albuminuria, Diabetes, & other Chronic ailments have been noticed. Surg. Capt Thomson[a] mentions one case where Small Pox and Plague pass their course side by side. The diagnosis of the double ailment was confirmed by the bacteriological cultures indicative of both diseases. The sufferer did not recover.

When pregnant females are attacked they nearly always abort, & most frequently die. And a living child prematurely born from this cause is still more rare than a living mother. Surgn Capt Childe[b] has recorded one case. The mother was twenty five, and aborted five days short of full term. She died, but the child was strong & healthy, and without any sign of the Plague.

(a). Bombay Med & Physical Soc. Proceedings March 1898. Pp. 19.

(b). Indian Plague Com. Rep. Evt. Appx. XIII. P. 373.

INCUBATION. The shortest period between infection and declared symptoms seems to be two days (Hirsch); and the longest ten days; but ten days is assuredly rare. Thomson records three cases. Eight days is not uncommon - (Bambridge); while five or six days are, it is thought, the most frequent of all - (L. Arnaud). Quarantine and segregation therefore require the lapse of ten days after the last exposure to any possible infection.

[a] Bombay Medical & Physical Surg. Proceedings, Mch 1898, p. 17.

MORTALITY. The great majority of fatal cases are within the first six days; and after the twelfth day a fatal result is rare. The degree of mortality varies much in different outbreaks. In the Volga epidemic of 1878-1879 Hirsch estimated the mortality at 85 per cent.

In the Surat Epidemic of 1896-1897 the mortality was 80.4 per cent. In the Dhárwár Town epidemic of 1898 it was 75.7 per cent. Where however inoculation had been largely practised, and when we exclude the inoculated cases, & consider only the non-inoculated mortality, we find it was 80.8 per cent.

Because, we think, near the truth therefore, when we estimate the average mortality, under ordinary conditions, as about 80 per cent.

Hospital treatment, as might be expected, decreases the mortality considerably. In Bombay, for the year 1897-1898, the Parsee Plague Hospitals had an average mortality of 66.7 per cent: but the year following, 1898-1899, in the same institutions the mortality averaged 73.6 per cent. Bulsar Plague Hospital in the same year had an average mortality of 61.1-

while in Cutch Plague Hospital the same year it was 72.6 per cent.

In Bombay the mortality among Hospital-treated Europeans and Eurasians has been respectively 32.35 and 42.62 per cent, while among the Native Races, taken jointly, treated in Hospital during the same period, the mortality was 69.54 per cent.

In the Hong Kong Epidemic of 1894 Manson states Ref. the deaths among the indifferently-fed, overcrowded, unwashed, and almost unnursed Chinese was 93.4 per cent; while it was only 18.2 per cent among the Europeans. A severe, it is evident Ref. he is not speaking of Hospital-treated Cases.

There are two prophylactic measures - Inoculation & Evacuation - about which we shall speak later, which largely tend at once to arrest the spread, & lessen the mortality, of the Plague.

MORBID ANATOMY.

1, The implication of the Lymphatic System is generally the most prominent feature in an autopsy. Even in the Pneumonic variety, while the signs are less pronounced than in the Bubonic, the involvement of the deep thoracic and Cervical glands characteristic. As we have seen, the favorite sites of bubonic development are the groin, axilla, and neck. These however are but localized manifestations of a wide-spread and general adenitis, as witnessed enormously by swelling and engorgement in both the superficial and the deep-seated glandular systems. The Bubos, besides enlargement, show inflamed tissues ▽ effusion of sero-purulent and sero-sanguinolent fluid, hyperplasia of the gland-cells, and an enormous number of the Specific bacteria. In the early stages, these microbe forms abound in the lymph

spaces around the follicles; later on, they appear in the follicles themselves, in the lymphatics, and in the medullary cords (Bayard).

The tubercle mass usually consists of a chain of glands in varying stages of enlargement, those proximal to the thoracic duct being smallest. In some groin tubes the whole glandular system along the femoral iliac and aorta, from the groin to the diaphragm, was noticed to be greatly enlarged & deeply congested. In the groin & in the axilla, from pressure of the enlarged mass upon the adjacent veins, the limb is often swollen & oedematous; in the neck, the dyspnoea sometimes noticed in life resulted probably from this mass-pressure upon the laryngeal nerves.

The loose areolar tissue around the gland is always deeply matted together, congested, & solidified by effusion. It is the chosen site of haemorrhage. Where, as in

the axilla, this tissue is abundant, the extravasation is often great, extending into & between the adjacent muscles.

The bronchial glands in the Pneumonic cases are always distinctly engorged, livid, and edematous. The connecting gland-chains towards the neck are also enlarged & congested. Delapine[a], in cases of artificially-induced Pneumonic Plague in the guinea-pig, remarks that the cervical glands were in some cases almost black from the numerous central haemorrhagic foci; and that the glands themselves were surrounded by blood-stained connective tissue.

2, Skin & Muscular System. The so-called "Carbuncle" occurs in about 5 per Cent. of recorded cases. (Bainbridge). It is rather a sloughing process arising from a localised cellulitis than a true Carbuncle. The feature, notwithstanding the judgment of those who delight in multiplying

[a] British Medical Journal, 27 Oct. 1900 - p. 1240.

types, is quite of subordinate and non accidental significance.

Under the early history (pp. 4, 5) we noted the prominence of dermal ecchymoses in some plague epidemics. This is not an eruption of diagnostic importance, but an accidental feature arising towards the close of the illness from ill-understood capillary lesions. The rete mucosum and the papillary layer of the cutis are its chief seats. These dermal ecchymoses vary much in size and sparseness, and in many cases, are altogether absent.

The rigor mortis is usually of short duration, and is not well-marked.

3. <u>Lungs & Pleurae</u>. The pneumonic patches when looked at in section are seen to be surrounded & circumscribed by a deep ring of congested tissue. Inside the affected area the bronchial vessels & the capillaries also are congested, and interspersed with haemorrhagic

patches. The alveoli are filled with catarrhal epithelium, fibrin, & blood-cells. The alveolar walls are made out with difficulty, & are sometimes broken down (a). The bronchial mucous surface is frothy, blood stained, & crowded with bacteria. The pneumonic patches are light pink or grey in colour, and vary in size from a bean to that of an orange. If on any side they abut upon a pleural surface the signs of acute pleurisy may be seen. Adhesion of two pleural surfaces is sometimes noticed. Petechiæ are usually abound under the visceral pleura, and sometimes well-marked hæmorrhagic patches occur as well. In the costal pleura also petechiæ occur, but less abundantly. The bronchial glands are also enlarged and congested, and exhibit peri-glandular effusion. The lower lobes of the lungs posteriorly are the most frequent sites of consolidation, but they often occur elsewhere.

(a). Indian Plague Com^n, 1906. I, appx. XIII, p. 368. Childs' Report.

4, Heart & Great Blood Vessels. The heart muscular fibre is generally normal, but the cavities of the right side are often dilated. Petechiæ are frequently seen both under the visceral & parietal pericardium. The vessels, supply of the heart are not usually congested; but the vena Cava, & other great cardiac vessels, are markedly so. When these are laid open numerous petechiæ under the inner coat are seen to mottle the Lumen.

5, Abdominal Viscera & Peritoneum. In the peritoneum, as in the pleuræ, petechiæ abound, both in the visceral & the parietal layers. Besides these, omental, mesenteric, splenic, & hepatic hæmorrhages are often witnessed. The lymphatic glands are at the same time swollen and congested, & show marks of peri-glandular effusion. The stomach is congested and hæmorrhages may be seen in the sub-mucous tissue, chiefly along the course of the blood-vessels, & most abundantly at the greater curvature.

Similar congestion & petechiae, or minor extravasations, are frequent in the large intestine & lower bowel. They are also frequent in the small intestine near the ileo-caecal valve. Peyer's patches & the solitary follicles are often congested and prominent. The liver is deeply congested, the cells degenerated, and the consistence friable. Petechiae and haemorrhages may be seen under the capsule. The gall-bladder also shows petechiae. The spleen is often enlarged to twice or thrice its normal size; is acutely congested & shows haemorrhages in the stroma, with petechiae beneath the capsule.

6, <u>Kidneys & urinary tract</u>. The kidneys are always enlarged & congested. The capsule shows numerous petechiae, & is easily stripped off. The substance of the organ is degenerated & soft, and the pelves within marked by numerous haemorrhages. The ureters & bladder are also congested & mottled by submucous haemorrhages. Urine obtained is frequently bloody, & generally albuminous.

7. Brain, Cord, & Menings. There is marked Congestion in the dura mater, and in the pia mater, and in the menings generally. The sub-arachnoid fluid is increased. Brain sections disclose numerous puncta cruenta. Occasionally larger extravasations are observed in the cerebral substance, the medulla oblongata, or the Ventricles.

While the marked involvement of the Lymphatic System is the most prominent feature disclosed in the post mortem room, the next undoubtedly is the presence of numerous scattered haemorrhages - dermal, sub-serous, sub-mucous, intra-ocular, and intra-visceral. The full pathological Cause of this symptom is not yet apparent. But, as we have the same Lesion, accompanied by the same profound adynamia, in Variola haemorrhagica, we are probably not wrong in regarding it as one of the signs of the presence of the specific Virus in its most virulent form.

DIAGNOSIS. It is chiefly during the onset that any difficulty is experienced in the diagnosis of Plague.

The Bubonic cases, and they are the great majority, are easily recognised by the local lesion, and recurring general symptoms.

The Pulmonary Pneumonic cases are apt to be confounded with ordinary Lobular Pneumonia. But the facial character, and leading symptoms together with frothy, non-viscid sputa, pink in colour or streaked with blood, are points of difference. The discovery of the Specific micrococcus in the sputum by Microscopic examination is proof absolute.

In the Talmonary variety there is much more doubt and difficulty. We need then to depend upon the occurrence of sudden & profound prostration, accompanied by high fever, and intense headache, together

with the facial expression as described, the congested eyes, staggering gait, and thick or inarticulate speech, while a Plague epidemic is prevalent. The development of the crystalline culture-forms of Staphine, from blood or gland serum, would remove all doubt; as no other microbe, similarly treated, behaves itself in this way - (See p. 1617).

Relapsing Fever has some superficial resemblances. But it is distinguished by the Spirilla in the blood, the flushed face, & intelligence unimpaired. It is not marked by mental delusion, indistinct utterance, or staggering gait.

Intermittent & Remittent Fevers are distinguished by their periodicity, freedom from prostration, and full & bounding pulse. The specific power of Quinine upon their course is wholly absent in the Plague. (See Remarks under High Fever, p. 34.)

TREATMENT.

In its widest sense Treatment embraces: General Prophylaxis, or all measures for the protection of the Community as a whole against its development or spread; & also all measures applicable to the help and healing of the individual when attacked; and these may be summed up under the two heads - Symptomatic Treatment and Specific Treatment.

I, General Prophylaxis: The measures which are indicated before and after the advent of the epidemic are widely different.

A- Before the advent Sanitation, Quarantine, Outgoing Sea-Inspection, and Road & Rail Inspection are the chief safeguards, and these we will briefly consider in order.

1, Sanitation: The strict enforcement of all those Laws of Public Health, whose neglect has, under the head of General Causation, been shown to be favorable

to the development of the disease is clearly indicated. These should be carried out by detailed & repeated inspection, & enforced by penalties.

2, Quarantine. The panic-stricken in a centre of disease, travellers of all kinds, by their persons, their clothing, or belongings, in their movements originate new foci. Foreign Countries, specially European, have got a natural dread of such ab extra originating of the disease in their midst. Towns in the same Country, indeed, have the same fear of any arrivals from a contaminated centre. The Quarantine Law is to guard against such infection more especially by Sea. The original "forty days" implied by the word, is usually reduced to "ten" in the Case of Plague. That is, an infected port shall not land passenger or Cargo of another port, till that time has elapsed since sailing from the infected port, and then only if the Plague has not one aboard developed on board. If the Ship has had, or arrives with a Plague Case

ten any such case, as well as any who may afterwards develop the disease are isolated; while the apparently healthy are also but separately segregated. Both groups are kept under observation for at least ten or twelve days. Disinfection of ship, crew, and passengers, with bedding, clothing, belongings is also enforced. No importation of rags, and all other things likely to carry infection is strictly prohibited from any infected centre.

3, Out-going Sea-Inspection from humanitarian reasons, as well as trade motives, has been devised in ports where any epidemic prevails. Nowhere is this so minutely & rigidly enforced as at Bombay where for some years past the plague has been so fatal. The Bombay Sanitary Committee rule that all persons about to sail should be examined on shore prior to embarkation & here carried out not only as to all the clothing & bedding of the native crew, of the third class and other deck passengers are first disinfected by being submitted for 15 minutes

to superheated steam under a pressure of 10 lbs to the square inch. The temperature developed, 239° F., or 115° C., is high enough to destroy any bacteria yet isolated.

The enormous labours which this involves may be estimated by the fact that during the year June, 1898 - to May, 1899 - in Bombay alone -

2,708 square-rigged vessels, 67,480 native craft, 546,881 Passengers, and 615,136 Crews were all inspected & disinfected. And the result was the rejection of 15,380 Passengers, & 1,314 members of crews, the great bulk being simply suspicious cases with temperatures above 100° F., or 38° C.

The ships carrying Pilgrims, with their crews and kits, from the well-known habits of that class of religious enthusiasts, both in going and in returning from Jeddah, have especially attentive consideration bestowed upon them.

4, Road & Railway Inspection, against either outgoing or incoming cases, has been found,

however approvable in theory, very difficult to carry out. The many ways by which any system of inspection can be evaded, the large staff required, the hindrance to usual occupations of life and to trade, whenever an epidemic is long-continued, have replaced the minuteness of the early attempts to hinder dissemination in these ways. In Bombay Presidency however a modified system of surveillance is kept up. Detention Camps, where suspects are kept under observation ten days, is part of this system.

B- After the advent of the Plague in any town or district, the most successful means of coping with and arresting the attack are Inoculation and Evacuation. As we deal with Inoculation under our consideration of Specific Treatment, we will dwell now upon Evacuation, and what this measure practically implies, the Segregation of the (probably) infected.

1, Evacuation. The method of arresting an epidemic is the logical outcome of the success which after years ago attended "Segregation Camps" [a]. During the Vind Epidemic, 1896/97. they were first tried on a large scale. In fact, "Contacts" and others from infected castes were moved out into temporary Camps in the open fields, with very gratifying results. Cases diminished, & recoveries became more frequent. The bolder disposal of complete e. -vacuation was soon entertained; and not many villages, & smaller-sized towns, have met outbreaks in their midst by this decisive measure. The feasibility for towns above 50,000 is not easy. Larger towns for the most part will be able to benefit by the principle involved through partial eva-cuations. The consideration of one case on a large scale brings into review the chief points.

[a]. Gen. Bainbridge's Report on Plague in Vind, 1896/97.

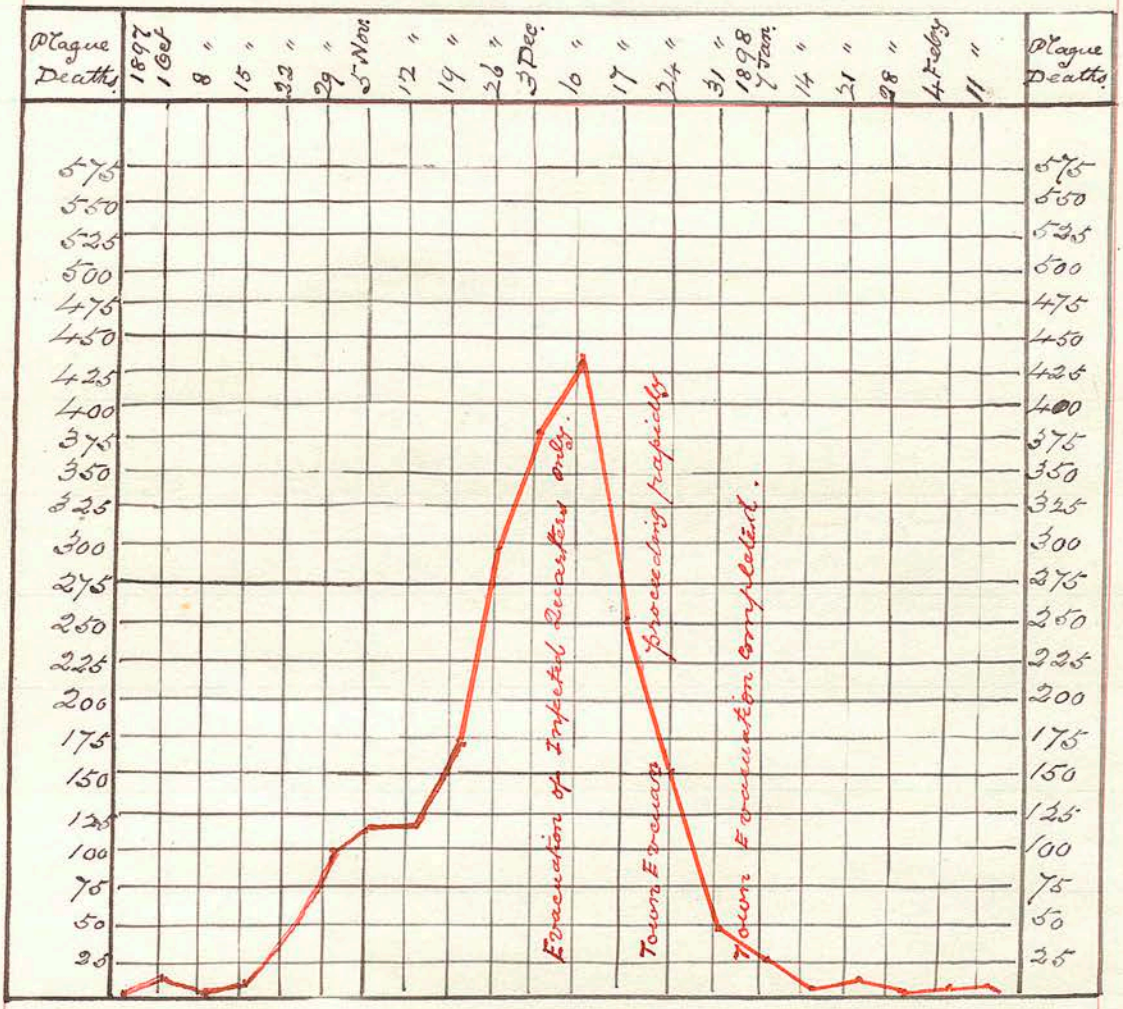
Sholápur Town, with a population of 61,564, was visited by a second Epidemic of Plague in October 1897. By the end of the month 211 Cases with 156 deaths had occurred. The people became panic-stricken, and before the end of November 25,000 had fled. The Sadar Bazár, where the poorer were herded together, got worse & worse. Inspection, Sanitation, Disinfection & similar measures seemed to have no effect. Partial evacuation was then begun. The Sadar Bazár, Modikhána, & other insanitary quarters were emptied of their poorer inhabitants, and removed to a Camp near the Motibág Tank. Bamboos and matting were supplied, & the people built their own huts. From the beginning of this measure improvement set in. Then it was decided to vacate the Sadar Bazár & Modikhána completely, which was done, two new camps being started. By the middle of Nov^r many fresh Cases had developed in other quarters of the town, & the Staff had to be largely increased.

All badly-infested quarters were then everywhere evacuated. Yet systematic disinfection failed to keep the disease from spreading. On the week ending 10th Dec. the maximum mortality was reached. It was then decided to evacuate the whole town, & this measure was rapidly pushed. Camps sprang up all around, the largest being the one near the Fort, holding about 10,000 people. It was wholly built of bamboos & gunny-bags stretched over them. It came to be familiarly called, "Gunny-Bag Town". By the close of December the city was completely evacuated. During the evacuation the mortality rapidly decreased, & when February closed, it had all but vanished. The last case occured during the week ending March 25th.

When the maximum mortality was reached, week ending 10th Dec., about one half the population had fled from fear, & in estimating the death percentage this should be borne in mind.

We append a diagrammatic picture of the change in the mortality from week to week.

Sholapur Town - Popn 61,564.



We head the cases and deaths week by week were:

Week.	Cases.	Deaths.	Week	Cases.	Deaths.
1897 Oct. 8	19	13	1898 Jany. 7	26	27
" " 15	26	8	" 14	9	9
" " 22	50	45	" 21	7	11
" " 29	116	90	" 28	5	8
" Nov. 5	146	117	" Feby 4	1	2
" " 12	148	118	" 11	9	8
" " 19	221	182	" 18	2	4
" " 26	363	297	" 25	6	4
" Dec. 3	502	377	" Mch 4	-	2
" " 10	501	436	" " 11	2	-
" " 17	300	246	" " 18	-	-
" " 24	134	149	" " 25	1	-
" " 31	53	36	" Apl. 1	-	-

The total cases during the Epidemic were 2,639 and the deaths 2,187 - giving a percentage mortality of 3.6. There is little doubt but that the mortality would have been less, and the duration of the epidemic shorter, if complete evacuation had not been so long delayed. A look at the diagram shows conclusively the arrest of an epidemic follows evacuation.

All evidence shows that in village communities, where few questions relating to occupation or prejudice demand consideration, prompt evacuation stamps out the attack. It was so in the village of Kanaswadi (a) in the district of Khandesh. The plague appeared on the 5th Oct. 1897. It spread slowly and by the middle of Nov. 4 other cases appeared. On week ending 2nd Dec. there were 5 cases, & on week ending 9th Dec. there were 14 cases. The village (300 of Population) was evacuated on the 5th Dec., and after the 9th Dec. the Plague wholly disappeared. No other case occurred.

(a) - Bombay Plague - Capt. Gordon, 1900 - p. 22.

2, Segregation. The usual practice is to send all "Contacts" into a separate camp for observation. "Contacts" are all those who have lived in a house where a Plague case has occurred. Their clothing, bedding, & belongings are disinfected, & they are detained during at least ten days. At Poona this detention is much less rigid. During the first ten days they are absolutely segregated. For the subsequent days, eight or more, they have liberty to follow their occupations in the day-time, but they must every night return to camp to sleep and be inspected.

Sometimes, in addition to the "Contacts", another class, known as "Suspects," are also segregated. These are the occupants of the houses adjacent to any infected block, where, from sanitary conditions, structural involvement, or ~~possible~~ past migration, there is reason to suspect a possible outbreak.

This measure may be only a part of an Evacuation movement, but sometimes, it is the only depopulation treatment followed.

The segregation of "contacts" and "suspects," as a selective and partial evacuation movement, greatly tends to curtail the spread of the disease. Of course, any case of Plague appearing among these segregated classes is at once removed to Hospital, & completely isolated; and all "contacts" belonging to the same hut must begin their period of segregation anew.

3, Disinfection. All houses where a Plague case occurs must be emptied & disinfected. The houses of "suspects," as well as "contacts," are also disinfected; and the re-occupation of these houses should not occur before the lapse of ten days complete.

As to disinfecting agents, Mr Hankin, the Government Bacteriologist at Agra, India, in a wide experimental inquiry, has found the Plague microbe specially susceptible to the action of Acids. Even weak acids quickly destroy it. He strongly recommends as the only thing which can disinfect

a cow-dung floor, Corrosive Sublimate in an acid solution; and the acid should be Sulphuric acid. As an after-treatment of court-yards, passages, drains, dilute Sulphuric acid, 1 in 250, is recommended. A room again may be thoroughly disinfected by burning a combustible layer two inches deep covering the floor. But where the house is of small value, burning the whole structure may be the wisest & most effectual measure.

Chloride of Lime for drains, & Permanganate of Potash in small doses for water, are very thorough.

Direct Sunlight & abundant Ventilation are Nature's disinfectants, and whatever other agents may be employed these two must never be omitted.

II, Symptomatic Treatment. The individual suf-
-fers is best helped in Hospital. The needful
disinfection of the person and clothing, the ex-
-perienced nursing aid, & full ventilation which
are so important are here best secured.

Isolation of every declared case of Plague to
prevent its spread is absolutely necessary.

The leading indication of treatment is in
the profound prostration which marks the
disease. All measures which tend to support
the nervous & muscular energy should be
sought for and applied as occasion arises.

From the beginning to the close of the
illness the patient should keep the recumbent
position. No personal need or bodily function
should be allowed to interfere with this rule.
No effort of sitting up, or leaving bed, is
highly dangerous, and has been fatal in some
instances.

While diarrhoea (which is frequently-

must be combated, yet constipation must be avoided. Calomel is the best purgative, from its antiseptic & bactericidal properties. All measures helpful to the free action of the skin and kidneys should be considered, and this more especially in Pneumonic cases. It relieves the stress upon the pulmonary circulation, and checks oedema. Alkalized tepid sponging is very serviceable & grateful. The best alkali for the purpose is Bicarbonate of Soda.

All depressing drugs & measures should be avoided. Antipyrin & its allies are not helpful. The cold-pack lowers, by its effect upon high temperature, & the free perspiration which it excites, is most valuable.

Food must be administered frequently and in easily-assimilated forms. Milk ice-cold, milk and Soda, Encentrated Soups, Lightly-cooked eggs, Light farinaceous foods, the

Extract of Mutton, Liebig's Extract, Valentine's Meat Juice, Calves foot Jelly - are all of value.

Vomiting may be checked by sinapism to the epigastrium; ice-pellets; effervescing draught with one grain of Bismuth Powder, or Dewy Powder; or Dilute Hydrocyanic acid in effervescing soda.

Hæmatemesis is helped by ice; while the other haemorrhages (haemoptysis, hæmaturia, Melæna,) are best met by Ergot hypodermically. As the haemorrhage may be sudden, it is always useful, if it is good to have the remedy at hand.

Pyrexia is best met by frequent cold-sponging, and by the cold-pack. As already remarked. Antipyretic drugs are not wise remedies, on account of their depressing effect.

Delirium is restrained by ice-caps, evaporating lotions, & certain drugs. The very best is Hyoscine Hydrobromide, in small doses, $\frac{1}{200}$ to $\frac{1}{75}$ th of a grain, given hypodermically. Chloral is preferable to any morphia preparation.

Insomnia, when moderate, may be removed by Sulphonal in 10 grain doses; but Bromide of Ammonium is more generally efficient. Avoid the Potassium Salt as it sometimes depresses. Yet more energetic, in ⅛ to ½ grain doses, is the Hydrochlorate of Morphia given hypodermically. It should be avoided however in delirium, & Hyoscine used instead.

Headache is mitigated by the ice-cap, and by boiling lotions. Besides the hypnotics already named Caffeine is valuable. In the form of citrate it may be given in an effervescing draught in 1 or 2 grain doses. Besides giving relief to the headache, it stimulates the cardiac nerve-centres, & acts as a diuretic; and both of these are generally helpful effects.

Threatened Syncope. Whenever the pulse is extremely feeble, the Tr. of Nux Vomica, or Liquor Strychniae, with aromatic Spirit of Ammonia in a little water, has the best effects.

A Cardiac tonic with the same drugs for chief ingredients may be helpful all along. They aid in counteracting the essential toxic depression of the disease.

Strophanthus Tincture, from its action upon striated muscular fibre, is most helpful. As it also possesses diuretic power it is indicated in the Pneumonic Congestion, and consequent impeded circulation on the left side of the heart. In the worst threatenings of Pyrexia the diffusible stimulants, especially Sulphuric Ether Sub-Cutaneously, may be needed.

Defective Urination should be met by diuretics and also by diaphoretics, as free action of the skin relieves the kidneys. Strophanthus, as already remarked, and other cardiac tonics, have beneficial effect as diuretic agents. Avoid Digitalis, or give with great caution, as its effect on the heart is variable. Liq: Ammon. Acetatis combined with Sp: Aetheris Nitrosi is chiefly diuretic. The most powerful of

all diuretics, Nitrate of Pilocarpine, must be used with caution. Administered hypodermically in ¼ grain dose it powerfully stimulates the action of the kidney, & also of the skin. Occurring initial tubular disease contra-indicates its use; or if used, it must be in greatly diminished dose.

Diarrhœa is helped by antiseptic remedies, such as Calomel, 5 grain doses every four hours; or Bismuth doses every two hours of the Liquor Hydrargyri Perchloridi. The last-named drug is said also to lessen delirium, and to be followed by a generally-improved Constitutional state.

Stimulants are helpful throughout; and in great weakness, & feable appetite, should be boldly given. Eight ounces of rum have often been used in the twenty-four hours. Whisky & brandy may be prescribed nearly as freely, whenever there is great adynamia.

the administration with Sterilised eggs, or fresh milk, or Soups, should be studied.

Local Symptoms sometimes demand treatment as Rubric pain & tension. This is best met by painting the inflamed Surface with Tinct. of Belladona. When suppuration occurs (a favourable sign) it should be freely opened, drainage tube, and Empress applied.

In the state of pain & tension, ere there any suppuration sets in, Chiblock & Cornwall (a) I.M.S. strongly advocate early incision, & give their reasons. In the Rind epidemic, 1896-1897, they tried this method, & always found that besides removing the pain, it was followed by a lowered temperature, & an improved constitutional state. In 11 consecutive cases the defervescence, 30 hours after incision, averaged nearly 4° F.

Application of Leeches also relieves pain. The Leeches however must afterwards be destroyed.

(a) Bombay Medical & Phys. Society Proceedings. July 1898, p 52.

For, subsequent to such use, Surg. Capt. Jones, I.M.S., found that even his own pure blood had become infected by the Bacillus Pestis.

Glacial paralysis, with distension, may occur. So, when the urinary flux is very scanty, examination should be made by percussion; and if supra-pubic dulness indicates the need, a soft rubber catheter should be employed.

Attendants & Relatives should remember all prophylactic precautions.

Excreta should be treated by powerful disinfectants, dried in the direct sunlight, and afterwards burnt. This specially applies to the sputa in Pneumonic cases.

We dealt of those days from Pneumonic Plague emphasises the warning - "Shun inhaling the patients' breath." This nurse, who had not before attended Plague patients, began attendance upon Dr. Manuel on 4 January 1897. She nursed him to the morning of the 6th. She was attacked by Plague on the evening of the 7th, & died upon the 9th of same month.

III, Specific Treatment: 1, Serum curative treatment:
important & helpful as the foregoing measures are
they are yet not directly curative. And ever since
the discovery of the Bacillus Pestis a specific cur-
-ative treatment has been diligently & hopefully sought
for. It was natural from the success of the anti-
-diphtheritic Serum that the possibility of producing
such a Plague antidote should occur to many
minds. And accordingly during the last few
years much thought, toil, and expense have been
disbursed towards the realisation of this ideal.
We regret to say that the result, so far, has not
been an unqualified success. For, as the
date and in the place where we now write -
-Bombay, March 1901 - at least four Sera
differing somewhat in their preparation,
but one in principle, have undergone con-
-siderable trial and testing, specially at the hands
of their inventors, without unmistakably mani-
-festing those virtues which were claimed

on their behalf. New candidates, with reputed specific powers, are still appearing. The latest of all is the serum of MM. Terni and Bandi of Messina, who have just arrived in India to advocate its use. But, as this serum, and some others, are as yet untested, we must omit further reference to them. Regarding the four sera however which have been already largely put to the proof, we will attempt to arrive at a definite judgment regarding their positive value; and we may state that we have taken some pains, both by the study of published reports, and by personal enquiry, to reach a decision wholly free from bias. But before submitting the chief data upon which our opinion of their merits is based, we would point out that great caution is necessary in the interpretation of statistics, and, not least, in the interpretation of Plague statistics.

In every Plague epidemic there is a certain proportion of cases which no treatment will benefit: we may call this, say, 30 per cent. And there is another percentage which, without any treatment, will always recover: let us estimate this at 20 per cent. These two groups, amounting together to 50 per cent, are, for statistical purposes, outside being affected by any curative means whatever. The remaining 50 per cent are however amenable to treatment. But, in judging of the effects of any remedy brought to bear upon this group there are certain conditions which must be observed. These in reality are but the canons of sound judgment specially applied. In the abstract their necessity is apparent; but in the

Concrete, they are often ignored. These Canons are:

1, The proposed treatment should be tested over an adequate range of instances.

2, There must be no selection of Cases.

and 3, Another group, entirely Similar in its subjects, but exempt from the special treatment, should be kept apart for Comparison, under the same general Conditions as the tested groups.

Should these Conditions be observed, it is not necessary to insist much upon the Correct diagnosis of Cases; for, as selection is then wholly avoided, and the examples are over a sufficiently wide range, any such error occurring in the one group, will be counterbalanced by a similar error in the other.

The first of the four tested sera we may distinguish as -

A. The Primary Yersin Serum. - After some preliminary experiment upon the immunisation of small animals, Yersin, Calmette, and Borrel selected the horse as affording the best source of serum for the human subject. For, it is not susceptible to Plague infection in the ordinary way; but, inoculation with living Plague microbes induces a sharp fever and a local reaction. They were thus able to begin their injections from the first with living culture-forms in small doses. After some 20 days, when the constitutional disturbance had subsided, they injected a second dose of the living virus. This, after the lapse of the requisite time, they followed up by a third in larger dose, and the third by a fourth, and so on. As the degree of reaction diminished they increased the dose. When the last

the last dose ceased to be followed by any reaction the animal was judged to be immune, and incapable of being infected by the Plague virus in any way. It is the serum from the blood of the horse thus immunised, which when injected is alleged to have the power of mitigating & arresting the Plague in man; and further is said to confer upon the healthy subject protection against infection. The method first followed, 1894 and 1895, was Sub-cutaneous injection. As this produced local indurations it was later on altered to intra-venous injection. Furnished with "eighty flasks" of this antidotal serum Yersin appeared at Amoy in 1896, when, as Calmette has recently reminded us, (a) the Plague epidemic was declining and nearly spent. Here, his most promising statistics were obtained. In 23 cases treated, only 2 deaths occurred, & these two were cases where treatment was begun upon the 6th day of illness.

(a) The Indian Lancet, Calcutta, 7 Jany 1901.

Yersin has published the following particulars of the 23 Amoy cases:

Cases treated.	Day of illness when the treatment was begun.	Quantity of the Serum employed.	Remarks.
6	First	20-30 CC.	Cured in 24 hours.
6	Second	30-60 C.C.	Cured more slowly.
4	Third	40-60 CC.	Fever persisted 48 hours. Convalescence very slow. Buboes suppurated.
3	Fourth	20-50 CC.	Recovery after 5 or 6 days.
4	Fifth	—	Two deaths.

Such apparently successful results were never afterwards obtained.

Before passing on we would point out that the range of cases is much too small; and that they were those occurring at the close of an epidemic; that is at the time when abortive cases are apt to appear. Later on, as Catanei reports, [a]

"When Dr. Yersin commenced his operations
"in Bombay he extended his treatment to all
"classes of patients in every part of the city
"so that it —

(a) Catanei's Bombay Plague Report, 1897. pp. 145/146.

"was impossible for any one but himself to compare
"his results. He communicated them to the Committee
"according to the accompanying statement, and they
"fell far short of the expectations and hopes of
"the public and of the medical profession."

No. of Cases.	Day of illness when treatment was begun.	Quantity of Serum employed	Cured.	~~Recovered~~ Died
17	First day	Not given	15	2
17	Second	"	11	6
12	Third	"	6	6
3	Fourth	"	1	2
1	Fifth	"	-	1

Total Treated 50 : Cured 33 : Died 17 -

Mortality 34 per cent.

In a second Table, Dr Yersin classifies the 50 cases by their race: namely, 2 Europeans, 9 Eurasians, 10 Parsees, 7 Mahomedans, & 2 Hindus. The three first-named races always have more frequent recoveries, and in his 21 cases

for the three groups there were 16 recoveries; while the remaining 29 Cases in the two other groups give 17 recoveries.

Dr. Yersin's method in Bombay must be regarded as one of selection; and it is evident that the race proportions which he chose for treatment do not represent the average Plague incidence among these races.

"When the circumstances", Lieut. Gatacre (a) adds, "under which the treatment was being "carried out came to the notice of the Com- "mittee, they requested Dr. Yersin to confine "his operations as much as possible to the "Plague Hospitals, so that the cases might "be under the observation of the Medical "Officers working under the Committee".

All subsequent reports by other operators regarding the efficacy of the

(a) Lieut. Gatacre's Report, 1897, p. 146.

method, as, for example, the Report by Surgeon Capt. Thomson[a] on Cases treated in Parel Hospital, give much less favorable results. To summarize Ref account, In the 23 Cases who were subjected to Yersin's Serum Treatment 10 recoveries and 13 deaths are recorded, giving a mortality of 56.5 per Cent.

A change was evolving made in the method of ~~preparing~~ producing Antiplague Serum, which, for the sake of distinction, we will term -

B - ~~The~~ Roux Simplified Serum. A new Laboratory at Garches, to prepare Serum on a larger scale, was put under the Care of Roux. In the belief, doubtless, Ref it would be found equally if not more effective, he adopted a modified process of preparation. For his injections

(a) Gen. Sataore's Report, 1897, pp 78-81 and 146.

he employed gelatine Culture-forms of the microbe heated in bouillon for an hour to 58°C. This heating kills the microbe, but leaves in undiminished vigour the toxins developed. The Constitutional & Local disturbances produced in the horse is very much the same as when living Culture-forms are used. The injections are repeated at intervals of about fifteen days, & continued until complete tolerance is established.

It was this protective serum which was used by Wilkins in the Cutch-Mandvi Epidemic 1897. In his Report[a] to Govt. Gataere he contrasts the results in 30 Cases treated by serum with the results in 100 Cases under exactly the same conditions, but treated by the usual methods. Owing to lack of the necessary serum his hope of completing 100 Serum Cases was not realised. In his 30 Cases 12 were cured, and 18 died.

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[a] Bombay Plague Epidemic, 1897, Pp. 227/228.

giving a mortality of 60 per cent. In the comparative group of 100 cases the mortality was 83 per cent.

From the phase of its preparation it is sometimes named the "Garches" serum, and under that name is not looked upon with much favor. Its ill success at Bangalore[a] is reported by Surgeon-Lieut. Douglas, I.M.S.

The "not so satisfactory results" (Calmette) of this serum led to the next modification, which we will distinguish by calling -

C. The Pasteur Institute Serum, as the parent institution in Paris has specially adopted it. In it, the first injection, and the first only, is that of cultures sterilised by heat. But all the subsequent injections contain living culture-forms, as in the early experiments in 1894-1895. It is prepared (Calmette) without the addition of any antiseptic. Sub-

(a) Plague Com. Report, Vol III, appx. LLLIX. pp 593-620

stance, its deterioration being prevented by heating it for an hour at least three times in one day, in a water-bath at 58°C.

The virtues of the serum prepared in this fashion were tried at Oporto in 1899. Calmette[a] states that in the Hospital there 142 cases were submitted to the serum treatment, of which 121 recovered, and only 21 died, showing a mortality of 14·78 per cent. This result he contrasts with 72 cases occurring in the town in which the serum treatment was not followed. In these cases there were 26 recoveries and 46 deaths, or a mortality of 62·73 per cent. Hence he argues the superiority of the serum treatment. We will only say, European cases have more frequent recoveries as a rule; and point out that the compared town cases were not treated under the same general conditions.

Simond has published two reports in support of it

(a) Calmette, Indian Lancet, Calcutta, 7 January 1901

efficacy. The first Report[a] is a selection of cases from Bombay, Cutch Mandvi, Karachi and Mumbra, amounting to 300. Of these he reports the cases cured as 42 per cent, and the mean mortality 58 per cent. The mortality among cases not treated by serum he assumes to be 75%, and points out that the advantage in favor of the sero-therapic treatment "oscillates around 15 per cent."

The other Report[b] deals with cases occurring in Karachi from 9 May to 6 June 1898. They are 75 in number. When the Report was written 7 remained under treatment, 31 were cured, and 37 died. This gives an ascertained mortality of 49.33 per cent.

It is to be regretted that the first group should have been gathered together from several centres, & that the last should be incomplete.

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[a] Plague Comm. Report, Vol. I. appx. VIII, pp. 349/350.

[b] Plague Comm. Rept, Vol II, appx XLIII, pp 457/460.

The only other serum which we need now notice is -

D. <u>Lustig's Chemical Serum</u>. The basis of this serum is a nucleo-protein prepared as follows. Virulent plague bacilli are cultivated on agar-agar for three days at a temperature of 37°C. The cultured mass is scraped and dissolved in a one per cent caustic potash solution. On the degree of concentration of this solution, we are told, will depend the active power of the remedy. From this solution, by slight excess of acid, Hydrochloric or Acetic, the active remedy is obtained as a white precipitate. It is collected, washed, & dried in vacuo, and in this state can keep indefinitely. When about to be used a measured dose, (1 to 5 mgrms.) is dissolved in sterilised alkalised water, and injected subcutaneously. It produces only slight oedema & slight uneasiness at the place of puncture, and slight fever. More minute

details are given in Vol I, Plague Commission Report.[a] The precipitate has all the chemical characters of a nucleo-proteid. By repeated inoculations horses are immunized in three to four months; and the serum of the horse, thus immunized, is used as an anti-plague remedy, like the other sera. 20 to 60 c.c. may be safely used as the dose for an adult, and it can be injected once or twice a day. It causes no local irritation if any moment if syringe used is aseptically clean. After 12 hours its effects are manifest in fall of temperature, lessened bubonic pain, & improved constitutional state,- so it is said.

In a paper submitted by Mayer & Apl. 1900, to Members of Bombay Medical Union,[b] it was stated that 403 cases had been treated at the Arthur Road Plague Hospital. Of these

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[a] P. C. Rept. Vol I, appendix VI., Pp. 346/7.

[b] Lustig's Curative Plague Serum, Bombay, 1900.

154 recovered, and 249 died, shewing a mortality of 61.78 per cent. It is acknowledged that cases in the last days of the disease, & moribund cases were re-jected. This selective element wholly vitiates the contrast which they proceed to make with 1190 cases under ordinary treat-ment in the Hospital, in which there were 233 recoveries, and 957 deaths - that is, a mortality of 80.42 per cent.

Further, the Mayr Paper frankly ac-knowledges that the Lustig serum had no effect on the progress of Plague Pneumonica.

Simond also, in his account of 75 Cases treated at Karachi,(a) says that any benefit to Pneumonic cases, either Primary or Boundary, was very doubtful; and that only cases needed anti-toxic and bactericidal serum of great potency. Indeed, this most fatal of all the forms of Plague

(a) Plague Enq. Dept. Vol II, Appx XLIII, pp. 457-460.

seems to march towards its end unchecked alike by Sera treatment, as by general remedies, which may be used to arrest it.

Calmette has recently affirmed that the Serums treatment is the "only efficient remedy "that could be employed in the treatment of declared "Plague." [a]. And Montenegro adds: [b]. "the Serum is the one really useful means "with which we can oppose the disease".

Is this opinion, arrived at by two Physicians of repute, based upon an impartial consideration of all the facts?

We think not.

If the so-called oscillating balance of 16 per cent, which is claimed by Simond in favor of the Serum treatment, were a reality, we would rejoice, and would most gladly recognise in it the assured basis at least of a future

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[a]. Paris International Congress of Hygiene, Nov. 1900.

[b]. "Bubonic Plague", Balliere, London, p. 62.

curative treatment. But we judge this stenicated margin of success, exhibited by statistics, as non-existent and delusive. For during the last four years, an all but unlimited field for the proof of the virtues of Sero-therapy has been wide open in many parts of India alone; and the examples of so-called success adduced by its advocates are comparatively limited; are also frequently exhibit a method of selection; are grouped in some cases in an arbitrary way; and contrasted with groups put under ordinary treatment by taking generally the needful similarity in general conditions. Both the limited results, and the neglect of the first principles of induction, alike constrain an impartial mind to reject their statistics, and also their conclusions, as wholly misleading & visionary.

Their own confession of impotence & failure to favourably affect or heal advanced cases, or cases of the graver type, lead us indeed to believe that the

essential principle by the knowledge of which an antidotal remedy becomes possible, remains as yet hidden and unknown.

In the anti-diphtheritic serum treatment the shedding of the false membrane, and the improved constitutional state, reveal unmistakeably the potency and the specific power of the remedy. But in the application of the four sera as curative agents, which we have just been considering, the signs of efficacy, and those marks of specific power, which convince the reason and sway the judgment, are only too conspicuous by their absence.

2) Serum prophylactic treatment. The preventive power of the serum injection happily does not correspond with its curative power. There is abundant & satisfactory evidence as to its efficacy as a prophylactic.

Simond[a] records 1,160 cases inoculated preventively among whom only 9 contracted the Plague within 20 days of inoculation. He remarks: "The immunity does not last very "long. In order that the Vaccination should be "efficacious it would be necessary to re-vaccinate "twice a month."

In the Cutch epidemic Capt. Mason[b] inoculated 1,044 persons of all ages with preventive serum obtained from the Pasteur Institute. The results were that only 6 of those who attacked with Plague & 3 of them recovered. The two fatal attacks occurred in another 7 days

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(a) Plague Com. Report, Vol I, app. VIII, pp. 349/350.

(b) Bombay Plague, Cape London, 1900, p 344.

twelve days after inoculation.

Numerous observations prove that the immunity conferred by serum injections expires in about fifteen days. This is the chief drawback to its universal use as a prophylactic. The labour involved in inoculation twice a month is so enormous, that it can never be applicable to large communities. But, inasmuch as the immunity conferred by the serum is immediate and absolute, and the injections painless & harmless, it is of the highest value for restricted classes whose duties bring them into close & continued contact with the plague virus, as Hospital nurses & attendants; Sanitary Inspectors & Physicians. Such deaths for example, as that of Dr. Manasse of Bombay in 1897, and of Dr. Müller of Vienna in 1898, would in all likelihood never have occurred, if they had been living & working under the protective power of the serum injection, or of Haffkine's vaccine, about which we are about to speak.

3. Vaccine Prophylactic Treatment is represented by one fluid, widely used, extensively tested, and of undoubted efficacy. It is best known as Haffkine's Prophylactic[a], so-styled from its discoverer, now Director of the Government Plague Research Laboratory, Parel, Bombay. His inoculating fluid is based upon the development of the stalactite-forms of the Bacillus Pestis already described - [Pp. 16, 17]. As there stated, a meat-infusion, acidulated, sterilized, & infested with virulent microbes, is kept developing stalactite-growths until, about the end of the fifth or sixth week, all growth has ceased. The shape of flask, the quality of the medium, & amount of Super-natant air, are all arranged so as to promote the largest possible accumulation of Intra-cellular toxins during the growth-period. The microbes themselves are killed by heating

[a]. "Preventive Inoculation". Address before Royal Soc., 8 June, 1899. By Haffkine; Reported in "Lancet" 24th June 1899. Fluid also described in British Med. Journal, 12 June, 1897.

the fluid up to 65° to 70° C. a temperature which leaves the toxins unaffected. This fluid is put up in flasks with aseptic precautions, with date, number, and dose. The average dose is 3 to 6 C.C. The immunising properties of this fluid were first tested on rabbits, which after injection were found able to resist ten- or fifteen-fold lethal dose of Virulent Plague microbes. Then its perfect harmlessness was proved by the inoculation of many leading European & Native Bombay gentlemen. And its efficacy on a large scale was first demonstrated in the treatment of the inmates of Byculla Jail. Nine cases of the Plague had appeared among the inmates, 3 to 6 in number. Of the 337 remaining 154 only volunteered for inoculation, leaving 183 uninoculated. After inoculation cases of Plague continued to occur among the Uninoculated Group, the average daily strength for seven days being 173. Altogether 12 cases

occurred among the Uninoculated with 6 deaths; while among the Inoculated Group two cases occurred & they both recovered.

This testing treatment, the first on a large scale, had the great advantage of an arranged similar conditions, and full observation in both groups throughout. So numerous are the subsequent Reports on Regiments, Jails, & Free Communities, in which this treatment has been tried, we can only select a few to summarize as types of all.

In the Epidemic at Kolhapur reported by Capt. Leumann of 1898, during the 16 weeks 15 June, to 27 Sept., 24,631 inoculations were made: among these 338 deaths occurred, shewing a percentage mortality of 1·3. The remaining average population numbered 17,786, & were Uninoculated: among them 2,348 deaths occurred, shewing a mortality of 13·2 per Cent.

(a) Govt. Report 7569 of 1898; also, "Statistics of Inoculation" by Major Bannerman. Bombay. 1900 – pp. 14/15.

That is, while one in every seventy two of the inoculated Europs died; one in every seven died in the Un-inoculated Europs. This may be regarded as a reduction of the mortality of 89.6 per Cent in favor of the inoculated Cases.

In the Dhárwar Epidemic of 1898 (a) during the twelve weeks Sep. 2 to Nov. 16, Dr. Mrs Cor-thorn inoculated 4,231 in an average pop-ulation of 21,088. Among the Inoculated 54 deaths occured, shewing a percentage mortality of 1.04. While in the 16,857 Not-inoculated 889 deaths occured, giving a percentage fatality of 5.28. Here the percentage mortality in favor of Inoculation is Ten Fold in the Public Statistics, namely 75.7, but it is still great.

At Public and at Dhárwar the Reports distinguish between the "Cases" and the "Lives" - Inoculated, shewing a general result confirmed

(a) Govt. Report Dhárwar Distt. Antiplague Inoc. March 1899.

by other Reports, that the system of double dosage and inoculation after ten days or any strengthens the immunity to the extent of not less than ten per cent. The duration of immunity is also prolonged.

The Dock Camp at Mauritius[a] was attacked by Plague in July 1899. It is occupied by Madrasis and Indian Mussulmans brought to the island under a Labour contract. They live somewhat closely packed together in barrack-like buildings which are dark & badly ventilated. The first case appeared on 6th July, and Inoculation was begun on 12th July & was completed quickly. At the end of Sept. about 90 were cut off to an Evacuation Camp. The results up to that date were:-

Inoculated numbered 423, among whom 6 deaths had occurred. The Un-inoculated were 13 only, & these had 6 deaths also. That is, the percentage of Plague fatalities among the Inoculated was 1.38: and among

[a] Bannerman's "Statistics of Inoculation". Bombay, 1900, p. 20.

the Un-inoculated 46·1. In other words, the percentage of lives saved by the Inoculation treatment was 93.33.

The estimate of amount of benefit conferred by Inoculation are necessarily based upon the Supposition that the separate mortality of the Inoculated Group was the same as that of the Un-inoculated. In reality the Inoculated Groups were more exposed, for they commonly embraced the bulk of the "contacts" in the district where the Plague appeared. Being wholly a voluntary measure it was largely the occurrence of the Group in their own households which shut up the surviving members to seek the protection of the Inoculative treatment. In the Dock Camps at Mauritius, a community under a measure of control, its occupants were persuaded to take the step by certain privileges which the Inoculatee acquired. The calculation therefore is, in most cases, dis-

-counted as regards those Inoculated. But this need not be pressed.

Can any un-biassed mind fail to see the benefit which Inoculation confers when he perceives that a mortality varying between 70 and 90 per cent is avoided by its use?

Its defensive power is indeed so great that its use is daily increasing, and is likely to increase. So long as Humanity & Civilisation stand face to face with the appalling fatalities of a Plague Epidemic so long will such powerful & effectual help be prized and used. From the Government Patel Laboratory 10,000 Doses of this Vaccine are at present (March, 1901) being dispatched every day to districts eagerly awaiting them. This speaks for itself. The Hindu in his tens of thousands, with all his conservatism and ignorance, stands calling aloud for the protective power conferred by this remedy!

The exact duration of the conferred immunity is an unsettled question. It is assumedly within the limit that the Once-inoculated are immune for three months, and the Twice-inoculated for six months. The Government of India indeed have recognised the Inoculation Certificate as entitling the holder to exemption from certain Plague laws, to be valid for a period of six months; or longer, should accurate data in the future be forthcoming as to a prolonged protection power. These data regarding the protective virtue lasting for a much longer period than six months are slowly accumulating; but no limit to the protection can be positively affirmed. We lately saw an unpublished Government Report in which Eighteen months after inoculation for the week ending 4th. January 1901, out of 19,346 Inoculated Cases there had only been 2 deaths among 6 Plague attacks!

The vaccine injections in a few cases are painful, & may excite a minor local inflammation. But these are rare indeed, and are supposed to have arisen from some failure in the aseptic precautions. The great majority of cases manifest only moderate local disturbance. Any lymphangitis around the seat of inoculation passes away entirely in a week, & the local induration generally more slowly.

In any threatened Plague invasion, while there are, as we have seen, two chief prophylactic measures available, inoculation and evacuation, there is yet sometimes but the choice of one. The prejudices & observation of the people may render inoculation for the moment impossible; or, the approach of the rainy season may make evacuation highly imprudent. The occasion and the circumstances

must decide which of the two measures should be adopted. In practice both are scarcely possible in one & the same epidemic.

Finally, one point should be specially noticed. The protective power which Haffkine's vaccine confers is not fully operative until some eight days have passed. For it needs time to be elaborated in the blood of the inoculatee. So, as ten days is the limit of incubation, it is beyond question that not a few who are inoculated are already infected with the disease. But all who have had practical experience in this inoculative work agree that if the infection is not advanced inoculation increases their chance of recovery. Some observers indeed go much further in their conclusions. Dr. Miss Lorrain, (a) for example, has minutely studied this point in the 1898 Dharwar Epidemic. Her cases indeed seem conclusive as regards

(a). See her Official Report, pubd 1899 - pp 3 and 12.

a wider induction. He summarizes his chief statements as follows:

Day of declared Symptoms after the inoculation.	Number of Cases.	Total Mortality.	Percentage Case Mortality.
The day of Inoculation	10	3	30.0
Second	18	4	30.7
Third & Fourth	7	5	71.4
Fifth & Sixth	19	11	57.8
Seventh to Tenth	25	4	16.0
	74	27	36.5

As the Un-inoculated Plague mortality for the whole town of Dhárwar during the period was 80.8 per cent. this Table proves Ref-inoculation does not increase the mortality. Indeed, it may be fairly assumed, says Dr. Orthom, Ref-inoculation is, if anything, beneficial to those incubating Plague; a conclusion which points hopefully towards the ultimate discovery of some allied form of a curative Specific remedy.