W8.4.

7/6

A TREATISE ON PLAGUE

SEMPER ALIQUID CERTI PROPONENDUM EST

FROM righteous acts let naught thy mind dissuade,
Of vulgar censures be thou ne'er afraid ;
Pursue the task which justice doth decree,
E'en tho' the crowd think different from thee.

Epictetus.

ENTIA NON SUNT MULTIPLICANDA PRÆTER NECESSITATEM

AS for the truth, it endureth and is always strong ; it liveth and conquereth for evermore (1 *Esdras* iv. 38).

A TREATISE ON PLAGUE

THE CONDITIONS FOR ITS CAUSATION
PREVALENCE, INCIDENCE, IMMUNITY
PREVENTION, AND TREATMENT

BY

MAJOR GEORGE S. THOMSON
M.B., M.CH.; M.A.O., ROY. UNIV. IREL.; I.M.S., BOMBAY

AND

DR. JOHN THOMSON
M.R.C.S.I.; L.R.C.P.I.
SPECIAL PLAGUE OFFICER UNDER THE GOVERNMENT OF BOMBAY

LONDON
SWAN SONNENSCHEIN AND CO., LIM.
PATERNOSTER SQUARE
1901

Dedicated by Permission

TO

HIS EXCELLENCY THE RIGHT HONORABLE

WILLIAM, BARON SANDHURST, G.C.I.E.

GOVERNOR OF BOMBAY

As the Pioneer of that noble band of Medical men, Civilians, Officers, and Volunteers who laboured so zealously to succour an ignorant and fatalistic populace suffering under the ravages of the most fatal of all epidemic diseases known to medical science; and in admiration of those sterling qualities of head and heart, which devised means in sympathy with people scourged by a malady chiefly due to their own ignorance of elementary sanitary laws, whilst yielding nothing that really conserved the public health, and prevented the transmission of the epidemic to other countries in commercial relations with India, by the numerous highways for the sea-borne exports from Bombay and elsewhere.

With profound respects by

THE AUTHORS.

PREFACE

SINCE the dawn of history the phenomena of plague have been recorded by various writers; and even in modern times the subject has attracted the attention of many as opportunities—fortunately with the advance of civilisation becoming more rare—have presented for the investigation and record of such phenomena.

The vast mass of such earlier records is unreliable, as coming from ignorant and superstitious persons who tinctured their records with hearsay stories, the outcome of the almost universal dread of the disease. Whilst the earlier writings on plague contain some suggestive facts, it will be found that up till 1836, when Clot-Bey investigated the malady scientifically in Egypt, a then epidemic home of plague, the study and generalisation of the literature of the subject is almost barren of reliable facts, and is merely the passing on of some platitude which tickled the fancy by one ignorant observer to another.

All knowledge is based upon experience. What is called inferential knowledge, in which we go from the less general to the more general, or from the general to the particular, has experience as its basis. In what are called the exact sciences, people easily find out the truth, because it appeals to the particular experiences of every human being. The scientist has certain results which come from his own experiences, and reasoning on those experiences asks us to believe in his conclusions, and appeals to some universal experience of humanity.

In every exact science there is a universal basis to which the scientist refers investigators, so that they can at once see the truth or fallacy of the conclusions drawn therefrom.

Theories are based upon belief; that being the true one which verifies *all* the *true* facts, and enables us to answer all objections and variations from the general rule, and which is based on universal experience. Uniformity, with explainable variations — on the almost universally admitted theory of evolution—is the rigorous law of nature.

The plague theory advocated in the following pages challenges verification or refutation, and is based on the truth of past and present experiences. Let anyone take up this method and investigate the subject candidly and impartially—making absolutely sure of the facts—then one will have the right, if led to different results, to say there is no truth, or only partial truth, in the claim put forth that the theory is a consistent and intelligible demonstration of plague phenomena and causation; but before that is done, no one is rational in denying the truth of these results. Any plague theory hitherto broached has depended on the mere *ipse dixit* of its promulgator, unsupported by reliable facts from experience, conclusions therefrom, or even a shred of argument.

In acquiring knowledge we make use of generalisation, and generalisation is based upon observation. We first observe facts, and then we generalise, and draw our conclusions or principles. It seems at first sight easy to observe and record facts in the rational world, but without a proper method of analysis and scientific training any science will be hopeless, mere theorising, that will not stand the test of universal experience. Truth requires no prop to make it stand.

In putting forth this record of our experiences and the conclusions therefrom, we feel certain in appealing to the experiences of others for its confirmation. The theory we prefer to term as demonstration rather than a discovery in the domain of plague, because investigations into the history of previous plague epidemics have shown us that others had now and again hit on the facts either in dealing with plague outbreaks practically, or by blind chance, but unfortunately for the scientific world and the cause of humanity and preventive medicine, the truth was not freely grasped, but clouded with other useless trash; and hence was not given that full confidence it deserved, and so was lost to the storehouse of real knowledge.

That the principles in this treatise are the only sound ones for governments and people, threatened with or invaded by plague, to work on and rely upon for complete success in their efforts to keep the malady at bay or thoroughly eradicate it we are fully convinced; and daily increasing experience only more strongly confirms that conviction.

Of the authors' qualifications and scientific training for the investigation of this disease this is not the place to write; suffice it to state that one of us has had upwards of two years' daily contact with plague cases, has treated and taken personally clinical notes of upwards of one thousand cases, and seen many rare types of the disease in the large plague hospitals in Bombay, and in the Satara districts, and has been almost exclusively engaged in plague work during the period mentioned, embracing the sole charge of one of the largest plague hospitals in Bombay during the height of the 1897 epidemic, and since then in medical charge of plague operations at Satara during two epidemics.

The other colleague has been solely engaged on plague duty in India for nine months, where an epidemic occurred in a town of 12,000 inhabitants, and the principles advocated in this volume were put to the test most rigidly and practically, without the use of disinfectants or other unreliable yet vaunted aids to stamp out a plague epidemic.

One of us had nearly all the cases injected in hospital by M. Yersin's curative serum, under his care; and the Imperial German Scientific Commission, composed of Koch, Gaffky, Pfeiffer, Sticker, and Dieudonne, and the first Russian Commission worked at the Parel Hospital;

so that frequent opportunities were availed of for studying the post-mortem appearances, bacteriological investigations, and laboratory experiments in connection with the disease.

To Mr. E. H. Hankin thanks are due for permission to work in his laboratory for three months under his direction on experiments with the capsular pesto-bacillus, and to Mons. W. M. Haffkine for much valuable information and the correction of the remarks on the technique of prophylactic inoculation and the preparation of his anti-plague prophylactic medium. The authors have performed upwards of 3,000 inoculations with the prophylactic medium, and their conclusions are embodied in the present work.

A few remarks seem necessary to correct the false impressions of Western medical men, without Indian experience, as it seems to be universally held that it is a slur on the Bombay Municipality or the Bombay Government that the epidemic of plague was not either confined to Bombay, or speedily "stamped out." Arguing, no doubt, from the analogy of other epidemic diseases, such as scarlatina and measles, having had no practical experience of plague and the difficulty—nay, the futility—of attempting to stamp it out or do more than mitigate its ravages by temporary expedients, and relying possibly on the success the French physicians have had by washing down infected walls and houses with chemical disinfectants, they illogically conclude that the same measures should have been successful in plague.

Indeed, some so-called experts with previous plague experience assured the authorities that having once carried out the measures they recommended on any town (disinfection, isolation, segregation, "the whitewash brush," etc.) that there need be no fear of a recurrence of an epidemic of plague in a town so dealt with. The subsequent history of their own infected cities disproved this claim, and our Indian experience entirely overthrows it. The local difficulties in a city like Bombay are well summed up in the words of a newspaper correspondent from observations made on the spot as follows. Mr. Steevens, of the *Daily Mail*, says :—

"I had the luck to fall in with men who could show me the whole process, from cause to cure—or death. The cause was simple enough : two minutes in the native quarter and you saw and smelt and tasted it. The cause is sheer piggery—foul air and rabbit-warren overcrowding. The huge houses, with their ranks of windows, their worn plaster and scratched, rickety shutters, have slum written all over them in a universal language : but for wooden hoods projecting like gargoyles to shade some of the windows, they might be in Edinburgh or Naples. But walk in, and what you see surpasses everything European. On stamped earth floors, between bare walls, in the dimness of one tiny window, you see shapes squatting like monkeys. They stir, lithe but always languid, and presently you see that they are human. Babies, naked children, young women and youths, mothers and fathers, shrivelled grandsires and grandames—whole families stifle together in the thick darkness, breed, and take in lodgers. In the room where there is hardly space to move, they sleep and work at trades, and cook their food with pungent cakes of camel-dung. Because January is cold to their bare limbs, they shut doors and windows, to fag and fester worse. The lower rooms are even down beneath the level of the street and of the drains ; the upper are holes beneath the sloping roof, where a man cannot stand upright. On the storeys between these are dens lighted only from the dark corridor ; you look into them, and at first see only a feeble wick fluttering in a night-glass ; then moist eyes shine at you out of the darkness, and again two, four, six, ten men and women are sitting motionless against the wall. They neither speak nor stir—just sit and ripen for pestilence. On the door-jamb of this house are a dozen red marks—dates with a line round them, in some circular, in others a complete circle. Each means a case of plague—the full circles a death, the halves a removal to hospital. For your own part you wonder that anybody in the poisonous lair is left alive.

IMPROVEMENT COMING.

"But improvement is coming—tardy and partial, still an improvement on the worst. At this house we fell in with an English gentleman, a man of business and a member of the municipality, who is devoting his money and time and life to saving these wretches. Equipped with large powers of compulsion, he was forcing the landlord to pierce shafts through the whole height of the house, to replace small windows by big, to do away with the garrets. The landlord, a Hindu, had all the native's terror of spending a farthing; he had argued and pleaded and dallied, but this morning he was at last beginning. We came across him—a fat, yellow toad in spotless white turbans, shirt and drawers, with a red kummerbund—half sulky, half-fawning, trembling to the naked eye. For most of his rooms he will be getting two rupees (2*s.* 8*d.* a week); a native docker's pay is only seven. But as a native can easily live on two rupees a week, and there are perhaps fifty rooms in the house, it is not wonderful that the English councillor had persuaded some of the worst-lodged to run up shelters of bamboo and matting and live in the yard outside. It was light and airy, at least, though foul, whereas the rooms indoors were mostly clean. Here, little isles of brown skin and scarlet, white and yellow cotton, sat families amid the carts and humped oxen, the goats, and the fowls. In the house the goat and kid lived upstairs with the people; at one door a cooped duck was quacking mournfully. In the yard the oxen lived in the open, for the councillor had converted the byre with bamboo and limewash into an emergency hospital."

It might be thought that this treatise is merely a compilation of instances telling in favour of a preconceived theory of plague causation. The very opposite of this surmise is the truth; for the theory was arrived at from facts and observations coming under our personal experience in plague epidemics in various parts of India, and then the literature of the subject was ransacked for confirmation or refutation of the theory enunciated first before the Bombay Medical and Physical Society in March, 1898.

The facts and instances in the literature—of which a bibliographical summary is appended—may be consulted by any candid critic who wishes to refute the theory. Further, it is to be borne in mind that all the instances of historical proofs have not been referred to, but only some of the more striking ones included in this treatise, for we found an *embarrassment de richesse* in this branch of inquiry rather than a paucity of confirmatory evidence. To formulate measures for the prevention or the stamping out of a disease, it is in the first place necessary to thoroughly understand its etiology. Without this knowledge it must be evident to all that we are only hitting in the dark. Some crude notions about what has been hitherto regarded as a mysterious and inexplicable disease may have led to methods of dealing with it that are wholly inapplicable and inefficient, whilst the remedy may all the time have been nigh, simple, efficient, plentiful, and attainable without any works of supererogation. It is, alas! only too true, man has shown an unhappy tendency to take delight in the creations of the imagination, and to elevate them at the expense of the truth; it is more quickly and easily done, and once these fetiches have been set up, he worships them, and systematically shuts his eyes to the evidence of every fact which might turn him from the false worship that has led him astray. The false deduction, the vain panacea having been once vouched for by some authority on imperfect conclusions from unverified premises, the lie gains adherents, and is passed on as current truth, until some bold truthseeker exposes its hollowness, and with a message for his age, brings the exponents of science back to right lines.

It was by proceeding on the above lines (verifying the conditions under which the germ gains virulence to attack), rather than by germ hunting, that the conclusion put forward, for the approbation of the profession and the guidance of governments, was reached. The want-of-fresh-air theory is the only one that explains all the facts now and in past epidemics, and reconciles all the variations noted and apparent vagaries of the multiform and dreadful malady. It holds the field, and has not been confuted by the experience of ages or the most recent researches, but confirmed by the facts that seem at first sight most at variance with it.

Throughout an endeavour has been made to distinguish between facts and opinions, and to suppress the natural desire to prove a theory by juggling with statistics.

It must not be supposed that we consider this work settles the whole subject under review for ever, as we are only too conscious of its shortcomings as a maiden effort in medical authorship; but it will be found up to date and reliable. There are many points yet to be cleared up in reference to plague, such as spectroscopic and chemical examination of the blood of patients and convalescents, identification and demonstration of the micro-organism in its supposed varying forms outside the human body, its pathogenicity for other animals, variations in degree of virulence and their causation, relation to subsoil damp and rainfall, the possible spread of plague by means of the milk supply, experimental induction of plague through a blistered or abraded skin of a susceptible animal, etc., etc., work requiring time, apparatus, and more than one investigator to settle satisfactorily.

No apology is necessary for offering to the profession a treatise on plague, as no work of the kind has been published separately by any English physician for a long time, and the great advances of late years in our knowledge of the disease justifies the summary of experience here presented by those brought into intimate contact with the disease in all its aspects.

A large share of attention has been devoted to the cause of plague from a conviction that the disease may be prevented. It is hoped the remarks on this subject may stimulate other observers to further investigations and to test the correctness of the conclusions.

The history of plague in ancient times has been touched upon, and two examples of the ravages of plague by eye-witnesses quoted to mark the contrast between the results of proper and improper methods of dealing with its outbreaks.

Whatever may be the verdict of the profession at large or of plague experts, the facts and observations put on record in this volume have an important practical bearing on disease causation and prevention, and "the truth is in the facts, and not in the mind which observes them."

CONTENTS

PLAGUE SYNONYMS

THIS is the λοιμός of Hippocrates and Galen; λοιμώδης πυρετός, Anct. Græc.; λοιμός σηπτικός; the *Pestilentia* of Celsus, Pliny, and Cicero; *Pestilitas; Pestilentia Septica; Pestis; Pestis acutissima*, *Inguinaria*, *Orientalis*, *Septica*, *Glandulosa; Adeno-Septica. Febris pestilentialis*, *Adeno-nervosa*, *Exanthema*, *Anthracia pestis. Ephemera pestilentialis, mortifera. Typhus pestis, pestilentialis, gravissimus, anthracicus, bubonicus, D'Orient. Peste orientalis;* Pestilential Fever; Levant Plague; Septic Pestilence; Glandular Pestilence; the Black Death; Pestilence; Pest. Oriental Plague; Bubonic Plague; Pali Plague, or *Mahamurrie* (*India*).

Waba, *Phugya rog* and *Taun* are the modern Indian names.

In Marathi it is known as *Gatak azav*, *i.e.* the disease with bubo; and a suggestive title, from the patient's aversion to being considered ill, is *Kote sikionare azar*, *i.e.* the disease that teaches to speak falsely.

The latest edition of the *Nomenclature of Diseases* gives: Latin, *Pestis;* French, *Peste;* German, *Pest;* English, *Plague;* and classifies it under General Diseases.

Nosologically Plague may be classed among the *Exanthemata*, or eruptive Fevers, of an infectious nature.

Cullen, in his *Practice of Physic*, defines the disease as *Pestis — Typhus maxime contagiosa cum summa debilitate. Incerto morbo die, eruptis bubonum vel anthracia.*

THE PLAGUE

CHAPTER I

DEFINITION AND ETIOLOGY

Definition.—Plague is an acute, specific febrile, inoculable, and otherwise communicable, epidemic, contagious, eruptive disease characterised by sudden onset, without premonitory bodily symptoms, a very high mortality especially amongst dark-skinned races, by the appearance of buboes and occasionally of carbuncles and petechiæ, and associated with the presence of a specific micro-organism in the affected lymphatic glands, or sputum, in the pneumonic variety, or in the blood and spleen, in fatal cases.

Plague in many particulars resembles typhus, and has by many of the older writers been claimed to be but a more malignant form of that disease. Like typhus, it is sometimes accompanied by petechiæ; and, indeed, post-mortem examination generally reveals those eruptions on the mucous coats of the viscera in plague, but the petechiæ of plague are larger than typhus, more significant of the putrescent changes within, and in fully eighty-five per cent. of all cases associated with buboes and rarely (according to recent experience) with carbuncles, these latter forming the diagnostic and essential characteristic of the disorder. It is probably dependent for its origin on putrefactive changes in animal products, and, like enterica, is usually transmitted in an indirect manner, through clothing or other articles in use by those affected, but only under certain insanitary conditions, and not, as in small-pox, directly from person to person except in the primary pneumonic form. It may be spread by direct inoculation, or by breathing the respired air of the sick, in the same atmosphere in which they themselves have become infected, but owing to the ability of the virus to retain its vitality undiminished for years outside of the human body, if the articles impregnated are kept confined in trunks or boxes away from the sanatory influence of fresh air and sunlight, it may break out in any locality and at any time when the conditions favourable for its development occur.

These are, chiefly, whatever devitalises the air and robs it of its life-sustaining ozone and oxygen, such as the crowding together of many unclean individuals in a small space; the absence of sanitary measures; the deficiency or absence of ventilation produced by narrow streets and badly-constructed dwellings, and favoured by a hot, humid atmosphere with only moderate winds or a complete calm. There are the best reasons for the assertion that these conditions, when consonant, are sufficient to engender an outbreak when from any extraneous cause, fomites, or an imported case, the plague poison has been introduced into such a suitable soil where it spreads like wildfire. Such conditions may exist for ages, just as a field of land may be ploughed, manured, and watered; but in the absence of the seed being sown no crop is produced and no epidemic occurs. Sporadic cases are often thus caused, and the disease fails to become epidemic simply because the influences that set it in motion are not sufficiently widespread.

Subsequently a few specific instances of such natural limitation will be adduced, especially on board ships and in well-ventilated sanitary gaols and houses. Plague cannot exist, much less develop, where even moderately good sanitary regulations are enforced, and even in plague-infected districts is confined to the ground floors and underground rooms, or dark, dirty, overcrowded, and ill-ventilated rooms and houses. It is an old and exploded notion that it cannot go upstairs, as the disease can occur anywhere, alike in the king's palace and the beggar's hovel, in the crowded city or the breezy jungle, in the closed valley or the salubrious mountain side, amidst the heat of tropical summer, or in the depths of arctic winter; wherever there is a deficiency of air or deterioration thereof by insanitary conditions or the abuse of provided means for renewing the supply of vital air.

The disorder consists of three stages, not counting incubation and convalescence, any of which may be absent or transitory owing to the fulminant character of the disease when it has once gained epidemic force; and death can occur in any one of them. But the fearful mortality with which the memory of this disorder is associated was due mainly to the neglect of the patients through popular panic and ignorance, and to the efforts made to prevent the spread of the disorder by shutting up people, patients and friends alike, in their plague-infected dwellings before the circumstances under which the spread of the disease was governed or conditioned were as thoroughly understood as at the present day. It is probable, as illustrated by the lessened mortality among those who believe in and resort to medical treatment early, that the natural death-rate is no larger than that of small-pox, diphtheria, and scarlatina, that is, one in every four attacked; and, like these, it is completely and permanently preventable under a wise system of personal hygiene and communal sanitation.

Etiology.—The cause of plague has long been a matter of doubt and contention, until Kitasato of Tokio discovered the exiting cause of the disease to be a bacillus, on June 14th, 1894, in the Kennedytown Barrack Hospital, Hong Kong. Previous to this the best post-mortem records and investigations of any scientific value were those of Clot-Bey and his associates in Egypt in 1835, amid the horrors of the terrible scourge, living in daily association with its victims, and observing every feature of the attack, recording its hourly progress, and settling questions of the utmost importance as to its methods of propagation. The sources of information on its symptoms before 1835 were the epidemic of Nimeguen in 1635 by Diemerbrock; London in 1665 by Sydenham and Bertrand; Marseilles in 1720 by Chicoyneau, Verney, Deidier, and Bertrand; Moscow in 1771 by Mertens, Orroeus, and Samoilowitz; and Egypt in 1798, 1799, and 1800 by Desguennettes, Larrey, Puguet, and Louis Frank, and by Russel and Brooke-Faulkner on plague in Malta.

Outside these records, and those inspired by them, the accounts of plague are vague and imaginative. The ancients considered plague an obsession, and its victims the objects of divine wrath, to be cut off from human help and sympathy, and left to die forlorn like the beasts of the forest, or shut up like criminals to expiate their sins.

Plague, later, was looked upon as an entity which seized a person and wasted his spirit, an undefined something which could leap forth and enter into those in close proximity to the victim. Hence arose the idea of contagion, and the plague victim, though no longer looked upon as paying the penalty of moral turpitude, was equally abhorrent on account of his supposed deadliness to every human being with whom he came in contact. The means taken to prevent the spread of contagion seem ludicrous enough now, as perhaps some more modern pet theories may appear in a decade or two. The absurd regulations, dictated by a spirit of superstitious dread, enforced during the last epidemic of plague in Marseilles, shows the lack of sense pervading methods of suppressing this disease.

The patient suffering, or suspected to be suffering, from an attack of plague, was put in a room by himself, and separated by an iron barrier from the attendants, who were dressed in oil-silk, and not permitted to have direct communication with the sick in any way. The medicines and food were put upon a tray and pushed within the enclosure. If a bubo was to be opened the patient was directed how to do it himself. The medical attendants were ordered not to approach within twelve yards of the infected persons!!! Even by such arbitrary quarantine the disease could not be kept from spreading, and under such depressing mental surroundings the death-rate was very high. In marked contrast, how much more sensible was the action of a Roman cardinal, to quote only one historical example, in Rome, in the year 1657:—

"He issued an order prohibiting any infected persons, or even any person whose health was suspected, to remain in the house in which they had been taken sick. All such were promptly carried to an hospital situated on an island in the midst of the Tiber. Other persons who had been living in the same house with the sick were then removed beyond the city walls, and comfortably provided for. All of the furniture was then taken out of the house, aired, *and all doors and windows left open to free access of the wind.* By these means the plague, in a few weeks, was completely eradicated, although it had been epidemic in the city for two years."

It may then be asked, But is the disease contagious? Professor Koch asked the author this very question, in the post-mortem room of Parel Hospital, the very first day he was introduced to him. One could only answer, Yes, but only under certain conditions. The disease is not at all infectious or contagious in sanitary plague hospitals, yet it must be a contagious disease, else how does it spread? Its contagiousness is determined by whatever deteriorates the air, robs it of its vital property, or diminishes its life-giving oxygen and ozone, whether by deficient supply of pure air, overcrowding, or filth.

In 1841 Dr. Robertson, the general medical officer of the troops in Syria, officially reported:—

"In reference to the contagiousness (transmissibility) or non-contagiousness of this, at times, frightful disease, I beg to state that the result of all my experience leads me to believe that the disease originates in local causes, and that it is not highly contagious. My firm conviction is that the plague cannot be communicated from one person to another *in a pure atmosphere*, even by contact; but I am not prepared to assert that, if plague patients are crowded together in confined and ill-ventilated apartments, infection will not be produced, just as in typhus."

Again, Mr. Brant, of Erzeroum, says:—

"As far as my experience goes I have been led to doubt the contagious nature of the disease, or, if contagious, it must be in a very slight degree. I have had within the sphere of my observation many cases of the most complete and extensive contact, without the disease being communicated."

Again, Sandison, of Brussa, says:—

"The cases are numerous in which persons escape the disease after contact with persons seized with it, even in its most malignant stage."

Clot-Bey and his corps of enthusiastic French physicians remained in hourly contact with the infected for weeks together, with but one of them taking the distemper, while others who observed every possible precaution then known fell victims, owing to their habits of life and breach of simple sanitary safeguards in the provision of fresh air, especially at night. In 1844 the Royal Academy of Medicine of France, after a very thorough and exhaustive research in Egypt, reported:—

"There is not a single fact which indisputably proves the transmissibility of the plague by mere contact with the sick."

As an old writer justly remarks:—

"Such an engine of destruction must, long ere this, have annihilated mankind, had not the Omniscient Creator encircled it with various atmospherical barriers which are constantly arresting its progress or suspending its powers. All, then, may not be lost in respect to the plague; it may yet come under rule. At all events, it is our duty, as it ought to be our pride, never to succumb without a struggle. Let the Ottoman lie supine under the fetters of fatalism, while the Christian philosopher exerts those faculties bestowed on him by his Creator in defending that Creator's noblest work from premature decay."—Dr. Johnson on *Tropical Climates*, 2nd edition, 1818, p. 333.

The evidence as to its transmissibility by fomites, clothing, furniture, and utensils used by plague patients is conclusive, and that, under certain conditions, it may be thus spread is undoubted; but, on the other hand, the exposure of such articles to the free access of pure air seems to quickly and certainly dissipate their power to infect. Laboratory experiments, with virulent cultures of the specific microbe, confirm this observation, as in Professor Hawkins' Laboratory in Bombay I repeatedly found that the plague bacilli can be readily killed in three or four hours by direct sunlight; and on woollen material they die after four or five days, on linen in three days. "A virulent culture on agar-agar is destroyed in strongly diffused daylight in forty to forty-eight hours."

"After the plague of 1835 at Cairo, the clothing, effects, etc., of 50,000 plague patients, who had been carried off by the pestilence, were sold in the public bazaars, without, as far as known, a single case arising among either the dealers or the purchasers. More than 600 houses remained tenantless in the city for several months; they were then ordered to be visited by the civil authorities, and an inventory was taken of their several contents. Not one of the persons engaged in this service fell sick. It is evident, therefore, that neither the infected themselves, nor their belongings, are capable of conveying the disease, except in the presence of congenial atmospheric conditions; and that a free circulation of air in the sick-room, and the exposure of the fomites to like benign influences, are sufficient to stay the progress of this dreaded distemper. This fact has been recognised by intuitive minds for centuries; but so oppressive is the inertia of preconceived notions, so slow the progress in alteration in national and hereditary habits, and so important the power of an idea which runs counter to popular thought, or want of thought, to impress itself against the prejudices of mankind, that it was not until the close of the first half of the current century that even those nations which had risen above the dangers of plague recognised the sources of their deliverance."—Winterburn.

That the pestilential condition of the air is the determining factor in plague, and furnishes its chief means of propagation, must now be recognised by all students of the subject. The demonstration of the plague bacillus was a great step in advance, and the reactions of this micro-organism to all physical agents confirm the facts recorded in the past, and witnessed in present epidemics, regarding plague incidence and immunity.

How comes it that certain parts are affected and others equally insanitary are free from the distemper? The answer is that man must himself be the cause, and, given suitable insanitary conditions, it only requires the specific germ to be introduced for the disease to develop with malignant intensity. Take a glance at the places that in modern history have been scourged by plague. The Nile delta has until recently been the endemic home of this distemper. The inhabitants of this region (once renowned under a high type of civilisation as an exceptionally healthy and salubrious country) were at the middle of the nineteenth century, as they had been for generations, filthy, destitute, and miserable almost beyond belief.

Their wretched hovels were so disgusting that language fails to be descriptive of the accumulation of horrors. They were not only surrounded by, but were the actual receptacles of the accumulated excrements of their inhabitants, of the animals which pertained to them, of garbage and rubbish, and of other disgusting and putrid matters. As if this was not sufficient, their dead were not unfrequently buried beneath the floor of the filthy hut in which they had passed their miserable lives.

Their food was of the worst possible description, and scanty at that—rotten cheese, decayed vegetables, semi-putrid fish, stinking meats, and other articles whose only merit was their insufficiency.

The water which they drank was filthy with animal and vegetable impurities. If to this we add the picture of their moral degradation, mental brutishness, the hopeless servitude and blank, unmitigated wretchedness of their lives, can we say that plague was anything but the inevitable consequence and natural close of a horrible existence? Cairo itself was the duplicature of these nasty villages on a huge scale. Disgusting and pestiferous impurities abounded. The city fresh water canal was as filthy as its vile streets; arising from which, under a tropical sun, was a constant cloud of intolerable offensiveness, and polluting the whole air in its neighbourhood. Within the city walls were twenty-five cemeteries, and in these were graves left open with the corpses festering in the sun. Sub-domal burial was permitted and practised. Separated by a few boards and a few shovelsful of earth, already saturated with the vilest impurities, were a half hundred or more corpses and the miserable living; and it would be hard to tell from which, the living or the dead, was given forth the most pestiferous odour. Ascending the Nile is found in Nubia and Abyssinia a population of cleanlier habits, living on a drier soil, *and with a purer atmosphere*, and to this region plague never came. Here, then, is the secret of prevention; and that this is the case has been illustrated over and over again.

In this hasty review of the etiology of plague the general question of its origin and diffusion and the essential factors favouring its precipitation and propagation have been discussed, and a review of the history of plague shows that it invariably becomes less frequent and less destructive in proportion as countries pass from the miseries and degradation of barbarism to the social comforts of civilised life. It remains to refute certain theories and crude statements passed on by one copyist to another regarding this disease, especially those relating to heat and moisture. One writer states heat and moisture are essential to cause an epidemic, and should the season become dry and cool the disease is at once stayed.

This statement has misled many, and is belied, for instance, by the Great Plague of London in 1665, where, according to Sydenham's account quoted by Milroy, towards midsummer cases of pestilential fever were accompanied by buboes and carbuncles on the surface; and the pestilence was then only recognised and designated plague.

It went on increasing in deadliness until the third week in September, when nearly 8,000 died in the course of a week, although two-thirds of the inhabitants had by this time fled from the city.

Plague had developed epidemic force in Russia at Vethauka in 1878–79 (first case October 15th, 1878), and was raging *at the coldest period of the year;* and in India is endemic on dry sites in Gharwal and Kunaon; and in 1898 has been epidemic in the comparatively dry regions of Jullunder district in the Punjaub and at Karachi, Karad in Satara district at the driest season of the year, not to cite Sukkur, Hyderabad (Sind), Bangalore, Hubli, and numerous other dry inland climates. An obvious fallacy underlies the statement that it only breaks out in seaport towns, or on the banks of rivers where a moist atmosphere exists, as very naturally seaports are the first places to which contagion is likely to be conveyed, and there dense masses of population of the submerged-tenth order are aggregated; and it is historically true that cities in the East, at any rate, are built on the banks of rivers. The fact is, wherever the general influences which induce plague exist in the shape of badly-constructed, ill-ventilated, and crowded tenements, filthy habits of the population, putrescent animal matter within or adjacent to their habitations, and the unwholesome food and physical and moral wretchedness accompanying existence in such air-befouled residences, there plague breaks out when once the specific germ is introduced by any means.

The immediately predisposing cause may be set down to the above, in conjunction with virulence of the plague germ under its natural conditions of existence outside the human body, and of which we are as yet wholly ignorant.

Its extra-somatic behaviour may be favoured by a certain degree of warmth and moisture of the atmosphere, as its virulence as seen in India seems to increase after the rainy season; but it must be borne in mind, as pointed out forcibly several times, that this is the season when people shut up all doors and windows if they have any, and overcrowd their badly-built, stuffy cabins. Certain it is that rats begin to suffer most and are found dead in greatest numbers, here in Satara, after the south-west monsoon rains, which may favour the evolution of the organism and confer increased virulence on it.

The individual causes of plague are predisposition to the disease, or want of that unknown factor termed increased individual resistance or natural immunity; most of all, habits that engender the disease, and prolonged residence in the same atmosphere as the sick became attacked in—residence in sanitary plague hospitals does not cause an attack; intense and prolonged anxiety and fear of the disease seem to favour an attack; yet children and others who have no mental anxiety or dread of the disease are readily and in fact first attacked.

CHAPTER II

HISTORICAL RETROSPECT

The history of plague extends back into the remote past, and is one long era of misery, terrorism, and misdirected effort, until the advancing ideas of improved sanitation crossed its path and marked the epoch of its decline. Prior to the dawn of the eighteenth century it was endemic throughout all Europe, including Britain, Ireland, and the Mediterranean Isles, and extended its annual ravages eastward to the shores of the Pacific, bursting out every few years in epidemic violence, and devastating vast tracts of country.

Here it is not intended to catalogue historical records of plague epidemics in all countries, as those can be found in the voluminous literature of plague as given under "Bibliography," especially in Hirsch's handbook; but simply to refer to some incidents in confirmation of the theory of plague causation and incidence elaborated in this treatise. In some countries, with a marked difference between the hot and so-called cold season, plague exhibits seasonal variations, as in its real home, before the eighteenth century, in the cities of the Nile, where it was truly perennial, universal in its ravages wherever dense masses were gathered together, lighting up its deadly flame in the second or third week in February, reaching its acme in April, dying down in July, and smouldering through the dry, hot season, only again to arouse in its fury. At Cairo it never continued, it has been said, beyond St. John's Day, that is, June 24th; at Hermopilis and Alexandria it continued two weeks or so later. So in Bombay, owing to the great difference of temperature and the hot, muggy heat of its insular climate operating on the sleeping-out habits of the natives in this hot, rainless season, plague exhibits a seasonal decline in May and June and the early part of July; but once the cold increases, from October up till the end of March, the people sleep indoors, overcrowd their dark, ill-ventilated, insanitary houses, and plague attacks then show a great development of the disease.

A strange and, at first sight, contradictory fact is the case with reference to Karachi, with an insular climate; but there the so-called hot and cold seasons are not so variable as to have any appreciable influence on the habits of the people, who mostly sleep inside their houses all the year round, and hence their liability to be affected and plague to break out as an epidemic in the hot season as happened in 1898, in the hot months of June, July, and August.* Plague has never been able to attain epidemic proportions on shipboard. Persons sick with it have indeed carried it on board and died on vessels, but those patients had in all cases been exposed to the pestilence on shore. During the virulent epidemic in Egypt which prevailed throughout the last years of the eighteenth and the beginning of the nineteenth century, the English and French fleets were exempt from attack, while the land forces were ravaged. During the memorable Great Plague in London more than ten thousand persons fled from the city and took refuge in ships and barges moored in the Thames, where they lived securely for many weeks; and although the epidemic raged violently in the city, there were no cases in the fleet or on the river.

In attempting to trace the history of plague, it is

* The same explanation holds good for the epidemic prevalence of plague at Poona in the hot season of 1898, for there the very same conditions of climate obtain as at Karachi in regard to their effects on the sleeping habits of the people; and the same applies everywhere, and proves that the continued occupation of the poisoned dens determines infection under the insanitary conditions existing within such habitations.

impossible to carry research beyond the sixth century A.D. without becoming involved in uncertainty, as there is good reason for the belief that the term λοιμός and *pestis* were previously employed in the generic sense, to denote any epidemic disorder which occasioned a large number of deaths, just as Mahamurrie has been used in India. That plague, as we now understand it, existed in the prehistoric period there is probably little reason to doubt, though there is accessible no absolute proof; while on the other hand various disorders were recorded as pest which we would now otherwise classify. Coming to the year A.D. 542, the records of Procopius and Evagorus so fully coincide with our present knowledge of the disease as to leave no doubt that the pestilence which decimated Constantinople in that year was the same which we now call plague. For the past fourteen hundred years, then, this appellation has been restricted, as a rule, to that form of epidemic fever which is accompanied by buboes, carbuncles sometimes, and petechiæ occasionally. During the ten centuries from the sixth to the sixteenth, plague was endemic throughout Europe, and vast epidemics sprang up in various localities and died out without reference to the prevalence of the disease elsewhere by natural limitations. Especially was this true along the banks of the Danube and Rhine, and wherever there were crowded tenements.

In the sixteenth century there were 14 such epidemics in France, 12 in Germany, 11 in Italy, 9 in Dalmatia, 6 in Turkey, 5 in England, 5 in Spain, 2 in Portugal, 2 in Belgium, and 1 in Switzerland. In the seventeenth century there were 19 epidemics in Germany, 11 in France, 11 in Italy, 6 in England, 5 in Russia, 4 in Turkey, 3 in Spain, 2 in Switzerland, 2 in Holland, 2 in Denmark, 1 in Sweden, and 1 in Poland. In some countries there would be lapses of years between the epidemics in which no cases occurred, while other cities and towns were never free from it.

Thus, in London, during the first seventy years of the century (1600–1670) not a year passed without some plague deaths; and vast epidemics broke out in 1603, 1625, 1636, and 1665. The following table shows the number of deaths from the affection in London during the first half of the seventeenth century:—

MORTALITY FROM PLAGUE, LONDON, 1601–50.

Year.	Deaths.	Year.	Deaths.
1601	341	1626	134
1602	176	1627	4
1603	36,269	1628	3
1604	896	1629	9
1605	444	1630	1,317
1606	2,124	1631	274
1607	2,352	1632	8
1608	2,262	1633	10
1609	4 140	1634	1
1610	1,803	1635	5
1611	617	1636	10,400
1612	64	1637	3,082
1613	16	1638	363
1614	22	1639	314
1615	37	1640	1,450
1616	9	1641	1,375
1617	6	1642	1,274
1618	18	1643	996
1619	9	1644	1,412
1620	21	1645	1,871
1621	11	1646	2,635
1622	16	1647	3,507
1623	17	1648	611
1624	11	1649	67
1625	35,417	1650	15

Grand total Plague Deaths in London in 50 years . 117,435.

In 1665 occurred the last extensive epidemic which devastated the city, and which De Foe chronicled and Pepys refers to graphically, and which has ever since been known as the Great Plague, in which 68,596 perished, and when the mortality for the year was 97,306, while the births were only 9,967, as recorded in returns.

Previous to the seventeenth century the great plague years were 1349, 1361, 1369, and 1593; but it should not be forgotten that so terrible was the insanitary condition of the city that even a century later, when plague no longer added its quota to the death-rate, the annual excess of deaths over births was upwards of 10,000, that is, for every 14 persons born 25 died, and it was not until the nineteenth century that the birth-rate for the first time in the entire history of London exceeded the death-rate.

From 1665, probably owing to the changes wrought by the Great Fire (rather the opportunity it gave for radical sanitary reform, for plague disappeared from other places where it had been epidemic, and which had not been purged by fire), plague declined, until in 1679 it disappeared entirely, and for the past two centuries there has been no indigenous plague in London; and with the growth of sanitation, and with the present enlightened ideas as to quarantine, it is not likely to ever again obtain a foothold there. "Plague has been practically ousted from Europe," as Manson states, "by the spread of civilisation, and the improved hygiene that has followed in its train." Although it lingered in the more remote parts of England after 1679, it never mustered force enough to become epidemic. In fact, beginning about the time of the Great Plague of 1665, there was a marked decline in the pestilential fury of the disease and the frequency of its outbursts, probably due to improved hygiene. Nevertheless, many severe, widespread, and destructive epidemics occurred during the eighteenth century: 19 in Egypt, 7 in Turkey, 4 in Dalmatia, 4 in Germany, 3 in Spain, 3 in Russia, 2 in Poland, 2 in Greece, 1 in Italy, 1 in Sweden, and 1 in France.

The date of the principal epidemic in Constantinople was 1778, in which 150,000 persons perished in the months of May, June, and July; and at the close of the century plague reigned epidemic in Lower Egypt and all along the entire north coast of Africa. The Barbary states suffered severely, and the loss in Algiers was enormous. In Morocco and Mogadore the pestilence reached its height in July, 1799, began to decline in August, and ceased altogether in October; and, as has been noticed in recent epidemics, the disease was more malignant before the acme of the epidemic than during the decline. The type of fever seems to become greatly modified — a peculiar and apparently characteristic feature of this distemper. Nevertheless, many persons who had fled from the cities at the beginning of the epidemic and then returned were seized with the disorder in its most virulent form, as abundantly testified in recent times.

Napoleon in Egypt.—The French army, under General Bonaparte, started on its Egyptian expedition from Toulon in May, 1798, and reached Alexandria about the first of July and pushed on to Cairo, where plague broke out in December and attacked the troops. The army originally comprised 30,000 men, and during December, 1798, and up till the following July they lost 1,300 from plague. From July, 1799, till February, 1800, there was an almost complete cessation of the pestilence; and from February until July it was epidemic again, but not nearly so severe as in the previous year. Notwithstanding plague, the total mortality from disease in the French army seems to have been under, rather than above, what it had often been in other campaigns, owing to Napoleon's wonderful sagacity and his appreciation of sanitation and a good commissariat far beyond the popular opinion of his day. The entire mortality from May, 1798, till August, 1801, was 8,915, and of these 4,157 died from disease, chiefly diarrhœa and plague, the latter accounting for 1,689 deaths. Desguennettes remarks that at first the mere suspicion of a fever being plague prevented due attention being paid to the sick, but that afterwards, when the disease was better known, the hospital attendants waited on them with much greater readiness.

This probably largely accounts for the fact that while the army lost 1,300 from plague, December, 1798–July, 1799, it only lost 400 during the two following years, although the disease was prevalent among the natives throughout N. Africa from Mogadore to the Red Sea. It was noticed here that the infection was *one of place rather than of person*, as by merely crossing from one bank of the Nile to the other (getting patients and attendants out of their infected and infective houses) the epidemic was frequently got rid of, and by carrying the patient from the ground floor to an upper room an immediate improvement in his condition was evident.

Quite a number of the French surgeons declared, as the result of their three years' experience, that there was scarcely any danger from going into a sick ward *provided there was a current of air through it.*

Abercrombie in Egypt.—A British force, 17,000 strong, under Sir Ralph Abercrombie, reached Aboukir Bay on March 1st, 1801, and immediately on landing gained a victory, and passed on through villages infected with plague to Cairo, where plague broke out in the English army, in the second week in April, with appalling malignancy.

The sanitary accommodations of the army were exceedingly defective, and the medical corps seems to have been without ability to appreciate the nature of the pestilence or to grapple with the problem of its eradication.

The wretched victims of plague were crowded into the old and filthy huts which had been vacated by the French soldiery, and over these a guard was mounted to prevent the pestilence from stalking forth! The attempt to thus confine the distemper by repression and police regulations was followed by the natural and inevitable result. The air in the huts became so impregnated with the miasm and fouled *that nearly all the medical men in attendance, as well as the hospital stewards and nurses, were seized with the pestilence and died.* But very few of the patients confined in the huts recovered. When the dreadful condition of these filthy quarters made it necessary to leave the sick in the open camp, it was found that the proportional death-rate manifestly and rapidly declined.

During the nineteenth century there were 8 epidemics in Egypt, 6 in Turkey, 3 in Greece, 3 in Russia, 2 in

Italy, 2 in Syria, 1 in Germany, 1 in Dalmatia, and 1 in Morocco. In 1803 there was a widespread epidemic in Turkey, especially fatal at Constantinople, where it again broke out in 1812, and 3,000 died in one day and 100,000 in the course of five months. In this year Greece, the whole of Turkey, and the Danubian Principalities were ravaged, as well as Tunis and all N. Africa. In 1813 epidemics occurred in Malta and Africa, and in 1814 Egypt, Dalmatia, and the shore of the Adriatic were ravaged. In 1815 began the great Pali Plague of India, which continued until 1820. The pestilence began in Cutch in the summer after a season of great scarcity and distress, and during this and the following five years it prevailed in different parts of Guzerat in Sind, at Ahmedabad, and elsewhere.

Early References to the Plague in Guzerat and the Deccan.—Of late the wildest statements have gained currency regarding plague, and some would have us believe that now for the first time has this scourge fallen on the land. The slightest acquaintance, however, with the older Mahomedan histories of India and the writings of the early European travellers in this country suffices to remove so erroneous a conception. From these works I have been able to glean references to the plague as being prevalent in India in about each of the following years: 1345, 1399, 1438, 1574, 1595, 1611–18, 1683–93, 1704–7, 1770, 1812–21, and 1836–8. Of three of these outbreaks, those of 1611–18, 1683–93, and 1812–21, considerable details are available, but whether the mortality from plague during these periods was really greater than in other years during which the disease was epidemic, it is impossible now to say. Writing of the earliest of these three outbreaks in his autobiographical memoirs, entitled the *Wagicat-i-Jahangiri*, the Emperor Jahangir says:—

"In the tenth year of my reign (*i.e.* in 1614–15 A.D.) a dreadful plague broke out in many parts of Hindustan. It first appeared in the districts of the Punjab, and gradually came to Lahore. It destroyed the lives of many Mahomedans and Hindus. It spread through Sirhind and the Doab to Delhi and its dependent districts, and reduced them and the villages to a miserable condition. Now it has wholly subsided. I asked the physicians and learned men what was the cause of it, as for two years in succession the country had suffered from famine, and there had been a deficiency of rain. Some said that it was to be attributed to the impurity of the air arising from drought and scarcity; but some ascribed it to other causes. God knows, and we must patiently submit to His will."—Elliot, *History of India as told by its own Historians*, edited by Dowson, vi. 346.

These pious physicians certainly came nearer the mark in accounting for the outbreak of plague than did the Nawab Muctamad Khan, one of the paymasters in Jahangir's army, and author of the *Ikbal-Nama*. He records how in the thirteenth year of the reign (*i.e.* 1617–18 A.D.) an hour and a quarter before the dawn of the day there appeared in the atmosphere a vaporous matter in the shape of a column, which was seen half an hour earlier every succeeding night. When it appeared in its full form it resembled the shape of a javelin. It was thin at both ends, and thick and crooked in the middle like a sickle. Sixteen nights after its appearance a star was seen in the same direction, the head of which was luminous, but its tail, which was two or three yards long, emitted no light.

"It was in consequence of *its* appearance," so Muctamad held, "that a pestilential disorder spread through this extensive country of Hindustan, which exceeded everything known and recorded in former ages. This pestilence," he frankly adds, though the fact tells against his little theory, "arose in the country one year *before* the appearance of the phenomenon, and continued to rage for eight years."—*Ibid.*, Elliot-Dowson, vi. 407.

In this same *Ikbal-Nama* he thus describes the terrible virulence of the plague:—

"When it was about to break out a mouse would rush out of its hole as if mad, and, striking itself against the door and walls of the house, would expire. If immediately after this signal the occupants left the house, and went away to the jungle, their lives were saved; if otherwise, the inhabitants of the whole village would be swept away by the hand of death. If any person touched the dead, or even the clothes of a dead man, he also could not survive the fatal contact. The effect of the epidemic was comparatively more severe upon the Hindus. In Lahore its ravages were so great that in one house ten or even twenty persons would die, and their surviving neighbours, annoyed by the stench, would be compelled to desert their habitations. Houses full of the disease were left locked, and no person dared go near them through fear of his life. It was also very severe in Cashmere, where its effect was so great that (as an instance) a *darwish*, who had performed the last sad offices of washing the corpse of a friend, the very next day shared the same fate. A cow, which had fed upon the grass on which the body of the man was washed, also died. The dogs, also, which ate the flesh of the cow, fell dead upon the spot. In Hindustan no place was free from this visitation, which continued to devastate the country for a space of eight years."—Elliot-Dowson, vi. 406.

In 1618 A.D. the Emperor Jahangir congratulated himself on having escaped the plague that had been raging at Agra by prolonging his stay in Ahmedabad. In the *Wagicat* he writes:—

"The Almighty always, and in all places, has extended His assistance and protection to this His humble creature, and this is shown from the fact that at this very time it was reported to me that a pestilential disease had broken out in Agra, and numbers of men had perished. For this reason I was fully confirmed in my resolution of postponing my march towards Agra, which occurred to my mind by the divine inspiration."—Elliot-Dowson, vi. 357.

One cannot help thinking that the "inspiration" would have been more justly called "divine" had it led the Emperor not away from, but into, his plague-stricken capital. Sufficiently striking is the contrast between the views entertained as to the duties of a ruler in the India then and the India now. In 1618 the plague assails Agra, Jahangir of set purpose stays away, and speaks of this his inaction as prompted by a "divine inspiration."

In 1896–7 the plague assails Bombay and Poona. Lord Sandhurst hastens to those cities, meets the local authorities, concerts with them preventive and remedial measures, and says just nothing at all about the good work he has done.

But if Jahangir thought to escape the plague by remaining on in Ahmedabad, he was mistaken; for not long after the Emperor's arrival the plague came too. Jahangir, now thoroughly alarmed and disgusted, sought relief for his feelings by heaping bad names on the city in its day of sore affliction, calling it with other opprobrious appellations, Bimaristan, the abode of sickness, and next the untranslatable Jahannamabad.

It so happened that for several months of this very year, 1618, the English Ambassador, Sir Thomas Roe, was resident in the city of Ahmedabad, and his worthy chaplain, Edward Terry, has left us a vivid description of the terrible ravages of the plague. In his *Voyage to East India*, he writes :—

"Sometimes they are visited with an inflammation, or an extreme burning, such as is spoken of in Deuteronomy xxviii. 22, or rather with a most grievous pestilence, which on a sudden sweeps away many thousands when it comes into great populous cities. This pestilence makes the bodies of men which are visited with it like a house, which on a sudden is covered all over with fire at once. The city Amadavar (at our being there with the King) was visited with this pestilence in the month of May, 1618, and our family was not exempted from that most uncomfortable visitation ; for within the space of nine days seven persons that were English of our family were taken away by it, and none of those which died lay sick above twenty hours, and the major part well and sick and dead in twelve hours. As our surgeon (who was then all the physician we had), and he led the way, falling sick at midday, and the following midnight dead. And there were three more that followed him one immediately after the other, who made as much haste to the grave as he had done ; and the rest went after them within that space of time I named before. And, as I before observed, all those that died in our family of the pestilence had their bodies set all on fire by it, so soon as they were first visited ; and when they were dying and dead broad spots of a black colour appeared on their breast, and their flesh was made so extreme hot by their most high distemper that we who survived could scarce endure to keep our hands upon it.

"It was a most sad time, a fiery trial indeed. But such is the goodness of Almighty God, that He makes the miseries of men here *aut tolerabiles aut breves*, either sufferable or short, so that if the thing imposed be extreme heavy to be borne, it continues not long, as this most grievous visitation, most violent for the time, like a mighty storm, and then blown away. For here the mercy of God suddenly stept in betwixt the living and the dead, so that not only in our family, but also in that great city the plague was stayed.

"All our family (my Lord Ambassador only excepted) were visited with this sickness; and we all, who through God's help and goodness outlived it, had many great blisters filled with a thick yellow watery substance that arose upon many parts of our bodies, which when they broke did even burn and corrode our skins as it ran down upon them.

"Death made many breaches into my Lord Ambassador's family; for of four-and-twenty waiters besides his secretary and myself, there was not above the fourth man returned home; and he himself, by violent fluxes, was twice brought even to the very brink of the grave."—Terry, *Voyage to East India*, pp. 226–8.

It is remarkable that, while the plague of 1618 was thus so fatal among the English in Ahmedabad, those in Surat had complete immunity from it during the severe epidemic of 1683–89. This fact is specially mentioned by Mr. Ovington, a chaplain, who came out to India in the vessel that brought tidings of the accession of William of Orange and Queen Mary. He writes:—

"Six years are now elapsed since a violent pestilence broke out among the Indians at Surat, and has raged without interruption from the time of its first rise, though not always with equal fury; for as it had some sort of interval in the times of the Mussouns, which cooled the air, so its greatest paroxysms were always immediately before and after that season of the year. Above an hundred gentiles in one of these seasons were carried out of the gates of this city one morning to be burnt, besides the Moors which were carried off by the plague, and those of both castes which died in the suburbs, which by a very modest calculation will amount to the number of three hundred a day. Before the eruption of this pestilence, there happened a small earthquake which alarmed the people, but without the ruin of houses or mortal effect to any inhabitant. But that which creates the greatest admiration in the Moors, and not a little joy in the English, is our escaping all this while the direful influence of this mortal disease, so that not one Englishman was ever yet affected by it. This makes the heathens to cry out that God is among us, whilst they observe whole families of their own swept away, without the least infection touching any of our nation. They observe those menial servants that attend us, both constantly in our chambers and in all public places, falling dead within a few hours after they have left our presence; and both the wives and children of those persons that wait upon us languishing at home of this pestilential sickness, whilst we all escape its horrid mortal blasts. And though I cannot in this case but ascribe something to second causes, to the generous wines and costly dishes, to the strength of that ailment whereon we feed, yet when I consider how languid and feeble several of the English are at some times of the year, and, notwithstanding their food, much less vigorous and athletic in their bodies than the Indians, and therefore less able to repel a contagious disease, I think there is some reason for this pious opinion of the Indians, and that the Almighty displays an extraordinary power in our preservation."—Ovington, *Voyage to Surat*, pp. 347-9.

Ovington further adds the astounding statement that

"From Balsera (Bussorah) we received advice in the year 1691 that two hundred thousand people in eighteen days were taken away by a sweeping pestilence; but it soon abated its rage, and the violence of it shortened its continuance."—*Ibid.*, p. 349.

Captain Alexander Hamilton in his *New Account of the East Indies*, published in 1727, reduces the above number to eighty thousand—a figure itself sufficiently high, —but goes on to say:—

"Those that remained fled from Bussorah, so that for three years following it was a desert inhabited only by wild beasts, who were at last driven out of the town by the circumjacent wild Arabs, who possessed it about twelve months, and were, in their turn, driven out by the Turks, who keep it till this day."—Pinkerton, *Voyages and Travels*, viii. 293.

Khaft Khan's highly esteemed history, the *Muntakhabu-Lubab*, gives us a glimpse of this same plague as it stalked through the Dekhan. It will be observed how closely the symptoms he describes agree with those noticeable during the present outbreak. Writing of the year 1689, he says:—

"The plague and pestilence which had for several years been in the Dekhan as far as the port of Surat and the city of Ahmedabad, now broke out with violence in Bijapur and in the royal camp. It was so virulent that when an individual was attacked with it he gave up all hope, and thought only about his nursing and mourning. The black-pated guest-slayer of the sky sought to pick out the seed of the human race from the field of the world, and the cold blast of destruction tried to cut down the tree of life in every living being, and to remove every shoot and sign of life from the surface of the world. The visible marks of the plague were swellings as big as a grape or banana under the arms, behind the ears, and in the groin, and a redness was perceptible round the pupils of the eyes. It was the business of heirs to provide for the interment of the dead, but thousands of obscure and friendless persons of no property died in the towns and markets, and very few of them had the means of burial. It began in the twenty-seventh year of the reign, and lasted for seven or eight years."—Elliot-Dowson, vii. 337.

If this statement be correct, the term of the plague was from 1683–90 A.D., but I find that the *Burhanu-l Futuh*, composed by Muhammad Ali in 1735–6 A.D., and especially valuable for its close attention to dates, definitely states:—

"In 1099 A.H. (*i.e.* 1687-8 A.D.) a pestilential disorder broke out in Burhanpur and the Dekhan, which continued till 1104 A.H. (*i.e.* 1692-3 A.D.), and destroyed half the people."—*Ibid.*, viii. 36.

Probably we shall be right in concluding that the plague broke out in Surat about the year 1683, raged there with more or less virulence till 1689 or 1690, and for still three years longer wrought its work of devastation in the Dekhan. Thus for full ten years, or perhaps even more, it would seem to have flitted from one part to another of the Bombay Presidency. Indeed, so late as 1695 the Neapolitan doctor, Gemelli Careri, while at Bassein makes mention of

"The contagious and pestilential disease, called Carazzo, that used to infect all the cities of the northern coast. It is exactly like a bubo, and so violent that it not only takes away all means of preparing for a good end, but in a few hours depopulates whole cities, as witness Suratte, Daman, Bazaim, Tana, and other places which often suffer under this calamity." —Churchill, *Voyages and Travels*, iv. 191, 192.

In the year 1707 Burhanpur was again the scene of the plague. The *Tarikh-i-Bahardur Shah*, written in 1747 A.D., records that when that monarch was marching against Kem Bakhsh

"A severe pestilence broke out amongst the royal troops. Those attacked suffered from such unnatural heat that they generally died in the course of a week, and those who lived longer than a week, after undergoing great pain and torment, recovered. The army continued its march towards Haidarabad. Twenty rupees was the hire paid to the porters for carrying a sick man for a march of three *kos*. Pioneers were sent on ahead of the camp to dig graves, and when the army reached its new camping ground the tents were filled on one side, and graves upon the other."—Elliot-Dowson, vii. 566.

The plague of 1812–21, known as the great Jhalawar sickness, was, in the earlier part of its course, most fatal in Ahmedabad. It then passed over to Cutch, where half the ryots in the country are reported to have fallen victims to the epidemic; and finally, after lurking some months in Dhandhuka and the villages bordering the Ran, in April, 1819, it burst out with fresh fury at Bhariad, about five miles west of Dhollera; and both Limbdi and Radhanpore had suffered severely before the cessation of the disease in 1821. Of its ravages in Ahmedabad, Captain, afterwards Major-General Sir James, Carnac, gave in 1815 an interesting account in a letter, addressed to William Erskine, as Secretary to the Literary Society of Bombay. In that communication Carnac attributes the outbreak of the plague chiefly to the fact that the bodies of many of the Marwaries dying during the famine of the preceding year had been left unburied on the spot where life expired.

"The mortality at Ahmedabad," he writes, "is computed at a hundred thousand souls, a number equal to one half of the population. The demand for wood to burn the Hindus called for the destruction of the houses; even this was barely sufficient for the performance of the rites required by the Hindu faith, and the half-consumed bodies on the banks of the Sabarmati evince at this hour to what straits the Hindus were reduced in fulfilling the last duties to their kindred. A description of the fury with which the contagion raged in that unhappy city would scarcely be credible—disease pervaded every habitation, entire families fell victims to its unsparing hand, and in many instances the dead body of one person had no sooner been disposed of than the party returned to repeat that same office to another. It is worthy of remark that latterly the females were engaged in moving the dead and committing them to the pile. The urgency must have been extreme to have induced this departure from usage in rites held in sacred estimation."—*Transactions of the Literary Society of Bombay*, Reprint of 1877, i. 326, 327.

The writer states later on that the mortality in the city was ten times as great as that of former years, and, after mentioning that in an evening's ride in the suburbs of Baroda he had seen not fewer than fifty bodies scattered around, which the servants of Government had not had time to inter, he estimates that not more than one in a hundred of the poor Marwari immigrants ever returned to their native country [*Ibid.*, i. 327, 328].

The Great Plague of Naples took place in 1817 after failure of the harvest in all parts of Europe the previous year. In 1819 Constantinople again suffered, and in 1824 it carried off 30,000 of the population of Cairo.

In 1828 Moldavia, Wallachia, and Bulgaria had epidemic visitations, and Constantinople was again devastated.

In 1832, in Bagdad, Mecca, and all along the Arabian Gulf it was regnant, and in both 1834 and 1835 it was general in the East; during the spring months the deaths in Cairo alone occasionally amounted to 1,000 a day.

In 1836 it broke out with terrific violence in Constantinople; and at the height of the epidemic 1,500 died daily. In 1837, in Salonica, out of a population of 20,000 Jews, more than 4,000 fell victims to plague, the filth and unhealthiness of the Jewish quarter being beyond belief. In 1837 it was epidemic at Alexandria and at various points up the Nile. In 1839 it ravaged Bulgaria, 90,000 deaths occurring in a few weeks. In 1841 it devastated Syria and Palestine; in 1858 it broke out fiercely among the Bedouins.

In 1873, 1875, and 1877 it was epidemic in Persia and along the Caspian Sea, destroying in these several years more than 50,000 persons. In 1877 it appeared in Russia on the banks of the Volga, and in 1878 was widespread in Astrakhan.

In 1879, the plague continuing to spread, the Russian Government ordered a number of infected villages to be destroyed, and their inhabitants were carried elsewhere and provided for at the public expense. These villages are described as having been in a most filthy state, and incapable of reclamation by any means; the only thing to do was to burn them up, and this was done, and the epidemic ceased; and Europe, with this exception, has long enjoyed exemption from the worst of all known epidemic diseases.

Plague has been endemic in the province of Yunnan for many years in South-West China. Roche and others saw it there in 1878 and succeeding years, and from 1871 till 1873 it was very active; and thence spread to Pakhoi, on the Gulf of Tonquin, in epidemic force in 1883, in that and other towns. In 1894 it extended to Canton (Rennie), where 60,000 people, it is estimated, perished. In the spring of 1894 it broke out in Hong Kong, spread to Swatow, Amoy, and many other cities in South China, and in 1896 it appeared at Bombay and, possibly, in Calcutta, and has continued in a more or less endemic and epidemic manner in both Hong Kong and Bombay and other parts of India up till date.

Plague has never crossed the Atlantic to America, or appeared in the southern hemisphere.

The reason why plague was not conveyed to America, Australia, New Zealand, or the islands of the southern seas, is that since those places have been discovered no place within rapid steam communication has been infected; and now they are partially protected by their long distances from other countries that might be the home of plague.

The only way plague could be imported to those countries would be in clothing shut up in trunks, etc., unexposed to the sun and air. By this manner two cases of plague were introduced into the port of London (September, 1896), but were detected and sent to the Seamen's Hospital, isolated, etc., and the disease did not spread. The infected clothing was, of course, destroyed by fire.

Plague has been reported at a village in the Samarkhand district of Russia, and 125 only to remain alive out of 569 inhabitants; and of the 125 survivors 80 are said to be children (October, 1898).

Plague has broken out at Tamatave, in Madagascar, and caused 109 deaths, including one European (December, 1898).

According to Dr. J. F. Payne the following places are the endemic centres of plague in this era:—

"*Endemic plague.*—The localities where plague is now known to occur, or to have occurred within the last twenty years, are as follows:—

"1. In the district of Benghazi (the ancient Cyrenaica), in the province of Tripoli, Northern Africa, the most westerly station now known; last definitely recorded in 1874.

"2. The district of Azir or Assyr, in South-Western Arabia, bordering on the Red Sea, as lately as 1889.

"3. A large area in Asia, comprising Persian Kurdistan and adjacent parts of Persia, Turkish Kurdistan, and parts of Irak or Mesopotamia on the banks of the Tigris and Euphrates, including Bagdad. From this area it has extended to Northern Persia on the shores of the Caspian (Resht) in 1877, to Baku on the western, and Astrakhan on the northern shore of that sea; and up the Volga to the village of Vetlanka and its neighbourhood in 1877–9.

"4. The districts of Kumaon and Gurwhal in the north-west of India, on the slopes of the Himalayas, as lately as 1888.

"5. In Southern China, the mountain district of Yunnan and the seaport Pakhoi on the Tonkin Gulf. Apparently by extension from Pakhoi, plague has in the last two years invaded Canton and Hong Kong in Eastern China.

"The five localities above named appear to be independent centres of the disease, since no communication can be traced between them; and plague is not known to exist in any other part of the world."

This treatise is not a work of supererogation, but occupies a place of its own, is projected on a definite independent plan, and is not intended to be either a rival or imitation of its predecessors. It is more comprehensive, illustrates the laws of health and our duty towards them; and its aim is eminently practical and informative in what it recommends to the individual and society against a very easily-prevented disease. It is the result of our own study and experience in plague. It is not intended for specialists whose opinions are already fixed, and to which they are committed beyond the power of conversion probably; but for the general reader and practitioner of the Anglo-Saxon speech. The work has been a laborious and congenial occupation, and published at the suggestion of those whose judgment cannot be doubted, as likely to be valuable and suggestive to Governments, Legislators, and Municipalities.

It is not merely a question of narrow professional import, but of vast practical importance and far-reaching results, a study upon which educated persons desire and may be expected to form just and correct ideas widely different to those now prevalent on the causes and prevention of plague. The conclusions arrived at are perhaps a little at variance with what at first sight may have been anticipated, and in breaking away from the trammels of preconceived opinions we hope to have demonstrated the truth.

An attempt has been made to storm the strongholds of ignorance or prejudiced opposition, by marshalling and demonstrating old or newly-discovered facts. The hypothesis has become a theory—a generalisation of science—making a fresh coign of vantage which cannot be overthrown except by a host of antagonistic facts yet undiscovered. In past times, doubtless, the correct hypothesis was blindly stumbled upon occasionally; was actually in the field, but its supremacy not yet conclusively proved, or rather looked on as a mere forlorn hope, regarded with contempt, if at all heeded. In this work an endeavour has been made to demonstrate truth before every other consideration, to prize it above the desire of ambition or preferment, above standing well with our fellow-men, above the love of influence or power, and without the sacrifice of consistency.

> "High spirits call
> The future from its cradle, and the past
> Out of its grave, and make the present last
> In thoughts, and joys which sleep but cannot die."

Statistics have been only used incidentally, and an endeavour made to strike out a suggestive and reflective line of thought, and details of engineering have been purposely avoided to prevent the compilation of a treatise on ventilation merely. The more elementary principles of sanitation, especially the value of light and pure air, are thrown into bold relief, precisely those principles that are so persistently neglected at enormous risks and penalties when the germs of an epidemic disease are imported, but which have such important factors on the health of the people. The most essential points in etiology, evolution, environment, prevention, and sanitation have been brought to a focus, bearing as they do most strongly on the preservation of the health of the public.

It has been considered advisable to give, in contrast, an account of pest in ancient times from the records of the disease in Florence and London—the former from Boccaccio and the latter from Dr. Guy's lectures on hygiene.

The practice of classifying diseases mainly by the micro-organisms that give rise to them confers on the germs a wholly factitious and overwrought importance, has caused us to pay less regard to the secondary controllable causes, equally, if not more important, and so they have come to usurp almost the entire interest of the medical profession and epidemiologists. Yet, after all, when every factor in causation has had its due quota given to it and been relegated to its proper position, the fact remains that the causal factors are those really amenable to control in stamping out or mitigating epidemic outbreaks, and the germ is merely a sort of after-thought, which enables us to explain otherwise inexplicable and apparently contradictory facts in the incidence and prevalence of infections and in the individual experiences of observers. In nature, whatever is is so under certain conditions, some of which are accidental, while others are essential.

The difference must be carefully ascertained. Having obtained a clue to the causal factors that are removable, the environment of the malignant germ is at once alterable; bearing in mind also the malignant type of the disease, one is put in possession of an enchanter's wand to reveal all the mysteries and apparently contradictory vagaries connected with plague, and has gained the sure divining-rod by which the dreaded infection may be exorcised with complete success. The microbes have been assumed to possess extraordinary potency; they are the sparks that set the gunpowder alight, but it is the latter gives energy to the explosion. Withdraw the microbes, and their consequences immediately cease to be manifested; but can science obey this huge demand? Alter the environment, work out your own salvation, says reason, guided by experience, backed up by historical proofs, and the germs may come into that unsuitable soil, to die themselves, but certainly not to kill anyone.

For the sake of disease-prevention *at present*, one might safely consider certain contributory incidents as entitled to rank as independent phenomena, and suppress the dominating factor which cannot be killed under the conditions one has to deal with in nature, however easily that scalp-hunting operation can be performed by numerous agents in a laboratory test-tube. If the profession could put away the *idola theatri* and *idola fori*, and accept such conclusions, the incubus under which it is weighed down, like a millstone placed round its neck, by bacteriologists would be got rid of and a fresh stride forwards taken in disease prevention. Perhaps now that opposition of seers amongst themselves against the only rational theory of plague causation yet broached has died down to the last expiring flicker, those same critics will turn round and state that we are merely seeking to establish what is already granted, that they knew this all along; that no authority accords to the germ the position of a distinct, unconditioned, material entity, endowed with a distinct and separate form of pathological energy. Mons. Haffkiner, when driven to a corner and asked to appraise the relative value of sanitation, inoculation, and the other so-called preventative panacea, had to acknowledge that our policy was sound and radical; yet does not feel called upon to preach our doctrine. Precisely so; the lesser lights treat the subject in a lukewarm manner, if not with complete indifference. The germ has become the dominant process in disease, and the practical objection remains. The theory overdriven has become a bar to medical progress and true preventive science; a barrier against the entrance of light and knowledge. Convinced that the principles we advocate are sound, we feel constrained at considerable risk of being deemed presumptuous to publish our conclusions. They

D

are in full accord with the most recent advances in the field of pathology, and especially in bacteriology. There must be a reaching forward towards the goal, and a forgetting of those obsolete conceptions handed down to us by preceding modes of thought—those things that are behind. It has been well put: "In striking at the *ignis fatuus* we overlook our real enemy, and are liable to injure our friend." We have tried to meet the demand of the hour for absolute truth in everything relating to the knowledge of plague-causation and prevention based thereon. The civilised world will at length awake to the fact that the dreaded scourge of plague can be resisted and stamped out by proper sanitary precautions alone in a sensible manner, based on the true theory of its causation.

As the immortal Pasteur enunciated, "It is in the power of man to cause all parasitic diseases to disappear from the world," so we undertake to show that it is in his power, each one for oneself, to eradicate plague, barring its malignant, non-preventable type—primary plague pneumonia. Hitherto plague has been fostered, pampered by false methods of scientists self-approved; and contagion encouraged by shutting the patient—sealed—up in the house, religiously excluding all air, with sealed-up windows, curtained partitions, causing impure and overheated air; and, in genuine mockery, "The Lord have mercy on us!" chalked over the doomed house. For certainly man in his ignorance had no mercy in his methods. He provided the very best ideal conditions for the destroying germs to flourish in. Plague bacilli enjoy this treatment, and under these circumstances their destructive work is easy. We had prepared the great feast for them—the general's inspection dinner—and why should they not flourish and come where the very best is provided? The fixed delusions on plague-prevention must be dispelled from the public mind and the field of science. The most dreaded and most easily preventable evil the world has ever known must be combated by general and gradual action, in education of a sound public opinion in sanitation, and direction of each man conserving the best gifts of the Great Architect of the universe—good health, pure air, pure water—universal cleanliness.

It has been a fatal fundamental error to suppose that such a disease could be stamped out by legislative action. It is now perfectly plain that the public must be educated in the causes, means of prevention, and hope of deliverance, before any legislative measures or coercive measure, based on the *ipse dixit* of self-styled experts, can be thought of. In this matter force is no remedy; force founded on fear, false science, and ignorance least of all. When the public mind shall have been sufficiently educated—and many years will be required for this work—they themselves will heartily co-operate with the health authorities in any measures adopted to eradicate plague.

We may formulate in this treatise intelligent rules based on the only true theory of plague causation; but the world will always contain three classes for whom these rules will be of no avail. The great class, and, according to Carlyle, the most numerous, will not understand them—mostly fools, born without brains, and never endowed with intellect, how can they be supposed to benefit by them? The second class, during the advent of plague, is nearly as numerous—the cowards. We know that in cholera those who most dread that disease, in an epidemic, are almost the first to be attacked; so it is in plague. Sanitary rules are no good for such people. Thirdly, however well designed one's rules may be they are perfectly useless to the easy-going intellectual assenter, who says, "Very good," but does not obey them. There are many such amongst our pupils in India and China who willingly admit the truth of our contentions and have a thorough intellectual conviction that the sound theory has been enunciated, but who, nevertheless, either cannot or will not give up their ingrained, life-destroying (in plague times), devitalising (at all times) habits of hatred of fresh air, of covering their heads at night, of overcrowding their sleeping apartments, and of shutting out fresh air by closing their doors and windows, and leaving their bodies, clothes, habitations, and their surroundings in a filthy, air-deozonising condition. What the minimum quota of error under any combination all or each of these factors may be we are unable to state; but this much is absolutely certain, that wherever plague exists a breach of such simple sanitary safeguards has occurred to explain its outbreak, incidence, and prevalence. That such a horrible malady can be due to neglect of elementary hygiene, we have frequently paused to ask ourselves; but the more rigid the tests to which our theory has been submitted the more triumphant has it evolved when judged by the light of increased knowledge and experience and the historical retrospect of reliable plague literature.

Fools cannot understand it; the indolent cannot or will not follow our advice; unfortunately it costs nothing. It is a casting of pearls before swine to offer it to cowards. If it could be bottled and sold for a great price many more would at once avail themselves of it.

The ignorant, the unbeliever, and he of a doubting mind utterly perish.

Natural law in the medical and spiritual world has had many expounders, but it takes a level-headed Westerner to give it practical application. In the recent Galveston disaster it is said that a Kansas man took refuge with his daughter in a church, but, seeing a brewery near by that looked stronger, and perhaps more familiar, decided to remove to it. The daughter had pious faith in the church, and preferred to trust it, but the father pulled her over to the brewery and saved both their lives, for that unhallowed edifice weathered the storm, while the church went to shreds in it.

The story, of course, is a little out of order for Sunday-school anecdotes or illustrations, and many will, no doubt, believe it the fabrication of some unregenerate sinner who ought to have gone down in the tornado. Notwithstanding, it has a robust moral to it and savours directly of that sturdy religion which Cromwell built upon when he charged his invincible Ironsides in the midst of their praying to remember well to keep their powder dry. The Providence that works by ordinary means and human agencies is growing a trifle musty in these days, when all imaginable faiths and cults are trying to get rid of natural laws and influences and to spring the victories of life and spirit directly upon the waiting mortal without regard to any intelligent effort or action of his own. The Micawber-like spirit which prefers to sit placid and wait for something to turn up from the other side to right wrongs, heal diseases, protect defective architecture, and turn tornadoes away from trusting saints, appears to have invaded the religious world and led more daughters than the one in the story to expect heaven to afford the help that her own judgment should furnish her, and ignore known laws of the material world of its own creation to afford her special protection.

That there are higher spiritual laws that have worked at special times in ways the world calls miraculous no one can question, but that they are not the ones that man can safely depend on or know how to command the common lessons of life and experience should teach him. Especially is it conspicuous, save, perhaps, in the founding of the Christian religion, that the spiritual victories and achievements of mankind have been brought about directly by natural means, and this even in that most commonly claimed point of the answer to prayer. In nearly every case the answer came through simplest human agencies. Whatever may be the power of the Almighty to work out His designs independent of human laws, His manifest purpose clearly is to work them out through those laws, so that what Pope calls the "exceptions few" can by no means be counted upon in any other way than to prove the rule. Wherefore, unless man is largely in the secrets of the Eternal, it is more than presumptuous for him to set himself directly in the path of any fixed laws and expect that special interposition will be made to protect him.

It is by no means clear that any later Daniels can brave lions' dens in safety, and some people even doubt if good, plump missionaries can fairly present themselves, in tempting tit-bits, to cannibal congregations and not expect to be eaten up. Certainly it has recently been shown that they cannot recklessly go out crying, "The sword, the sword of the Lord and of Gideon" to people of other gods and not naturally be chopped to pieces. The laws of life and nature will assert themselves even with sweet saints and consecrated temples, and the German deacon who declined to put a lightning-rod on the church on the ground that if the Almighty wanted to "dunder on His own home and burn it down, He could dunder" for all of him, was not a bad exemplar of the intelligent idea that the Almighty should make one law of matter for the temple and another for the brewery.

The amount of it is that the common laws of life and nature are given man for his guidance, and it is assuming a great deal to suppose that he can cross them anywhere with impunity. To study and apply them with utmost care and understanding to all the problems of life is therefore the part of the Christian, as well as the scientist, and everywhere of the rational being. There is nothing more irrational, says a recent writer on irrigation, than the manner in which the agriculturist ignores the ways and means for protecting his crops, and trusts to the chance winds and rains of heaven to supply his deficiencies. In childlike simplicity he puts the precious seed in the ground, and trusts to providence to send the vivifying showers, when perhaps five seasons out of ten providence neglects him altogether. And all the time he has the means in his own hands for watering his fields and determining the abundant harvest. This last reflection strikes at the root of the whole matter. It is man's extremity, we are told, that is God's opportunity. So long as man has one resource left in himself he cannot fairly ask God to do his work for him, however wisely he may ask Him to bless or favour him in those determining ends that are beyond him. The part that is in his own hand, with every law that can bear upon it, must first be regarded before he can honestly cry to the gods for the part in their hands. Wherefore any enterprising spirits of our own day who attempt to play with scorpions or tumble over precipices in the expectation that God will give His angels charge concerning them are liable to reckon blindly and spoil their beauty or dash themselves against many a stone. What, indeed, was the significance of the Saviour's rebuke to the devil, "Thou shalt not tempt the Lord thy God," if He did not mean that, in defying His laws, man was tempting God to destroy him?

Of course it is no way out of the line of those laws that the mental forces should be stronger than the physical, and in many cases—far more than men realise—can turn back the tide of disease, poison or decay, or any ills that flesh is heir to. Moreover, the calm spirit of the seer or hero can conquer time and destiny, and bring beauty and harmony out of the most turbulent elements. There is no event but death, says Maeterlinck, that the sage cannot overcome. But he does not do it by disregarding the laws and elements about him, but, as Emerson so grandly shows, by making those elements serve him. In the opinion of this Concord philosopher, the difference between the wise man and the fool lies largely in the power of the former to make all the forces of the earth, air, and sea wait upon him. To run counter to them, to set his sails against them, is the part of ignorance everywhere. To defy them is, in a certain sense, to defy the power that works through them, and the fact that this Supreme Power chooses to work through them makes it really more pious, as well as more sensible, to seek the protection of a brewery than a church in a tornado, provided the former shows the more promising foundations. That the children of this world are often wiser than the children of light in regarding these fundamental laws and principles of safety there is no denying, and that is why their profane halls can sometimes protect trembling saints who are turned out of their own. Certainly, on the theory that it is the special favour of heaven, independent of known laws, that controls such matters, it would be embarrassing to account for the breweries and boweries of sin or pleasure that survive in many a tornado when the temples of the righteous are swept away. "Through wisdom is a house builded, and by understanding is it established," says Solomon, and that seems to be the end of the matter, whether God or men are concerned in it.

"Every good and every perfect gift cometh down from above." Good health, which presupposes life, pure air, pure water, sleep, food, clothing, house (to protect us from the elements), luxuries—all those latter four as the product of organised labour, not of money which only nowadays purchases the fruit of labour, all in abundance generally—are the free gift of God ultimately. It is for us to conserve them pure and untarnished. The Almighty provides a horse; He does not put the bridle in his mouth and guide him for us; we must do that for ourselves, guided by knowledge and experience. So it is in the field of disease; and when medical seers shall have proved themselves true guides instead of false lights, the mastery of educated, intelligent mankind over disease shall be infinite and astonishing. God does wish us to know His laws and obey them.

"Science professes to exhibit what is actually known, or may be learned by exact observations, precise definition, fixed terminology, classified arrangement, and rational explanation." This is truth; unbiassed, unprejudiced, uninfluenced by like or dislike; the one thing eternal, incorruptible, undefiled.

We have truth in nature as it came from God, if we can only find and obey it. It has to be read with the unbiassed mind, the open eye, faith, trust, and reverence begetting a willing obedience. Our theory stands at the tribunal of professional opinion. To carry it as a working principle to its full, legitimate conclusion may appear impracticable. Difficulties lie on the threshold which may seem, at first sight, insurmountable. All obstacles, however, to a true method only test its stability and validity. Who honestly tackles the task will find the attempt at least in harmony with the foremost scientific thought and truth.

In the first place it tends to corroborate all of true science hitherto discovered in Pest; and in the second to purify medicine. Dogmas have too much rested on a particular exegesis by some star in the world of medical science. Sometimes the evidence was a weighing of a mass of probabilities, or a gauging of the weight of authority; now a court of appeal to reason, fact, experience, and historical confirmation is invoked. We desire a thoughtful consideration of the theory—the applications of it to practice may be successful or not—its fertility and helpful guidance cannot be gainsaid. The application has most decidedly wide scope; and if it has been presented with what appears to be undue enthusiasm, that may be charged to exaggeration produced in the demonstrators' minds by a new idea which is certainly, if slowly, climbing to the zenith of fame, and a real power in the guidance of the world in dealing with pest.

We claim no merit as discoverers of something new, but simply focus our knowledge and experience to demonstrate what has already been accidentally stumbled upon, yet never before fully grasped in its far-reaching significance. Hitherto the profession has been swayed by a system—*idola theatri*—which is opposed to scientific progress, and is entirely contrary to the spirit of an enlightened, philanthropic, professional idea.

The legitimate conclusion of the whole matter is that we must recognise our true interests, abandon all professional *ex cathedrâ* statements, start afresh for ourselves, give up the mammon of demand, and patronise truth, and live up to our convictions. The laws of ethics and of permanent well-being alike urge us to protect our beloved profession by practical concerted action, the effect of which will be to stamp out humbug, abolish pest, and advance the real interests of scientific medicine.

"We may not choose!
. . . . or we, triumphant, late, should see
Some great cause win for which our hearts had bled,—
Some hope come true which all our lives had fed."

We can but set before us the ideal time when

"Only the Master shall praise us,
And only the Master shall blame;
And no one shall work for money,
And no one shall work for fame;
But each for the joy of the working."

An unbiassed deduction from the experience of pest epidemics, from the records of medicine, must convince the most unwilling of us that the benefits of our method of dealing with this disease are real and appreciable.

We understand our subject in all its vast and multifarious bearings; our detractors, if there still be any, do not. Our aim is, and they cannot dispute that, ultimately to eliminate pest as a malady to be dreaded from the cumulative factors of civilised society.

Because of understanding thoroughly one takes a broad view, and can look beyond the individual case to principles which must prove of general beneficence.

Sincerity must come from a cool-headed review of known facts; those who are ranged in opposition are suffering from temporary hallucination; their sincerity is begotten of emotion which overwhelms reason.

The prejudices that formerly existed were founded on idle speculations, and originated with imperfect observation, and have been handed down to vulgar imitators accustomed to take statements on authority without sufficient proof or personal investigation.

The only way to arrive at the truth is to test an hypothesis that is based on probability. If the hypothesis which is adopted suffice to explain all the known facts connected with the subject, no scientific mind can hesitate to accept it.

To form a judgment intuitively is the privilege of few, authority and example lead the rest of the world. They see with the eyes of others. Therefore it is very easy to think as the world thinks now; but to think as all the world will think thirty years hence is not in the power of everyone. How dangerous following authority can be is borne out by the recent exploration of pest by so-called scientists and experts. It is sufficient to indicate what we have proved when their statements are probed to the quick that we could put no confidence in reports of some leading authorities, in their experiments or conclusions. Thank God they are NOT Britishers—they scorn to lie in science even at the spur of patriotism, or to snatch a passing applause for their country's fame. From henceforth may they be found out and be justly discredited. In pest it is true

> "Man is supreme lord and master
> Of his own ruin and disaster;
> Controls his fate."

Perfection is alone attained by him who swerves not from the business of his caste. *Ne sutor ultra crepidam.*

That there is a vast difference in what we have attained and what might be the student of the laws of life and health easily perceives. This depends not so much on want of knowledge as on want of action. Rather there has been too much corybantic activity after false ideals; now for the man who wishes to act according to knowledge, it will no longer be difficult to understand or impracticable to obey the laws of health and prevention of pest. The habits and modes of life are circumstances within the control of the individual, and it is easier to avoid things that are injurious than obtain many that might be desirable; life and health themselves are only opportunity.

The course of investigations and subsequent events have confirmed the general principles, first enunciated in March, 1898, and the particular conclusions reached in the book. It has been our fixed intention to draw as sharp a line of demarcation as possible between facts and the hypothesis by which an attempt is made to colligate them. May the repertory of facts continue to support the hypothesis till it be superseded; but in the present state of our knowledge the conclusions must stand accepted.

Pest is one of Nature's scourges for the punishment of those who disobey her laws, and for instruction in the most elementary rules of sanitary science.

It might be imagined that we have attempted to bolster up our theory by selecting opinions favourable to it, and suppressing those that were adverse; but that is not so, and examples of the insanitary factors essential for pest could have been multiplied indefinitely almost; only the most striking have been referred to in substantiation of pest prevalence and incidence.

The hypothesis has been deduced from the facts; if they do not fit it then it must be abandoned. The facts have not been twisted to suit the hypothesis. The book tries to prove—1st, by historical retrospect of the facts found in the literature of pest; 2nd, by facts under incidence in (*a*) places, and (*b*) communities; 3rd, by the facts under immunity in (*a*) places, and (*b*) communities; and 4th, by personal observation on environment—the truth of the theory of causation espoused. The most important in our opinion under the latter head are the failure of ordinary measures scientifically carried out—even with a zeal that in some instances may have gone beyond judicial and political discretion, such as burning the first few infected houses in Satara, and the use of disinfection, isolation, segregation, cordons, quarantine, to stop an epidemic, whereas the same or no measures defied pest where it was introduced by rats, etc.—as at Satara gaol, where many susceptible individuals, whose friends of the same social position, etc., were dying outside, were domiciled for lengthened periods—because the environment was fatal to the germs of the disease. When we find malefactors confined in the prisons of a city where the pest epidemic is making such havoc everywhere else around—some ascribed their immunity to sobriety, temperance, and cleanliness; but these qualities can be shown to exist in certain classes in the same Indian city who are nevertheless attacked in greatly preponderating ratios — some other more efficacious and more immediate factor must have been in operation — compulsory ventilation. The prisoners escaped, amidst a virulent epidemic around them, because they were in proper sanitary buildings, although possibly more susceptible than their friends outside, owing to a less luxurious dietary. The facts regarding the gaoler's house, a perfect sanitary building, thrice disinfected with perchloride solution, 1 in 996, under the supervision of two zealous European officers, show that abuse of the best means of providing fresh air is the determinant factor in pest causation. The well-ventilated house in Bapty Road that suddenly underwent a change with dreadful consequences proves the same incontestably, and was recorded by an unbiassed witness who had not then heard of our theory. Where our principles have been tested they have come out triumphant.

PLAGUE LESSONS FROM SATARA

"The *Times of India* draws attention to the effective manner in which Major Faulkner, I.M.S., handled the recent outbreak of plague in the city of Satara. Plague was introduced into Satara by a person who came to the city from an outlying village. It quickly obtained a hold in the most insanitary portion of the town, where one of the principal features of the landscape is an odorous nullah. In ordinary times, it is stated, this nullah is a receptacle for indescribable filth. The drought accentuated its offensiveness, and it soon became a centre of infection, which was spread by rats and human beings to other parts of the city. Major Faulkner substituted the less irksome system of medical and volunteer surveillance for the usual stringent measures; he disbanded the minor officials and police guards, and had the camps of detention given up. People coming from an infected area were subjected to ten days' medical surveillance at the civil hospital; those arriving from healthy districts had to undergo surveillance at the hands of volunteers. The principle acted upon was that as no system of surveillance can be worked with complete efficiency, it was best to trust to the common sense of the inhabitants, which should lead them to report cases of plague. Although this implicit confidence would not be successful in many cases, it proved successful in Satara. Cases of plague were removed to the hospital, except where the patient was in a comatose condition, and the persons living in the vicinity of the victim were placed in observation camps or sent outside into the fields. Their houses were unroofed, but at the end of ten days they were permitted to return under medical surveillance. Previous to reoccupation the houses were freely ventilated and the walls whitewashed and scraped; vermin were destroyed, and the floors were dug up to the extent of one foot deep, and the soil turned daily. No disinfectants were used. The epidemic disappeared in three months. The cost proved to be nothing like that in other localities where the results were no better. Major Faulkner claims for his plan cheapness and efficiency. There were only 129 cases and 106 deaths."

One need not stop to show the fallacies in some objections. We ourselves started some to puzzle our critics and expose their own notions to ridicule—for instance why when the causes were greatest, as in the days preceding British rule, the disease was not greatest, for under native rulers it will be conceded there was more overcrowding, covering of heads with blankets (if possible), sealing up of habitations by night, filth and insanitation. The increase of commerce and the facilities for intercommunication render insanitary countries infinitely more liable to pest in the twentieth century than ever before; and the wide extent of its spread from its endemic centres that the opening year of that century has witnessed is consequently not surprising. Strange that pest should be least infectious where it is to be most expected—in a sanitary pest house. This proves the determining factor in an attack incontestably.

Let it be granted that the *causa causans* of pest is the diplo-bacillus demonstrated by Kitasato and Yersin, and it would not be easy to enumerate the errors into which this radical fact has led the medical profession, owing to its being pushed beyond its legitimate place as a factor in pest causation. Until and unless all the factors, primary and secondary, in causation and propagation are duly subordinated to each other and given their relative importance by epidemiologists, our efforts to combat a threatened invasion or accomplished epidemic must be spasmodic, without method, futile.

No one doubts that for the explanation of the advent of the disease the diplo-bacillus is all important and necessary, and connotes our knowledge with that of other infections. The germ exists, has been identified, and submitted to new differential tests by us without one's becoming so enamoured of its behaviour as to ignore secondary and preventable causes. One might formulate the axiom, "no germ, no pest"; but its virulence or potency to attack is circumscribed, conditioned, dependent on environment. The axiom, "no favouring conditions, no pest," is equally true, although the germ may be abundantly present.

Bacteriologists state that, *under laboratory conditions*, certain chemical disinfectants in certain strengths kill the germ; but they are not to be believed when they ask us to blindly jump the wide breach between sterilised test-tubes and the cow-dung floor of an infected dwelling. "Laboratory test-tubes are not human bodies," said a prominent bacteriologist when asked if his experiments could throw any light on the treatment of the disease; neither, one may indubitably reply, are they native huts. Vaunted disinfectants have been wasted without tangible results. Because French bacteriologists found spraying of the walls with $HgCl_2$ solution useful in scarlatina and measles, the medical world argued that by analogy the same would be useful in other infections. No one could refuse to use disinfectants if efficient ones could be discovered for practical use. There are too many loop-holes for mistake in the use of those recommended, and the one badly-infected article may be missed in a house, when our efforts become love's labour lost. All lines of defence are ideally perfect until put into practice, when most of them break down—the ideally unattainable remains unattained—successive failures reduce the populace to despair, and rob them of energy to keep up the struggle with its endemic manifestations. It is not only idle, it is positively mischievous, to delude ourselves with ideals that cannot be realised, because they blind us to actual improvements that might be made with such means as are even now at our disposal. We must prefer a candle and a plain road to a meteor and a marsh. It should be as easy to stop pest in the beginning as to extinguish a fire—the earlier both are attacked the better. Once the conflagration has spread beyond a certain limit it must burn itself out as long as any inflammable materials remain. On reflection one might be led to speculate why the house caught fire at all, and try to build in future with non-inflammable materials, which would for ever afterwards resist conflagration.

This is the reliable proposal with regard to pest prevention based on a tested theory of its causation, and leading to radical sanitary reform, chiefly in the habits of the people and their obtaining fresh air at all times, and removal of the structural defects in their habitations. It may be sneered at as an impracticable proposal, an unattainable ideal, pooh-poohed at, as has been done, as like one crying in the wilderness; but increasing experience everywhere is now proving to full conviction that every other measure is unreliable. It is not to be wondered at that pest continues and has become pandemic when even educated medical men cannot see the reasons for the comparative immunity of Europeans and others. They endeavour to account for it by inventing an "alteration of constitution hypothesis," rather than recognise the obvious factor—the alteration of environment produced by improved sanitation and personal hygiene. It took many years for a comparatively educated English community, aided by a great fire, which gave the opportunity to London to set an example to other infected areas to put their houses in order and get rid of pest. Even now many Europeans deny or are wholly ignorant of the causes of their comparative immunity, and therefore it would require years of preaching the true doctrine of pest prevention to remove the prejudices of the ignorant masses and their ingrained hatred of fresh air. When driven to a corner by the fact that pest does occasionally attack Europeans, instead of acknowledging the almost invariable breach of sanitary law as the precipitating factor in an individual attack (when not malignant in origin), they maintain that such particular individual has not undergone the necessary "change of constitution." Europeans are not exempt from pest when they live under the conditions necessary for its development. When one pointed out the comparative immunity of classes and localities habitually enjoying fresh air conditions, one was met with isolated instances to the contrary to disprove the bearing of the contention in the guarded statement. The qualifying adjective failed to arouse a sensation in consciousness.

The crux of the whole problem is the proper appreciation of secondary controllable causes and the analogy of pneumonic pest with the malignant varieties of other epidemic infections. For such varieties of disease ordinary laws do not hold; in fact, in legal phraseology, there is no legislating for them. We must recognise them, however, and they help us to explain otherwise contradictory vagaries and puzzling anomalies. All measures yet tried have their place, but should not obscure the only real safeguard—perfect sanitation—which so alters the environment that the germ cannot attack. To those who cannot or will not adopt those supreme sanitary safeguards which everywhere and always protect from preventable pest, the resort to inoculation with Haffkine's prophylactic serum is a very important temporary protective measure. Granting that it protects 99 per cent. of those resorting to it, what is the remaining one to do? It is not a radical, effectual, permanent defence—it is throwing water on the inflammable materials, not the constructing of an asbestos house.

Experience has proved that this contagion, when diluted with pure atmospheric air, becomes innocuous to those in close contact with the afflicted, and hence the surest means of preventing its dissemination are cleanliness, prevention of overcrowding, and perfect ventilation. It is only where these *cannot* be procured that the juggling processes of fumigation, etc., need ever be resorted to—disinfectants that smell strongly, inspire public confidence, and lead the people to praise the authorities and give them credit for killing millions of germs suffocated by a smell like a druggist's shop, and that's about all the good they do.

One might almost doubt the infectious nature of pest from never observing a single orderly attending those ill with the disease, or friends of the patients indiscriminately mixed together oftentimes and performing the ablutions, catching vomited matter in their hands, breathing the air, and fondling the patients, contract the disease. Where the disease should be most in evidence according to the contagionists it is least prevalent. Surely this fact points to the true remedy. Under ordinary circumstances of ventilation it is NOT contagious, under the contrary circumstances it abounds, to be certainly dissipated, however, as soon as ventilation and purity are restored. Ventilation and a pure atmosphere are fatal to the existence of pest; even when it happens to be brought into such conditions it cannot subsist, much less propagate itself. We believe that disease to be epidemical only in the abodes of filthy and confined air; the infectious quality, which is only accidental, becomes lost when the patient or his foul clothes have been transferred to a pure air and his dwelling, even with the patient remaining in it, properly ventilated. Without the education of the masses, and an enlistment of their sympathy on the side of truth, for their own salvation and sanitary progress, our best-directed efforts are vain as regards permanent results. The most perfect and sanitary dwellings are soon made insanitary by the ignorant inhabitants, hence evacuation alone often fails. When experts in pest shall have conscientiously answered the following questions, they shall have progressed far towards ridding their minds of medical cant and faddism and to attaining a better appreciation of the relative importance of repressive pest measures and pest theories:

1. Is pest epidemic and non-epidemic?
2. „ preventable and non-preventable?
3. „ malignant and non-malignant?
4. „ inoculable and non-inoculable?
5. „ infectious and non-infectious?
6. „ a filth and a non-filth disease?

A ripe experience will enable one to answer affirmatively all those apparently contradictory questions; the last requires a definition of what filth means before an intelligible rejoinder can be given. In one sense it is certainly *per se* not a filth disease—the most filthy are often particularly immune. Very clean Brahmins are attacked and very filthy sweepers to a great extent comparatively exempt.

That theory of disease causation that harmonises *all* the known facts, and best helps us to understand the apparently contradictory and otherwise inexplicable vagaries of incidence and immunity of any infection under investigation is the one to challenge criticism and gain credence when it answers all objections satisfactorily. The damp theory won't hold water; the diseased grain theory is rotten; the want-of-fresh-air theory remains unshaken by the assaults of time and confirmed by facts which at first sight are most calculated to completely upset it.

We now wish to try still further the above theory by a direct application of its principles to practice, the grand, legitimate criterion of its truth. If we can show that it is consonant with, and elucidates the operation of those remedial measures which either ancient or modern experience has employed, it is no trifling corroboration of its solid foundation—it points to the most successful plan of dealing with pest that modern investigation has devised. *Sublata causa, tollitur effectus.*

The facts are changeless and enduring, and can suffer no mutation from prejudice or ignorance; yet it is science alone that gives value to these facts. Without its illuminating aid they are only an aggregate of curios and chaos; but when combined in a synthetic and comprehensive view, arranged in proper sequence and value, elucidate the truth entombed in world-wide experience and evolve order out of the sibylline mysteries of the past. Hitherto this writing on the wall, though it express the most irrefragable truths in the history of pest, has remained, like undeciphered hieroglyphics, useless and unprofitable to the student, and confusing to the researcher.

To the uneducated masses, who know nothing of the fixed eternal laws of nature, every phenomenon seems to result from some non-human power, invisible though ever present; but among the educated classes in all nations a belief in the supernatural, acting directly on life and constantly interfering with the natural course of human action, is soon dissipated, for the increased knowledge of natural laws solves many mysteries that were once inexplicable; yet much remains unsolved.

So long as such conditions as described by the Rev. A. Mearns exist, Christian England cannot be looked on as having her houses in order or being proof against an invasion of pest.

The Bitter Cry of Outcast London: An enquiry into the condition of the abject poor.—This little pamphlet has created much stir in England. The story of heart-breaking misery it has to tell is sad enough; and one only fears that, amid the variety of counter remedies that are being suggested and discussed, the public sympathy, now so widely roused, will evaporate in talk and magazine articles, instead of being crystallised into action.

The pamphlet begins by pointing out that, in spite of the best efforts of the various benevolent agencies—missions, reformatories, refuges, temperance societies, etc.—we are simply living in a fool's paradise if we suppose that all these agencies combined are doing a thousandth part of what needs to be done. And not only so; but facts compel the conviction that *this terrible flood of sin and misery is gaining upon us.* The writer proceeds to disclaim any selection of special cases, or any tinge of exaggeration in what he has to tell us. He has rather had to tone down everything, and often wholly to omit what most needs to be known, to avoid outraging the ears and eyes of his readers.

After showing how very few among these classes ever attend a place of worship, the writer passes on to the *condition in which they live.* Here is a picture of their "homes":—

"Eight feet square—that is about the average size of very many of these rooms. Walls and ceiling are black with the accretions of filth which has gathered upon them through long years of neglect. It is exuding through cracks in the boards overhead; it is running down the walls; it is everywhere. What goes by the name of a window is half of it stuffed with rags or covered by boards to keep out wind and rain; the rest is so begrimed and obscured that scarcely can light enter or anything be seen outside. Should you have ascended to the attic, where at least some approach to fresh air might be expected to enter from open or broken window, you look out upon the roofs and ledges of lower tenements, and discover that the sickly air which finds its way into the room has to pass over the putrefying carcases of dead cats or birds, or viler abominations still. The buildings are in such miserable repair as to suggest the thought that if the wind could only reach them they would soon be toppling about the heads of their occupants. As to furniture—you may perchance discover a broken chair, the tottering relics of an old bedstead, or the mere fragment of a table; but more commonly you will find rude substitutes for these things in the shape of rough boards resting upon bricks, an old hamper or box turned upside down, or more frequently still, nothing but rubbish and rags."

It will scarcely be credited that every room in these rotten and reeking tenements houses a family, often two. In one cellar were to be found a father, a mother, three children, and four pigs! Here are seven people living in one underground kitchen and a little dead child lying in the same room. There lives a widow and her six children, including one daughter of twenty-nine, another of twenty-one, and a son of twenty-seven. In another apartment nine brothers and sisters, from twenty-nine years of age downwards, live, eat, and sleep together. The tenant of one room is a widow who herself occupies the only bed, and lets the floor to a married couple for 2*s.* 6*d.* per week. The poisonous stenches arising from accumulations of sewage and refuse are often made worse through the occupations of the inhabitants, and evil odours from the skins of rabbits, rats, and dogs in preparation for the furrier mingle with the smell of paste and of drying matchboxes.

And turning aside, like the Samaritan of old, from all this misery at our doors, we subscribe our tens of thousands of pounds sterling to send forth missionaries to the banks of the Congo and the Ganges.—*Sunt lacrimæ rerum, et mentum mortalia tangunt.*

The *Fortnightly Review* for December, 1883, has an able article, "Labourers' and Artisans' Dwellings," by the Right Hon. J. Chamberlain, M.P., on this very subject that deals with it in a fair and practical manner.

CHAPTER III

INCIDENCE

Even in the same city during an epidemic one notes a great difference in the incidence of plague attacks according as the structure of the houses and their sanitary surroundings are superior, and the intelligence of their inhabitants leads them to adopt those supreme sanitary safeguards which protect from epidemic at all times and in all places. Thus it is sometimes stated that an exemption from plague has always been the result of a residence on a dry soil or on an elevated site; whereas the real protection has been due to the superior style of edifices and better classes of people inhabiting them on those sites. For in Kirkee and Karachi, where the soil is laterite or sand, also in Sukkur and elsewhere in India, where it is a sandy desert almost, and with small rainfall, and well drained, in a high situation and phenomenally dry atmosphere, plague has broken out with extreme epidemic force. One can understand such statements as:

"Thus the village of Alem-Daghe, near Constantinople, never suffers from an attack when the disease rages in the city below, and this in spite of constant intercommunication. The higher parts of Valetta suffered very little in the Malta epidemic of 1813, the ratio of attacked became greater and greater in descending from the higher to the lower levels of the city."—Milroy.

Experience in Bombay and India bears out the truth of the same observation. In January, 1900, we read: "The plague epidemic is increasing steadily to its maximum mortality." The following figures indicate the rate of progress during the present epidemic:—

PLAGUE MORTALITY AS REPORTED.

Week ending November 21st	110
,, ,, 28th	137
,, December 5th	135
,, ,, 12th	170
,, ,, 19th	248
,, ,, 26th	301
,, January 2nd	244
,, ,, 9th	324
Total	1,669

In the corresponding weeks of last year the total plague mortality only reached 838, being one-half the mortality of the present year; but, of course, the record increased in January, February, and March, so it will probably increase this year, unless the attendant epidemics of other diseases which are now prevailing should overcome plague.

The mortality in one week from plague occurred amongst the classes thus:—

Caste Hindus	222
Mohammedans	43
Brahmins	20
Jains	12
Low-caste Hindus	10
Native Christians	6
Bhattias	5
Parsis	3
Lingaijets	1
Eurasians	1
Europeans	1
Total	324

The rate of mortality in races and castes per 1,000 was:

Low-caste Hindus	299·32
Caste Hindus	118·39
Jains	101·01
Bhattias	85·66
Brahmins	82·14
Native Christians	73·50
Eurasians	60·04
Parsis	31·77
Jews	31·06
Europeans	13·81

A community cannot be the nidus of an epidemic if they possess that virtue which the sacred Word declares to be akin to godliness, but the care of the provision of all things clean must extend to the most important of all vital necessaries—fresh air, for insanitary cities suffer repeatedly and disastrously in consequence of the ignorance and filthiness of their inhabitants. Another fact bearing out the truth of this contention is worthy of record. In any town attacked by plague the deaths from this distemper will be, in the various classes of its inhabitants, in proportion to their approximation to correct habits of living. The most degraded, inhabiting the most insanitary dwellings, will die at a high ratio, while the more refined suffer but slightly.

The exceptions to this, noticed in India, are among castes who habitually exclude air from their sleeping apartments; and even by day, from caste prejudices, cover their faces with wraps and clothing, such as the Jains and Bhattias, who show an excessive mortality from plague. No fact has been more clearly demonstrated than the peculiar susceptibility of the poor and degraded to fall victims to this disorder. One of its ancient and significant names was the "poor's plague." Yet many dirty people are exempt, and many cleanly classes give relatively a great number of attacks and deaths; so that whilst one cannot maintain that filth has nothing to do with it, "the filth theory" does not explain all the facts under incidence and immunity, and must therefore be rejected as an incomplete hypothesis of this disease's causation.

Dr. Roche gives the following table of the relative mortality among different classes during the great plague of Alexandria in 1835:—

	Deaths.		Inhabitants.	Per Cent.
Nubians and Negroes lost . . .	1,528	out of	1,800	=84
Malays lost	367	,,	600	=61
Arabs (not soldiers) lost . .	10,936	,,	20,000	=55
Greeks lost	257	,,	1,800	=14
Jews and Copts lost . . .	482	,,	4,000	=12
Turks lost	678	,,	6,000	=11
Italians and others of the Latins lost	118	,,	1,600	= 7
French, English, Russians, and Germans lost . . .	52	,,	1,000	= 5

In other words, the death-rate was inversely proportionate to the cleanliness, good living, and general comfort and sanitary condition of the several classes into which the inhabitants of the city were divisible.

While it is evident that the spread as well as the cause of plague is dependent upon the habits of the population in every country where plague has prevailed, certain other local conditions, producing want of fresh air, have been found to favour its development and continuance.

The outbreak of plague has not unfrequently followed upon wars, famines, and other wasting diseases, which produce great hardships and miserable want, and lead to the shutting up of vast populations within beleaguered cities in a confined and, possibly, gradually diminished space. On the other hand, civilisation and the arts of peace, and the physical comforts and improved hygienic knowledge which proceed therefrom, are the principal means which put a period to its progress.

As showing how war indirectly causes plague, the following is an illustrative instance: In 1834, in the month of June, an insurrection broke out in Judea, and the insurgents pillaged and sacked Jerusalem. A number of Roman Catholics took refuge in the Convent of S. Saviour. The accommodation being insufficient, these were crowded together not only in the various rooms, but on the staircases, under the stairs, in passage ways, and in every conceivable place. The foul air and privation caused, at the end of twelve days, cases of plague. After twenty-five days the city was relieved, and the holy fathers, full of alarm, drove this multitude of people, including the sick, out of the building *and shut themselves up in strict quarantine.* Now mark the result. Of all those who left the convent only three persons died—having been removed into fresh air; but of the sixty-three priests, who thought to save themselves by isolation, twenty-two were slain by the epidemic. This well illustrates the proposition, already formulated, that plague is an infection of place rather than of person.

In Hong Kong and Bombay it was suggested that the increased prevalence of the disease about three months after the rainy season was due to the rise of subsoil water causing expulsion of polluted ground air, but the fact is that the heavy rains drove coolies and others into the infected houses to sleep instead of sleeping in the streets as they generally do in the summer. It takes some time for the change in their sleeping habits to tell with full force in the tables of morbidity and mortality—about six weeks. This interval is accounted for by the disease then spreading from person to person in an overcrowded insanitary atmosphere, and from house to house and area to area to infect all parts of a populous city. The maximum mortality in Bombay city, for the same reasons, is about six weeks after the minimum diurnal temperature period is registered. Where no such seasonal alteration of sleeping habits obtain—as at Karachi—any season may be that of the maximum morbidity and mortality, dependent, as always, on "want-of-fresh-air" conditions, however superinduced.

Whilst it is universally true that the crowding together of human beings in interiors not only increases the prevalence, but also the virulence of infections, this is pre-eminently true of pest.

". . . a long, low cellar, without any window opening, and with the air entering only by a square open shaft from the level of the roof three or four stories high. Although it was broad daylight outside a lantern was necessary to see one's way. No one unfamiliar with the horrors of some coolie accommodation in China could credit 'how the poor live' in Hong Kong, or could imagine how the horrors of their everyday life were intensified by the plague."—Lowson.

Benares.—"The inlets for the admission of air and light are undoubtedly insufficient in most of the houses of Benares. As the houses are back to back through ventilation cannot be obtained in them. Wells and tanks which constitute still some of the sources of water-supply are apt to be polluted by leaking cesspools and drains. The street sweepings, household refuse of every description, and the sewage which is extracted from the old sewers, are still utilised in filling up tanks situated amidst habitations of the city, a method of disposal highly dangerous to public health. . . . The underground drains and sewers in the 'pakka mohollas' are merely 'elongated cesspools.' They are defective in construction and gradient, the consequence being that they are frequently obstructed. The sewage and trade effluent which these sewers carry are poured into the river Ganges at the very places where people are accustomed to bathe and drink water. The air of the streets and dwellings is impregnated with foul and noxious gases emanating from the same previous drains and sewers. . . . There are within municipal limits many tanks with stagnant water mixed with sewage."

This is not a pleasing picture of the condition of a city under British rule—Benares, where pest is now, February, 1901, epidemic. (*Sanitary Commissioner's Report.*)

China.—*A Plague Centre.*—"From a report on bubonic plague in Mongolia by Dr. Matignon, communicated to the Academy of Paris. With the assistance of two maps Dr. Matignon conveys to his readers a clear idea of the position of Toung-kia-yug-tze, where plague has prevailed since 1888. The village is in a valley situated in a mountainous district some 5,000 feet high; twenty years ago it was not inhabited, but now it contains about 360 inhabitants, entirely Chinese. The region, except from June to September, is cold. The hygienic condition of the population is as bad as it could well be. The people live in mud huts with thatched roofs, entered by a sort of vestibule, the rooms open into this by a low door, each room is occupied by a family, and is generally about twelve feet square and nine feet or ten feet high. It contains numerous boxes and a large bed, which occupies more than half the room, and under which is placed an arrangement to keep the room warm. The bed may serve for the accommodation of five or six persons, parents, children, and domestics being huddled together. In the winter all windows and openings are hermetically sealed until the advance of spring. Those who are sick occupy the same bed as those that are well, and the conditions are excellent for the development of typhus fever, small-pox, and granular ophthalmia, which are the most common affections. Added to these insanitary conditions of the environment is an extreme filthiness of person and clothes. None wash more than once a year, and the clothes are only changed when from wear and filth they drop off. The water is excellent.

There is no impurity from privies, because there are none ; the Chinese satisfy their needs in the open air. The clothes of those who die of infectious diseases are neither washed nor disinfected, but are worn by some member of the family. Their modes of burial are extremely primitive, and consist in covering the coffin slightly over with earth, which the first shower of rain displaces. In times of epidemics the bodies are thrown into a gorge, where they may or may not be devoured by wolves.

"It is under these conditions plague prevails, the astonishing circumstance is that it does not sweep away the whole of the inhabitants. Perhaps it would if the inhabitants when the disease becomes severe did not get alarmed and flee from the place. But this, after all, seldom occurs. The outbreaks vary in intensity, sometimes they are widespread, at other times only a few persons are attacked. From Dr. Matignon's description of the clinical features they seem to partake of the pneumonia type. Yersin's serum proved of no avail in these cases, and the disease was often fatal to the extent of nearly or actually 100 per cent. Dr. Matignon believes that it was introduced from the endemic centres in the south by workmen."

Calcutta.—*A Plague Spot.*—"The *Indian Daily News*, in a long article on matters insanitary, thus describes the present condition of Calcutta's great trade centre, the Burra Bazaar : It is impossible, we suppose, to find words in the English language which shall convey an adequate idea of the abominations of the Burra Bazaar of to-day. To abolish it (however sore the temptation may be) is out of the question, for it is the great native mart or agency through which the products, both agricultural and manufactured, of a hundred millions of people are exchanged with those of the outer world. And yet, as it stands, it is a disgrace to the town of Calcutta and a positive source of danger to the health of its inhabitants. Accessible only by narrow gullies, it is one mass of squalid, dilapidated buildings, subdivided vertically, horizontally, and in every conceivable direction, into cabins and hovels which literally reek with filth of the most horrible description, and swarm with rats and vermin. It is a fact that two or three years ago twenty-four tons of night-soil were removed from between the walls of two of these buildings ! The pervading atmosphere is stifling and sickening to a degree. Conservancy, sanitation, ventilation, are one and all impossible in any shape or form. And yet these buildings, which any humane European would reject as wholly unfit for the occupation of a horse or a dog, are tenanted by crowds of the most prosperous and enterprising traders in India. Can it be a matter for astonishment that the plague in Calcutta should first have broken out in Burra Bazaar? The wonder is, rather, that such a fermenting hotbed of disease should be permitted to exist in a city of the importance and extent of Calcutta."

"The Chinese Christian converts suffer less than their pagan countrymen, from the superior hygiene which, as we are informed, their faith inculcates; whereas, amongst the Chinese, where the most elementary sanitary laws are never dreamt of and utterly ignored by the inhabitants, where even the well-to-do are often unclean and filthy in their habits, in their clothing, in their surroundings, and where overcrowding prevails to the utter disregard of ventilation and fresh air, it revels in its filthy haunts; it ensconces itself in the malodorous districts and fœtid precincts of a Chinese city, town, or village."—Roche, *La Province Chinoise Yünnan.*

The confined atmosphere in summer operating upon a densely-crowded mass of dwellings where the most contemptuous disregard of sanitary law prevails renders it at that time a nursery of pest.

"In Hong Kong the filth which had accumulated in the dwellings is almost indescribable, and would scarcely be credited by those who do not know how the Chinese live, . . . underground basements were occupied not only by workmen during the day as workshops, but were used as sleeping dens at night; the rooms, small and ill-ventilated enough already, were in the majority of cases further diminished in size and the atmosphere rendered more foul by being subdivided by low board partitions into cubicles, and, not content with this, a horizontal division of the apartments was effected by cock-lofts, or mezzanine floors, and these latter were in some cases even partitioned off into little tiny rooms, and in some rooms a second cockloft would even be found; the streets and lanes were narrow and intricate; the houses, which had originally been built low and of only one or two stories, of late years were in many cases being replaced by higher dwellings, and every available piece of ground in the city was being rapidly built over, so that what was once a sparsely populated district was soon converted into a congested mass of buildings, with but little means of ventilation; where even in some houses an open verandah would offer some chance of fresh air, the Chinese would, unless under constant supervision, quickly economise the space by either enclosing the verandah or putting up bedrooms in it.

"The streets presented a very different aspect from the period when a full tide of life flowed through them: business was seriously affected, the foreign trade of the colony greatly hampered, the outlook was dismal in the extreme, many steamers were afraid of calling at the port, the law courts were nearly deserted, the schools were almost forsaken; in the foreign offices pots of chloride of lime stood at every desk, or disinfectants were freely used about the premises."—Dyer Ball, *Things Chinese*.

The use of such so-called disinfectants was quite as beneficial as nailing pegs into wood, as related in *The Golden Bough* by Frazer, or the smoking, dousing, and bismuth adverted to in *The Day of Wrath* by Maurus Jokai in staying the pestilence.

"Men whose own knowledge was of the most elementary description were to explain what was still a profound mystery to the collective wisdom of the world, for the deaths reached 70 or 80 per diem, and from May 10th till September 3rd, 1894, there were 2,547 deaths (registered) from it."

The case mortality here was:—

Chinese . .	93·4 per cent.
Indians . .	77 ,,
Japanese . .	60 ,,
Eurasians . .	100 ,,
Europeans . .	18·2 ,,

"The suspicion that Bombay owes the introduction of plague within its limits to communication with Hong Kong gives us a certain interest in the sanitary fortunes of that town. Its plague history has a special claim upon our attention. If analogy counts for much there is little in this that encourages the hope of an early disappearance of plague from Bombay. Hong Kong was first visited with the epidemic in 1894—two years before it was detected in Bombay, and in 1899 plague was still prevalent on the island, the sixth visitation lasting from March until September. It never reached the proportions of the earlier outbreaks. In March there were 25 cases, in April 101, in May 421, in June 514. Then, when the maximum mean monthly temperature was reached, the epidemic gradually decreased. There were 263 cases in July, 86 in August, and 57 in September. Here again we have an illustration of the baffling caprice of plague incidence in relation to temperature. In Mesopotamia the plague disappears with the cold weather; in Karachi it has been at its worst in the hot season; in Bombay, as in Hong Kong, the approach of high temperature has been a signal for decline; in Hong Kong, as in Bombay, the plague has shown a tendency to cling persistently to chosen seats of infection. In spite of all measures of disinfection, eleven per cent. of the cases occurred in houses infected in the previous visitation. The rat, we learn from Hong Kong experience, seems determined to puzzle inquiries into the part that he plays in plague. How is it, if the rat is the most potent disseminator of plague, that the West Point, the district of Hong Kong where plague was most severe last year, was never so free of rats as just before the outbreak? Plague notwithstanding, and despite the insanitary condition of the Chinese quarters, Hong Kong is able to show, statistically at all events, a sanitary condition which we may well envy. With a population of over a quarter of a million, there was last year a death-rate of only 23·8 per mille. This included plague mortality; had this been excluded the rate would have been only about 18 per mille. This seems excellent, but in reality Hong Kong is not quite the city of health that the bare death statistics reveal. The fact that the birth-rate was only a little more than 4 per mille shows that the population is less dependent upon that source than average towns for its increase, and that the factor of infant mortality, therefore, has a subordinate place in its vital statistics. Hong Kong, in fact, maintains its population chiefly by immigration instead of by birth, and keeps numbers down by emigrations instead of by deaths. The fact that last year there were 110,000 Chinese immigrants and 60,000 emigrants explains the relative insignificance of births and deaths amongst the vital data of the town. The young and the old are alike largely eliminated from the tables in this way, and once again we are warned that things are not what they seem, and that it is well sometimes not to let even figures speak entirely for themselves."

"In Maudri the relative immunity of vagrants, who do not live in houses and who go barefooted, was noticed. Among thousands of individuals in Bombay employed in the work of disinfection, who went about all day barefooted, there were very few cases."—Montenegro.

"The immediate cause of the plague is, as everyone knows, a bacillus, which lives and thrives where dirt and filth abound, and comes as a punishment to those who forget that cleanliness is next to godliness, and its presence is a severe condemnation of the habits and manners of its hosts. Once landed in Bombay, it found such an ideal state of things, and such a suitable soil for its comfortable growth, that it has stayed with us for the past five or six months.

"The filthy, insanitary houses and chawls in which the poorer natives live, and the utter disregard most poor natives have for sanitary laws, are all-important factors to be remembered, when one considers why plague has taken such a firm hold of the city.

"Filthy, ill-constructed, overcrowded houses, with insanitary surroundings, abound in every Indian city, and what the plague bacillus has found congenial for its welfare in Bombay has existed wherever it has gone, and hence the reason why it is taking such a firm hold of towns in the Mofussil."—Grayfoot.

"The extraordinary freedom, almost immunity, that has so far been enjoyed by the halalkhores who clean the privies and the sweepers who clean the streets and gullies, living in municipal buildings, is due, I believe, to the ventilation of the buildings in which they live. The same classes living in other buildings have suffered as much as the rest of the population.

"When the disease is described as a 'filth' one, the sense in which the word 'filth' is used must be defined. The 'filth' condition in this city that has most influenced the disease has been insufficient ventilation of buildings, and hence the measures that had most direct effect on the progress of the disease have been directed to the inside of buildings—ventilation, cleansing, and disinfection, and the measures of house drainage so admirably carried out by Mr. James.

"The organism does not seem to be able to virulently develop where there are free currents of air, and hence it passes by or little affects well-ventilated buildings.

"I have referred to the extraordinary freedom of the halalkhores and scavengers living in municipal chawls, but a similar immunity has been observed in the case of disreputable women living in many portions of the city.

Dr. Rogers Pasha and Professor Bitter, who examined the municipal chawls or barracks in Kamatipura with me, and the houses of the disreputable classes in the same localities, agreed that better ventilation and less overcrowding were the conditions in which these buildings differed from the houses around them.

"*The measures for the prevention of the disease that we have found most efficient are the removal of all obstructions to the admission of light and air*, and the thorough cleansing and disinfection of the inside of buildings. Of disinfectants, chloride of lime seems to be the most repellent.

"Crowded houses, in which goats and sheep are kept, must be flushed down with fluids such as cresol or permanganate of potash before they can be made wholesome and sweet.

"In considering the measures for the prevention of the spread of the disease it has to be remembered that the organism can be communicated to domestic animals, as may be seen from the researches and experiments of Professor Haffkine. This knowledge is most important in estimating the value and effect of the measures adopted for the segregation of human beings. It has to be determined whether the organism exists in nature outside human beings and animals before any final opinion can be arrived at."—Weir.

The interest with which such a disease must at all times be viewed has much heightened of late years from the circumstance of its having appeared in our own settlements, and been subjected there, as well as in Egypt in 1800, to the observations of our countrymen. The symptoms of this disease, the peculiarities in the laws of the contagion of the plague, the circumstances which appear to favour its diffusion, and the consequent appearance of the disease as an *epidemic*, are the points to which attention will be principally directed.

In women the axillæ, in men the groins, are chiefly affected. Carbuncles appear at the same time but indifferently on all parts of the body. Petechiæ and vibices are much more frequent than carbuncles, which, it appears, do not occur above once in twenty cases. The fatal termination is sometimes preceded by violent hemorrhages from the mouth, nose, or intestines.

The duration of the disease is very various. A few cases are on record where the patient died within a few hours from the invasion. To many it proves fatal during the first paroxysm or period, which includes the time from the evening of the attack to the close of the following night. The third and fifth days are, however, upon the whole those of the greatest danger. The former is the usual period of the appearance of bubo; the latter of the abatement of the febrile symptoms. If the patient survives the seventh day, and the bubo is fully formed, he may be considered as nearly out of danger. The convalescence, indeed, is always very tedious, from the extreme debility which the disease leaves; and the patient's life is not infrequently again put into imminent hazard from the occurrence of gangrene in the extremities.

Some idea of the extent of the mortality which it occasions may be formed from the fact that out of 700 persons attacked by it in the district of Leftimo, in Corfu, in 1815, 70 only were saved and 630 died. It is curious, however, to observe that occasionally this very formidable disease assumes a totally different character. The *mild* form of plague is not peculiar to any families, or classes of persons, or districts, or periods of the epidemic. It is more commonly met with towards its decline, but is observed occasionally even from the very first. Buboes form in this variety of the disease about the usual period, generally with a good deal of inflammation, and go on to suppuration. Carbuncles and petechiæ, however, are never observed to attend it. It is marked by the same set of febrile symptoms as characterise the malignant form of the disease, but they are all milder in degree. It terminates occasionally by a critical discharge, but does not appear to require, or to be at all affected by, any kind of medical treatment. A few cases have been recorded of plague appearing in the form of buboes without any constitutional affection.

A circumstance of some importance, as tending to point out the analogy between the plague and other forms of continued fever, has been noticed by Sir James M'Grigor in his *Medical Sketches of the Expedition from India to Egypt*—I mean the effect of season, ventilation, and peculiarities of soil, in modifying the character of the symptoms. The cases of plague which occurred in the cold months of the year were marked by an inflammatory diathesis. Those which were sent in from crowded hospitals were attended from the very first with low or malignant symptoms. Those which occurred when the army was encamped near the marshes of El-Hammed showed a kind of remittent or intermittent type.

Treatment of Plague.—In the malignant form of plague every variety of treatment has been tried, but with so little effect that it may be considered as a disease nearly beyond the reach of medicine.

Where mercury can be brought to affect the mouth it appears to be of some service, but it is seldom that sufficient time is afforded for this specific effect of the remedy. Ether and laudanum are valuable medicines in allaying the irritability of the stomach. Wine and opium are of no use during the violence of the disease, and bark can seldom be retained. This is much to be regretted, for wherever it can be made to stay on the stomach, even in those severe cases where carbuncles and vibices appear, its good effects are conspicuous. Camphor, bark, and wine are given with much advantage during the period of convalescence. Emetics, purgatives, and the cold affusion have been tried, but it does not appear that they are of any service. Diaphoresis can seldom be produced, owing to the disposition to vomit; but wherever it can be procured, the symptoms seem to be mitigated by it.

Great attention is always paid to the local treatment of the buboes. They seldom disperse, and it is usual therefore to employ means with the view of accelerating their suppuration. For this purpose applying the actual cautery did not answer in the practice of our army surgeons. The irritation occasioned by it was excessive, so as sometimes to hasten the patient's death. Blisters and poultices are certainly preferable, but upon the whole it is quite obvious that as little can be done in the way of surgical treatment in the plague as by internal medicines.

Causes of Plague.—The general resemblance which plague bears to those malignant forms of typhus fever which are occasionally witnessed in cold countries must be abundantly obvious. The great distinction between them lies in the occurrence of buboes; in other words, in the tendency which plague has to affect the lymphatic system. This line of distinction, however, is so broad that plague is to be viewed as a continued fever, allied indeed to typhus, but differing from it in the important circumstance of having its origin in *specific* contagion. That the plague is a highly contagious disease cannot for a moment be made a matter of dispute; but some physicians have maintained that it is not a fever *sui generis,* generated by a specific contagion, but only an aggravated form of typhus; in support of which opinion it has been argued that cases of typhus complicated with buboes have sometimes been observed in this country.* This idea, however, is entertained only by a few, and the doctrine of a specific contagion in plague is that which is now generally received. Its laws have been investigated with some accuracy, and the following seem to be the most important of those which have hitherto been ascertained:—

Laws of Pestilential Contagion.—1. The *latent period* of the contagion of plague, or that between communication with an affected individual and the appearance of symptoms, is extremely short, and liable to very little variation. It is scarcely ever less than three days, and it seldom exceeds six. Instances indeed are recorded of the disease not appearing until the tenth day, but these cases are rare.

2. The contagion spreads to a very small distance only

* See Minutes of Evidence taken before the House of Commons on the Question of Plague, 1819.

from the body of the patient. The consequence of which is that the disease is seldom, if ever, communicated except by actual *contact*.

3. The dead body does not communicate the disease so readily as the living. This appears to be well understood in Turkey; but that the contagion is sometimes received from the dead body cannot be doubted.

4. The contagion of plague is readily imparted to *fomites*, in which it may lurk for a very long time, more particularly if secluded from the air.

5. Re-infection is occasionally observed, but upon the whole is not common. The individuals throughout Turkey who are employed about the persons of plague patients have, with very few exceptions, undergone the disease. Sufficient instances, however, are met with of persons taking the disease a second time, and even dying of the second attack, to make all who have previously had it cautious in their intercourse with the affected.

6. Plague, like the small-pox, may be taken by inoculation. The experiment has been tried in several instances, but in none has it succeeded in mitigating the disorder. Dr. Whyte in 1801 and Mr. Van Rosenfeldt in 1817 paid with their lives the forfeit of their temerity. The former died on the fourth, the latter on the second day of the disease.

Many inquiries have been instituted with the view of determining, if possible, what the circumstances are which render the plague epidemic at certain seasons. Some particular constitution of the air is generally supposed to occasion it; but what that is never has been and probably never will be ascertained. The extremes both of heat and cold are said to be unfavourable to the propagation of plague, but this opinion must be taken with some limitations. The plague raged in summer at Malta, in the winter months at Corfu. Nor is it clear that it is upon any peculiar state of dryness or moisture in the atmosphere that the phenomenon depends; though indeed there is a popular belief all over the Levant that the heavy dews which begin to fall about St. John's day check the advance of the plague. To this circumstance is attributed the curious but well-ascertained fact, that though the disease had been previously raging in the town, the inhabitants may after that day leave their homes and mix in society with comparative security, because of the heat after June 24th forcing them to keep their houses ventilated by night.

Diffusion of Plague.—The slowness of the diffusion of plague has always been a noted characteristic of its past history, and is confirmed by all recent experience. There was, it will be noted in the history of the Satara epidemic, exactly an elapse of five weeks from the introduction of plague into the town till its outbreak subsequently in epidemic virulence. During this "latent interval," no doubt, fresh foci of infection are being set up by the migration of infected persons and fomites of all sorts from place to place. The origin of indigenous cases after a period of from five to seven weeks' "latent interval" seems to be determined by conditions as yet unknown, except such as are admittedly favourable for its propagation in insanitary conditions of defective ventilation, overcrowding, and filth.

Possibly the micro-organism has an extra somatic habitat or an intermediate host, or a parasitic stage of existence as yet undemonstrated, and takes time to evolve and develop virulence and become pathogenic for man and animals. Once it has gained an entrance into a locality suitable for its precipitation and propagation, it spreads with the rapidity of wild-fire, and soon makes its presence known with a virulence and fatality of such swiftness as contrasts remarkably well with the latency. *Rags and clothing* have always been looked upon with the utmost suspicion as powerful fomites in spreading plague. Hankin has proved experimentally that sputa and discharges such as pus, blood, etc., containing bacilli of plague, can retain their virulence for a period of six days at least in a dried condition on clothing and the fibres of fabrics. Exposure of infected rags to sunlight and air speedily disinfects them. Two verified instances in which infected clothing spread plague have been met with in our experience, and every other source of infection could be excluded.

In one instance, to avoid disinfection, infected clothing was sent to a friend's house three hundred yards away, and plague then broke out in this new locality, beginning in this very house; in another instance, stolen infected clothing was carried to a village three miles off, and plague began in this village in the house into which the clothing had been conveyed. The person who brought in the clothing did not suffer from plague.

Rats and Plague Diffusion.—That rats, and probably squirrels, play an important part in the dissemination of plague cannot be doubted, and in Satara it was frequently noted that dead rats were found before or at the same time as places became liable to furnish plague attacks and deaths. Before the acme of the epidemic in January, 1898, very few rats or squirrels could be seen in the town, although the place had up till then been infested with those rodents. Such an occurrence had never been noticed before by the inhabitants, who often voluntarily called attention to the phenomenon. Frequently plague rats were found dead, as in the gaol, and were examined bacteriologically, and proved to harbour plague bacilli, and often presented typical post-mortem appearances, buboes in the groin or axilla, etc. That rats carry plague from one house to another seems fairly certain, and explains why neighbouring villages become infected outside the most perfectly-devised police cordon, and also how villagers segregated wholesale away from the village site continue to develop plague long after the incubation period of the last case attacked previously has elapsed. In many instances without any (direct or surreptitious) intercourse between the segregated villagers and their infected homes, or by a carrying on of infection from previous to succeeding cases, the disease continues to break out afresh. It is very doubtful if rats infect human beings by direct inoculation, but recently an undoubted instance has been recorded of such an occurrence in Calcutta.

"A good deal of interest is centring in Mr. Hill's plague seizure. The locality is as sanitary as any part here, and is away from the *bustis* or affected areas. Some light on the cause of his attack has been thrown by the following facts: A dog belonging to a patient brought into his bedroom a rat he had killed, and plumped it down upon the bed. Mr. Hill at once threw the rat away. The dog then licked his master's hand, on which there was a slight abrasion, and plague showed itself a few days after."—July 3rd, 1898.

Such a catastrophe must be exceptional.

The presence of colonies of rats is therefore a source of danger during a plague epidemic, and suppressive measures should take cognisance of this menace to the public health, and lead to steps being taken for their destruction owing to their liability to plague.

It is by means of continued plague amongst rats that many times re-infection is started, and the necessity for their destruction after an epidemic is the more imperative. At the same time, as pointed out under plague preventive measures, the main safeguard is to trust in improved sanitation, especially free ventilation constantly provided for and maintained, to render any place plague proof. Anything that leads the public mind away from that sheet anchor of safety merely delays the day of deliverance from plague epidemics by leading them to resort to temporary and unreliable expedients that turn out a delusion and a snare, and end in untold misery and sacrifice of human lives.

It is an interesting fact that, under suitable conditions, an epidemic of plague spreads more rapidly and develops after a shorter "latent interval" when introduced by rats than when human intercourse or other fomites are the means by which infection has been conveyed into a locality.

The earliest historical record (1141 B.C.) noted of a connection between rats and plague is in 1 Sam. v.–vi., and this connection has been frequently met with in many places. In the Himalayan villages the inhabitants look upon the death of rats as a signal to quit their houses and occupy a fresh village site, well knowing by experience that an epidemic of plague is presaged by this phenomenon.

Whilst the microbe of plague is pathogenic for men, rats, squirrels, guinea pigs, and monkeys, especially the grey monkey, it is not so for pigeons, fowls, geese, pigs, horses, dogs, cattle, or cats. Sheep and goats are somewhat sensitive to virulent cultures, and horses less so, but under conditions which exist in nature the chances of spontaneous plague infection in those animals must be very small. In Kumaon and Garhwal, and in the Himalayan plague-infected villages generally, cattle and men are crowded together in ill-ventilated tenements, without any disease or mortality being developed among the former, whereas under the same peculiarly favourable conditions for infection the natives noted that a great mortality among the rats in their houses preceded and accompanied an epidemic of plague in themselves.

The German Plague Commission report states:—"A rat which had become infected while in a state of freedom contained in its body a very great number of plague bacilli, and rats showed themselves in a high degree sensitive to plague infection, mere contact of the external (ocular, *e.g.*) mucous membranes with a cultivation was enough to produce invariably fatal plague . . . and by means of rats the plague germs can be introduced into another house and conveyed to men."

Those observations resolve the fears entertained by some that vaccine lymph prepared within any plague-infected area may give rise to a spread of infection.

When the disease has effected a lodgment in a susceptible locality, the area of infection extends slowly; and in places having a common water supply some districts remain healthy, while another, usually the most insanitary, is decimated by the scourge.

There is no evidence to support the view that the disease is spread by water, milk, or food; the idea has been entertained on speculative grounds, and knowledge gained by study of the book of nature refutes it.

Diagnosis.—It is one of the curiosities of this distemper that on first breaking out the disease has never been known to be plague.

This is partly accounted for by the fact that the invasion of the disease is insidious, a latent interval generally follows the development of the first cases, and the spread of the epidemic is slow and exhibits undulations in a few weeks, or at most two months, rising to the full tide of epidemic proportions. The glandular swellings and carbuncles, which are the significant evidences of this disorder, also occur in connection with the intermittent fevers of the same district occasionally; not to the same extent, nor with the same malignancy, but still sufficient to obscure diagnosis. Its non-recognition has also doubtless been partly due to the want of previous personal plague experience among the medical men in a community where it breaks out perhaps at intervals of a century or more, and to the extreme and almost universal unwillingness to admit the presence of so dread a disease so long as it could be concealed and the consequent popular panic averted. Some authors have endeavoured to base a problematical diagnosis on the supposed extreme contagiousness of plague; but, says Milroy, "to make use of so uncertain and variable an attribute as the contagiousness, or the degree of contagiousness of an existing fever, as a diagnostic mark of the plague—as some nosologists and other medical writers have done—is obviously illogical, and must inevitably serve to mislead. In the case of the malignant Danubian fevers several of the Russian medical officers denied their pestilential character, on the sole ground that no distinct proofs of *contagion par attouchement* had been observed, while they admitted that all the symptomatic characters of the true plague were present. Many similar instances might be cited where this fallacious test has been employed; indeed, most of the absurd errors in the history of the disease during the present and last century may be traced to this very source."

The fact of plague having appeared in a susceptible community cannot be long concealed; it very soon diagnoses or declares its presence by increased and alarming mortality. The very first thing to investigate in villages suspected of plague infectedness, or in newly-infected places, is the cause of the abnormal death-rate, especially in the same houses or families, and from such fanciful diseases as asthma in young children, convulsions, worms, childbirth, accompanied by abortion due to plague-obstetric diseases, and mumps; those together with simple fever, pneumonia, or snake-bite serving as ruses to mask the presence of plague in Indian experience here.

The diseases which most resemble plague are typhus fever—its cousin-german—severe forms of malarial fever, apoplexy, dysentery, syphilis and ague combined, parotitis, scrofula with febrile symptoms of a typhoid type, boil or ulcer of the limb with sympathetic inflammation of the lymph glands associated anatomically, lymphangitis, enterica, pneumonia, relapsing fever, alcoholic poisoning, yellow fever, mumps.

Additional experience suggests the following diagnostic points as worthy of attention in addition to those referred to in the earlier and hurriedly-composed plague report regarding Parel Hospital:—

1. That the patient invariably has an aversion to being considered ill, and yet looks ill. That this is not entirely due to fears of segregation, etc., is proved by an extract from a work printed in 1818 regarding the Malta plague, of which Russel wrote and Faulkner records that "the initiatory symptoms, besides the foregoing, were pain in the back opposite to the kidneys, drunken appearance of the countenance, inability to stand upright, *and aversion to being thought ill*" (Johnson on *Tropical Climates*, p. 334, footnote, 2nd ed. London, 1818). At that time and in Malta it is hardly likely that fears of segregation caused the patient to deny illness, at least among ignorant people not given to analysing their symptoms.

Europeans and the educated, knowing something of the disease and accustomed to note the slightest variation from health, doubtless report the fact of feeling ill early, and thereby resorting to treatment and hospital comforts, recover much more readily. The majority of patients in India deny feeling ill.

2. Hesitating speech is a most constant and valuable diagnostic sign, and is usually met with early in the disease.

The patient clips his words, slurs them over in a monosyllabic, hesitating style, with thick utterance resembling that of a drunken debauchee. The symptom is due to nervous prostration, and is most marked in septicæmic cases with strongly-developed nervous symptoms. It is not by any means an invariably fatal sign, and is present in upwards of two-thirds of all plague patients. Impediment of speech sometimes continues for months after recovery. Tremors of the lips, a peculiar biting motion, is sometimes present, indicating profound nervous exhaustion, but is by no means a dangerous symptom.

3. Staggering gait, not due to muscular paralysis but to nervous incoordination, is frequently present and associated with giddiness due to the same cause. On this symptom is founded what may be termed "the walking test," which is a fairly reliable practical test readily applicable; and a patient or suspect should invariably be submitted to this ordeal before being discharged as free from plague. If he can stand up steadily and walk about and turn round without a drunken reel in his gait the probability is that he is not suffering from pest.

4. Let no one rashly conclude that any suspect is not a plague case because the temperature is normal and he has no bubo.

In this connection the feel of the skin of the extremities is a very false guide—plague patients' extremities being often cold from failing circulation—and the axillary temperature must be carefully taken with a reliable thermometer. As there is naturally a fall to normal or even sub-normal on the third to fifth day of the disease, plague cannot be diagnosed infallibly by the temperature alone. To the same end Russel wrote :—

"*Buboes.* — The presence of these is diagnostic of true plague, and removes all doubt as to its nature ; but fatal has been the error of rashly, *from their absence*, pronouncing a distemper not to be the plague, which in the sequel has desolated regions and which early precautions might probably have prevented from spreading."—Johnson's *Tropical Climates*, p. 339.

A burning, shooting pain is often felt in the part anterior to the appearance of swelling; and when the tumour has once formed there is always tenderness.

In the incipient state a small, hard, round tumour is felt, more or less deeply seated, but generally movable under the skin which is yet colourless and non-protuberant. As the gland enlarges it commonly takes on an oblong form, becomes more immovable, and the integuments thicken and protrude into a visible outstanding lump without external inflammation.

The progress to maturity is rapid, but not apparently influenced by strength of constitution or the contrary—hence the prognosis from the bubo alone is very uncertain. When there is great surrounding œdema the prognosis is distinctly grave. The bubo seldom begins to suppurate externally or show symptoms of maturation till fever has abated, rarely sooner than the eighth or ninth day; the inflammation advancing and the tumour by degrees softening, opens of itself between the fifteenth and twenty-second day. Buboes that do not suppurate, which is the rule if they be not irritated, disperse gradually in one or two months, seldom being apparent up till the third month. In the slightest cases buboes are often the first symptom of infection.

Differential Diagnosis.—From ordinary pneumonia it is exceedingly difficult, without previous clinical experience, to diagnose primary plague pneumonia. The points in which the latter differs from the former are the character of the pulse, soft and frequent, never full and bounding, the rapid onset with high fever, marked prostration and severe head symptoms immediately following attack, the absence of acute or subacute bronchitis before the attack, the profuse and watery expectoration, sudden onset of pulmonary œdema, and localised patches of pneumonic inflammation altogether too slight to account for the severe general symptoms and profound prostration.

From relapsing fever, with which plague might be confounded occasionally, as they often become epidemic together during or following times of scarcity, it is distinguished by the greater prostration, remissions of temperature, *with perspirations*, and jaundice, flushed face, buboes, and spirilla being absent. Tenderness and enlargement of the liver and spleen, severe muscular and arthritic pains, epistaxis and other hemorrhages, anæmic cardiac murmurs, and the comparatively low death-rate of relapsing fever are other distinguishing characteristics.

From glandular fever or drüsenfieber, as described by Pfeiffer in 1889, the narrowly-limited epidemic nature, chiefly affecting children, stiffness of the neck and adenitis of the deep cervical glands, and nephritis as a complication, enlargement of the liver, spleen, and mesenteric glands with tenderness, several cervical glands being affected subsequently, absence of suppuration and of the specific pest bacillus, different temperature curve, with maximum 104° on third day, benign course, and absence of the nervous symptoms, injected eyes, characteristic tongue, etc., of plague, serve as distinguishing points.*

"Inflammatory swellings in typhus are interesting, as they constitute a connecting link between this disease and oriental plague. The more the subject is studied, the more the conviction is forced on the mind that there is a strong resemblance between these two diseases in their causes, as well as in their symptoms, and that, in fact, typhus is probably the plague of modern times.

* *Vide* Clifford Allbutt's *System of Medicine*, pp. 716–18 and references.

"The main differences are three, viz. the more rapid progress of plague; the presence in plague of buboes or inflammatory swellings in the inguinal, axillary, cervical, parotid, and submaxillary glands; and the presence in typhus of an eruption, the spots of which have a tendency to become converted into petechiæ. But first, it has been shown that typhus may be as speedily fatal as true plague (see pp. 186–226). Secondly, typhus is occasionally, like plague, complicated with buboes, which greatly aggravate the severity of the case. It is true that these buboes appear later in typhus than in plague, and that they are met with in other febrile diseases, such as remittent and enteric fevers. But, although they are not pathognomonic either of plague or typhus, they are, as far as my knowledge extends, much more common in typhus than in any other febrile diseases, excepting plague, while in the *typhus siderans* of Torgau and Mayence they seem to have appeared as early as in plague. Thirdly, most writers agree in stating that 'dusky-red or pale purplish spots, which, as the disease advances, acquire a livid hue,' are very common in plague. (See article 'Plague' in *Lib. of Med.*, vol. i. 1840, p. 192.) Among the *Directions for the Searchers*, drawn up by the Royal College of Physicians of London in 1665, is the following:—'Whether there be any tokens, which are spots arising upon the skin, chiefly about the breast and back, but sometimes also in other parts; their colour is something various, sometimes more reddish, sometimes inclining a little towards a faint blue, and sometimes brownish mixed with blue' (1801). Many observers have been struck with the similarity in the symptoms of typhus and plague. The early writers often confounded the two diseases (*pestis* and *febris pestilens*), while both Cullen and Sauvages regarded plague as merely a severe form of typhus (*Typhus Ægyptiacus*, Sauvages; a variety of *Typhus gravior*, Cullen). Sydenham, speaking of typhus (*febris pestilens*), says:—'Cum ipsissima peste specie convenit, nec ab ea, nisi ob gradum remissiorem, discriminatur' (*Op. Om.* Syd. Soc. Ed., p. 96). The historians of the outbreak of plague at Marseilles in 1720 observe:—'La rapidité et quelques accidents sont les seules choses qui distinguent les fièvres malignes ordinaries de la peste' (1821). Dr. Ferriar wrote as follows:—'Although the symptoms of eruptions and buboes be distinguished by individual characters in the plague, yet they do not depart in their general type very far from the symptoms of malignant fevers; for the latter are very commonly attended by flat eruptions, which physicians call petechiæ, and glandular abscesses are not unfrequent in them' (1810, i. 268). According to Dr. Copland, the symptoms of plague 'differ but little from those of true typhus fever, excepting in the appearance of carbuncles and buboes' (1858, iii. 196). Lastly, the celebrated Egyptian physician, Clot-Bey, on visiting the London Fever Hospital some years since, was much struck with certain cases of typhus complicated with swellings in the parotid region, and declared that in Egypt they would be regarded as examples of plague. Excepting the buboes, the post-mortem appearances of typhus and true plague are identical (1834, p. 273).

"But, secondly, in the plague, as in typhus, there is reason to believe that the poison can be generated *de novo*, and that the disease does not of necessity arise from contagion nor from some epidemic influence. On this subject the reader is referred to the works of Heberden (1801) and Hancock (1821), and to the valuable report on the plague and quarantine, drawn up by a commission of the French Royal Academy in 1846, and published in the name of Dr. Prus (1846). From the evidence collected in these works and elsewhere it seems probable that the poison of plague is generated by the concentration of animal exhalations consequent on overcrowding with deficient ventilation. In Cairo, the modern headquarters of the plague, the streets are extremely narrow, and the population is crowded into close chambers devoid of all ventilation. Throughout the rest of Egypt the habitations are no better; the house, or rather the hole, of the Egyptian is built of mud, and the door is so small and low that it can only be entered by creeping. A number of these huts, which resemble so many ant-hills, are constructed close to one another, and every means of ventilation is cut off, while whole families lie huddled together. Such are the localities in which plague appears, independently of any importation from without. Moreover, the great predisposing cause of plague, as of typhus, is starvation. Failures of the crops and other causes of famine convert sporadic cases of plague into great epidemics. Speaking of the events which preceded the great epidemic of plague in the fourteenth century, Hecker observes, 'Children die of hunger in their mothers' arms. Want, misery, and despair were general throughout Christendom' (1844, p. 17). 'The outbreak of the plague,' says Dr. Milroy, in his review of the French Report, 'has not unfrequently followed upon wars, famines, and other wasting calamities; and, on the other hand, its ravages have invariably been observed to become less frequent and less desolating in proportion as the condition of the inhabitants of the affected countries, in point of civilisation and comfort, has improved' (1846). According to M. Prus, 'Si nous recherchons, avec soin, les causes qui paraissent exercer l'influence la plus grande sur le développement de la peste, nous pourrons les résumer ainsi: habitation sur des terrains d'alluvions ou sur des terrains marécageux; *maisons basses, mal aérées, encombrées; air chaud et humide;* action des matières animales et végétales en putréfaction; *alimentation malsaine et insuffisante; grande misère physique et morale*' (1846). The resemblance between the causes of plague and typhus requires no comment. It is possible that the warm, moist climate of Egypt may lead to the development of plague from causes which in this country would only suffice to generate typhus. But some centuries ago, when our dwellings resembled those of the Egyptians, plague was a common disease in London, and occasionally, like typhus, it appeared in great epidemics. It has been the fashion to refer the origin of all these epidemics to imported contagion; but there is no satisfactory evidence that this was the case. If the poison of plague was always imported, it is strange that during the last two centuries, while an extended commerce has increased the means of importation a thousand-fold, plague (except in the form of typhus) has been unknown in Britain. No one will be bold enough to attribute this exemption to the operation of our quarantine laws.

"The disappearance of the plague from London was coincident with an improved construction of the dwelling-houses, which followed the Great Fire of 1666. Heberden describes the state of the city prior to the fire as follows: 'The streets were narrow and crooked, and many of them unpaved; the houses were built of wood and lofty; they were dark, irregular, and ill-contrived, with each story hanging over the one below, so as almost to meet at the top, and thereby preclude as much as possible all access to a purer air; they were besides furnished with enormous signs, which, by hanging into the middle of the street, contributed not a little to prevent all ventilation below' (1801). 'It is probable,' says Hancock, 'that if this country has been so long forsaken by the plague, as almost to have forgotten, or at least to be unwilling to own, its natural offspring, it has been because the parent has been disgusted with the circumstances under which that hateful birth was brought to light, has removed the filth from her doors in which it was matured, and has adopted a system of cleanliness fatal to its nourishment at home. But if ever this favoured country, now grown wise by experience, should relapse into former errors and recur to her odious habits, as in past ages, it is not to be doubted that a mutual recognition will take place, and she will again be visited by her abandoned child, who has been wandering a fugitive among kindred associates, sometimes in the mud-cots of Egypt, sometimes in the crowded tents of Barbary, and sometimes in the filthy kaisarias of Aleppo' (1821).

"Moreover, many epidemics of plague in Europe have been preceded and accompanied by a great prevalence of typhus. Instances of this nature have already been referred to (pp. 27, 29), and others will be found in the works of Heberden and Hancock. Many writers state that the one affection merged into the other, so that it was sometimes difficult to say whether a case was typhus or genuine plague."

That there are radical clinical points of difference between enterica and plague no one can doubt who has had large experience of both diseases, despite the high authorities' remarks just quoted, and can be made out from the clinical reports in this volume and the reader's knowledge of typhoid. The temperature curve, course, mortality, etiological factors, duration, post-mortem appearances, sequelæ, habitat, and complications of the two diseases are entirely different, and prove that they are separate entities. Finally, the bacteriological test, due to the demonstration of the bacillus of Kitasato and Yersin in plague and of the Eberth-Gaffky bacillus in typhoid fever —both unknown when Murchison wrote—carries the proof of the two diseases being quite different beyond the field of discussion.

Yellow fever, from the descriptions in text-books we have read, seems to be closely allied to plague in its symptoms, etiology, and other features; but as we have not seen any cases of yellow fever no analysis or differentiation is attempted here.

It would be an important and interesting subject of investigation if someone with plague experience took up the inquiry and examined the micro-organism isolated by Sanarelli and established the relations, etiological and otherwise, if any, between plague and yellow fever. Should the interoceanic canal at Panama or Nicaragua become an accomplished undertaking, the danger of the importation of plague westwards and of yellow fever eastwards will be intensified and within measurable distance.

The diagnosis of the disease is not always so easy as might be expected from the observation of typical cases. It is necessary, in the first place, for plague as all other diseases, to construct a mental picture embracing its full development, relation of symptoms in logical sequence to their pathology, giving due prominence to those most important, noting the less frequent and aberrant symptoms, not omitting necessary symptoms and complications of varying value.

By careful consideration and just comparisons in a considerable series of plague cases, and by bestowing diligent caution on the interpretation of the symptoms, proceeding in a methodical manner, the disease can be separated from others closely allied and a definitive diagnosis arrived at.

Pathology.—The plague poison decomposes the blood, so that even during life it is dark in colour with increased fluidity and imperfect coagulability. This is well seen when taking blood specimens for bacteriological examination, which are easily prepared as follows:—The patient's finger is thoroughly cleansed with soap and water, and the part about to be pricked soused with 1 in 20 carbolic lotion, and a little absolute alcohol run over it to wash off the antiseptic lotion. After the part has dried, an ordinary clean sharp needle, fixed in a suitable handle or stuck into a stout cork, is sterilised by heating it in the flame of a spirit lamp and then allowed to cool, and with this the tip or side of the patient's finger is pricked, when a drop of blood oozes out. A couple of cover glasses or slides are kept ready, previously cleaned, floating in absolute alcohol, and now rapidly sterilised in the flame of the spirit lamp and one of them applied to the drop of blood which adheres to its surface, and this is spread evenly between the cover slips by gently pressing the two together. This thin, even layer of blood is then dried by holding the adherent slips about a foot above the spirit flame, and fixed by passing them through the flame several times. Suitable staining with carbol-fuchsin, methyl-blue, or gentian violet will demonstrate the bacilli present. Several such specimens should always be made, as the bacilli, even when present in the blood, are not demonstrable in every such specimen. To make the specimen permanent it may be mounted in Farrant's solution or Canada Balsam in the usual way. The blood clot, when formed, is friable and presents very different physical characteristics from that of healthy blood, oily globules forming on the top and the whole mass rapidly putrefying. In this respect the plague miasm produces pathological blood changes closely resembling the riper venoms, particularly crotalus; but the latter acts more intensely on white persons than on negroes, while in plague, it would appear, the reverse obtains. No opportunity for a spectroscopic examination of the blood has presented itself, and this should be undertaken by experts to determine the nature of the blood changes in plague.

The most characteristic effect of the plague toxin is upon the lymph glandular structures. The whole lymphatic system, internal as well as external, is inflamed, swollen, or softened, according to the stage of the disease or severity of the attack. "Bulard has found the entire chain of glands from the groin to the solar plexus enormously swollen, forming with the arteries, veins, and nerves a compact mass, embedded in extravasated blood" (Milroy). This entirely corresponds with experience at Parel Hospital and elsewhere in India, and proves that the plague, as seen in Egypt and in India, is one and the identically same disease. The gland changes begin as simple induration, and the patient may die from the toxic effects of the poison on the nervous system before the disease has made any special progress in the lymphatics. In the case given *in extenso* such changes were found, although death followed in a few hours from the attack. In cases that die later the process of inflammation goes on rapidly with increasing hardness and tenderness, immense surrounding œdema, followed by dark-coloured softening and putrescence with inter and intra glandular foci of hemorrhage and hemorrhagic infarcts. The course is almost similar to that in a gonorrhœal bubo, but much more intense and hemorrhagic. According to Russel, in 2,700 cases 1,841 had inguinal buboes, 569 had axillary buboes, 231 had maxillary buboes. Although buboes are frequent in the glands of the neck and at the angle of the jaw, the salivary glands are very rarely, and, in the author's experience never, affected. The so-called parotid buboes are such only in site, for it must be borne in mind as an anatomical fact that there is a lymphatic superjacent to the parotid salivary gland (*vide* Macalister's *Human Anatomy*, p. 574: "Embedded in its anterior surface are three small lymphatic glands").

The inguinal pestilential bubo is for the most part situated lower in the thigh.

Incubation Period.—There is a fallacy in the method of counting the incubation period which requires to be noted, as it is not obvious at first sight or without reflection. The patient first attacked may have been exposed to infection for any number of days up till ten before he falls ill, and it is obvious that the friends in his family have been running equal risks all that period. Yet one generally begins to count from the first day on which the latter have been segregated or placed under observation in determining the period of incubation in their cases. That the majority of attacks follow shortly after exposure to infection (if at all), and under certain insanitary conditions only, is true; as will be seen, most attacks are simultaneous in families or within six days, and a few, in diminishing numbers, up till ten days' time; but this affords no criteria for fixing the maximum possible incubation period for plague.

The following are authentic instances of apparently prolonged incubation, and whilst it is notoriously difficult to fix the incubation period, because we can seldom be sure that infection took place at any particular time, or that the patient was exposed to subsequent infection from the date of coming under surveillance, it is pretty certain that a ten days' period covers the incubation of the majority of cases. Every precaution was taken in segregation camps by roll calls, surprise visits, passes, inspection posts, sealed houses, etc., to prevent reinfection, but the possibility of this could not be denied, as no system of quarantine is germ-proof. The instances of prolonged incubation are, moreover, quite exceptional, about one per cent. only of segregated persons developing plague beyond the accepted ten days' incubation period.

EXAMPLES OF PROLONGED INCUBATION.

1. Haja valad Sayad Ameen, segregated December 6th on account of death in Shukarwár Peit; discharged December 17th, and readmitted December 18th. Incubation 16 days at least.

2. Yesoobai kom Mana, segregated December 7th on account of death in the house; discharged December 18th; admitted to hospital for plague December 19th. Incubation 12 days at least.

3. Mahibub valad Dawoobhai Pharas, segregated December 7th on account of death in Shukarwár Peit; on December 17th discharged; symptoms of plague declared themselves on December 18th in the afternoon. Incubation 11 days at least.

4. Dondi nom Sidoo Teli, admitted Godoli health camp November 22nd, 1898; attacked December 2nd, 1898. Incubation 11 days at least.

5. Shankar Vishwanath, admitted Godoli health camp November 22nd, 1898; attacked December 5th, 1898. Incubation 14 days.

6. Gopal Rama, prisoner, segregated in gaol camp, under guard, unexposed to any source of local infection, January 10th, 1899.

Left Koregaon, where he had been four days in the lock-up, January 9th, 1899, by road for Satara, where he developed plague on January 21st, 1899. Incubation 12 days.

Prisoner could not have caught infection in the gaol camp, for no previous case of plague had occurred among the Satara gaol prisoners, nor has there been a single case since.

TABULAR STATEMENT OF PLAGUE IN

No.	Name.	Age.	Date of arrival and segregation.	Incubation period.
1	Vishnu bin Appa ...	11 years	Oct. 14, 1898	——
2	Sundra kom Govind ...	20 ,,	,,	Not less than 9 days
3	Mathu, father Govind	9 months	,,	,, 9 ,,
4	Shankar Appa	13 years	,,	,, 1 day
5	Krishna báp Gangaram	9 ,,	,,	,, 1 ,,
6	Rakhamak Appa ...	40 ,,	,,	,, 7 days
7	Mahadu Appa ...	25 ,,	,,	——

There were four other members in this family, segregated on the same day. After the rest of the family; they were therefore not exposed to the risk of direct contagion after

TABULAR STATEMENT OF PLAGUE

No.	Name.	Age.	Date of arrival and segregation.	Incubation period.
1	Baju kom Hama ...	25 years	Oct. 14, 1898	——
2	Ganga kom Ramnac ...	35 ,,	,,	Not less than 11 days
3	Arjuna valad Dhamnak	13 ,,	,,	,, 11 ,,
4	Bhagu kom Tannak ...	50 ,,	,,	,, 10 ,,
5	Ramnac valad Kamalnac	50 ,,	,,	,, 3 ,,
6	Govind valad Harnac ...	3 ,,	,,	——

Five members of this family of six succumbed, in spite of the eviction of the family from disinfected on admission (including clothing), and after each death the survivors underwent 4 and 5 must have contracted plague in camp, and most probably from the sick they attended.

ARANJA FAMILY.

of attack.	Date of death.	Duration of fatal cases.	Bubo, presence of	Remarks.
14, 1898	Oct. 16, 1898	2 days ...	Bubo observed.	
25 ,,	,, 25 ,,	1 day ...	No bubo.	
25 ,,	,, 25 ,,	1 ,, ...	,,	
26 ,,	—	—	Bubo ...	Recovered.
26 ,,	—	—	,, ...	,,
2 ,,	Nov. 3 ,,	1 day ...	Bubo in neck	Complicated with goitre, hence early death by asphyxia.
—	—	—	—	Not attacked.

of Nos. 2 and 3 on the 25th, these four were by request entirely separated from the er 25th. They were discharged on November 14th and have all remained in good health.

A SADAR BAZÁR FAMILY.

of attack.	Date of death.	Duration of fatal cases.	Bubo.	Remarks.
4, 1898	Oct. 16, 1898	2 days ...	Bubo.	
27 ,,	,, 28 ,,	1 day ...	No Bubo.	
27 ,,	,, 28 ,,	1 ,, ...	,,	
8, 1898	Nov. 8, 1898	1 ,, ...	,,	
11 ,,	,, 12 ,,	1 ,, ...	Bubo.	
—	—	—	—	Not attacked.

ected site on the occurrence of the first case and their removal to a distance. All were ction. Cases 1, 2, 3, may have been brought to camp in the incubation stage, but cases oteworthy that the only one to escape was a child too young to visit his sick relatives.

Number of Case Sheet.	Date when segregated.	Date of admission to Hospital.	Days under segregation.	If an attendant, days since death of person attended.	Remarks.
13	Oct. 8 ...	Oct. 12 ...	5	—	Died in a hut on 12th day.
18	,, 8 ...	,, 9 ...	1	—	
21	,, 10 ...	,, 12 ...	2	—	
26	,, 12 ...	,, 13 ...	1	—	
46	,, 11 ...	,, 17 ...	6	—	
58	,, 19 ...	,, 23 ...	4	4	
73	,, 14 ...	,, 27 ...	13	11	Relative attendant died Oct. 16.
74	,, 13 ...	,, 27 ...	14	11	Cousin died Oct. 16.
75	,, 23 ...	,, 28 ...	5	—	
76	,, 23 ...	,, 29 ...	6	—	
83	,, 14 ...	Nov. 2 ...	18	7	Death of relative attended occurred Oct. 26.
94	Nov. 2 ...	,, 7 ...	5	—	
96	Oct. 13 ...	,, 7 ...	24	10	Death of relative attended Oct. 28.
97	Nov. 1 ...	,, 10 ...	9	9	Father died of plague Nov. 1.
98	Oct. 14 ...	,, 11 ...	27	3	Disinfected 4 times on following dates: Oct. 14, 17, 29 and Nov. 9 (upon admission and after death of relatives).
102	Nov. 12 ...	,, 13 ...	1	—	
110	,, 1 ...	,, 14 ...	13	—	Attended sick parent who recovered.
113	,, 5 ...	,, 16 ...	11	—	
114	Oct. 26 ...	,, 18 ...	23	—	A relative convalescent and put in same hut as No. 114 on Nov. 9; 9 days later the latter fell ill.
117	Nov. 12 ...	,, 19 ...	7	2	
128	,, 28 ...	Dec. 6 ...	8	8	
129	,, 28 ...	,, 6 ...	8	—	

Comparative immunity of Europeans generally now, with historical comparisons and their explanation.—It is an historical and very remarkable fact that in Surat, during the epidemics of 1684 and 1690, the Europeans escaped the disease, also that the disease appeared in Bombay in 1689–90 and again in 1702. In 1690 it reduced the Bombay garrison to 35 English soldiers (Bruce's *Annals*, iii. 94), and in 1690 to 1700 Sir James Campbell, quoting Bruce's *Annals*, Anderson's *English in Western India*, and Hamilton's *New Account*, writes :—

"Bombay was in no state to receive an envoy. The unfortunate 'Isle of the East' was plague-stricken, empty, and ruined. Of 800 Europeans only 50 were left—6 civilians, 6 commissioned officers, and not quite 40 English soldiers. There was only one horse fit to ride, and one pair of oxen to draw a coach. Bombay, that had been one of the pleasantest places in India, was brought to be one of the most dismal deserts."

What reasons can be adduced for the comparative immunity of Europeans now compared with the fate they shared in Bombay in 1690? Why were Europeans immune at Surat in 1684 and 1690, whereas the same class of people fell victims in Bombay about the same time? One critic has attempted to explain the first question by the greater prevalence of habits of cleanliness among Europeans now than formerly.

On that showing the then presupposed equally dirty European contemporaries of Surat should have contracted plague—on the filth theory of this disease—but they escaped in 1684 and 1690!

The following historical and antiquarian note solves the problem why the Europeans in Bombay were attacked before 1810 and are generally immune nowadays :—

"*Bombay Change of Fashions* (1810).—This pleasant and salutary article (cow-dung) is falling into disuse with the English, who, in their habitations and habits, are departing more and more from the sober dictates of nature and the obedient usages of the natives. We now, for instance, build lofty rooms, admitting insufferable glare and heat through long glazed windows fronting the sun, reflected by marble or polished floors; domestic comfort is sacrificed to exterior decoration. No man of taste would now build a low, sun-excluding verandah, nor mitigate the intensity of the heat by a cow-dung flooring. In Bombay the delectable light that, twenty or thirty years ago, was so commonly admitted through thin, semi-transparent panes, composed of oyster shells, is no longer known among the English except in the church; and these, perhaps, will, when the present worthy clergyman shall vacate his cure, give way to the superior transparency of glass."—Note from Moor's "Hindu Pantheon," Second Edition of *Bombay and Western India*, vol. ii. p. 253. James Douglas.

The houses built by the pioneers of Western civilisation—the traders, or factors—at Surat were large, roomy, well-ventilated, as can be attested to this day by the massive ruins of some and the standing existence of others; hence their escape from "the want-of-fresh-air disease."

A further confirmatory proof of this historical fact, if any more cogent reason be required, is afforded by the Report of the Barracks Commission, showing a woeful state of deficient ventilation in barracks at home and abroad up till recent times; and the old barracks in Bombay, now used as commissariat godowns, attest the same state of affairs.

That Europeans generally are now comparatively immune is an undoubted fact; but the very fact that some of them have been attacked and fallen victims to this disease shows that all of them have not recognised or acted on the source of their deliverance as a class.

Many men now will deny the truth of the theory advocated for plague incidence and causation, which it is the burthen of this treatise to elucidate, or, at least, fail to give it that full confidence which it deserves. Whilst all learned men admit the value of fresh air, many of them continue obstinately to bar their minds against incontrovertible facts and evidences as to its relation to plague epidemics, and mix it up with other supposed causative factors; hence it is not to be wondered at that some Europeans even are occasionally attacked.

Investigations in reference to such have elicited exposure to infection from primary plague pneumonia, which stands on a par with malignant small-pox, and for which laws governing the ordinary types of disease are not applicable. Just as anyone, although living in ideally sanitary surroundings, and who may have been not only vaccinated but revaccinated once or twice even, may be attacked by and die of malignant small-pox, so in similar circumstances anyone may be attacked and killed by plague pneumonia, for a white skin is no protection *per se* against plague, "25,000,000 white-skinned Europeans having died of it within the historical period."—Hecker.

Again, we know from certain annexe to most bungalows in India that the relations of Europeans with certain classes of the natives was one of greater intimacy than happily prevails nowadays; hence their greater risk of incurring infection, and it is true that at Hong Kong and elsewhere such risks were run with fatal results.

Another explanation offers in the fact that plague is readily inoculable in human beings, and Dr. Sticker, of the German Plague Commission, suffered from a mild attack of plague accidentally inoculated at Parel in performing a post-mortem examination on a plague corpse in 1897. Most such cases are mild, and recover—in Europeans.

There is, still further, the consideration that the virulence of the plague, capsular pesto-cocci, may vary at times, and under favourable environments gain such an extraordinary degree of virulence as to occasionally attack those in freely-ventilated houses.

Immunity of hospital attendants at Satara in 1897–9 *when properly hutted on the premises.*

RAUCHATRI PLAGUE HOSPITAL.

Twenty-seven attendants in 1897–8 with one plague attack and death.

Fourteen attendants 1898–9. No cases.

This hospital opened in July, 1897, and closed in May, 1898. Again opened in October, 1898, and still in operation.

WADHA CAMP HOSPITAL, 1898–9.

Twenty-two attendants, with only one attack and death, in the person of a corpse-bearer, and the source of infection could not be traced. He was in the habit of going outside the camp, and may have slept in a plague area. The medical officer was able to exclude any special or recent source of infection in hospital, where the man had been on duty for seven months.

BUDHWAI HOSPITAL, 1897–8.

Twenty-seven attendants. No plague cases.

GODOLI CAMP HOSPITAL, 1898–9.

Fourteen attendants. No plague cases.

Totals : 104 attendants, with 2 attacks and 2 deaths.

The above figures include only *bonâ-fide* attendants and not policemen (twenty-two in number), who were engaged at and in the hospital compound, and were completely immune.

No notice is taken of changes in the incumbents of the various offices in this return, which would add at least twenty to the number of attendants exposed to infection.

The conclusion is that special exposure to plague miasm, in freely-ventilated hospitals, is not specially liable to lead to plague attacks. In olden times the breath of a plague patient was held to mean death to the inhaler, and plague attendants at Marseilles in 1720 were not allowed to touch the patients.

It is to be borne in mind that it is not the locale of a man that saves him from plague during an epidemic except in so far as his habitation and habits are hygienic. Occupation *per se* is no preventive of plague. No doubt, and in investigation in every such instance it was found so, those attacked had insanitary sleeping habits, and thus rendered themselves equally liable to attack as the patients they attended had done in their hovels.

To find complete immunity among such a number of attendants, specially exposed to infection, would argue their possession of habits of living to which they had been hitherto strangers, and prove too much, as an argument, why they were comparatively immune. That so few were attacked is contrary at first sight, and from historical fancies regarding plague, to what one would have expected.

Plague attacks and deaths by castes in Satara city, 1897–8.

Castes, with English equivalents.	Population.	Attacks.	Male deaths.	Female deaths.
Brahmans	5249	214	102	81
Mahrattas	6048	232	96	86
Mussulmans	2789	64	31	25
Mangs, night-soil labourers	656	6	3	2
Dhors, tamers	408	4	1	—
Malis, gardeners	589	17	8	6
Rajputs	325	19	2	6
Jangams, worshippers	105	2	—	2
Banniahs, moneylenders	437	18	8	7
Goldsmiths	621	5	2	3
Shoemakers	440	3	1	2
Gujars, moneylenders	333	24	11	6
Washermen	126	4	3	1
Tailors	1172	31	11	15
Kasars, brassfounders	527	11	5	6
Butchers	18	2	1	1
Marwaris, moneylenders	321	5	2	3
Barbers	444	14	4	8
Mahars, night-soil labourers, etc.	525	6	4	—
Shepherds	104	4	—	2
Sangaŕs, blanket sellers	221	11	4	5
Telis, oil pressers	527	11	7	3
Karanjkars, saddlers	45	7	4	3
Tinmen	57	9	—	—
Parbhu, Guzerati Brahmans	113	4	2	2
Tamboli, betel leaf sellers	62	3	1	2
Carpenters	212	6	2	4

Castes, with English equivalents.	Population.	Attacks.	Male deaths.	Female deaths.
Vangaris, grain traders	197	6	—	1
Mehtars, sweepers	140	9	6	1
Otari, metal moulders	43	1	—	1
Christians	57	1	—	—
Koniti, pedlars	11	1	1	—
Blacksmiths	84	1	—	1
Gosawi, beggars	128	4	3	1
Masons	60	2	1	1
Jewellers	13	1	—	1
Lonari, coal merchants and burners	210	1	—	1
Coppersmiths	57	9	6	3
Fishermen	367	4	2	2
Lakeri, bangle sellers	40	2	1	1
Hymn singers	71	1	1	—
Patwegar, silkworkers	—	8	5	3
Shenwi, fish-eating Brahmans	—	1	1	—
Weavers	149	3	1	2
Potters	172	3	1	2
Totals	—	—	344	300

The undernoted castes furnished no plague cases:—

Castes.	Population.
Parsis	63
Jews	14
Buruds, basketmakers	203
European Christians	155
Goanese	70
Gowlis, milkmen	126
Europeans	102
Madrasis	13
Arabs	17
Eurasians	36
Naikini, prostitutes	33
Bairagis, wandering beggars	186
Total	1018

Ranchatri Plague Hospital, 1898, *till March* 31*st*, 1899.

TABLE A.

Type.	Attacks.	Deaths.	Recoveries.	Mortality per cent.
Bubonic	92	63	29	68·5
Non-Bubonic	30	26	4	86·6
Total	122	89	33	—

TABLE B.

Type.	Attacks.		Deaths.		Recoveries.		Mortality per cent.
Simple	88	...	61	...	27	...	69·3
Bubonic Multiple .	4	...	2	...	2	...	50
Pneumonic	2	...	2	...	—	...	100
Non-Bubonic Toxœmic .	28	...	24	...	4	...	85·7

TABLE C.

Site.	Attacks.		Deaths.		Recoveries.
Groin	54	...	32	...	22
Axilla	23	...	17	...	6
Neck	10	...	9	...	1
Parotid	1	...	1	...	—
Mixed	4	...	4	...	—

TABLE D.

Age.	Attacks.		Deaths.		Recoveries.		Mortality per cent.
Under 5 years . .	5	...	4	...	1	...	80
5 to 15 years . .	40	...	29	...	11	...	77
Over 16 years . .	77	...	56	...	21	...	75·3

TABLE E.

Sex.	Attacks.		Deaths.		Recoveries.		Mortality per cent.
Male	51	...	39	...	12	...	76·5
Female	39	...	26	...	13	...	66·6
Children	32	...	24	...	8	...	75

TABLE F.

Caste.	Attacks.		Deaths.		Recoveries.
Brahman	7	...	5	...	2
Mahratta	39	...	25	...	14
Wani	26	...	19	...	7
Christian	1	...	—	...	1
Shoemaker	6	...	5	...	1
Mang	3	...	3	...	—
Mussulman	21	...	16	...	5
Kafsar	1	...	1	...	—
Koombhar	2	...	1	...	1
Tailor	7	...	7	...	—
Parclesi	3	...	3	...	—
Patwegar	1	...	—	...	1
Lonaree	1	...	1	...	—
Sonar	1	...	1	...	—
Dhor	3	...	2	...	1
Total	122	...	89	...	33

"The following analysis of the results of perchloride of mercury in plague are published for the benefit of the profession. The statistics may be regarded as fairly accurate and as nearly impartial as possible, as they were firstly compiled by the respective hospital assistants in subordinate charge of the two hospitals, and without any idea of the purpose for which they are now used. Apparently they were only to show the relative rates of mortality for buboes in different situations.

"The two hospitals were under different medical officers. Dr. Walton for a short time, and subsequently Dr. Beach had charge of the Budhwar Plague Hospital in which the ordinary tonic, stimulant, expectant treatment of symptoms was carried out exclusively. The figures are taken from bubonic cases only in order to exclude those of doubtful diagnosis; those of malignant primary pneumonic plague, in which all treatment is useless, and those admitted moribund. As both hospitals were open simultaneously during the first Satara plague epidemic, and daily received as nearly as possible half the cases discovered by the search parties working morning and evening, there can scarcely be any appreciable chance differences on the severity of the cases admitted for treatment.

"For the same reasons the statistics show better than those of Parel Hospital the results of treatment amongst all cases admitted to hospital from an epidemic area; and although in Satara there were 150 "deaths out of hospital" during the first epidemic of 722 attacks, amounting to 20 per cent. of the cases, therefore, it would be impossible to tell how many attacks the Parel admissions represented. In the report on Parel Hospital, by excluding moribund cases, those due to pneumonia and cases treated by Yersin's and Haffkine's serum and by other methods, the general hospital mortality was 66 per cent. about; and this would represent all cases treated by perchloride of mercury as a routine practice.

"Being rather sceptically inclined regarding drug treatment, and believing more in good nursing and the benefits of rest and a comfortable bed, although fully recognising the usefulness of an appropriate drug, rising almost to the dignity of a remedy, administered at the proper time; still the impression remains that perchloride treatment is at least as useful as any other in plague. There were some very marked effects following large doses in comatose cases, and by hypodermic injection below the first affected bubo; but in other instances, apparently promising equally successful results, the treatment, although pushed, ended in failure to cure. Salivation was never seen, and that is a word one is averse to using, except on good grounds, although the same solution of mercury used on suspected but non-plagued patients with buboes immediately gave the physiological action of its active ingredient. As a confession of faith in drug treatment, results might be stated fairly thus: In the graver forms of plague medicine has been confessedly useless; in the milder it was probably unnecessary; in the intermediate shades it may have had some influence. In plague, to use an old simile, if the medical attendant can enable the shattered bark to weather the oppressing gale and mount the billows of complications, he may hope to reach a haven of safety and restoration to health.

From Ranchatri Plague Hospital: Mercurial Treatment.

Site of Bubo.	Admitted.	Died.	Recovered.	Mortality per cent.
Left groin	102	72	30	70
Right groin	87	65	20	75
Left axilla	25	22	3	88
Right axilla	23	19	4	82
Left neck	28	21	7	75
Right neck	32	25	7	78
Totals	297	224	73	75·42

"The average mortality, therefore, in bubonic cases under mercurial treatment was about 75·42 per cent. of admissions.

From Budhwar Plague Hospital: Expectant treatment.

Site of Bubo.	Admitted.	Died.	Recovered.	Mortality per cent.
Left groin	31	22	9	71
Right groin	23	17	6	74
Left axilla	22	19	3	91
Right axilla	17	12	5	71
Left neck	11	11	—	100
Right neck	15	12	3	80
Totals	119	93	26	78·16

"The average mortality, therefore, in bubonic cases under the expectant treatment was about 78·16 per cent. of the admissions; this gives about 2 or 3 per cent. of recoveries more under the perchloride of mercury treatment, as nearly as possible 2·64 per cent. In a disease so fatal this undoubtedly is fairly satisfactory, for those who refused hospital treatment only gave 11 per cent. of recoveries, and about 20 per cent. of those attacked died out of hospital, whereas those submitted to all kinds of treatment, including primary plague pneumonia, non-bubonic and fulminant cases, gave 22 per cent of recoveries. A margin of 3 per cent., therefore, in favour of our line of treatment is encouraging and shows it is worthy of further and more extensive trial; but in no case is it to be regarded as a remedy to the exclusion of rational therapeutic measures."

CHAPTER IV

RATS AND PEST

THE extermination of rats as a remedy against plague has lately been put before the public in a most authoritative manner by some distinguished experts. The problem is as difficult and futile as the proposed extermination of the germ—both, if feasible, would practically abolish the disease; but human beings suffer because they live like rats, congregated in a filthy manner. When people have changed their habits and habitations and live as civilised human beings should do, in clean spacious, airy, and open houses, with ample cubic space for each occupant and clean surroundings, the rats may freely invade their dwelling, but no plague will ever come nigh them. The good effects that would follow to a certain extent the destruction on a wholesale scale of plague-conveying rodents, such as by Loffler's bacillus, will be very considerably rendered nugatory by the extremely insanitary conditions that obtain in the densely-crowded native towns and villages in India.

The partisans of this school are young men full of enthusiasm for scientific progress, but often deficient in that experience which is essentially necessary to enable practitioners, or scientists, who are not medical men to appreciate the practical value of luminous theories.

Their labours often fascinate the understanding without really conveying useful instruction to such votaries.

"The question as to the participation of insects in the conveyance of plague is far from settled. In Oporto one patient suffering from the pustular form of plague said that his disease began from a bug-bite; and it was judged that the first man attacked in Sydney had been infected by a flea-bite. It is considered probable by some that the infectivity of old rags resides in the fleas harboured therein; and it has even been suggested that man is but incidentally affected by the rat-disease plague, which, but for the mediation of insects, would remain confined to rodents. Daly of Newchang has reported a case in which a servant carried out a dead rat in his hands, and was attacked by plague the following day. The shortness of the incubation period suggests the possibility of previous infection. Otherwise similar cases, reported by Simond and by Hankin, have been noticed in previous reports. Matignon in Mongolia noted, like Yersin, a heavy mortality among flies in plague time. The chief of the Pasteur Institute, M. Duclaux, evidently believes in the likelihood of the transmission of plague by insects, as among prophylactic measures he advocates the destruction of rats, fleas, and bugs. Müller, of the Austrian Plague Commission which visited India, did not find any evidence of the agency of insects in the conveyance of infection; and in the bacteriological part of the report since published Albrecht and Ghon state that they saw no striking mortality among flies, and that in about 700 experiments with animals they never saw infection take place by fleas, flies, lice, etc. They found, however, that flies which had been in contact with infective matter, and were then allowed to run about over the surface of an appropriate nutrient medium, left germs behind them, which developed into colonies of the plague bacillus. E. Calmette, having stated that Simond had 'proved that fleas are the chief agent of infection in this terrible disease,' Nuttall replied :—

"'The fact is that Simond has proved nothing of the kind, and it is altogether premature to accept Simond's generalisations, especially when that author does not know how to distinguish one species of flea from another, and has vague ideas about the mouse-flea and *Pulex irritans* possibly being one and the same insect. The experiments of Simond may be suggestive, but they are far too few in number to base any conclusions upon. A number of experiments made by me have given negative results. Simond rides his hobby to death when he speculates about the possibility of plague bacilli becoming increased in virulence by passing through the body of the flea! He ignores the facts established by my experiments, which proved conclusively that various pathogenic bacteria are simply digested in the alimentary canal of the flea. I by no means deny the possibility of virulent bacilli escaping in the fæces, and, in fact, in experiments on bugs have proved that this is the case, but only within the first twenty-four hours after they have sucked infected blood. Numerous experiments on bugs and fleas have shown that *B. pestis*, *B. anthracis*, *B. murisepticus*, and *B. choleræ gallinarum* die off in the alimentary canal of these insects. Another considerable series of experiments in which these insects were allowed to infect themselves and afterwards bite healthy animals gave uniformly negative results, proving that if this mode of infection is possible, it is the exception and not the rule. Of course when an insect that had just filled itself with infected blood is crushed upon the skin, and the part scratched, infection may occur. . . . I express the hope that more accurate knowledge will be gained in the future upon the part played by insects, etc., in the transmission of disease-agents. It is one thing to establish facts, it is another to write fancies. The time has passed when assertions can be accepted as evidence.'

"Galli-Valerio also reproached Simond with his ignorance of the flea fauna, and published an article containing descriptions and illustrations of fleas of man, of the rat, and of the mouse. He granted the possibility of the rat and the mouse being infected by their own flea, but pointed out that it had not been shown that the flea of the rat or the mouse could transmit the disease to man. Galli-Valerio also failed to induce the *Typhlopsylla musculi*, the most common flea of rats and mice, to bite himself, or even to remain long on his body; and he mentions that this was not because he is refractory to flea-bites, because the human flea bites him readily. He noted that neither the German Plague Commission in India nor the Italian in Oporto met with instances of the transmission of plague from rats by fleas to man; and added his own opinion that if transmission of plague by fleas is a fact, it is much more probable that the transmission is from man to man by the *Pulex irritans*. Tidswell in Australia is stated to have 'confirmed the observations of Simond as to the part played by fleas, and to have demonstrated the existence of plague in the alimentary canal of fleas taken from plague-infected rats'; and 'supports the view that, owing to the apparent ease with which the bacillus can be destroyed in nature, plague most likely finds the best mode of dissemination in hosts such as the rat and flea.' Nuttall's remarks quoted above may serve as a commentary on the value of Tidswell's find as a proof of insect-transmission of plague. A writer in the *Lancet* says, 'Galli-Valerio's rat-fleas would not bite him; but that proves nothing, for no flea will bite the present writer, and many other people doubtless.' He had apparently not noticed that Galli-Valerio, as quoted above from the original article, distinctly states that he is readily bitten by the human flea. Blackmore, again, is of opinion that it is only reasonable to suppose that the species of fleas which do bite human beings are as capable of conveying the disease from a diseased person to a healthy person as the flea of a rat is of conveying it from a diseased rat to a healthy one; and that it is, in fact, judging by clinical experience, extremely probable that vermin play an active part in passing plague on from person to person. It has lately been brought to notice that a hymenopterous insect in Cyprus can transmit anthrax to human beings either by its sting or by accidentally rubbing off on an abraded surface infective material conveyed on its body hairs; and with regard to this Dr. Manson 'remarked upon the close analogy between the method of infection in plague and such diseases as this.' In a discussion in Berlin in October, 1899, Pfeiffer said that the experiments of Simond were not quite satisfactory, that the whole question was still in obscurity, and that in India no such epidemiological influence of insects had been demonstrable. Sticker considered it doubtful whether rat-fleas ever came on to men. Gärtner pointed out that in general the several races of fleas remained confined each to its own host-genus; but that it was not impossible that they might occasionally pay short visits to men, have a sample bite, and then go away. Battlehner declared that there were from sixty to eighty races of fleas, that each kind of animal had its own special flea, and that the flea of man was a cosmopolitan, though he was not sure that it went to rats and mice. The general result of the discussion was that the possibility of the agency of insects could not be disregarded, as it was evidently physically possible that they might be directly or indirectly concerned in the introduction of virus through the skin, or in its deposition upon food, implements, and furniture. The following appears to give a fairly good account of the present position of the question. It is said to have been written by a member of the German Plague Commission in reply to an inquiry:—

"'The plague is spread in two ways—first from man to man: (*a*) by contact and (*b*) by inhalation; secondly, from the surroundings of man to man: (*c*) by contact with infected inanimate objects, and (*d*) by the transfer of the contagion from rats to man. We have no difficulty in explaining (*a*) as the penetration of plague germs through wounds or scratches, and (*b*) as the inhalation of minute germ-laden drops of moisture from the lungs of a plague patient. But the second method is less simple. No doubt contact with infected clothes is to be explained as in (*a*). But it is more difficult to understand why living among infected surroundings, *i.e.* in an infected house, should cause infection without there having been any proved "contact." In this connection we have the disease of rats as an important factor, a factor not similarly observed in the case of any other infectious disease. Rats generally suffer from a form of plague which occurs in man very rarely, if at all, namely, plague of the intestines. When thus diseased they evacuate great quantities of plague germs. It is probable that numbers of plague cases among human beings are due to contact with evacuations of diseased rats, *e.g.* in the case of the flooring thus contaminated being trodden on by the naked foot. Less probable is the inhalation of such germs in the floor dust, because plague germs are easily destroyed by desiccation. Children often infect themselves by crawling on the floor, and then putting their fingers in the mouth, thus getting plague with neck buboes. A second possible method in which rats might convey the plague to human beings is by fleas. It is scarcely to be doubted that a flea which has bitten a sick man, and then bites a healthy man, can thus inoculate with the plague; though it is not clear that this method is as frequent as many investigators, *e.g.* the French school, are inclined to think. This much is certain, namely, that there are from sixty to eighty different kinds of fleas; and nearly every animal rejoices in his own particular kind of flea; so also rats. Now, it is understood that fleas go from beasts to man; but it is not so certain that they will all bite man. No doubt a flea need not actually bite in order to infect. If it causes itching by crawling on the skin, and the person concerned rubs at himself to allay the itching, he may conceivably rub the infected blood from the flea into his own system. It is also asserted that the fleas infesting man are of catholic tastes, *i.e.* go over to beasts, *e.g.* rats, and then return infected to human beings. Infection by fleas becomes rather doubtful through the fact that in India the relatives of the sick have often, though not sick themselves, been taken to the hospital and have rarely fallen ill, though they most probably have brought fleas in their clothes which might have conveyed the disease from the patients to themselves. It is also on the flea theory of infection not easily intelligible why doctors and nurses are so rarely attacked. The question of infection of plague by fleas cannot therefore be readily answered at present. The fact that when infected houses are once well cleaned and aired they do not give rise to further attacks also speaks against the flea and bug theory, for these are not so readily driven out of houses.'

"The idea that insects play a part in the propagation of plague is fascinating, especially at the present time, and no doubt the supposed intervention of insects seems to explain some otherwise obscure points in the epidemiology of the disease; but all that can be said at present on the subject must be mere theorising, on account of the absence of facts. There is sufficient suspicion attaching to the possible rôle of insects not only to justify, but to call for further research.

"While from several parts of the world (Asia, Africa, Australia) reports have been received of the discovery of the plague bacillus in the bodies of rats found dead of naturally-acquired plague, and while rat mortality has been noticed in connection with most outbreaks, yet cases have been recorded both in India and in Europe where there was no marked participation of rats, and at the time of a human outbreak in Russia a veterinary bacteriologist is said to have made more than three thousand post-mortem examinations of rodents without being able to find the plague bacillus.* In fact, the exact connection between rat plague and human plague has not yet been determined. The soil, articles of food eaten raw, fleas, have been thought of as possible links in the chain of causation, and the benefit of evacuation of affected premises has been ascribed to the fact that the rats are left behind. In a few cases direct infection by the bites of rats has been observed. Clemow, in the course of a very valuable paper dealing, among other subjects, with the relation of rats to plague, says that for the present it must be admitted that rats can and do suffer from plague under natural conditions; that they can and do act as a means of diffusing infection, and transmitting it to man; but that the extent to which they are responsible for the diffusion of the disease, and the distance over which they diffuse it, are uncertain; and, finally, that they are an important, but not the sole means of spreading the disease. It has, therefore, been proposed to wage war against rats with traps, poisons, suffocating gases, artificially induced epidemic diseases. Löffler,

* The absence of rat infection was supposed to explain the case with which this outbreak was controlled.

Laser, Mereshkowsky, Issatchenko, and Danysz, all isolated from cases of spontaneous disease in mice microbes capable of producing epidemic outbreaks in these animals ; but only Danysz so far apparently has rendered his microbe regularly virulent for rats. The practical experiments in ridding country-sides of field mice do not seem to have been uniformly successful, and do appear to have required some amount of care and skill ; and the question may be, not whether rats are to be destroyed, but whether it is practicable to destroy them. It has been somewhat pertinently asked, 'If the plague bacillus, to which rats are so extremely susceptible, does not exterminate the rats, why is it expected that these other microbes will do so?' However, perhaps keeping down the number of rats by the use of a microbe not pathogenic to man, might have some effect in checking plague. On the other hand, it is not known whether the absence of rats might not give opportunity for the increase of some other evil.

"There is this year for the first time some evidence to bring forward to show that cats may occasionally take a part in the spread of plague. Lorans in Mauritius mentions that in several cases it was possible to trace infection in the human subject to plague-stricken cats with open cervical buboes, in which, moreover, plague bacilli were discovered. A case, too, is reported from Australia in which a cat was actually found to be suffering from plague, the bacillus being found in the swollen cervical glands. The Austrian Plague Commission succeeded in infecting three cats by feeding, and all developed cervical buboes ; and Di Mattei points out that the excrement of infected cats is infectious. Some less definite reports on plague in cats have also been made. The Austrian Commission, too, found the excrement of infected dogs to be dangerous ; and, according to Yersin, village dogs have been known to die from eating or biting infected rats. A case has been reported by Hanna of natural infection of a monkey in a state of captivity. The body of the animal was examined in the Bombay Plague Research Laboratory, and the plague bacillus was demonstrated microscopically and culturally in the heart blood and in the tissue of the axillary bubo and of the spleen.

"It may be noted that Ogata has, with the agreement and consent of Kitasato, reported to the Japanese Government that the plague at Kobe was caused by the bacillus of Yersin, and not by that of Kitasato.

"One of the most important observations made by the

Austrian Plague Commission was the fact that they could infect a guinea-pig, etc., by rubbing without any great force the skin, shaved or not, of one of the hinder extremities with infective material. So readily did infection take place by this method that they were able to use it as a test for the presence of the plague bacillus in suspected material; for example, fæces.

"It has been shown by Gottschlich and by Métin that the sputum of patients may continue to harbour virulent plague bacilli for days or weeks after convalescence has been established, but the German Commission failed to find the germ in any except septicæmic and fatal cases; and unless the saliva, vomit, fæces, or urine were contaminated with blood, in such patients those secretions and excretions were not diagnostic of pest at all by bacteriological examination."—*Annual Report of Sanitary Commission*, 1899.

It may be stated that plague is a disease of rats, and communicable from them to man. Generally, before an epidemic breaks out dead rats are found in the streets and houses. At Satara, and in the infected district thereof, as at Karad in 1897, and subsequent epidemics, this was observed and commented on by the people. The first cases of plague develop precisely in those places where dead rats are first discovered, and spreads from those as foci, rather than following the routes taken by the fugitive panic-stricken inhabitants. Handling the dead bodies of rats, *in the open air*, is not dangerous; going into the warehouses or grain stores to remove them is highly dangerous and fraught with great risk owing to the insanitary conditions of such pest centres. The street arabs in Mandvi pelted each other with rats dead of plague, *in the public thoroughfares*, without any cases of the disease appearing amongst them.

The very latest expert pronouncement plumps for the crusade against rodents; for Cantlie in *Allchin's Manual*, page 137, states—and Manson is in the same boat:—

"*Prophylaxis.*—Seeing that rats and mice are the animals which convey plague, and by which human beings become affected, their destruction *before* a threatened invasion of plague is an absolute necessity if the disease is to be averted . . . whilst at the same time war is waged against the rat." Although on page 136, under Prognosis, it is stated, "Persons living in insanitary abodes, where overcrowding and insufficiency of food prevail, are most liable to infection. Europeans in tropical countries, no doubt on account of their superior housing and mode of living as compared with the natives, seem to enjoy a certain immunity. . . . In Egypt (1899), however, the residents of European extraction seemed as liable to the disease as the native Egyptian. This is due in all probability to the fact that many of the former live after the manner of the native Egyptian," and very correctly explained; yet no word of advice regarding alteration of the environment is added, not a syllable about removal of the insanitary conditions which make the invasion of the disease triumphant over *every temporary expedient* hitherto adopted or recommended. Again, he states (*Plague*, pp. 21–2):—

"*Insanitary environment.*—Although a filth disease, yet plague cannot arise *de novo* or because of dirt.

"The specific bacillus must be imported, and it is only when this takes place that an insanitary state serves to propagate the disease. In the history of every recent outbreak, it is invariably the uncleanly poor that suffer. Inmates of good sanitary houses escape plague in a marked manner, even when they dwell in a locality where the disease is rife, and Europeans in the tropics possess no immunity except by reason of their cleanliness. The improved sanitation of European cities and dwellings generally would seem to prove an obstacle to the spread of plague. The outbreak of the disease, even in a city with so slight pretensions to sanitation as Oporto, proved abortive, and the same it is to be hoped will (no doubt) prove to be the case in Glasgow. It is well to remember, however, that there are 'slums' in our cities of Western Europe as foul as any in Calcutta or Canton. We are apt to pride ourselves on the superiority of our dwellings, but we have only to visit some parts of London, Glasgow, or Dublin to gather how unjustified such an assumption is. Our public sanitation may be superior; a pure and plentiful water supply and perfect sewage arrangements may all help to keep plague at a distance, but if our neighbours have plague, and our domestic and personal conditions are uncleanly, we have no guarantee that in our large cities plague may not gain a firm footing. Hong Kong is as well provided with pure water as Glasgow, and its drainage as good as that of London, yet because of the proximity of plague in Canton, Hong Kong suffered severely.

"*Infection of the soil.*—Were the earth to harbour or grow the bacillus, the explanation of infection by way of the skin of the lower extremities, in persons who go barefooted more especially, would seem a simple explanation of a difficult point. In 1894 Yersin believed he found the bacillus of plague in the mud floors of dwellings infected by plague, and also in adjacent plots of ground. This observation has not been verified by any other observers. The bacillus has been found 'on' the mud floor and in the dust of infected house, but the spots may have been recently contaminated by sputa or excretions.

"The results of Hankin's observations, in short, are 'that the chief source of infection is not likely to be in a saprophytic form of the microbe in the outside world, but more probably in the recently passed excreta of men or animals suffering from the disease.'

"Soiled clothing may harbour the plague bacillus for over two months, and Haffkine's prophylactic inoculations do not afford protection after an interval of nine months.

"*Grain and other food-stuffs.*—Hankin devoted considerable attention to this subject during the Bombay epidemics of 1896–7. It is of especial importance to arrive at a distinct understanding on this point, as the prohibition of the import or export of grain in some parts of the world might have wide and important significance. In grain infected with plague cultures the bacilli soon die out. How soon they disappear is not quite known, but, after four to six days, extracts from the plague-smeared grain are not infective. In rice, sugar, etc., the same law holds good, so that food-stuffs of themselves are not pre-eminently dangerous. But all these articles may harbour rats, mice, etc., and are therefore liable to be foci of infection. It should be laid down as a rule, therefore, that when rats are found in any article of commerce, shipped at a plague-infected port, the goods must be viewed with suspicion.

"It is frequently asserted that it is not fresh grain but 'rotten' grain which harbours plague. This point Hankin also investigated, with the result that 'rotten' grain is less likely to favour the growth of plague than is fresh grain. The acid reaction set up in decomposing grain is fatal to the bacillus, and in all probability the microbe can live in such a medium for a few hours only, and certainly not longer than twenty-four hours.—Ras.

"*Air as a vehicle.*—Plague is not readily infectious. In plague hospitals, doctors, nurses, and even native attendants, although of the same nationality as the sick, are but seldom attacked by the disease. Amongst the staff of inspectors and workmen employed in inspecting and in disinfecting plague houses, or in transporting patients to the hospitals, or dead bodies to the mortuary or cemetery, the same holds good, attacks of plague occurring amongst persons so employed being exceptional. It is possible that prolonged exposure to a close atmosphere, loaded with effluvia from the patients and saturated with emanations from their excreta, as occurs in the houses of the poor, especially amongst orientals, may be sufficiently concentrated to infect; but in the well-ventilated wards of a hospital, or in fair-sized sanitary houses, the danger of infection by the air is not great. In support of this statement, it must be remembered that the bacillus does not outlive desiccation, and therefore cannot exist as a living entity in the dust of the air."

That destruction of rats is a useful palliative measure, of a purely temporary benefit, no one denies, *e.g.* Kitasato reports on the limitations of outbreaks at Kobe and

Osaka which he attributed to the measures adopted, and where it is believed the epidemic would have attained much larger proportions had not so many rats been destroyed.

First it was the use of the whitewash brush, now the abuse of the rat.

Imbecility could hardly go further or show greater impotency; but an imbecile's reasoning faculties were always *non est* over those of many guides, and seem only in abeyance, we can charitably suppose. The recognition of the diseased conditions, and the knowledge of influences bringing them about, failed to complete the equipment requisite to combat disease.

Pest-stricken patients have been treated in numbers in the open air without their attendants contracting the disease; it is the closed room that increases the contagiousness, and the closely-confined air that adds to the virulence. Whatever tends to bring persons more frequently and nearly together must tend to spread the disease; it is most tenacious of ill-ventilated and crowded houses. The effects apparently produced by seasonal changes are the results of such changes on the habits of the population.

"In their thirty-seven pages of letterpress and six illustrative tables and charts the authors (Drs. G. Galeotti and G. Polverini) have given a clear account of the course of the recrudescence of the plague in Bombay from July, 1897, to May, 1898. It is not overburdened with statistics nor prejudiced by the desire to prove or disprove any given theory on the subject; it aims solely at giving a plain unvarnished tale of what actually occurred. They point out the inverse relation which existed between the height of the temperature and the intensity of the epidemic, and by means of charts show that, contrary to what might be expected, the atmospheric conditions which appeared most favourable to the growth and development of the bacillus were just those in which the intensity of the plague was least and *vice versâ*. If this inverse relation between the temperature and the prevalence of the plague were universally observed throughout India, it would tend strongly to support the authors' view that the increase of plague was rather due to some adverse condition in the subjects than to an increase in number or virulence of the bacilli. It would then follow that treatment should be more strongly directed towards strengthening the resisting power of the organism than to the mere destruction of the bacillus, important as this is. In fact, in their conclusions, the authors say the course of the epidemic was very little if at all influenced by the energetic measures taken to cope with it, and that it decreased just when these—for example, separation of the sick, house-to-house visitation, disinfection, etc.—were less rigorously applied owing to disturbances in the city."

Manson (*B.M.J.*, 1899, p. 924) has declared that rats supply "the best and most probably the initial opportunity" for the bacilli of pest. "Were I asked how I would protect a State from plague, I would certainly answer, Exterminate the rats as a first and most important measure." He likens a plague-threatened city to a grate in which the fire is laid all ready for lighting. "The coals stand for the human inhabitants, the sticks for the rodent inhabitants, the lighted match for the plague germ that has dodged the quarantine intended to protect the threatened city. No sticks, no fire; no rats, no plague epidemic." Dr. Doriga, of Venice ("The Prevention of Plague," *Revue d'Hygiene*, August, 1899), states, "Well-constructed and well-maintained houses, *i.e.* where rats cannot find harbour, nearly always remain free from plague." Now, in opposition to this we had experience in the first epidemic at Satara of pest without rats introduced by human intercourse alone, and spread by patients and fomites under insanitary conditions; whereas in 1898–9 rats were affected from two to six weeks before human beings began to fall ill. We think the truth and explanation of this as follows: Pest infects rats and men; once the germ has been introduced into a suitable environment it flourishes, and rats become primarily infected, then men.

Rats are more liable to pest than mankind. Man is liable because of his insanitary environment, whether the first germ be introduced by pest-suffering rodents, afflicted human beings, or fomites. Again, we have noted good sanitary houses repeatedly infested with pest-stricken dying and dead rats, and although somewhat crowded, remain free from attacks of pest amongst the inhabitants during an epidemic all around them. Our own servants' quarters, our own houses even, had refugee, pest-afflicted rats; and one of us turned out five dead rats from our clothes-bag—within a week they had accumulated there—and no pest followed among natives even exposed to rat infection in such good sanitary surroundings. The fact that rats found under such conditions were pest-infected was proved repeatedly by post-mortem and bacteriological and sub-culture tests, etc. Surely alteration of environment is easier and more universally applicable than extermination of rodents. It sounds nice to formulate: no rats, no plague epidemic; it is too ideal, just as the hankering after abolition of all disease by germicides is futile.

CHAPTER V

MODE OF INFECTION IN PLAGUE

THIS is one of the most important questions, and although much advance has recently been made in our knowledge of the disease and how it finds entrance into the human body, yet this point is not definitely settled. Some of the theories of infection deserve mention :—

1. **By Cuts or Abrasions.**—There is great probability that this mode of infection, by direct inoculation, occurs in some cases, as related in the Parel Report. In all five positive instances have been experimentally verified to have contained the specific bacillus in the local vesicle and corresponding lymphatic gland.

Prof. Aoyama, in Hong Kong, inoculated himself accidentally in this way and died of plague (also Dr. Ishigami, assistant to Kitasato), and Dr. Sticker, of the German Scientific Mission, in Bombay, during a post-mortem examination, accidentally cut his finger and got a mild attack of plague, with the corresponding axillary gland inflamed and tender, but recovered rapidly. Again, animals are easily, and in the laboratory generally, inoculated in this manner successfully with plague. There can be no doubt, therefore, but that plague can be contracted in this way. That it is the usual, still less the only, mode of infection, is not warranted by all the facts and experiences of plague epidemics. "One fails to see how, on this mode of infection-theory only, the disease is so infectious, and why it attacks so many people simultaneously. All those attacked can hardly have abrasions, and the bacillus is not so ubiquitous as to get at the possibly microscopic abrasions that might exist. Medical attendants, hospital assistants, and nurses often have abrasions during their attendance on those sick of plague, nevertheless usually escape." Staff-Surgeon M. Wilm, of the German Navy, relates the following ("Bainbridge") facts during his experience of the 1894 epidemic at Hong Kong:—About 300 European soldiers were employed on disinfecting operations, and all wore boots and putties, yet the few who were affected *all* had enlarged glands in the groin! It is extremely unlikely, with such good protection, that they had cuts or abrasions on their feet or legs, or developed such whilst at their cleansing operations in infected houses, but they must frequently have had such cuts or abrasions on their hands and come in contact with infection by handling infected articles; yet none developed enlarged glands in the axillæ! This shows that direct inoculation through cuts or abrasions was not, and is not, the usual mode of infection. Our Hong Kong experts maintained cutaneous inoculation was the most usual mode of infection, but further considerations show that its general occurrence is improbable, though no doubt it does account for occasional cases:—

"1. Plague would be even more destructive than it is, and its spread unlimited and immunity rare, if minute cutaneous lesions determined its mode of infection.

"2. It is not probable that a large proportion of those attacked have *suitable* skin lesions through which the infection could become absorbed, and even that such lesions should chance to become infected.

"3. The rapid diffusion of the disease, when once it gains a footing in an epidemic intensity, negatives infection by external inoculation.

"4. The superior class of natives, living in good sanitary, well-ventilated houses, rarely develop plague, although it may rage around their dwellings, and yet their habits as regards the non-use of shoes ordinarily do not differ from their worse-housed neighbours. The same is true for other classes of natives and Europeans who have been shown generally to be immune, on other grounds, under the heading Incidence and Immunity.

"5. In those infectious diseases which most resemble plague —typhus, relapsing fever, yellow fever—there is no evidence of external inoculation being the general mode of infection. Local manifestations of infection are met with usually in those infections (tubercle, syphilis, anthrax, etc.) which in their general characters differ entirely from plague clinically ; so that on grounds of analogy with other contagions the external mode of inoculation through cuts and abrasions must be rejected."—Modified from Bainbridge.

The inoculation theory of plague infection cannot account for sequential cases, inside ten days, in the same family, and those cases are very common in plague, as will be seen by their analysis appended, whereas such are easily accounted for and support causation by aërial infection.

The facts recorded show that 73 families had more than one plague case in each, and, from the difficulty in tracing relationship in Indian families, this number by no means includes all who had more than one plague case in their house. The 73 families group as follows:—In 41 instances two persons were attacked; in 14, three; in 13, four; in 2, five; and in 2, six persons. The 73 families aggregated 201 persons.

Amongst those 201 persons 115 were attacked on the first day, and the table herewith gives the days on which subsequent attacks took place. It is to be noted that re-infection and concealment accounted for attacks beyond ten days from the initial case in a family.

Day .	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	19	20	26
Attacks .	115	7	16	21	4	7	3	10	3	1	4	1	1	1	3	1	2	1

Total . . 201

In the 41 families with two attacks the distribution in time was: In 24 instances, both on the same day; in 5, on the second day; in 4, on the third; in 4, on the fourth; and 1 each on the sixth, ninth, and tenth days. The particulars regarding the families having more than two attacks are best exhibited in tabular form.

It is interesting to note that in all 33 families developed more than one case on the same day, and that in three families as many as three, and in three others as many as four persons fell victims simultaneously in spite of careful segregation and medical inspection (to discover fresh cases) twice daily. The amazing morbidity and mortality that would have ensued, as in the Great Plague of London, without those mitigatory measures can be more easily imagined than readily described.

	DAY.																
	1	2	3	4	5	6	7	8	9	10	11	13	14	15	19	20	26
No. in family.	ATTACKS.																
3 .	1	–	–	–	–	–	–	2	–	–	–	–	–	–	–	–	–
,, .	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
,, .	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
,, .	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
,, .	1	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
,, .	1	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–
,, .	1	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–
,, .	1	–	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–
,, .	1	–	–	1	–	–	–	–	–	–	–	–	–	1	–	–	–
,, .	2	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–
,, .	1	–	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–
,, .	2	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–
,, .	1	–	1	–	–	–	–	–	1	–	–	–	–	–	–	–	–
,, .	1	–	–	–	–	–	–	–	–	–	1	–	–	–	1	–	–
,, .	1	–	–	1	–	–	–	1	–	–	–	–	–	–	–	–	–
4 .	1	–	1	–	–	–	–	2	–	–	–	–	–	–	–	–	–
,, .	1	–	–	–	–	–	–	–	–	2	–	–	–	1	–	–	–
,, .	1	–	–	–	2	–	–	–	–	–	–	–	–	1	–	–	–
,, .	1	–	–	3	–	–	–	–	–	–	–	–	–	–	–	–	–
,, .	1	–	–	2	–	1	–	–	–	–	–	–	–	–	–	–	–
,, .	1	–	–	2	–	–	–	1	–	–	–	–	–	–	–	–	–
,, .	1	–	2	–	–	–	–	1	–	–	–	–	–	–	–	–	–
,, .	1	–	–	–	–	3	–	–	–	–	–	–	–	–	–	–	–
,, .	1	–	–	2	–	–	–	–	–	–	1	–	–	–	–	–	–
,, .	2	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	–
,, .	1	–	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–
,, .	1	–	–	–	–	1	–	–	1	–	1	–	–	–	–	–	–
,, .	4	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
5 .	4	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
,, .	1	–	–	1	–	–	1	2	–	–	–	–	–	–	–	–	–
6 .	1	–	–	1	–	–	–	–	–	–	–	–	1	–	–	2	1
,, .	4	–	–	1	–	–	–	–	–	–	–	1	–	–	–	–	–
Totals per day	50	2	12	17	4	7	2	9	2	2	3	1	1	3	1	2	1

2. **Infection by the Lungs.**—The pneumonic, constituting about three per cent. of all cases, is probably contracted by inhaling the germs. Some experiments on monkeys by Wyssokowicz and Zabolotony, of the Imperial Russian Scientific Commission in Bombay, have proved conclusively that this is a ready mode of infection. Primary plague pneumonia, therefore, may be granted to occur in this way, but it has yet to be proved that the ordinary—bubonic and septicæmic—forms of the disease are thus conveyed. This special form of primary plague pneumonia, in which the lymph glands are not tangibly involved—and indeed by post-mortem examination of such cases are not found enlarged—may depend on the direct entry of the pest bacilli into the blood through the lungs. In no pneumonic case has a general affection of the lymphatic glands occurred, but that such cannot occur from pulmonary infection does not seem probable, and its rarity or non-occurrence may be explained by the extremely rapid fatality of primary plague pneumonia.

The greater facility with which infection by way of the lungs occurs—and this is acknowledged by the supporters of external inoculation—would support the contention that the malignant type of plague (primary plague pneumonia) is contracted by this route, and lends probability to its being the general mode of infection.

3. **Infection by the Alimentary Canal.**—The few cases of "abdominal type" or "typhoid" plague that have been described lend countenance to infection by the ingesta or rather through the mucous membrane of the alimentary canal. This "abdominal type" of plague is not, as some suppose, confined to Europeans, as the writer has seen at least six cases amongst natives, chiefly women. The mesenteric glands are frequently—though not chiefly—found affected in plague post-mortems; even when external glands are slightly or not at all infected the mesenteric glands show morbid changes, but in a generalised septicæmic condition such is to be expected. This form of infection is rare, but that it does take place is highly probable.

In the Hong Kong reports Kitasato found plague bacilli invariably in the urine and fæces and also in the blood of convalescents up till thirty days after subsidence of fever and all acute symptoms.

In marked contradiction to this *all* the Scientific Commissions that visited Bombay failed to find the bacilli in either the fæces or urine under repeated experiments and varied conditions, and never in the blood *except in fatal cases*, and not at all in true convalescents once the temperature had become normal. It would seem that to see the germs under all conditions very often one uses a microscope that can produce them. It would be a false and perhaps dangerous conclusion to regard the excreta as non-infectious on those grounds, for the bacilli may exist in the excreta in forms which are not as yet identified by bacteriologists, perhaps in the condition of "involution or altered forms," as demonstrated by Hankin, Haffkine, James Thomson, etc.

Whilst treating excrement as a suspect with the utmost caution, it is to be borne in mind that it has not been actually demonstrated to be capable of transmitting the disease. I am inclined to a contrary view owing to the fact of "halalcores" and night-soil (sweepers) workers generally being conspicuously exempt, even in plague hospitals, from plague. Houses near latrines are stated to have been most affected, but the sanitary condition and state of ventilation of such houses is not referred to or may not have been considered, and latrines are likely to be situated near houses that are closely built together, and the effluvia from latrines, badly kept, devitalise the air and burn up some of its oxygen.

Plague is probably not often conveyed by ingesta owing to the destructive effect of cooking food grains on the plague germ. The comparatively slow manner in which the disease spreads from place to place, although food grains are rapidly transported all over the country, and the fact that several persons partaking of the same food (as in cholera) are not affected at the same time, is against food as a vehicle of infection.

Both laboratory experiments and general experience tend to show that this is not a general mode of infection (*vide* Hankin's Reports). The special type of disease attributed to infection by ingesta is rare—the rarest of all forms of plague—and a very artificial division of the disease depending chiefly on the presence of acid diarrhœa and the "typhoid state," which latter is met with in other types of this disease. Many authorities who have seen typhoid plague so-called deny its claim to a special nosological position, and we are inclined to this view.

There is no evidence to show that plague has spread from one place to another, much less from one country to another, by infected grain or other food materials.

4. **Aërial Infection.**—This seems, on a review of all the facts available, the most general mode of infection, and explains all those instances of "incidence and immunity" already noted under that heading, and which are explainable on no other grounds as far as observation and experience can help in a solution of this problem. As has been already pointed out, all observers are agreed that primary plague pneumonia occurs by aërial infection through the pulmonary membrane, and from the facility with which this can occur it is not unreasonable that it is the general mode of infection in ordinary circumstances.

Why as a general rule one particular lymphatic gland should be affected and that not the one in nearest anatomical relation with the exposed, and, on this view, infected and infective pulmonary surface area, seems difficult to account for, nor why the whole lymphatic system escapes in plague contracted through pulmonary inoculation. In a similar disease of epidemic character —mumps—one (or two) of a special group of glands is inflamed from general infection of the blood by the assumed micro-organism of that disease, for in it external inoculation can hardly be considered as the mode of infection. One is inclined still further to support aërial infection when one considers the great objections to inoculation through cuts and abrasions and the inability of its advocates to explain the development of multiple buboes simultaneously and primarily, which is met with in about eight per cent. of plague cases. Infection takes place by remaining in and inhaling the devitalised air in which patients are attacked, and under the insanitary conditions of their dwellings few who tried the experiment of living in the same atmosphere with them under identical conditions would escape. The great fatality of former plagues, *e.g.* the "Great Plague" of London, in which sick and healthy were compulsorily shut up together, bears out the truth of this view. The instances in which whole households are affected, when segregation is not enforced especially, and even during rigorous segregation, within the ten days' incubation period of plague, after exposure to infection or by coming in contact with infected persons, are so numerous that the conclusion that inhaling the microbes in any place in which the air is tainted and possibly contains them in great numbers (as yet no positive experiments have been published on the air of plague-infected houses) seems conclusive as regards the mode of general infection.

The exceptions to this in which susceptible persons may inhale the same air as plague patients, in *sanitary* plague hospitals for instance, and yet remain exempt, only go to show that the virulence of the germs is neutralised by a sufficiency of fresh air, cleanliness, and light, all of which have been proved experimentally to have a very detrimental effect on the potency of the pest bacillus for harm. It is, of course, also probable that under the more favourable hygienic conditions persons so exposed possess an enhanced power of vital resistance—or natural insusceptibility—to the inroads of the microbe. It has many times been noted that medical men and other attendants on plague patients occasionally suffer from headache, malaise, anorexia, and an inflamed or tender lymphatic gland at times without being at all further inconvenienced or developing symptoms of plague such as are clinically met with. The case of the sweeper at Parel Hospital is an instance in point, and since then two fresh instances of a similar transient character have come to notice.

Here the vital resistance of the healthy organism has been capable of resisting the inroads of the microbe, which under less favourable conditions of general health and sanitary surroundings might have been overcome and the individual claimed as a plague victim. As in the case of tuberculosis, it is known the microbes are very generally diffused, and yet general infection of the whole populace does not follow; so in a plague epidemic it is scarcely possible that the germs are entirely absent from all dwellings in which plague cases do not occur. In this respect plague contrasts favourably, and in a strikingly forcible manner, with its cousin-german disease typhus fever, in which latter disease six weeks' attendance on the sick suffices to induce an attack on those not protected by a previous attack of typhus (Murchison), even under very ideal sanitary surroundings. Free dilution with pure air seems to kill the plague germ readily.

Other Sources of Infection.—There is no evidence to prove that a single case of plague has been caused by the (usually contraband) merchandise exported from the infected areas in India. It is proved that the microbe does not travel for considerable distances in the air or dust; and the microbe is of itself non-motile.

Healthy persons can only carry the *contagium vivum* in infected clothing, rags, etc., especially when such articles are shut up in trunks or bundles, and unexposed to the purifying action of air and sunlight. The longer the distance to which fugitives from plague-infected localities travel, the longer the interval before they themselves fall ill with plague, and their new habitation becomes infected. This is due no doubt to the partial inhibition of the virulence of the germs on the journey, when they are influenced to some extent by air and sunlight in India, and thereby scotched, but not killed. When the germs gain a suitable nidus, and are suckled, as it were, into fresh vigour by the insanitary surroundings into which they have been introduced, they regain their virulence and plague develops.

The water supply does not, from Hankin's researches and experience of others, appear to be a source of danger; nor do drains and sewers harbour the germ, so that they only contribute to plague incidence by their insanitary condition and devitalising the surrounding atmosphere. Graveyards need not be looked on with suspicion, as the germs require air for their growth, and the post-mortem decomposition with the acids and other micro-organisms produced therein destroy the pest bacilli of the corpses of interred plague patients.

Although all parts of the body present channels of entrance, some parts appear to offer a greater aptitude for receiving infection than others. It is a mistake, however, to suppose that the site of the primary bubo indicates the gate of entrance of the specific germ. In a disease which shows itself most malignant without the supposed pathognomonic lesion of a local tangible bubo in 15 per cent. of all cases almost, it does seem absurd to guess what has been the mode of entrance in any particular instance.

Regarding infection through the skin, there cannot be any doubt of its possible occurrence. It is doubtful if the microbe can pierce the healthy human skin. Some experiments made on the blistered skin of monkeys would throw light on this subject.

It has become a fixed delusion that the point of entrance of the pest organisms can be guessed at by finding the supposed primary lesion. As well might one argue that the tongue is the route, because it is very early furred; or the conjunctiva, because in many cases it shows early and marked injection; as factitiously assume that the rarely discoverable "phlyctene" was the site of entrance.

It would be just as rational to state that the enteric germ enters by the nose because of the early headache, or through Peyers glands because of their marked inflammation in enterica. It is a fact that germs betray a selective affinity for certain tissues, that is the extent of our knowledge; anything different is not of science, but of speculation. It reads clever when Batzaroff states, "It is possible in a certain way to conjecture what has been the gate that has given entrance to the infection, considering the site at which the primary bubo appears, since the relation is usually so direct that the inoculation of the plague would supply an excellent means for the study of the anastomoses of the lymphatic vessels."

It is best to state that all parts of the body do not offer the same aptitude for receptivity of the infection; in the septicæmic variety buboes form anywhere, and tunefaction of groups of ganglia signify nothing as to seat of infection. The primary bubo, however, is distinguishable by its size, early appearance, great peripheral œdema, and multiple growth of bacilli inside it.

It is dangerous to dogmatise from experiments on animals as to what happens in mankind. For instance, infection *per vaginam* has not been possible in animals, yet we are quite positive that there is no more certain way of contracting malignant pest than by sexual intercourse with a woman the subject of the ordinary type of pest with buboes, or incubating pest. The three cook orderlies at Parel were infected in this manner, and our inquiries regarding pneumonia attacks at Hong Kong and elsewhere fully confirm this view—a terrible penalty for such indiscretions or immoralities.

"All the Shropshire Regiment men infected had femoral or inguinal buboes, and they were well booted. . . . Seeing that the disease often causes a general enlargement of glands . . . the mere point as to which set of glands is usually enlarged has been made too much of; more especially considering that sometimes the biggest gland is situated in the abdomen out of sight until the post-mortem examination."—Lowson.

It will thus be seen that several modes of infection exist, but the fact that such an engine of destruction must, long ere this, have annihilated mankind, had not various atmospherical barriers which are constantly arresting its progress or suspending its powers been interposed, must not be lost sight of, and gives the key to its eradication on the only reliable scientific grounds. Its spread is conditioned, else how did previous epidemics die out and disappear?

The chief conditions favouring its precipitation and propagation are, in the order of their importance (1) want of fresh air, (2) overcrowding, (3) filth. On a strict analysis it will be seen that all three involve the main idea of bad air as the greatest contributory factor to the incidence and spread of plague epidemics; for filth of body, clothing, habitation and its surroundings devitalise the air by robbing it of its vital oxygen, and possibly other recently discovered important elements which exercise an incalculable benefit on human beings—perhaps as much as overcrowding and deficient ventilation.

It is interesting to note how historically accurate is this conclusion, as it is supported by the undesigned record of facts and observations of previous observers before the what might be termed "want-of-fresh-air-theory" of plague causation had been demonstrated. To quote only a few facts from the voluminous field of previous Indian plague literature.

Dr. Ranken's report on the Pali plague of 1836 :—

"The town is abundantly filthy, the cattle being either the actual inmates of a number of the houses, or pent in folds as close to them as possible. The most studied art could hardly devise a more effectual plan for rendering their nuisances every way offensive than that universally prevailing among the people. . . . Immensely high hedges run round the town as a defensive outwork, and into every crevice or corner where there may be possibility of egress or ingress either to man or animal."

Dr. Hutcheson, regarding Garhwal and Kumaon, states :—

"Mahamari has been fostered by the uncleanly and filthy habits of the people who house cattle, sheep, goats, and other animals on the ground floors of their *unventilated* houses. They also defile and pollute the neighbourhood of the village in defiance of all sanitary law, and in their helplessness permit refuse and noxious weeds to fill the air with rank odours, adding to the foul emanation that penetrates every nook and corner of the *overcrowded* impure dwelling, which forms a nursery of zymotic disease, and is the birthplace of the pestilence."

Dr. Whyte, on plague in Kathiawar in 1816, reports :—

"It (the town of Muli) was surrounded by an old ruinous wall full of breaches, which were all carefully stuffed with thorns, and every house had a wall of the same material much higher than a man's head. No better means could possibly have been adopted completely to exclude ventilation, if this had been the sole object of the inhabitants."

He concludes that while it spread with facility in a close and insanitary situation, the reverse was the case in an open space and where sanitary conditions prevailed, thus fully confirming the present opinion.

"It was the habit of the people to live in crowded, dirty, ill-ventilated, walled towns, and in the houses men and cattle were herded together in the most unwholesome manner."

Dr. Ranken thus describes a typical Rajputana village :—

"The hut, or one of the same dimensions, which was the unwholesome den of four persons, for example, fifty years ago, now shelters six human beings within a space barely sufficient for the accommodation of one. These miserable habitations are often enclosed by an outer screen or wall, for the double purpose of confining the cattle and secluding females from the public gaze. Glass to let in light, or apertures to admit fresh air being unknown, the door, in order to keep out heat at one season and cold at another, is generally shut. The poor feel most at home in such dark places with their children lying round them on the floor, too much like hogs in a stye amidst their litter. The sense of insecurity for life and property which deterred their ancestors from living near the fields which they cultivated, in farms, houses, and cottages scattered over the face of the country, owing to hereditary habits of thinking, still perceptible to this day"—(and up till 1901)—"under the very cannon of Fort William, makes the peasantry everywhere accumulate their hovels within the narrowest limits, and the consequence is that each dirty village, unventilated, and overcrowded with man and beast, exhibiting every sort of nastiness, is a focus of disease."

As regards Himalayan epidemics of plague within the endemic districts of Kumaon and Garhwal, it seems at first sight surprising that constant outbreaks should occur in villages scattered over the mountain sides, open to the pure air of the hills, and supplied with water from the mountain streams. On strict investigation, however, the explanation is found in the very insanitary conditions under which the people live, in their ill-ventilated, overcrowded, and filthy houses. Dr. Rennie in 1850 noted :—

"The filth is everywhere—in their villages, their houses, and their persons. It destroys the otherwise pure quality of the air, and maintains ever round the inhabitants that contaminated atmosphere so favourable to the condensation of infectious emanations. Their dwellings are generally low and ill-ventilated, except through their bad construction; and the advantage, to the natives of other parts of India, of living in the open air is lost to the villagers of Garhwal, from the necessity of their crowding together for mutual warmth and shelter against the inclemency of the weather."

In Dr. Stiven's report :—

"The infection spread from the house in which the first case occurred, choosing the most populous, crowded, and filthiest parts for its development, whereas the more sanitary part of the town had only one case, that ended in recovery."

These corroborative quotations are strictly authentic, and are enhanced in value by the consideration that they are spontaneous records of facts, commemorated without preconceived theory or preconcerted design.

CHAPTER VI

CHEMICAL DISINFECTANTS

THE microbe of plague is easily destroyed in a laboratory test-tube by various agents. Even heating up to 100° C. (212° F.) a cultivation of the germ suspended in water kills all the bacilli. Fifteen minutes' exposure to heat at 70° C., and five minutes at 80° C., kills virulent cultures on fluid or solid media. Corrosive sublimate 1 in 1,000 kills the bacilli at once. Carbolic acid 1 in 100 within ten minutes, and many other substances can destroy the germ under laboratory conditions. When, however, the bacteriologist tries to imitate the conditions existing in nature as nearly as possible, there is an increasing mass of evidence to prove that the annihilation of the germ is not such an easy matter. It has been suggested that the laboratory microbe may be more virulent than that found in its natural habitat, but this assumption is disproved by the attenuation that all varieties of the pesto-coccus, from whatever source obtained, undergoes during cultivation. This variability towards attenuation is the great obstacle to producing anti-plague prophylactic medium of an unvarying strength.

Laboratory experiments may prove that the plague microbe is destroyed by certain chemical disinfectants; but the houses of the plague-infected are not laboratory test-tubes. Moreover, it is to be carefully noted that our bacteriologists and scientists know hardly anything of the existence (it has been recognised once or twice only *outside* the animal body) of the plague bacillus in its extra-somatic (human or animal) habitat, of its forms, life history, etc. That it does exist they do know. And further, our corrosive sublimate is neutralised, hindered in its action, and rendered almost inert by other microbes in the floors, etc., of houses, and is converted into albuminate of mercury by the organic matter it meets with on cow-dunged floors and everywhere it is applied: and this albuminate of mercury is a very weak disinfectant.

In his report to the Surgeon-General, Mr. Hankin states:—

"The conditions of the above experiments appear to be *more favourable* to the disinfectant than would as a rule be the case in practice. If a disinfectant is unable to destroy the microbe in ten minutes, in the absence of foreign substances that might tend to neutralise or mask its action, it is *not likely* to be always able to destroy the microbe within a reasonable time under the conditions that obtain in practice. This reason, while justifying the condemnation of a disinfectant from the results of such experiments, necessitates caution in using such experiments to recommend a disinfectant. In practice a disinfectant is not required to sterilise test-tubes containing suspensions of microbes, but to treat infected floors, clothing, drains, etc. The floor may be made of cow-dung, which generally, though not always, has an alkaline reaction, and this alkali may tend to neutralise acid disinfectants, or to hinder the liberation of chlorine from chloride of lime. Clothing and drains are likely to contain mucous, albuminous, and other substances which may precipitate sublimate and other metallic disinfectants. An adequate disinfectant of a cow-dung floor appears from my researches to be a far more difficult matter than is commonly supposed" (p. 30).

"Chloride of lime, phenyle, and lysol *appear to be without much action* on the microbes of a cow-dung floor, although, as is known, they are energetic disinfectants of microbes suspended in test-tubes of bouillon" (p. 32).

"Another question that must be taken into consideration in choosing a disinfectant is whether its action is likely to be *lasting;* whether, in other words, its employment is likely to make the medium unsuited for a considerable time for the life of the bubonic microbe. This is possibly more important in the case of bubonic plague than with other diseases. Not only in this disease is a disinfected area liable to be reinfected by human patients, but in addition in many cases this may occur through the agency of infected rats. Hence a disinfectant that merely destroys the microbes present at the time, and that has no lasting action, is not sufficient for the purpose. As shown by previous experiments, acidulated sublimate solution is the only one of the disinfectants tried that showed a clearly good (approaching but *not* procuring complete disinfection) action on a cow-dung floor. Unfortunately, however, solutions of mercuric chloride, even with the addition of volatile hydrochloric acid, are by no means stable, especially when mixed with the material of a cow-dung floor. A further consideration bearing on the choice of an antiseptic depends on a view that is generally held by those having experience of plague, namely, that the virus is sooner or later destroyed by ventilation" (p. 35).

It is an undeniable fact that plague cases have developed (not been imported merely into) in houses that have been disinfected over and over again. Of course one may reply, Oh! the disinfection cannot have been thorough. But the number of instances have been too great to justify that reply; and besides, what does it amount to but a confession that the only practicable method of disinfecting is, in actual operation as opposed to scientific idealism, untrustworthy. Moreover, there is reliable scientific evidence to hand that ideal disinfection cannot be wholly relied on to kill the plague bacilli. Mr. E. H. Hankin, in his investigations on plague, reports to the Surgeon-General with the Government of Bombay, under date Agra, July 17th, 1897, on disinfection against the bubonic microbe. He states:—

"It will be noted that the only substance tried that produced anything *approaching* a complete disinfection was corrosive sublimate in an acidulated solution" (p. 32).

Even this did not destroy all the microbes, and it is quite fair to argue that if even one microbe was left under suitable environments, it could develop into lakhs. In fact, he concludes that "thus in the above experiment complete disinfection appears to have been produced by the burning of a layer of grass two inches thick." All chemical means of disinfecting proved unreliable for producing a lasting action.

Chemical disinfection with perchloride of mercury

1 in 1,000 has been practically tested in Satara plague epidemics, under the most favourable circumstances and with the greatest practical precautions to ensure a fair trial of this method of combating the disease. Practical experience confirms the results of reliable laboratory experiments to try to kill the bacillus under conditions similar to those in actual practice with approved disinfectants.

Instances of Plague in houses disinfected by chemicals.—Many instances of plague attacks and deaths inside the accepted ten days' incubation period were noted during the first epidemic in Satara. The following instances were noted where a longer interval than ten days elapsed between attack and disinfection by 1 in 1,000 perchloride of mercury solution to the ceiling, walls, and floor, pumped forcibly through wooden pumps with every precaution as to purity and strength of the solution :—

Name.	Date of disinfection.	Date of attack by plague.
S.R.L.	12.2.98	26.2.98 = 14 days.
S.S.B.	21.2.98	3.3.98 = 11 ,,
P.K.G.	21.2.98	16.3.98 = 24 ,,
B.W.S.	27.2.98	26.3.98 = 27 ,,
D.N.J.	15.2.98	8.3.98 = 21 ,,
G.R.	23.1.98	27.2.98 = 35 ,,

In January, 1898, the gaoler's house was disinfected with mercury solution, and his daughter was attacked on December 19th, 1898.

The house was again disinfected on December 20th, and under strict European supervision, yet two persons were attacked with fatal plague January 10th, 1899, eleven days after re-occupation. The house is isolated and the inmates guarded against outside sources of re-infection and kept themselves aloof from likely sources of contagion in the town, and were practically "sealed" or segregated whilst in residence. They had been disinfected with their clothing before re-admission. This instance is also interesting in determining the length of interval after which a plague-infected house is fit for occupation. At least one month's exposure to light and air is necessary.

The segregation of this family for twelve days, where for the first two days both mother and father (subsequently attacked and died) attended their daughter ill with plague, did not infect them; but immediately almost on return to their house, in which they could put their habits of air exclusion into practice.

The only reliable measure is the demolition of insanitary dwellings in the crowded and filthy quarters of our towns and their reconstruction on approved sanitary principles, and a system of skilled supervision by a reliable staff of sanitary officers and subordinates so as to prevent gross abuses of sanitary laws subsequently. To accomplish this public opinion must be enlightened and the sympathies of the people enlisted on the side of sanitary progress. It is a great undertaking, and requires time; but the results will be commensurate with the trouble and expense, and convert our towns into collections of neat, clean, detached houses, instead of a congeries of ill-built, insanitary hovels as at present. To secure sufficient cubic space and ample ventilation are the desiderata to be aimed at. A uniform plan suitable to the needs of the climate and the simple tastes of the people should not be beyond the power of engineering experts to devise. The proposal has been decried as outside the range of possibility; the only alternative is the pettifogging and expensive method hitherto relied on, woefully barren of permanent and tangible results. The plan only requires to be kept before the public, and when they see that it affords the only means of escape radically and for ever from this scourge they will very soon follow the light and leading of reason, science, and common sense. The purpose can be easily accomplished, in time, with capital to back it up, on a sound financial basis. The money that is practically thrown away at present on whitewash, disinfectants, and temporary expedients of sorts—bamboo perishable huts, etc.—might have gone far towards inaugurating the dawn of a new era for plague-stricken populations. The necessity for such radical sanitary reform requires to be recognised and acknowledged by the profession and legislators; and a definite sanitary policy adopted which will soon make the proposition, at the idea of which some may at first stand aghast, an accomplished fact. The inception of this crusade against insanitary dwellings and habits is a duty the leaders of the profession owe to the age and to posterity. It is doubtful whether the next century will wonder more at our pursuit of gold and diamonds and the lamentable waste of energy that might be well diverted to the useful work of making the cultivable earth more fruitful or the barren places to rejoice and blossom, in the acquisition of things in themselves well-nigh valueless; or at our puny efforts to combat plague epidemics in the light of our boasted civilisation. Experts, so called, may even laugh at this idea, and over-rate the supposed technical difficulties that bar its way; but it is sufficient to draw the public attention to the dangers present and prospective of our breaches of sanitary law, and to impress upon governments the urgent necessity for preventive remedial action before an invasion of the dreaded malady drives home the truth when too late to set our houses in proper order. State remedies cannot be applied with success in advance of public opinion; the education of the people is the most difficult of tasks for practical sanitarians. Here we put the unscientific mind in possession of the facts, endeavour to convince it, to overcome its prejudices, and rouse it to take action for its own salvation.

Pythagoras advised mankind to find out that course in life which is best, and habit will render it the most delightful.

The anxious competitions of modern life have obscured the real things that are worth pursuing, so that even the most enlightened fail to give them their proper relative value. The science of hygiene aims not only at stamping out, but preventing infectious diseases, and this is a very extensive task. How shall they hear, however, without a preacher? hence this publication is justified. That mankind would be led to look less and less on money as the be-all and end-all of their existence, and more to health and how to conserve it as more desirable; for money is not health, or life, or air, or food, or clothing, or rest, or sleep, or protection from the elements; and these are the essentials of a good life. The attempt at disease prevention, however far short of its realisation our efforts attain, is a labour worthy of our best energies.

Professor Fraser's opinion:—

"The evidence adduced is insufficient to show that chemical disinfection has had a preponderating effect in destroying plague infection—chemical disinfection was not alone trusted to, but was accompanied by other means. Chemical disinfection, though useful as an auxiliary measure, has never by itself proved sufficient to arrest plague.

"It is not to be overlooked, also, that the probabilities of success by the use of the solutions of even the most powerful disinfectants are dependent upon the supposition that the large majority of the plague bacilli are found only upon the surface of the floor, whereas the relatively porous nature of the materials of earth and cow-dung floors and the conditions to which their surfaces are subjected are against the supposition. The chemical composition of these, and still more of concrete floors, is such that the effective ingredients in strong and acidified solutions of perchloride of mercury would nearly instantaneously be neutralised by contact with them. It is not the case that the bacilli are generally free or naked, but rather for the most part incorporated with sputum and excreta, the constituents of which would protect them from contact with the disinfectant, whose action upon these constituents would indeed result in the formation of a surrounding covering nearly impermeable by the disinfectant; and, further, if any bacilli upon the surface of the floors were covered 'by leaves, bits of rags, etc.,' they 'could hardly be hurt at all' by even so strong a disinfectant as an acidified solution of 1 in 725 of perchloride of mercury. Infected rats burrow in the walls and roofs, and obviously are not affected by chemical disinfection. However effectually, therefore, the process of chemical disinfection may have been carried out, the house remains as dangerous for occupation after the process as it was before it, for the infected rats would enter the rooms and reinfect them on the first opportunity. It is probably because of this that chemical disinfection alone has so frequently failed, while the providing of openings sufficiently large to admit air and light into each room, conjoined with the removal of the inmates from the houses for a period of several weeks, has proved so successful. The difficulties connected with the efficient application of chemical disinfectants, and the uncertainties regarding the strength of the solution or mixture of any of them required to ensure the death of plague bacilli in earth and cow-dung floors, give further support to the value and importance of utilising the disinfecting actions of sunlight and free access of air, which experience has amply shown to be efficient for the purpose."

"From February, 1897, in Bombay, 31,000 people were engaged in washing the streets, houses, drains, etc.; at the end of that year the mortality was frightful. In September it was decided to burn the bedding and clothing of the sick, to isolate them, and disinfect their dwellings; the epidemic continued indifferent to all. . . . It is a fact that not one case occurred on the (local) steamers, in spite of the enormous overcrowding. Finally, people are recommended to isolate themselves as much as possible; but in London and Bombay the prostitutes, tinkers, and beggars—people whose occupations force them to be sociable—were those least affected by the epidemic."—Montenegro.

The means used did not attack the true causal factors in the disease; hence they proved, if not altogether useless, abortive. They ought, therefore, in future to take a quite secondary position in the minds of administrators—they are only palliatives.

The combating of pest by solutions of $HgCl_2$, made with Indian river water in the rains, when it is like pea-soup, or any other natural water, is as useful as pumping rose water through a garden hose for the purpose; and radical sanitary reform, based on the true theory of the causation of the disease, is applicable at all times, during the rains as well as in the hot season; so that the answer to one of the pet questions of a very astute member of the Plague Commission—"What would you do during the rains?"—is universally true—sanitate! sanitate! sanitate!

CHAPTER VII

PLAGUE EPIDEMIC IN SATARA CITY 1897–8

SATARA city, in N. latitude 17° 31′ and E. longitude 74° 3′, is the headquarters of the Satara district, with, in 1881, a population of 29,028, and is situated 2,320 feet above sea-level, 60 miles from the coast and 69 miles S. of Poona, and 10 miles from the Southern Mahratta Railway. The 1881 census showed that Satara is the twelfth city in the Bombay presidency, with a town site of 526 acres, and a population of 55 to the square acre. Satara is bounded on the N. by the new Poona-Satara road, on the W. by Yavteshvar hill (1,500 feet above the town), on the S. by the fort (900 feet high), and on the E. by an offshoot of the fort hill. Its greatest length from E. to W. is about 2 miles, and from N. to S. about 1½ miles. Seen from a distance, the town is situated at the base of the fort, and in a semi-circular recess on the S.W. border of the valley formed by the fort and Yavteshvar hill. It is built on the slope below a range of hills, and this high situation affords natural drainage to the Yenna—a branch of the Krishna—on the N. by means of many small brooks. The southern part of the town is most of it on a slope, some of it rather steep, being the lower declivities of the fort hill. The centre of the town is fairly level, but a good deal cut up by the streamlets which run through it. The main streets are broad thoroughfares, but the buildings are of small pretensions. The city has 4,652 houses, of which 1,610 are of the better sort and 3,042 of the poorer sort. The better class of houses are, as a general rule, built upon a plinth of chiselled cut stones, with a superstructure of burnt bricks, and roofed with good seasoned wood, sometimes with an upper story. The outer walls of the principal houses of this class are strongly built, with a gateway leading into an open courtyard, with a verandah running all round the main building. The rooms and the upper stories have generally windows facing the courtyard; the roofs of the houses are invariably covered with the flat brick tiles made in the town; the front stories have in some cases balconies facing the road, which add to the appearance of the building.

The houses of the poorer sort have generally a coarse rubble plinth, and are built with sun-dried bricks, the walls being in many cases plastered with mud. They have only one ground floor, and when they have an upper story or loft it is generally set apart as a lumber room. They have the doors facing the streets, and in very few instances one or two small windows. The ventilation of these houses is very defective, as it is only from the low doorway opening into the street by which air finds admittance into the house in the day-time, while during the night, the door being closed, ventilation is obstructed. All these buildings are also covered with tiles. The internal arrangement of these houses is regulated according to the social position, means, and the religious prejudices of the owners. Houses of the better sort, belonging to well-to-do Brahmans, Prabhus, and Mahrattas contain generally a separate god-room, cook-room, sleeping-room, store-room, and a hall, which latter is usually more spacious and open to light than the other apartments. The rooms for the female members of the family are the darkest, and, with the bathing-rooms, are provided for in the rear of the building. Private cattle sheds, privies, and stables are detached from the main building.

Poor houses cannot afford such conveniences, but when the owner of such a house happens to be a Brahman these objects are attained by the use of reed or bamboo partition walls plastered with mud. If, however, the house is sufficiently large, mud walls are built to form the requisite number of rooms to accommodate cattle, persons, bathing-place, privies, etc., under the same roof!

The houses of Mahomedans have the halls and the female apartments more spacious and well ventilated, the rest of the internal arrangements of the buildings being the same as observed in Hindu houses.

The Parsis, who form a very small portion of the community, have their houses built entirely after European fashion. Some of the newly-built houses have been provided with means of ventilation, but, as a rule, such provision is conspicuous by its absence.

Houses consisting of thatched roofs and wattled walls are inhabited by poor landholders and field labourers, and by the depressed and impure castes. The inside of a wattled hut is generally divided into two or three spaces by bamboo matting or by branches, and except when the number of cattle is large a part of the hut is given to them.

The rich use copper and brass vessels for cooking, and the poor cook in clay pots and use earthenware for all household purposes, at most possessing a metal drinking cup or water pot.

The ordinary wooden furniture in a rich Hindu house includes cots, boxes, and stools; and many have a wooden swing on which to recline and smoke the grateful hookah. Of late chairs, tables, and cupboards have begun to be introduced. The elders prefer carpets, cushions, and quilted rugs to chairs and tables, and metal pots to glassware. The furniture of a middle-class family is the same as that of a rich man's, but is only enough for the use of the family. He may own a few spare dishes, but not enough to lend to others or to use in giving a caste feast.

The daily food of a rich Hindu family includes rice, wheat, millet, pulse, vegetables, clarified butter, pepper, salt, and oil; and, in families to whom flesh-eating is lawful, fish, mutton, fowls, and eggs. The everyday food of a middle-class family includes millet or rice, butter, pepper, salt, and oil, and occasionally, where lawful, fish and flesh. The daily food of the lower classes includes millet, vegetables, pepper, and salt, and occasionally they use rice, fish, and flesh. Rich and middle-class families lay in a stock of the chief grains at the harvest time of each grain. Those who drink liquor also generally keep some in store. Except in rich and middle-class families, who employ cooks, the cooking is done by the women (usually widows) of the household. Even in well-to-do families the women of the house not only supervise the cooking, but themselves prepare dishes which require special skill or little labour.

The style of dress of almost all Satara Hindus is much the same. The differences are chiefly in material due to difference in wealth. A rich man's indoor dress includes a waistcloth and a shoulder cloth; when he goes out he adds a waistcoat, a coat, a turban or headscarf, and shoes. If the home waistcloth is short, he puts on a larger and costlier one, with or without a silk border. His wife's indoor and outdoor dress is a coloured robe and bodice. The wearing of caps for boys is a fashion which has lately come in from Bombay. A boy's show dress is a rich pair of trousers or loose cloth, a silk or broadcloth coat, and a fine lace-bordered cap. Up to three years old the dress of a rich man's daughter is the same as her brother's dress. After three she generally wears a bodice and petticoat, and sometimes a robe. Middle-class men and women wear clothes of the same form as those worn by the rich, but of cheaper quality in thin cotton. Among the poor the men wear a loincloth or a pair of short, coarse cotton breeches, a waistcloth of the same material, a woollen blanket, and a long, narrow headscarf wound into a turban. The women dress in the robe and bodice.

Climate.—The climate of Satara is one of the best in Western India, and is said to be particularly good for Europeans. The hot season generally sets in about the beginning of March, and the heat reaches its maximum in April. The early part of the day is still and calm and pleasant till about eight, after which the heat rapidly increases. Soon after twelve a strong westerly breeze sets in and continues to blow during the remainder of the day. It is hot, dry, and disagreeable until sunset, when it gets cool, soft, and refreshing. During April and May the sea breeze blows, and ensures cool nights. April, both to the feelings and as measured by the thermometer, is the hottest month. Thunderstorms in April and May moderate the heat of Satara hot weather, which is neither immoderate nor protracted.

The south-west monsoon sets in between June 10th and 20th, and the climate now gains the coolness characteristic of the Deccan monsoon, and in a few days the fields and surrounding hills assume the freshness and verdure of a northern spring. For about a fortnight in July rain falls heavily, and during the rest of the monsoon there are two or three heavy falls of a week or ten days each, when the weather often gets chilly and damp, but no excessive dampness of the air is ever experienced indoors. Towards the end of August or beginning of September the showers become lighter, more partial, and of shorter duration. The roads and paths dry up so quickly that exercise can be indulged in between the showers almost every evening. The air is now pleasantly moist and agreeable to the feelings, and hailstorms occasionally are experienced at this time from the north and east, marking the close as they ushered in the beginning of the monsoon.

The climate of the four monsoon months, which but for the opportune fall of the periodical rains would prove the hottest part of the year, is in this part more agreeable than that of the hot season. The temperature in a house during three months of this period ranges from 72° to 75°; the atmosphere moisture is moderate, and exercise in the open air during the day may be indulged in with pleasure and with greater impunity than during the cold weather. During the twenty-four years ending 1883 the rainfall varied at Satara from 30 inches in 1866 to 58 inches in

1875, and averaged 41·52 inches. The rainfall at the Civil Hospital situated in the town usually exceeds that in the station situated a mile north-east by six or eight inches. The month of October connects the rainy and cold seasons. During the first part of the month the sky is usually chequered with clouds; there are occasional heavy showers, with or without thunder, from the eastward; the winds are light and changing, and the air is soft and sometimes close, though by no means unpleasantly warm. The atmosphere is without the bracing freshness so characteristic of the hill stations' air at this time, but, on the other hand, it does not partake of the oppressiveness which is felt on the coast. But when there is a deficiency of the late rains, a hot, dry, easterly wind sometimes prevails, succeeded by close nights. In the latter part of the month the sky is clear, and the air becomes dry and warm at midday. In the evening there is generally a light westerly wind and a heavy dew at night. The cold season begins in the first week of November, after which, and during the two following months, the climate maintains a tolerably uniform and steady character. The mornings are still and cool, and frequently cold, with occasional morning mists. In the early part of the day an easterly or north-easterly wind springs up, and blows with varying degrees of strength until three or four in the morning.

In clear weather, during the early part of the season, there is a fairly copious deposit of dew. Towards the end of January the wind generally begins to veer westward in the evening, and in February the sea breeze sets in with great regularity between eleven and one, and blows throughout the rest of the day, rendering the climate more agreeable than in the colder and drier months that precede it. Such is the prevailing character of the weather of the cold season.

But there are frequent intervals of cloudy weather which last for a week or ten days. The coldest weather is always experienced when the sky is perfectly clear. A few showers of rain fall in the course of the cold months, but they are less frequent and less heavy at this station than in the district to the east. They occur most frequently in November. The mean temperature of the four winter months, excluding October, averages from 68° to 76°; but though this is the coolest part of the year, the weather is not so pleasant as the monsoon climate. The air is often unpleasantly dry, and in the cold season the temperature sometimes varies as much as 40° in twenty-four hours.

The average rainfall is 41·52 inches yearly.

Soil.—The hills in the neighbourhood are composed of trap capped with laterite. At Satara the soil varies in depth from two or three feet to perhaps fifteen or twenty, and consists of soft, spongy, easily friable earth (murum or cotton soil) overlying the hard trap rock.

The 1872 census showed for Satara city a population of 25,603, of whom 85·24 per cent. were Hindus, 12·4 per cent. were Mussulmans, 2 per cent. were Christians, and 0·2 per cent. others.

The 1881 census showed an increase of 3,425, or 29,028, of whom 85·47 per cent. were Hindus, 12·38 per cent. were Mussulmans, 527 were Christians, 48 Parsis, and 48 others.

The city is administered in civic affairs by a municipality, established August 1, 1853, and the municipality consists of twenty-five commissioners. Of these twelve are elected, and the remaining thirteen, inclusive of the president, are nominated by Government. According to the general census of 1891 the city population was 25,749, viz. 13,009 males and 12,740 females.

An analysis of the patients admitted into Parel Plague Hospital, Bombay, during February–July, 1897, shows that in nineteen instances two members of the same family were attacked and admitted; in five instances, three members; and in one instance, four members; but this takes no account of the other members of the families who died, fled, or concealed themselves, or reached other hospitals; nor of the fact that many persons were put out on the streets, or hidden in cowsheds, and disowned by their friends and returned under the heading "Non-resident and Unknown," in the Bombay Municipal Health Reports and Returns.

In October, 1897, when plague broke out, the population had increased to 29,153 souls, chiefly through refugees and fugitives from Bombay, Poona, and the Satara district, where plague had been raging epidemically since April, 1897, especially in Karad, a town of about 12,000 people, twenty-four miles south-east of Satara city. Up till the end of July, 1897, there had been eleven imported and one suspected cases of plague—all fatal, except the one suspected case. It is to be noted that the imported cases had been detected at the observation posts, and had not actually gained admission into the city, *i.e.* were what we term IMPORTED "AT" as distinguished from IMPORTED "INTO" cases.

The organisation in existence then was one camp of detention and observation and three observation posts, where people were medically examined twice daily, and all people without village passes, or coming from infected or doubtfully infected places, were detained under medical surveillance for a period of ten days. All who failed to develop plague symptoms, and whose temperatures were normal, were passed into the city on the eleventh morning of detention and observation.

Passed-in lists were sent to the municipality, giving full particulars of the incomers' residence in the city, and they were visited twice daily, and medically inspected during the house-to-house visitation then in operation. At my advice the following additional precautionary measures were readily adopted by the collector, whose efforts to keep out plague were unceasing and well designed, and had been crowned with success for eleven months:—

(*a*) Six additional observation posts were added, so that every road was watched. (*b*) Traders and cartmen got "pratique passes," and were medically examined coming and going. (*c*) Notification of all diseases was made compulsory. (*d*) Notification of all deaths was made compulsory, and no corpse was allowed to be disposed of without medical inspection or a medical certificate as to the cause of illness and death. (*e*) All cemeteries and burning-grounds were carefully guarded, and no body could be disposed of without a permit, and a special burning-ground was selected for the disposal of plague corpses. (*f*) A careful daily scrutiny of the death register was made, and the returns were compared with the average daily death-rate for the past ten years and for the same periods of the year.

Every village within three miles of Satara was visited, and a careful house-to-house inspection made, but no cases of plague, or indeed of much sickness of any kind (during the month of August, 1897), were discovered. Printed plague preventive rules were widely circulated everywhere up to 20,000 in number, both in the districts and cantonments, in English and Marathi (see Appendix No. 1).

The first case that really can be looked on as a truly imported case got secretly into the city through the fields by night, and was discovered on February 14th, 1897. This house was unroofed, disinfected by mercury and vacated, and does not seem to have been the source from which infection subsequently spread. Curiously enough the same locality was freshly infected on September 27th, 1897, by a resident of Satara who went to collect taxes in the Pathan taluka; and the first indigenous case occurred in his house in the case of his child on October 3rd, and resulted in her death on October 5th, 1897. The man himself died of plague the following day.

The locality into which plague had been thus secretly imported was carefully cordoned and medically inspected twice daily, and after fifteen days' freedom from plague the cordon was withdrawn.

Finally it was decided to vacate the infected area, and the healthy were removed to a health camp at Godoli, two miles outside the city; but no further cases of plague developed amongst them.

As a further precautionary measure all the first four infected houses were afterwards burned to the ground, having been vacated and disinfected, and compensation costing eleven hundred rupees given to the owners. The houses had been previously disinfected with mercury and the roofs completely removed.

One house, one hundred yards (across a deep nullah) from the nearest house in the infected area, then developed four cases of plague on November 10th, 1897. This was a house consisting of three small, dark, stuffy, ill-ventilated rooms, inhabited by two families of barbers. The heads of the families were two brothers, who, with their two wives and four children, lived in this house.

At about 8 a.m. a report was brought in that three people were suffering from snake-bite in this barber's house. At once proceeding thither, one boy, aged nine, was already dead of plague, and two women and another boy were suffering from undoubted plague. They had all been attacked suddenly during the night. This house was also burned.

In another quarter, five hundred yards away, fugitive plague patients from Poona were secretly conveyed into the town—secreted in barrels of merchandise it has been reported, and a fresh focus of infection might have been started, as four patients had thus gained entrance, of whom three died, but no epidemic followed in this locality because the house in which they lodged was large, well-ventilated, and occupied by people of intelligence with sanitary habits.

This was discovered afterwards to have taken place about February 12th, 1897.

It is to be noted that the disease spread from and around those parts into which it had first been imported, and in a direction from south to north and from west to east.

It is a remarkable fact that there was a latent interval of about five weeks between the first imported case and the first indigenous case; and the first indigenous case occurred on October 3rd, 1897, whereas the epidemic of indigenous cases really began on November 4th, 7th, and 10th, 1897. Only imported cases were found *outside* in the interval of about five weeks. In the Great Plague of London in 1665 De Foe mentions (Bohn's Select Library Edn., pp. 164–5) an interval of about seven weeks, and pertinently asks, "Where lay the seeds of infection all this while; what was taking place in the interval?" Even now we do not know sufficient about the extra-somatic habitats (human and animal), forms, life history, etc., of the plague bacillus to satisfactorily solve this query. That it does exist we do know. How it exists, where it exists—except by analogy we may make a shrewd guess that it is in the dark, ill-ventilated, overcrowded, and perhaps filthy dwellings of the indigent poor where plague chiefly and primarily abounds—we have not proved as yet, as it has not been satisfactorily identified in dust or air, etc., from plague-stricken houses by competent bacteriologists. Hence also arises the futility and unreliability of purely disinfecting measures alone, unaided by radical sanitary reforms and provision of adequate inlets for vivifying sunshine and fresh air—Nature's great reliable disinfectants.

Now, the inhabitants sought safety and wanted to flee the plague-stricken city; but no one was allowed to go out, except from uninfected districts, and even those had to go into health camps and continue under medical supervision for seven days. Persons from infected districts were thus detained for a whole ten days. Here I would record my humble opinion, founded on bitter experience, that the Government of India are mistaken in advising that there should be no restrictions or detention of people leaving a plague-stricken city at first. No one should be allowed to seek safety in flight, except under appropriate restrictions; otherwise infection is conveyed thus to fresh suitable localities, and propagates freely and reaps a rich harvest in havoc-working disease and death. The disease *is* infectious, *under limitations*, else how does it spread from place to place?

A reference to the diagram will show the progress of the epidemic. During the week ending January 14th the climax was reached with 93 cases in that week; and on each day of January 12th and 13th the maxima of daily attacks were recorded, viz. 19 cases. The Christmas week was a very dark period, and from 23rd till the end of December inclusive 116 attacks were registered.

To show the enormous exodus from the city, about 12,000 people left through our observation camps in six weeks, beginning from the end of the first week in October. Some went to the outskirts of the city, where they camped or built huts for themselves, some went to the neighbourhood of small towns, and some to friends elsewhere. None of them, so far as the civil officials could learn, conveyed infection to their new places of residence. No doubt some did secretly connive at the restrictions to prevent escape and crept out, and thus perhaps infected other places.

Rigorous house-to-house visitation was carried out twice daily in thirty-two parties, with the aid of volunteers, chiefly men of influence and position—vakils, school teachers, medical men, etc. It is a notable fact that only two out of twenty-four of the Municipal Commissioners remained all the time devoting themselves with energy and zeal to stem the pestilence!

European officers, civil or military, were in charge of each division, and night raids were made. An officer was specially told off to visit and search all surrounding villages, and warn them against harbouring refugees from Satara—perhaps plague-stricken people.

The cause of plague is to be put down to the devitalising, life-destroying habits of the people. No one who has not mixed with the Deccani people can have any idea of their ingrained hatred of fresh air. They cover their heads with their blankets, shut every door and window, stuff every crevice with rags or paper, and hang curtains around them by night to keep out air. This habit taken in conjunction with the fact that their houses are generally small, overcrowded, and perhaps dirty, makes it a wonder, not that they get plague, but that they have escaped it so long.

"Again, even if it were a true contention, what does it amount to? You had plenty of gunpowder, but no fire had been brought in contact with it. You had cracker fire-works in store, but no match had been applied to them, and they did not explode—the gunpowder was not apparent. To use another analogy you will all understand, you had your fields ploughed, manured, watered, and a benignant climate; but you had not the suitable seed sown, and no crop was developed. Now the seeds of this death-dealing disease were brought from China to Bombay, thence to Poona, thence to Karad, and now to Satara, and it is growing luxuriously where it finds the suitable soil (filth in and around your houses, clothing, and persons), favouring climate (dark, ill-ventilated houses where sun and life-giving air cannot enter), and manure ready (overcrowding) for it. The torch has come, meets with the gunpowder, and the explosions are taking place; and the disease is reaping a rich harvest among you, who hate fresh air and cling to habits that favour its precipitation and rapid propagation."

Some people were exempt from plague. The following have been practically immune:—

COMPARATIVE IMMUNITY OF EUROPEANS.

(A) Europeans. In Satara we have an average of 45 adult Europeans and 20 European children and 125 European soldiers, and not one of them has been attacked. Twenty Europeans, including one lady nurse, are daily engaged in plague operations, and have been completely immune.

(B) No Eurasians, native Christians, or missionaries, or their families have been attacked, and according to 1881 census there were 527 native Christians in Satara city.

(C) No Parsis were attacked, and they comprised about fifty souls, and have all remained at their occupations. Some natives are exempt.

IMMUNITY OF HOSPITAL ATTENDANTS, ETC.

(*a*) None of the hospital servants have been attacked; they are engaged as ward boys, sweepers, ayahs, corpse-bearers, etc., etc., and numbered some sixty—sixty-five individuals from time to time, yet not one has been attacked. Their immunity cannot be put down to their use of reliable (?) disinfectants.

(*b*) None of the gaol population has been attacked. The daily number of prisoners has been:—

In October, 1897	(in prison	and under trial)	.	60
,, November ,,	,,	,,	.	57
,, December ,,	,,	,,	.	62
,, January, 1898	,,	,,	.	70
,, February ,,	,,	,,	.	75

And this immunity is all the more noticeable when it is borne in mind that the gaol harboured a constantly shifting population drawn from all infected parts, whose friends often were dying of the dire disease, which was also raging around the gaol.

During those five months 198 prisoners passed through the gaol, and gaol attendants were not attacked.

(*c*) The depôt sepoys of the 3rd Bombay Light Infantry and their wives and families have remained free from plague. They are cantoned in the station immediately to the east of the city and under three-quarters of a mile distant, and there is constant communication between the two places. On February 15th, 1898, in the native infantry lines there were, including sick:—

In hospital (17) . .	81	N.C.O.'s and men.
,, ,, . .	96	Women.
,, ,, . .	161	Children.
,, ,, . .	26	Relatives of sepoys.
,, ,, . .	21	Followers.
Total .	385	

(*d*) The inhabitants of the Sudder Bazaar, less than one mile distant from the plague-stricken city, remain exempt. It has an area of 28 acres, 345 houses, and a population of 1,523, mostly Parsis, Mussulmans, and Mhars; and in camp or cantonment proper 542 persons are exempt.

(*e*) One very interesting epidemiological fact is that the houseless, wandering beggars known as *Byragees* have not furnished a single plague case either in the returns of Satara city or district. Sir James Campbell in the *Bombay Gazette* gives the beggar population of Satara collectorate in 13 classes as 9,485 in the 1881 census. The number of homeless beggars is not shown separately and is not available; but I meet them in numbers of one to two hundred every Sunday and Thursday, and see the same faces again and again, and on repeated inquiries they deny that any one of them has had plague. For myself I can state I have never seen nor even heard of a case of plague amongst such people. Asked why they are free from this disease, they answer, "We will not hang ourselves by living in dark holes of houses."

(*f*) Buruds go to outskirt villages in cold and epidemic season. Buruds (cane-workers), 1,060, dirty and degraded class, living in miserable huts and very poor. Dhangars (shepherds), who lead an open, outdoor life grazing and tending their flocks, are nearly immune.

(*g*) Incidentally I would remark another class of Europeans and natives who, from the fresh-air-inhabiting nature of their occupations, are immune—the sailors *on ships*. No doubt one or two sailors have been attacked in Bombay, but they did *not* contract the disease on board their ships. Apropos of this, I especially investigated one such case, and discovered that he had been living in a prostitute's house for a week in the native town. She was taken ill with plague and died, and he developed it the next day but recovered. Surgeon-Lieutenant-Colonel F. F. McCartie, I.M.S., Port Health Officer, in his report remarks that plague developed *inside* the ten days' incubation period on a transport and on a pilgrim ship, respectively, in only two instances. Note that, contrary to what would have happened on land, in neither instance did the disease spread to others on those ships. In Satara city, in spite of disinfecting and burning of five houses, plague became epidemic, so that it cannot be claimed that it was owing to the liberal use of disinfectants on the ships that plague did not spread, and owing to their neglect or faulty application in Satara that it was not strangled at its birth. No, the whole facts show that where there is plenty of fresh air plague will not spread; nature's reliable disinfectors are at work. But where the habits of the people place every obstruction to the entrance of fresh air plague will spread in spite of the vigorous use of the most approved chemical disinfectants.

(*h*) The neighbouring village of Godoli, with an area of about half a square mile and a population of 1,002 people in 160 houses, and less than one mile distant, has remained free from plague: also the village of Kamatpura, half a mile distant, population 286 in 51 houses, has remained free from plague.

In the above villages and instances I attempted to fight ahead of the plague by opening up the roofs four tiles, or equal to 2½ feet broad, from front to rear and making permanent air inlets, as laid down in Appendix No. VI., in every house. To this I attribute their immunity.

(A) In marked contrast to the above facts, Karanga village, in which there has been great opposition (through ignorance of the populace and encouragement of the revenue patel) to all sanitary precautions and preventive plague measures, especially opening up the roofs and making ventilation holes in their walls, plague is now epidemic, and this is the only place *now* giving indigenous plague attacks in the returns of Satara city. It will thus be seen that the measures adopted have eradicated plague in exactly five months' time. Karanga village has an area of about half a square mile, has 206 houses, and a population of 2,261, principally cultivators, and a dhobie hamlet attached to the village.

(B) Disinfecting coolies, 37 (1897–9) in number, have been attacked; but since I stopped brushing the walls and whitewashing houses none have been attacked.

(C) Police sepoys, 16 (1897–9) in number, on duty in the house-to-house visitation work have been attacked.

(D) Municipal clerks engaged on this work, 19 (1897–9) in number, have fallen victims.

(E) Other municipal servants (101) 151.

(F) Others, municipal servants (butlers 2, gaoler 1, pensioners 3, porter 1), 7.

Making in all, of those engaged in house-to-house visitation, etc., a grand total of 251.

(G) Clean Brahmans, who hate fresh air and overcrowd their houses, have furnished a large proportion of plague cases—214 out of a total of 722 attacks indigenous to Satara city up till the end of March, 1898.

(H) There is no doubt but that plague, as seen in Satara, prevailed in the overcrowded dwellings of the poor in the oldest and most thickly populated districts of the city.

The exceptions in the above classes enjoying immunity prove the rule and carry conviction to a certain demonstration that plague is not filth-fever but a "want-of-fresh-air disease." For instance, the only exception in which one of the hospital servants was attacked is very apposite and convincingly incontrovertible. This hospital servant had been engaged for exactly two months, living in the servants' quarters in the hospital compound, and constantly in contact with plague patients all that time. His mother died of plague in the city, and the same day he was engaged removing his effects from the plague-stricken house into one of the camps, with the object of leaving Satara and having the property under a camp guard. *The very same day*, on completion of this duty, he was attacked on the road on his way from the health camp to the plague hospital, and died that very night of plague!

Again, a doolie bearer's wife and child were attacked *in the city*, whereas he is still, after six months' constant contact with plague cases, including his own family members, and for two months since their death, quite exempt; but he constantly resides at night and by day in the plague hospital camp! Another ward boy has lost nearly all his relatives, and an ayah in hospital all her friends, except one who recovered from an attack of plague, yet neither of these servants suffered.

There was one exception also *at* but not *in* the gaol in the case of a member of the gaoler's family. The gaoler's house is, from a sanitary standpoint, an ideal house—everything a good house should be structurally. It consists of three large rooms and four small rooms, chiefly bath and cook-rooms, etc., has double rows of windows, front, rear, and sides, clerestory windows above the abutment of the verandah roofs on the main buildings, and no less than six large doors with fanlights above them. These measures for ensuring abundance of fresh air were grossly and criminally abused, for the gaoler is an ignorant, proud, fanatical, old-fashioned, obdurate Brahman. He, with his wife, mother-in-law, six children, six buffaloes, and three buffalo calves *practically occupied the same bed*, *i.e.* lying huddled on the floor, with a brazier of charcoal burning in their midst in the central room, with every door and window closed and every exit for fresh air blocked. No wonder one of his children developed plague!

Five dead rats were found in the gaol in a room next the cook-house. I examined these rats and grew pest bacilli on agar-agar from each of them, and afterwards destroyed the rats by fire. The room in which they were found was unroofed completely; it had never been occupied lately, yet no plague ever appeared *inside* the gaol. What plague precautions were used, and to what can one attribute the immunity enjoyed by the prisoners?

The rules circulated by the Inspector-General of Prisons, formulated by our Surgeon-General when he was Principal Medical Officer at Karachi, were carefully followed in every detail. Each prisoner dropped his clothing at the door, had a phenyle bath all over, including the hair of the head, and his clothing was boiled for a quarter of an hour in phenyle 1 in 100 and hot water and put in the hot sun for six hours every day, and he was kept quite apart for at least twelve days after incarceration. Ventilation of cells and ample cubic space was insisted upon. Every door and window was kept open by day and every window by night, and surprise visits were paid by night to see that this valuable rule was rigorously enforced. Nature's reliable disinfectors had full play; hence no outbreak of plague.

No doubt plague has and will occasionally attack persons living in ideal sanitary surroundings and obeying every sanitary law; but those are exceptional instances only, and must not lead one to form hasty and unwarranted conclusions regarding the etiology of the disease. Hence arose the grain theory, the cold-air theory of the natives (why on this theory it ought to prevail only in cold countries—England for choice), the bad-drain theory, etc.; but "those partial views of human kind are surely *not* the best." On a general view sounder opinions will replace false dogmatism.

Most of those exceptional instances can on investigation be traced to overcrowding, as I have seen in one good house in Satara city, or to direct inoculation, as in the case of the nurse into whose eye a plague patient spat, and in whose case local reaction followed and fatal plague developed, or in the case of Dr. Sticker, who cut his thumb in making a post-mortem examination and developed plague. Just as we know in the case of the cousin-german disease typhus that it occasionally attacks medical men visiting the typhus patient, yet it is absurd to think that any intelligent, educated physician lives under suitable insanitary conditions which engender an attack of typhus fever.

Those attacks of Europeans in Bombay, Poona, and elsewhere I ventured to explain by analogy, thus: Increased virulence of the microbe under favouring environment. A tiger cub when but a few days old is not dangerous—a child might play with it; when it is three months old a grown man may fondle it; but when it is a year or two old it will attempt to kill, and perhaps sometimes succeed in certainly injuring, if not slaying, even an elephant. Primary plague pneumonia, being the malignant type of the disease, is not subject to sanitary rules.

Plague is not a dirt disease. Clean Brahmans are attacked and filthy Byragees remain exempt; halalkhores in Bombay enjoy immunity, and to exceptional attacks in the case of people who abuse the existing means of ventilation in their habitations, or through ignorance fail to provide for ventilation. Although cleanly in their habits, no condition can be assigned for their being attacked except defective air supply.

Prisoners in gaol are filthy sometimes, but are exempt, although their relatives die in the town, because their cubic space is ample.

"The camp had a severe test, for within thirty yards of my house a lady permitted her tailor to come into one of her out-houses (in spite of printed exhortations to the contrary) on December 19th. That house was burned, and the other servants living under the roof segregated. Yet no other cases occurred in cantonment limits. The tailor said he had toothache. I found a bubo the size of an orange in his right groin, and removed him the next morning."

Amongst other posers of questions put by the Satara people was the necessity for Government measures in the direction of segregation in plague, whereas no such measures were enforced against cholera. They very logically pointed out that cholera comes every year, and kills off thousands of people, whereas plague comes only once in a century perhaps, hence why this difference leading to trouble to the people? I endeavoured to answer this question in the following manner, and hope it meets with the approval of the members of the medical profession—my compeers and superiors.

I pointed to the house as the poisonous place, that it was a want-of-fresh-air disease (as proved by those amongst whom it was epidemic and those exempt), and that removal of the sick into fresh air afforded the only chance of recovery, and gave every prospect of exemption for his relatives and other occupants of the plague-infected house.

The opposite plan had been tried in the Great Plague in London in 1665, when we were ignorant of its nature, and that "3,000 people died in a single night, and all within the space of two hours (De Foe, *op. cit.*, pp. 138–9); that about 50,000 died within two months (*op. cit.*, p. 71); that many houses were left desolate, all the people being carried away dead (*op. cit.*, p. 139), several houses together, which had not one person left alive in them" (*idem*). I pointed them to the Nizam's territory, where there was as yet no segregation, rather the opposite, as in London, the people being opposed to segregation, and that there, as in London, whole villages were left desolate, whole households died, leaving no heir. Which arrangement was most deserving of praise—segregation of the healthy contacts and removal of the sick to open hospitals, or shutting them up in their houses, so that they all died? In the one case some recovered amongst the sick, for it is a very fatal disease, but most of the friends survived; and in the other case none of the sick recovered, and all the friends of the patient first attacked sickened and died. In the one case, no doubt, there was some temporary inconvenience (they called it oppression, *zoolum*), but people survived and the object of Government was attained—the salvation of the people from this voracious tiger; in the other case there was no arrangement, no inconvenience, plenty of property, ornaments, etc.—but NO HEIR.

In the instance of cholera it was altogether different. Cholera was chiefly a bad-water disease, did not wipe out whole families—run through the family as the poor Irish say. Cholera is a common tiger; this plague is a man-eating tiger, and, left to itself, devours whole cities (*ab ante*); and if Government did not undertake rescue measures, not on the grounds of conserving our international commercial relations merely, but on the advice of sanitary scientists and experienced medical men, Government would be neglecting its sacred trust and its primary duty towards its ignorant subjects.

The presence of purulent conjunctivitis in a patient under treatment from an early period of the attack argues bad nursing or neglect, as the patient ignorantly and possibly in sleep or delirium infects a part already a locus resistentiæ minoris by transference of pus from a suppurating bubo or other site.

An impression remains that as a rule, when the eyes (or eye) are injected, it will usually be the eye on the same side as the bubo that is so altered, or that shows the change in the most marked degree.

1. The most important point is, do not let the patient sit up, for any purpose whatsoever, until the temperature shall have been normal for at least four days. Fatal in numerous instances in Satara has been the result of a breach of the primary rule in plague administration in hospitals.

2. As for drugs, perchloride of mercury in large doses, which was introduced in March, 1897, at Parel, has proved itself worthy of further trial, and given early and combined with strychnine (the next sheet-anchor of treatment) and stimulants, and frequent feeding and good nursing, gives good results without subsequent salivation.

3. For sleeplessness opium in some form with bromides is good.

4. Hyoscine up to one-fiftieth grain is relied on for wild delirium. It controls the delirium, but most such patients die on any and every treatment.

5. Iron, quinine, massage, and nux vomica are useful for the anæmia of convalescence.

6. The bubo should be treated with emollient *sedatives*, and not irritated, poulticed, or blistered, etc. There prevails in Bombay a great outcry amongst the ignorant that poulticing and fomenting the bubo disperses the disease through the system generally.

7. Digitalis being a cumulative poison, causing sudden collapses if the patient sits up under its use in any

disease, and thus acting like plague toxines through the central nervous system, is not to be given, in my opinion, to plague patients. In most cases the heart musculature (exclusive of febrile changes perhaps) is quite sound in plague post-mortems.

8. Phenacetin, antipyrin, and antifebrin, for the same reasons, are dangerous.

The only reliable disinfectants for the pest deble-bacilli, as met with on cow-dunged floors and in nature, are (1) fire and superheated steam, (2) strong sunlight, (3) free ventilation. Clothing if good is boiled for one quarter of an hour in one per cent. solution phenyle with quarter pound of soap and two drams of kerosine oil.

In addition to what has been already placed on record in the Parel report, the following are worthy of remark in diagnosing plague :—

1. That the patient invariably has an aversion to being considered ill, and yet looks ill. That this is not entirely due to fears of segregation, etc., is proved by an extract from an old book printed in 1818 regarding the Malta plague, of which Russel wrote and Faulkner records that "the initiatory symptoms, besides the foregoing, were pain in the back opposite to the kidneys, drunken appearance of the countenance, inability to stand upright, and *aversion to being thought ill*" (Johnson on *Tropical Climates*, 2nd edition, p. 334, footnote: London, 1818). At this time and in Malta it is hardly likely that fears of segregation caused the patient to deny illness. This stage is like the exaltation and feeling of "*bein être*" produced by alcoholic intoxication.

2. Hesitating speech is a most constant and valuable diagnostic sign.

3. Staggering gait.

Under this head it is necessary to warn every medical man in charge of camps or hospitals never to discharge a patient or suspect without making him undergo what may be called the "walking test." If he can walk and turn round without a drunken reel in his gait, ten chances to one he is not suffering from plague.

4. In addition to injected eyes, etc., of course the best test is the discovery of the characteristic bacillus in the blood, *in fatal cases only*, or in a little matter extracted from the bubo and grown on agar or examined in covered glass preparations with suitable staining and fixing.

Let medical men not rashly conclude that any suspect is not a plague case because his temperature is normal and he has no bubo. Even with six months' experience of plague one nearly made this fatal error, and was willing to allow a suspect to go in the morning on the above grounds, etc., but fortunately in the evening the patient developed fever and a bubo and real plague. To the same end (Johnson's *Tropical Climates*, *op. cit.*, p. 339) Russel wrote :—

> "*Buboes.*—The presence of these is diagnostic of true plague, and removes all doubt as to its nature ; but fatal has been the error of rashly, *from their absence*, pronouncing a distemper not to be the plague, which in the sequel has desolated regions, and which early precautions might probably have prevented from spreading."

5. Desire to ROAM from "the delirium of intoxication."

Amongst a crafty, bigoted, untruthful people who conceal cases, it is not fair to judge the results of any method of treatment which, applied early and with appreciation of its usefulness and intention rather than with dilatory consent or sullen jealousy and mistrust, would likely give more favourable results. The attempt to extract the day of disease, even by assertions that such information made a great difference in the medicines necessary, proved utterly unreliable. Besides, many patients at first refused treatment, and afterwards, seeing recoveries and induced by their friends' entreaties, agreed to take hospital treatment; and such are included amongst hospital cases.

Again, others followed advice and kept strictly lying down, *the*, in our opinion, most important and single conservative plague treatment, and recovered, although they refused every drop of hospital medicine.

There is, however, a marked contrast in the two classes—(*a*) under hospital treatment, and (*b*) refused medicines—for 22 per cent. of the former recovered, whereas only 11 per cent. of the latter recovered.

We took steps to disabuse their minds by asking all the available editors of the native papers to visit the hospital, and every patient had his free choice of taking or refusing hospital medicine, or could call in his own native practitioners. Soon their fears disappeared. All the native practitioners died of plague, except those that we succeeded in converting to our views, and nearly all their friends and patients also succumbed. In nearly every native practitioner's family one or more plague deaths occurred. They shut up their patients—sealed them. They were told that they must be got out of their death-traps and removed either by their own arrangements or in the municipal ambulance to the plague hospital; but they are not required to take hospital treatment, food or water even, that is provided there for them.

By those means their fears disappeared, and they recognised the value of early treatment. There are fewer concealed cases and more recoveries consequently than at first, and they are willing to allow the crowbar brigade to work at making holes for permanent ventilation in the walls of their houses. This is the most important preventive sanitary measure for preventing so-called recrudescence of plague. It is a measure that would have met with violent opposition, and perhaps open resistance, at first, as the people are obdurate and proud; but they were taken very gradually, and the objects of our measures thoroughly explained to them beforehand with great tact and discretion.

Many refused to leave camp when granted permission to do so, as their fears had altogether disappeared. Not only so, but their habits were changed, and they no longer dreaded fresh air, and although we had 800 to 1,000 people daily present in camps as a rule, they had no plague, no cholera, no coughs nor colds, no bronchitis, no rheumatism, no itch, no ringworm, no skin diseases, no worms (and these are the permanent plagues of such peoples' lives), and they slept better, were stronger, had better appetites, and felt better than they had ever done. They wondered that they had not died of too much air —of cold air—till it was explained to them it was their want of being accustomed to it that made them suffer subjectively and feel cold previously. Just as a man who is accustomed to bathe in cold water daily can do so all the year round, at home or abroad, winter or summer, without injury, so one gets used to cold fresh air. But if one is accustomed to a hot or lukewarm bath daily, an immediate resort to a cold bath would perhaps be dangerous, so one must gradually accustom oneself to love what one used to hate—to look on one's former supposed enemy as one's best friend.

The complications seen in Satara have been in the main the same as chronicled in the Parel Hospital report; but the following are worth reiterating or noting:—

One case developed aphemia, which lasted three months.

One case began with aphasia, and lasted thus till death.

Five others had aphasia as a sequel, and one amnesia; and all recovered.

One case began with dementia and serous apoplexy, but ultimately recovered. One patient, out of hospital, committed suicide by jumping into a well when he recognised that he had plague.

One patient developed mania and another dementia; and both survived.

There were five undoubted cases complicated with syphilis, and one died.

Syphilis seems to modify plague. The disease poisons neutralise each other. A syphilitic recovers from severe types of plague which would kill an ordinary patient free from the venereal taint; but the nervous symptoms are liable to be exaggerated in plague combined with syphilis and assume wildly maniacal manifestations. Hereditary syphilitics suffer mildly from a plague attack, and those with secondary and tertiary symptoms less than those in the primary stage.

At Parel, out of 304 acute plague cases there never was a case with carbuncle, whereas four such so-called carbuncular cases were seen at Satara. Of these two died and two recovered.

In one of the cases a necrosed patch of skin and subcutaneous tissue appeared on the left side of the neck just below the left ear; another case had a similar patch two inches long by one inch broad on the tip of the left shoulder, the left axillary gland being enlarged and inflamed; another case had two black blister-like patches on the right chest, and right axillary gland inflamed; and the fourth case developed a huge slough—coal-black in centre, ashy-grey at margins, and skin surrounding red and granular-looking on outside left thigh. This latter patient recovered with partial paralysis of the left leg below the knee, involving the anterior tibial nerves, and is still paralysed after thirteen months' convalescence.

So-called typhoid plague occurred in three patients associated with the profound nervous depression and diarrhœa described as characteristic and they all died; one survived till the twenty-third day of the disease.

One patient had a huge bubo on the left side of the cheek in front of the ear, which opened into the oral cavity by numerous (200 or upwards) minute openings, and many similar pin-hole openings on to the cheek, without suppurating.

Two lepers developed plague, of whom one died and one recovered. Both had loss of fingers and toes and the leontine facies of anæsthetic leprosy; and the father of one had leprosy; the other had no friends alive.

One very interesting case developed acute small-pox and plague, and the diagnosis was confirmed by bacteriological cultures and microscopic examination. This case died.

As a clinical fact it was recorded that many patients with suppurating buboes have no rise of temperature, but only heating, suppurating pain in their abscesses. Perhaps this may be accounted for by the well-known phenomena that convalescent plague patients' temperatures are often sub-normal, and that the force of suppuration is only sufficient to bring this sub-normal temperature up to the standard of health.

Primary plague pneumonia gave twenty cases, all fatal except one. This primary as distinguished from secondary pneumonia is that variety of plague in which the lungs are primarily infected, most probably by inhalation of the virus, and is very fatal and infective. One or both lungs are attacked with patches of lobular pneumonia —the whole lobe is rarely involved. Death ensues so rapidly that there is no eruption of buboes. This type constitutes 2 to 3 per cent. of all plague cases. Hirsch states that this is a characteristic form of Indian plague. Primary plague pneumonia should be distinguished from plague complicated by hæmoptysis, or hypostatic congestion of the lungs and secondary pneumonia, as these latter complications are seen in 15 to 20 per cent. of all plague cases when carefully looked for.

The outbreak of plague in Vienna was of the pneumonic form, which explains its great fatality and virulence, as all the patients attacked by it died.

It is also noteworthy that it spread in a laboratory and hygienic hospital to the laboratory attendant physician and nurses under conditions in which the other forms of the disease are unable to manifest virulence. It is rightly therefore classed separately as the malignant type of plague.

Without buboes are returned as 168 in No. 2 hospital with 120 deaths and 48 recoveries, and in No. 1 hospital as 57 with 39 deaths and 18 recoveries; but in the latter hospital every doubtful case was kept under observation until the presence of plague was certainly declared. The percentages of deaths and recoveries amongst cases of this class was almost equal in both hospitals.

Convulsions, 18 to 20 per minute, were seen in two cases not undergoing strychnine treatment. They were confined to the upper extremities. Children frequently died, struck down suddenly and convulsed without developing buboes, and this confirms Parel experience.

There were nine pregnant females admitted. All aborted, and all died. They were all over three months pregnant, and in most cases the fœtus had black bullæ on the skin all over the body, and all the fœtuses died or were born dead. One full-time pregnant woman was safely delivered, and the mother and child survive. The mother had plague with bubo.

Seven nursing mothers suffering from plague suckled their children, one such only five days old, yet none of the latter contracted the disease.

Five children were plague patients, and were nursed at their mothers' breasts, and the mothers never contracted the disease in hospital.

In marked contrast to this nearly every concealed plague nursing mother and child developed the disease in their own houses, and invariably both died.

The sequelæ were the same as at Parel, except that boils were not so frequently in evidence.

No cases who had been inoculated by Haffkine's preventive were met with; and very few, if any, of the people at Satara have been inoculated. All efforts to persuade them to resort to Haffkinism have, for various reasons, hitherto failed.

Two monkeys died suddenly in the city, and by postmortem examination and bacteriological culture they were proved to have died from plague. Numerous plague rats were also found and similarly investigated; and the paucity of rats everywhere in the city is remarkable, and has been commented on by the inhabitants. It is well to look upon the finding of dead rats as the precursor of a plague outbreak, and their discovery affords a warning to vacate the premises and adopt precautionary, preventive, and sanitary measures.

The friends of a patient applied eighteen leeches to her bubo from time to time, and refused to allow those leeches to be given back to the leech woman. They were examined on agar-agar, and cultures of pest bacilli found from their blood, and they all died. The fact that leeches applied to plague buboes can convey the disease to other people has been proved in the present plague epidemic.

Post-mortem on one case that was seen at 12 noon and temperature then normal, and no signs or symptoms of plague, enabled foul play by poisoning to be excluded, and proved beyond a shadow of doubt that the man died before 5 p.m. the same day of plague, the post-mortem appearances being numerous and characteristic. An enlarged gland was found deep in the left axilla, not tangible by palpation.

A diagram shows the deaths out of hospital. Several conclusions may be drawn from a number of deaths out of hospital, and one or all may be justified. One is that a good deal of concealment is going on proportionate to the number of such deaths. Another indicates great virulence of the disease, as is evidenced by the sudden death before 5 p.m. of a patient who was quite well at noon of the same day. Most of the deaths out of hospital occurred at night. No dead bodies were found on the roads or in the fields, or neglected by friends when any such existed.

No. II. *Budhwar Plague Hospital.*

DISTRIBUTION IN TIME OF DEATHS AND RECOVERIES.

Total deaths, 133. Recoveries, 35.

Date of death after admission:—

	HOURS.											DAYS.						
Moribund . .	½	¾	1	2	3	4	5	6	8	12	24	2	3	4	5	6	7	8
Nos. 2 . . .	2	1	1	1	1	1	3	3	5	10	22	36	16	11	8	4	2	4
Total first day											52	Total .						133

Dates of recovery and discharge from hospital:—

Days	7	12	14	15	17	18	19	20	21	25	26	27	31	32	40	41	48	50	51
Nos.	1	2	1	4	3	2	1	3	4	3	1	2	1	1	2	1	1	1	1
Total																			35

No. I. *Ranchatri Plague Hospital.*

DISTRIBUTION IN TIME OF DEATHS AND RECOVERIES.

Total deaths 475. Recoveries 87.

Date of death after admission:—

HOURS.

Moribund .	3	5	6	8	9	10	11	12	13	14	15
Nos. . .	2	1	3	3	1	3	1	1	1	1	1

DAYS.

Moribund .	1	2	3	4	5	6	7	8	10	11	12	15
Nos. . . .	235	94	42	36	26	11	3	3	2	2	1	2

Total first day . . 253 Total . . 475

Dates of recovery and discharge from hospital:—

Day .	3	6	8	9	10	11	12	13	14	15	16	17	19	20	21
Nos. .	*1	3	2	1	1	2	10	3	1	4	4	5	12	2	4

Day .	22	23	24	25	26	27	28	30	31	upwards
Nos. .	2	2	2	7	2	3	4	4	1	5

Total 87

* Absconded.

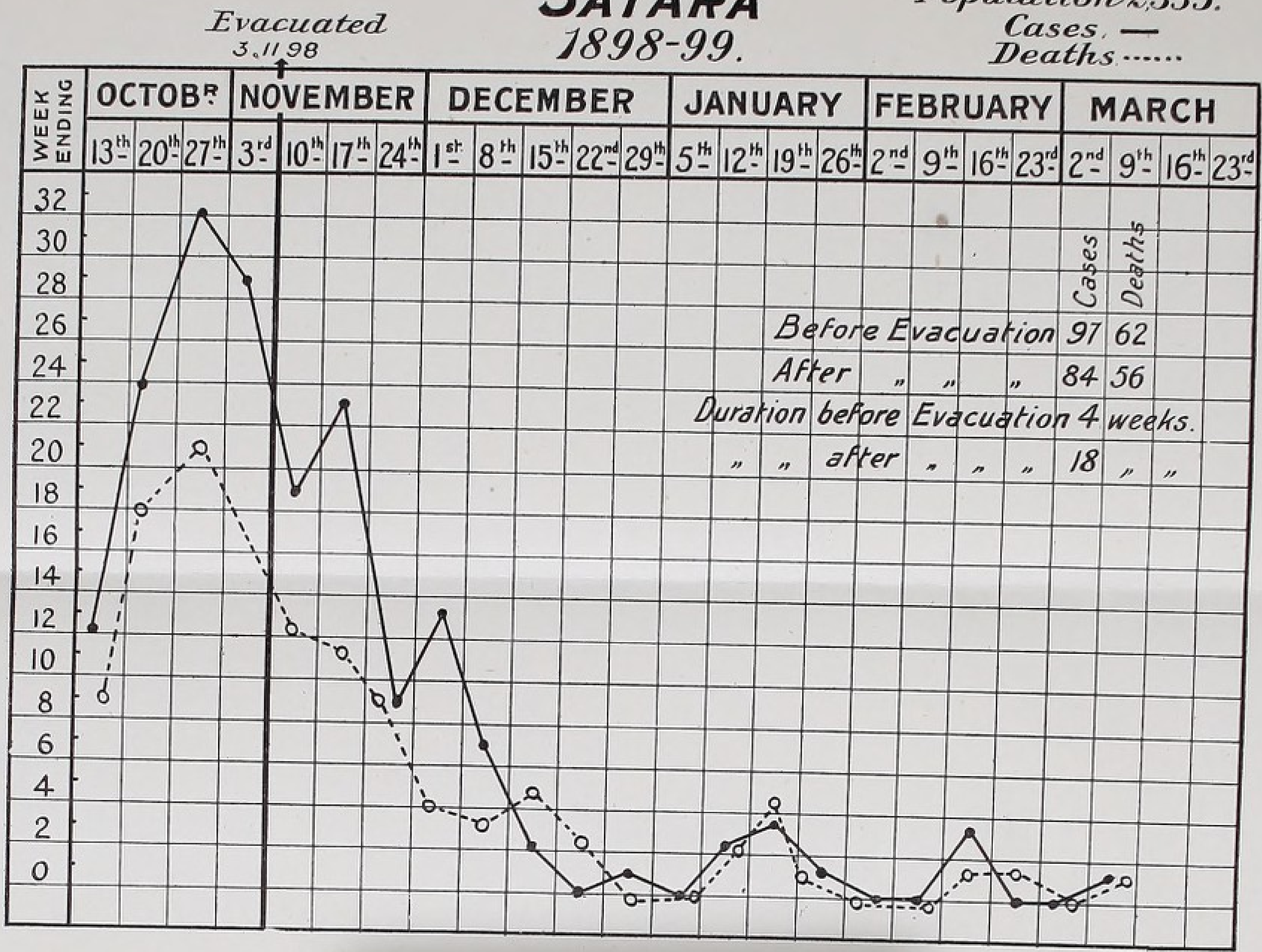
Monthly Mortality, Satara City, 1892–8.

	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.	Population 1898–9.
January .	76	40	66	45	50	45	316 P.=292	81 P.=21	12,000? 19,583
February .	51	40	48	75	60	60	117 P.=103	77 P.=28	7,000? 18,806
March .	69	46	66	70	51	75	38 P.=34	63 P.=7	3,432
April .	58	53	50	57	71	118 cholera	23 P.=3	—	11,000?
May .	44	44	134	62	148	99	26 P.=nil	—	15,000?
June .	54	56	66	76	60	109	45	—	17,000?
July .	88	62	53	98	84	163	48	—	18,450
August .	66	80	68	87	85	117	56 P.=4	—	——
September	71	59	53	99	67	127 P.=1	56 P.=2	—	——
October .	53	80	58	73	73	128 P.=7	70 P.=14	—	19,589
November	64	58	52	91	71	131 P.=26	98 P.=41	—	19,000?
December	48	52	46	94	61	246 P.=164	99 P.=22	—	19,849?
Totals .	742	670	760	927	881	1413	—	—	——

P.=Pest.

Normal population by 1891 census 25,748.
The population January to October, 1897, was 29,153.

Plague Chart of the Suburbs Satara 1898-99.



CHAPTER VIII

MONS. W. M. HAFFKINE'S PLAGUE PROPHYLACTIC INOCULATION

Prophylactic Inoculation against Plague.—The nature of this prophylactic requires to be defined in order to prevent ignorant prejudices being unnecessarily aroused. It is prepared by Prof. Haffkine according to the method devised by him and fully described in the *British Medical Journal*, September, 1897, and reported testing in the same journal September, 1898.

It is usually termed prophylactic serum, which conveys a wrong impression, as it is not a serum at all in the true sense of the word.

As long as it is clearly understood that the preparation is not made from the blood of animals, as all true serums are, there is no objection to the term "serum" in general use for it. Serum is the watery part of blood, while the anti-plague prophylactic medium, as Prôf. Haffkine himself prefers to term it, is bouillon or broth consisting of gelatinous watery material, usually employed in laboratories, to which a little purified ghee (or clarified butter) has been added, prepared, filtered, and sterilised with special precautions.

"After three months of research, namely, in January, 1897, Mons. W. M. Haffkine reported to the Municipal Commissioner his plan of a prophylactic treatment against the plague. That plan has now been under trial for nearly two years, and was subjected to repeated crucial experiments in different parts of this presidency.

"*Origin.*—The following conditions guided Prof. Haffkine in the preparation of his prophylactic fluid, in his own words (vide *British Medical Journal*, September, 1897): 'The inoculation against cholera, which is made with the bodies of Koch's bacilli, cultivated on solid media, results in a reduction of the susceptibility and of the absolute mortality from the disease, but does not affect the case mortality. In the light of the present knowledge this is to be put in relation with the production in the inoculated individuals of bactericidal powers, and not of antitoxic, as has been actually demonstrated by Pfeiffer and Kolle. There is the possibility of the bactericidal powers being created by the injection of bodies of microbes, or substances enclosed in them ; while antitoxic properties may be communicated by injection of metabolic substances, secreted or produced in the surrounding media, as is the case in diphtheria treatment of horses.'

"*Preparations of the Prophylactic.*—Working upon these theoretical considerations, which thus represented a direct development of Prof. Haffkine's studies on cholera, the following preparation, corresponding in its mode of action to the vaccine lymph against small-pox, has been arrived at.

"The fluid for the inoculation against plague is not taken from an animal, as is the case with the vaccine lymph in small-pox; but is prepared in an artificial manner from minute fragments of mutton infused in hydrochloric acid. The infusion is strained and filtered, the whole of the solid remainder of the fragments is thrown away, while the acid solution is heated at a very high temperature, which partly chars the organic matter, is then neutralised by soda largely diluted with water again, mixed with a trace of cocoanut oil or ghee, and inseminated with the vegetable microbe of plague. The fluid is then placed in a quiet place, on a solid table or a shelf, because the least shaking disturbs the process. For twenty-four to forty-eight hours after the introduction of the bacilli the liquid remains limpid, while flakes of vegetation appear underneath the surface, forming small islands of growth. During the next twenty-four to forty-eight hours the flakes grow down in a long stalactite-like jungle, while the liquid remains clear. In four to six days the islands of growth get more compact and solidified. If the flask is slightly disturbed the islands fall down to the bottom in a sort of snowfall, bringing down the stalactites, the whole growth getting deposited at the bottom of the flask. The islands, when solidified, are not disintegrated even by violent shaking, whereas the stalactites are very fragile. The appearance of the islands of growth underneath the surface is accompanied or preceded by the deposition of a powderlike residue on the sides of the flask and at the bottom, as well as by the appearance of a ring round the surface of the liquid. When the fluid is filled with a rich jungle of vegetation the growth is shaken off the drops of ghee or oil, and brought down to the bottom of the liquid, leaving the ghee or oil on the surface free to produce a second crop of growth. In the course of a month half a dozen successive crops are thus obtained, which fill the liquid, when shaken, with an opaque milky emulsion.

"Thus the vegetable seed grows in the liquid and purifies it from the animal matter which it destroys. When the liquid gets entirely altered, and the vegetable stops growing any further, the latter is rendered harmless by heating and carbolising the liquid.

"If some portion of this fluid is transferred to a test-tube and left quiet for several days, two substances are obtained, viz. a thick white sediment, representing the remains of the bacilli, and a perfectly limpid liquid, which represents the purified and transformed original solution. When they are injected subcutaneously into animals, the following results are observed: (1) the *sediment* produces a local inflammation and a nodule at the seat of inoculation, accompanied but by slight fever; and (2) the *fluid* produces a considerable rise of temperature and a general affection without any noticeable effects at the seat of inoculation. Extreme care is exercised in the proceedings, in the cleaning, purifying, and sterilising of every vessel or apparatus, and of every ingredient, and in the final treatment of the fluid before it is pronounced fit for use.

"The power of that fluid to confer protection against plague was first demonstrated in the following manner:—Twenty rabbits were taken. Ten of them were inoculated with the prophylactic against plague, and the others were left as they were. All the twenty rabbits were put together and infected with plague bacilli. After some time all the unprotected rabbits succumbed to the disease, while not a single rabbit that had been inoculated with the protective *fluid* died. These experiments, made in December, 1896, afforded the first ground for trying the new preventive on human beings, and a method for inoculation in man was devised.

"The first person on whom Prof. Haffkine tried his method was himself, and on January 10th, 1897, he got himself inoculated by Dr. N. F. Surveyor, M.A., M.D., in the presence of Lieut.-Colonel W. K. Hatch, F.R.C.S., I.M.S., Principal of the Grant Medical College. After that a large number of leading European and native gentlemen offered themselves to be inoculated with the fluid. By the observations made on these volunteers the question as to the harmlessness of the method and its immediate effects was solved to the satisfaction of every one who took the trouble of attentively examining it.

"*Mode of Operation.*—The prophylactic is injected subcutaneously, preferably in the left arm, by means of a hypodermic syringe, which is for that purpose disinfected by keeping it filled for twenty-four hours with a 5 per cent. solution of carbolic acid. After the instrument has been once treated in this way—provided it is not used for any other purpose—it may afterwards be employed safely day after day, only filling it up with the same antiseptic for half an hour before commencing each new series of operations. After completing the work of the day the syringe should be washed out again with the same lotion of carbolic acid. The needle, before the syringe is used for injection, should be cleaned outside with a cotton pad soaked in the same lotion. The part of the skin where the injection is to be made should be washed before the operation with the same antiseptic lotion.

"The injection itself, when properly done, should scarcely be felt by the patient, so absolutely painless is it.

"*Dose.*—For an adult male in an average state of health the prophylactic of standard strength is injected with the standard dose of 2·5 c.c. (15 minims = 1 c.c.) at a time. For an adult female the dose is 2 c.cs. at a time. For a person in a weak condition it may be 1 to 1·5 c.cs. The standard dose for an infant one year old is 0·1 c.c., for an infant two years old 0·2 c.cs., for every year of age 0·1 c.c. is added. For a child of ten years it is 1·0 c.c. A boy of twelve years gets 1·25 c.cs., and of fifteen years 1·5 to 1·75 c.cs. Should the *brew* of prophylactic be below the standard strength this is noted on the bottle, and direction is given to double or treble the doses as the case may be.

It is a pity that the serum has been issued in varying strengths, some one-third and even one-fourth of the standard, as this necessitates the injection of a large quantity of fluid and frequent filling of the syringe to the discomfort of the operator and patient, and delay in the number of inoculations possible during a rush of people to avail themselves of its use. The actual amount of fluid inoculated is, of course, immaterial, the quantity of anti-toxin injected along with it is the important point.

Symptoms after Operation.—Successful inoculation is followed by fever of from 100° to 103° F. for a couple of days, some swelling and pain at the seat of inoculation, preferably the deltoid region of the left arm, lasting up to five days, and headache of a dull, heavy nature at the frontal bases, and a feeling of general malaise are common.

In children drowsiness accompanies a full dose. The symptoms soon pass off, and no permanent discomfort remains except a slight hardening at the seat of insertion of the fluid, which may last a month or two. The pain is particularly felt on moving the arm. The fever is accompanied, as is usually the case in such condition, by general uneasiness and pains in the body. The general symptoms subside after twenty-four to thirty-six hours. The pain at the seat of inoculation lasts from three to five days and gradually disappears, leaving behind a painless induration for some days. Doses followed by reaction confer greatest protection, and the severity of the symptoms are in proportion to the dose administered. Where reaction does not follow, a second and larger dose should be given, whilst severe symptoms indicate reduction of the dose on the patient, applying for a second one to increase the protection from inoculation. Generally a full dose should be given in the first instance, as many object to have a further dose.

Just as revaccinated people are less liable to contract or die of small-pox, so those availing themselves of a second or even third prophylactic inoculation, it is believed, are less liable to contract or die of plague. The second operation should be done ten days after the first, or at a later date. Those who resort to inoculation for the purpose of obtaining an inoculation certificate with its accompanying privileges should not be given that document unless they have had a full protective dose, as but a small proportion of them would ever resort to a second operation, and if inefficiently protected their consequent liability to contract and die of plague brings discredit on the method.

Reaction.—It is desirable for the inoculation to be successful that there should be a rise of temperature not less than 102°. If there be no rise of temperature in an individual case it does not follow that the inoculation has failed, or that its protective effect is less. If, however, in a whole group of people inoculated with a certain brew of prophylactic the febrile reaction be weak or absent, this would show that either the particular *brew* used was weak or the doses prescribed on the bottles were too small. In such cases the doses should be increased for all the subsequent operations to be made with that brew.

Whether the effect of inoculation be noticeable or weak, in every case it is useful to repeat the injection in the other arm eight or ten days or a fortnight after the first operation. The dose for the second injection may be the same as for the first, or it may be increased or decreased as the febrile reaction after the first was weak or strong.

Age.—Inoculation can be performed on persons of any age, from children of three months to persons aged seventy years. In Hubli it was performed on a child of ten days with perfect safety.

Diathesis.—It has not been definitely proved that inoculation is contra-indicated in any particular diathesis. It is believed that in scrofulous and uric-acid diathesis the prophylactic fluid if injected in full doses is likely to do harm. Prof. Haffkine believes that if injected cautiously in moderate doses it is not known to produce any injurious effects.

Evil Results.—When inoculation was first commenced rumours were freely circulated that inoculation was likely to produce evil results after a lapse of some time, such as leprosy, syphilis, tuberculosis, etc. The experience of the last two years has, however, given no ground whatever for such apprehension; no case of leprosy or syphilis has been observed as its result. Moreover, considering the nature of the prophylactic, which does not contain any living bacilli, it is certain that such an eventuality is absolutely impossible. Some cases developed joint pains, and from one bottle seven of the author's patients in early operations had abscesses at the site of needle puncture. This was due, as afterwards discovered, to putrefactive change, and the importance of smelling each bottle as opened and before use is emphasised thereby.

In the inoculations performed in Bombay during the first year of plague there were altogether three deaths, which occurred within a few days after inoculation—one of real plague, one of suspicious plague, and one of paralysis. It is to be remembered, however, that the above three cases occurred among a number of 8,142 inoculated persons living in a plague-stricken town. It is hardly fair that inoculation should be held responsible for the three deaths.

Some medical men believed that inoculation might produce abortion in pregnant women. The experience of those who were engaged in inoculating the people at Belgaum and Hubli is, however, contrary to this belief, as women advanced to seven or eight months were inoculated without any evil effect. It is, however, advisable to act cautiously in such cases, inoculating with small doses and repeating the inoculation several times.

Efficacy of the treatment.—The main question is as to whether the treatment devised by Prof. Haffkine is really effective in protecting people against the plague. This question was made the object of a long series of experiments, repeated in different places and under different conditions, and the result of which all pointed to a strikingly identical conclusion. These experiments have been summarised for a meeting of the British Medical Association, held in Edinburgh in August last, and it is from that summary, as reproduced in the *British Medical Journal* of September 24th, 1898, that the following description is taken :—

"In the last week of January, 1897, plague broke out in the Byculla House of Correction; 9 prisoners were attacked, of whom 5 eventually died. A few professors and students from the Grant Medical College offered to be inoculated in the presence of the prisoners in order to inspire confidence in their minds by their example. Half of the prisoners at once offered themselves to be inoculated. On January 30th, 1897, before the inoculation was applied, there occurred in the gaol 6 more cases, of which 3 proved fatal. After the inoculation it was discovered that one of the inoculated prisoners had already a bubo and two others developed buboes the same evening. These three inoculated cases, attacked on the day of inoculation, also proved fatal. The inoculated and the uninoculated remained under absolutely identical conditions of life, had the same kind of food and drink, the same resting and working hours, slept in the same barracks, etc., and were therefore exposed to the same chances of infection. From the next morning after inoculation a marked difference showed itself in the plague incidences in the inoculated and the non-inoculated. The epidemic lasted for eight days longer, and of the 173 uninoculated 12 got the disease and 6 died; while of the 148 inoculated 2 were attacked and both recovered. This result was considered by Prof. Haffkine as distinctly encouraging, but he did not produce it as final proof of the efficacy of inoculation.

"During the next few months 8,200 persons were inoculated in Bombay. A large number of these belonged to the higher classes, and their escape from infection would have had little bearing on the question of efficacy or otherwise of inoculation, but for the fact that, out of the 8,200, 18 actually contracted the plague during the subsequent months of the epidemic, and went through a full course of the disease. Of these, however, 16 recovered and only 2 died. The latter had developed plague within 24 hours of inoculation, and most probably had symptoms of the disease at the time when they came to be inoculated.

"Mora, a village in the Kolaba District, was the first mofussil station where inoculation was given a trial. The population of the place was about 1,000 souls at the time. The plague broke out there in February, and 429 persons submitted themselves to inoculation. The remaining about 570 persons were left uninoculated. Of the 429 inoculated up to the end of the epidemic, 7 were attacked with plague, and all of them recovered; while during the same period there were 26 attacks among the uninoculated, of whom 24 died.

"At Damaun, 2,197 were inoculated, while 6,033 remained uninoculated. A careful investigation carried out at the end of the epidemic by Profs. Koch and Gaffky, of the German Scientific Mission, Surgeon-Major Lyons, I.M.S., and Prof. Haffkine, showed that between the end of March and the end of May, 1897, the uninoculated lost from plague 1,482 of their number. The 2,197 inoculated, when compared week by week with the others, and supposing that they had remained as susceptible to plague as their uninoculated neighbours, should have lost 332 individuals. The actual number of deaths among them was 36, which represented a reduction of 89·2 per cent. of mortality.

"The plague broke out at Lanowlie in July, 1897, and the officers of the Research Laboratory were allowed to inoculate in two wards where the plague was most severe. They found 700 persons living in those wards. The inoculation was performed in families who lived in, and close by, the affected houses, and who volunteered to undergo the operation. In the course of the first week 323 persons were inoculated, while 377 remained uninoculated. The result of this at the end of the epidemic was that among the 323 inoculated there were 14 cases and 7 deaths, while among the 377 uninoculated 78 contracted the disease and 58 died. Supposing that the inoculated remained as susceptible or as resistant to plague as their uninoculated relatives and neighbours, they should have produced 67 cases and 49 deaths in proportion to their numerical strength. The number of 49 deaths appeared reduced by 42, which represents a difference of 85·7 per cent. of mortality.

"At Kirkee there were 1,530 followers of the artillery living in 27 barracks. Out of the total number 671 availed themselves of inoculation, while 859, belonging to the same families, living under the same roofs, and having the same food and drink, etc., and subject to the same general preventive measures, remained uninoculated. From the time of inoculation up to the end of the epidemic, the 859 uninoculated had 143 cases with 98 deaths. Bearing in mind the absolute similarity of conditions, the 671 inoculated should have had proportionately 112 cases and 77 deaths if they had remained as susceptible to the disease as were their uninoculated brothers and sisters. Instead of that they had 32 cases with 17 deaths. The number of 77 deaths was, therefore, reduced by 60, that is, by 77·9 per cent. The military authorities did everything that was practicable at

N

the time to minimise the effect of the epidemic. In spite of all their efforts, among those who had not the additional protection of inoculation 1 out of 6 was attacked, and 2 out of every 3 attacked died.

"At the end of December, 1897, plague appeared in the Umarkhadi Gaol, Bombay, which had 400 prisoners in it. Three fatal cases occurred in the gaol before inoculation was tried. On Saturday, January 1st, 1898, the prisoners being asked whether they would wish to protect themselves by inoculation, expressed their willingness in a body. In order to demonstrate, however, the harmlessness of the operation and its protective effect, it was agreed that only half the inmates should be permitted to undergo inoculation. All the prisoners were brought out into the courtyard and paraded in ten regular rows. An officer was put over them, and every second individual, without any further distinction, was inoculated. The following day being Sunday, all the prisoners were allowed to rest, and the gaol authorities allowed all the prisoners rest on Monday also, because some of the inoculated required rest on that day. Thus, in every respect, in their food and drink, in their housing and clothing, in the hours of work, rest and sleep, the inoculated and the uninoculated prisoners were absolutely in the same conditions, and were exposed to the same chances of infection or of natural resistance. After January 1st, thirteen cases of plague occurred in the gaol on eleven different days, the average daily strength of the inoculated and uninoculated being 147 and 127 respectively. The attacks were as follow :—Ten cases, of which six were fatal, occurred in the 127 uninoculated ; and three cases, which all recovered, occurred in the 147 inoculated. Surgeon-Major-General Harvey, Director-General, Indian Medical Service, says about these three cases in a report to the Government of India :—'The hospital authorities at Parel were not quite sure that they were cases of plague. If they were, they were so much modified as to be with difficulty recognisable. I saw two of them, and they looked to me as mumps.' The 147 inoculated prisoners should have had proportionately seven deaths from plague, if they had after inoculation remained as susceptible to plague as were their 127 uninoculated fellow-prisoners. Instead of that they had none.

"The next—and one of the most convincing—experiment was made at Undhera, a village near Baroda. Plague broke out in this village in January, 1898. On February 5th a careful census was taken by the Baroda authorities, and the population was found to comprise 1,029 souls. Up to and inclusive of February 14th, 79 plague deaths occurred, leaving 950 in the village. Of these 513 were inoculated, leaving 436 uninoculated. As far as was possible an equal number of each *sex*, *age*, and *family* were inoculated. All were living under precisely identical conditions as to sanitary surroundings, food, drink, and clothing, etc. The usual sanitary precautions regarding segregation and disinfection were carried out. All plague cases were removed to a hospital, and every effort was made to combat the disease. The inoculations were performed on February 12th, but the figures are taken from the 15th so as to eliminate cases of incubation at the time of inoculation. Three deaths occurred among the uninoculated between the 12th and 14th, and none amongst the inoculated. These three deaths, together with two others, which might possibly have been due to diseases other than plague, were eliminated, so that no exaggeration as to the effects of the inoculation could be possible. The results up to April 2nd (the epidemic ceased after March 26th) are as follows :—Between February 15th and the cessation of the epidemic, plague occurred in 29 families living together under precisely similar conditions. These 29 families were composed of 135 individuals of all ages, 71 of whom had been inoculated and 64 were not inoculated. The 71 inoculated had 8 cases with 3 deaths, while the 64 uninoculated had 28 cases with 26 deaths. Had the inoculated been as susceptible as the uninoculated, they should have had 29 deaths instead of 3, and the inference is that inoculation saved 26 lives of this small number, or 89·65 per cent. Taking the whole number of inoculated, 513 had 8 cases, or 1·56 per cent., and 3 deaths, or ·58 per cent.; while the 437 uninoculated had 28 cases, or 6·4 per cent., and 26 deaths, or 5·9 per cent., that is, *ten times as many.*

"The investigation as to the result of the measure was made by Surgeon-Major-General Harvey, Major Bannerman, I.M.S., Captain Dyson, I.M.S., Prof. Haffkine, and some officers of the Baroda State.

"The next experiment, in which the effects of inoculation was observed in conditions permitting of a comparison between the inoculated and uninoculated, was made amongst the Khoja community in Bombay. Out of the total of 13,330 persons of that community, 5,184 were inoculated and 8,146 remained uninoculated. The average daily strength of the inoculated throughout the period was 3,814, and of the uninoculated 9,516. The result obtained in this community was the most striking of all hitherto obtained. During the period between December 27th, 1897, and April 20th, 1898, three deaths from plague and four deaths from other causes took place in the 3,814 inoculated; while the uninoculated 9,516 had 59 deaths in babies below three years and in old people above 60; and 118 deaths from all causes, including plague, in the rest of the community.

"The reduction of mortality from plague attributable to the inoculation of the prophylactic amounts, from the above observations, to over 86 per cent. in the average.

"The following table will show the effect of plague among the inoculated and the uninoculated in Bombay gaols, in Mora, Damaun, Lonavla, Kirkee, in the Khoja community in Bombay and in Undhera:—

Name of Place.	No. of Uninoculated.	Plague cases in Uninoculated.	Deaths in Uninoculated.	No. of Inoculated.	Plague cases in Inoculated.	Deaths in Inoculated.
Byculla Gaol .	173	12	6	148	2	0
Umarkhadi Gaol .	127	10	6	147	3	0
Mora . .	571	26	24	429	7	0
Damaun . .	6,033	—	1,482	2,197	—	36
Lonavla . .	377	78	58	323	14	7
Kirkee . .	859	143	98	671	32	17
Khoja community	9,516	—	82	3,814	—	3
Undhera in Baroda territory .	64	28	26	71	8	3

In reading the detailed reports, it becomes evident that all the above data were very carefully tested, and the experiments at Damaun, Undhera, Mora, and the two gaols in Bombay were conducted with the greatest care and attention, and with a view to maintaining, as far as possible, identical conditions of life and surrounding circumstances. In all the inoculations the age, sex, occupation, social position and the results of inoculation were most carefully recorded.

Immunity.—From the above observations the conclusion is that inoculation with Prof. Haffkine's prophylactic fluid undoubtedly confers immunity against plague; and for practical purposes a person inoculated with the full dose is protected at least for six months, which is the average duration of one plague epidemic. A second inoculation produces still better results, as shown by the figures from Hubli, and the immunity may probably last longer. From the analysis of the facts it is evident that the advantage of inoculation is twofold, first, *it reduces the number of attacks;* thus, in Hubli, against every 100 attacked among the uninoculated there were only one or two attacked among the inoculated; this may be characterised as the bactericidal power conferred by the inoculation; and, secondly, apart from that, *it also reduces the fatality from the disease* in those who happen to be attacked in spite of having been inoculated, viz., whereas the average case mortality among non-inoculated is 70 to 80 per cent., it is only 30 to 35 among the inoculated. Thus every physician in charge of a plague hospital knows at present that a plague patient admitted to his hospital, and who had been inoculated before the attack, has at least twice more chances of recovery than an uninoculated patient. This may be viewed as the antitoxic effect of the treatment.

Theoretical Objection to the anti-Plague Inoculation.—It is but fair and reasonable to examine carefully both sides of the question. It has been said that the information on this question is not yet complete; that due weight has not been attached to age, sex, locality, and social position. The possibility has been pointed out of the bacilli in the prophylactic fluid being merely suspended and dormant, and not really dead; and that when they find a suitable soil in the human blood they may multiply; and thus an inoculated person, although himself rendered immune by the fluid, may act as a centre of infection to the non-inoculated. This is held to account for the high mortality amongst the uninoculated in Hubli and some other places.

As regards the contention that the bacilli are simply suspended and dormant, and are not really dead, it is enough to recall the details of the preparation of the fluid. The prophylactic is heated to 65° C. to 70° C. (158° F.)

for an hour and carbolised afterwards. No microbes not possessing spores, or not protected in some other special way, are known to stand a temperature of 50° C. or 122° F. The microbe of plague has no spores, and, when grown in the prophylactic, is not protected by albuminous or any other coatings; and when it is maintained for a whole hour in a temperature 15° to 20° higher than the one necessary for killing it, it requires an uncommon stretch of imagination to maintain that any living bacilli remain suspended or dormant in the fluid.

Moreover, the prophylactic thus sterilised is further treated with a half per cent. of carbolic acid. This proceeding itself is far more than sufficient to kill the plague bacilli, even if they are not killed by a previous heating, as a much lower proportion of antiseptic is fatal to them. The carbolising is employed simply in order to prevent any other microbes from growing in the liquid if such happened to fall into it in the process of preparation. The prophylactic treated as above was many times tested in the usual bacteriological ways, and found to be entirely free from living bacilli.

But those who appear anxious on this point apparently do not know that such a state of the bacilli is not at all an absolutely necessary condition. In fact, Prof. Haffkine's prophylactic against plague, in addition to that which he and Prof. Wright have devised for the projected inoculation against typhoid, are the only ones where there are no living microbes; in other methods, on the contrary, the lymph used does contain living microbes, and sometimes very virulent ones. Thus the vaccine lymph is a matter containing living virus, capable of propagation, though weakened in its virulence; while Prof. Haffkine's inoculation against cholera is done with living bacilli of a higher degree of virulence obtainable; in spite of that, no one ever heard of epidemics of cholera being produced by the anti-cholera inoculation, which is now extensively practised in Bengal. In the face of this fact, it is incomprehensible that a contention of the kind should have ever been put forward.

The second contention is the corollary of the first, and if the premises are not correct, the conclusion cannot be right. Admitting for a moment that inoculated persons act as centres of infection, we should have now in Bombay numbers of families where such a fact could not have escaped observation; whereas it is perfectly certain that not a single physician in Bombay has ever had a report of inoculation having introduced plague into the families of the inoculated. As regards the races, ages, and social position, etc., the facts collected at Damaun, Undhera, in the Khoja community in Bombay, and the two Bombay gaols clearly show that this contention is entirely groundless. In all these experiments the conditions of life of the inoculated and the uninoculated were absolutely identical. It is impossible to maintain for a moment that at any of these places the inoculated represented the upper or any other particular class possessing a degree of personal or local immunity at all different from that of the rest of the population, and to which their reduced death-rate could be ascribed apart from the inoculation. The high mortality amongst the uninoculated in places where large numbers of inoculations are performed is due entirely to the fact that large numbers of people present themselves for inoculation only in localities severely affected; and that, up to quite lately, with the object of proving the real effect of inoculation such badly infected localities were expressly chosen for testing the method.

Does the health of a person suffer from inoculation? The best answer is afforded by the Khoja community in Bombay, where not only you have not heard that the mortality from general causes among the inoculated was higher than among the uninoculated, but, on the contrary, it was most remarkably low.

It is a fact that in places where inoculation has been practised while plague was absent no cases of plague were originated by the inoculation. That was observed in the Baroda Gaol, where five hundred prisoners were inoculated and no plague cases have occurred. In the Byculla Gaol in January, 1898, half of the prisoners were inoculated in the absence of plague, and no cases occurred. Similarly in Madras, now hundreds of inoculations are being done without cases of plague having followed in the families of the inoculated. Generally speaking, in plague it is the *locality* that has the poison. Not only a person inoculated with sterilised plague prophylactic, but even a person actually suffering from plague—unless it is the pneumonic type—is not a source of immediate danger, as proved by all experience in hospitals.

Conclusion.—The *Lancet* of October 22nd, 1898, says:—

"The measures which have been taken in India have, we regret to say, been only partially successful, with the exception, perhaps, of Professor Haffkine's system of inoculation, about which, however, we do not yet know enough to decide positively whether it is efficacious, and if so, how long the immunity conferred by it lasts, or whether it is a practical scheme to apply in India with its teeming population."

It is fair and reasonable that, as all the facts bearing on the question are being observed here, no papers in Europe should pronounce a final decision before they have our own declaration—that of personal observers, and it is time for us to make known the result of our observation.

We are convinced of the protective power of Professor Haffkine's prophylactic. We are of opinion that of all the temporary measures for combating the plague known up to now, inoculation is the most reliable and safe measure, and that it is our duty as medical men to encourage it by all possible means, and to induce the public to take full advantage of it.

Prophylactic inoculation can never be the sole remedy against plague, and by leading to sense of false security in the ignorant masses simply postpones the day of deliverance from inroads of this deadly disease.

It may possibly be one of the chief temporary expedients to be adopted amongst a community who cannot or will not adopt those supreme sanitary safeguards that can alone and at all times protect from plague epidemics. In the case of small-pox a more perfect protective serum exists—vaccine lymph—tried and trusted for upwards of one hundred years almost universally, yet it has not banished that disease, although its ravages have undoubtedly been considerably mitigated by vaccination.

Just in the same way it is impossible to trust in protective inoculation ALONE to combat plague. Besides, there are immense practical and political difficulties against its universal adoption, and the few who refuse its protection carry on infection, which will certainly cause epidemic prevalence when suitable conditions exist for an outbreak. The main point is to so modify those conditions by alteration of environment through radical sanitary reforms that the germs will die or become innocuous even if introduced into surroundings inimical to their growth and propagation.

That an epidemic can be checked by rapid inoculation, in full doses, of those liable to attack has been borne out by repeated experiences in different divisions of Satara city when plague again became epidemic.

Inoculation in Families.—A number of instances have been noted where some members of a household have been inoculated and all escaped, whereas some not inoculated were attacked by plague. There was an interesting crucial test of its value in one family where four members were said to be inoculated, although only three had been injected. One inoculated member developed plague the evening she was inoculated and died fifteen days afterwards; the uncle, also inoculated, had a mild attack for two days, and recovered rapidly; the mother, non-inoculated, was attacked by plague and died. All four members lived in the same house, and these facts were discovered subsequently. In another family fourteen members had been inoculated and one had not been inoculated; and the latter was the only one who was attacked by fatal plague.

Modifying Effects on other Diseases.—There is an indication that, besides the protection against plague, inoculation influences favourably the resistance to other diseases. In four cases of syphilis, two of gleet, and twelve of gonorrhœa such favourable effects have ensued. In one case of *psoriasis* of syphilitic origin the eruption was generalised, and attacked the palms of the hands, and entirely disappeared in the space of twenty-two days, following a single full dose of Haffkine's anti-plague prophylactic medium. In another case a large gluteal ulcer healed rapidly after inoculation, although it had been very indolent under empirical and anti-syphilitic treatment. The infection—from three cases seen—does not seem to be very useful in early secondaries or at all in primary syphilis; its best effects are witnessed in late secondary and tertiary syphilis.

In gonorrhœa the discharge dries up with the onset of the reactionary fever, and in gleet the same result follows a single full dose. Many patients have declared that piles have become reduced in volume, and less inclined to bleed as a sequence of inoculation; and in not a single instance has any permanent ill effect been noted or brought forward. Many people voluntarily came to be reinoculated, believing in its efficacy in gonorrhœa and piles, from the experience of their friends.

Others have noted a modifying effect on chronic eczema, and chronic malarial fever of an obstinate type has been thought by some to have been favourably influenced and caused to disappear by inoculation. Such instances we have not met with ourselves.

There can be no doubt but that inoculation in a plague epidemic, amongst susceptible people who will not or cannot adopt those supreme sanitary safeguards, based on the etiology of the disease, that protect everyone effectually—primary plague pneumonia excepted—from plague, is a measure of great value and rapidly applicable.

A group of inoculated persons at Satara allowed to remain under the identical insanitary surroundings after as before the operation compared with a group from the same infected quarters who had the benefit of evacuation and segregation only, the latter being under strict observation for ten days only :—

Ward.	No. of houses.	No. of infected houses.	Population.	No. inoculated.	After segregation among non-inoculated.		After inoculation among the inoculated.	
					Attacks.	Deaths. Pest.	Attacks.	Deaths. Pest.
Durga . . .	78	2	333	60	3	2	–	–
Raviwar . .	68	13	292	107	13	10	1	1
Pantachagote .	75	12	160	83	10	7	2	2
Totals . . .	221	27	785	250	26	19	3	3

Incidentally this proves the value of early evacuation, as Durga had no cases, because it was evacuated immediately after the second house had been infected, whereas the other two were fully infected before evacuation, and developed twenty-three cases during the ensuing few days.

It is very probable that many others of the non-inoculated were attacked by pest afterwards, but not one of the inoculated has been attacked during the 1897–1901 epidemics. There were three attacks and deaths among the inoculated, all on the day after their inoculation, so that they may be considered as already incubating the disease when operated upon. Of the 708 persons inoculated at Satara not one has been attacked, except the above three, and had any been missed in the calculations of the authorities there were many observant critics of an experiment then in its earliest development who would have been only too ready to draw public attention to them.

Inoculation Statistics in Three Divisions in Satara City, 1898–99.

Division.	No. of Houses.	Population.	Infected Houses.	Inoculated.	Plague Attacks & Deaths Before & After Evacuation.		Plague Attacks & Deaths Before & After Inoculation.		REMARKS
					A. D.	A. D.	A D.	A. D.	
Durga . .	78	333	3	60	3 & 2	nil.	3 & 2	nil.	All the inoculated persons were allowed to live in their houses without any reformation in diet, habits, or habitations, etc.
Raviwar . .	68	292	13	107	12 & 10	2 & 2	14 & 12	nil.	
Pantachagote	75	160	12	83	17 & 15	1 & 1	18 & 16	2 & 2	The two persons were attacked and died the first day of inoculation, and were incubating plague the day of operation.
	221	785	28	250	32 & 27	3 & 3	35 & 30	2 & 2	

Inoculation Report for the Week ending March 15*th*, 1899, *for Satara City.*

Satara . .	—	19,872	—	519	—	—	149 & 120	3 & 3	Only 3 attacks and 3 deaths from plague, all developed on the 1st day of inoculation, among the 519 inoculated.

The inoculated have remained immune upwards of 4 months from the last person operated on; and some of those earlier inoculated for upwards of 7 months. Only 3 persons have been twice inoculated. All occupations and ages are represented among those inoculated. 35 are below 5 years old, 440 between 5 and 60 years, and 44 are 61 years or upwards. The youngest inoculated was 2 months, and the eldest 87 years old.

INSTRUCTIONS FOR THE USE OF THE PLAGUE PROPHYLACTIC.

"1. Parcel to be opened and unpacked carefully. Any bottle found open, cracked, or with the sealing-wax broken, is to be sent back to the laboratory without being used. Prolonged exposure of the prophylactic to daylight is to be avoided.

"2. The prophylactic is to be given by injection under the skin. For this purpose a hypodermic syringe of a suitable size is to be disinfected in the beginning by keeping it filled with a 5 per cent. solution of carbolic acid for twenty-four hours. After that, if the syringe is not used for other purposes, it will be sufficient to keep it filled for one hour before commencing operations. After the completion of each series of injections the syringe is to be washed out with the same antiseptic solution. The needle is cleaned outside with a wet cotton pad soaked with carbolic lotion. Syringes may be obtained from the Plague Research Laboratory, Bombay.

"3. Each bottle before being opened is to be shaken, and the contents well mixed up each time before being absorbed into the syringe.

"4. For opening a bottle a pair of dissecting forceps is used, the branches being heated beforehand in a spirit lamp, and guarded from contact with any other unsterilised object.

"5. While opening a bottle, the mouth of it is passed several times through the flame of a lamp, and the sealing-wax melted. The cork is then withdrawn with the sterilised forceps, both branches of which are shoved in between the cork and the neck of the bottle on two opposite sides of the cork simultaneously. After the bottle is opened any contact between its mouth and other unsterilised objects is to be avoided; and if contact inadvertently occurs the mouth is to be heated again in the flame, for disinfecting it. The contents, or a part of it, is absorbed into the syringe. For this purpose the bottle is kept as nearly horizontal as possible.

"6. For an adult man, in average state of health, the *standard dose* is $2\frac{1}{2}$ cubic centimetres (15 minims counting for 1 c.c.). This is to be injected under the skin of the back of the upper arm, preferably the left one, avoiding as carefully as possible the muscles or the big vessels. For a woman the dose is 2 c.c.; for weakly persons the initial injection is tried with a reduced dose. A child of 10 get 1 c.c., of 3 years from 0·1 to 0·3 c.c. The symptoms commence as a rule three to five hours after inoculation, and consist chiefly of swelling and pain at the seat of inoculation, and of a rise of temperature. The pain is felt particularly on movement of the part. The fever is accompanied by general discomfort usual to this condition. No treatment of the symptoms is required, beyond applying ice for the relief of headache, if any felt, and taking some rest. General symptoms subside after twenty-four to thirty-six hours; the pain at the seat of inoculation lasts for three or four days, disappearing gradually; a painless induration remains there for some time longer. It is desirable to produce a rise of temperature of at least 102° F. If the reaction is less marked the operation may be repeated three or four days later with the same or an increased dose, according to the result of the first inoculation. There is no harm in leaving a longer interval between the two inoculations, or in dividing the doses in several parts, to be given at an interval of a few days. In case the supply of prophylactic is accompanied by a direction of doubling or trebling the *standard* doses, this should be attended to; please, therefore, note the instructions on the label of each bottle.

"7. No changes in diet or occupation are necessary, beyond, if possible, taking some rest.

"8. The prophylactic material is harmless, and can be thrown about without danger; but it is liable to get infected. A bottle, once opened, is therefore *not to be corked again*, but used up at once, or the rest of the contents thrown away. While a bottle is open it should be guarded from insects flying or walking into it, or dust falling in. The empty bottles, the boxes, and, if possible, also the cotton in which they were packed are to be returned to the laboratory.

"9. In sealed-up bottles, and when kept in dark and sufficiently cool places, the prophylactic is likely to retain its power indefinitely.

"10. It is requested that a detailed account of all operations done, and of any observations made, be communicated at the earliest convenience to the Plague Research Laboratory, Bombay, the *inoculation forms* supplied being filled up at the time of inoculation, and the occurrence of plague in families of the inoculated being noted, as soon as the information is obtained, in the *observation sheets*."

"In bacteriology conclusions are too readily drawn on incomplete evidence, yet in this study especially rigorous and unimpeachable evidence is required. Before we can approach the question of the spread of infectious disease, it is, therefore, our duty in all sanitary and other inquiries into its contagious nature, to ascertain under what conditions it becomes contagious for a particular community. It is easy to scoff at vague generalities about unsound personal and social hygiene, but their potency in establishing disposition to an infectious disease is fully borne out by animal experiments; the precise application of this knowledge to a certain community can be made only on the historical and epidemiological experience, and the scientific evidence obtainable on the particular case. If it be found that the removal or abatement of unsound hygienic conditions is attended by a concomitant variation of the disease, we may be a step nearer to the proof of a correlation between those vague generalities about unsound hygiene, on the one hand, and contagion and susceptibility on the other. In reasoning upon laboratory experiments, the precepts of logic and common sense are not to be altogether forgotten when practical sanitary and preventive measures are contemplated, the natural and epidemiological conditions must be carefully considered."—Kanthack.

The bacteriologist is generally too dogmatic and apt to undervalue the importance of practical sanitary measures. One cannot rely entirely on a method of dealing with disease which laboratory experience alone might pronounce infallible. Laboratory test-tubes are not human bodies, nor is the wisdom of the world contained in the results of culture experiments. The concurrent testimony of numerous observers strengthens the claim of inoculation to a premier place in dealing *rapidly* with plague epidemics. Personally, we have never inoculated anyone without at the same time bringing before their minds simple sanitary safeguards which we have found perfectly protective against this disease—primary plague pneumonia excepted. As this is the malignant type of the disease, corresponding to malignant small-pox or scarlatina, it does not appear to be mitigable by sanitary safeguards, or amenable to the laws governing the ordinary and more common types of plague.

The conditions of the disease are much more important for the individual and the community than juggling with the germ, the discovery of which, however much it may have increased our knowledge, does not diminish the adoption of safeguards that the natural spread of the disease suggests; and which are not usually the subject of study by laboratory experts.

CHAPTER IX

PAREL HOSPITAL REPORTS

Statistical and Clinical Record of Work done in the Parel Hospital (Government House) during the Period of its Existence from February 9th to June 26th, 1897, *by Surg.-Capt. Thomson,* I.M.S

PAREL Plague Hospital was opened on February 19th, 1897, and closed on June 26th, 1897. During the period—upwards of four months—630 patients were admitted, and 70 were detained under observation for periods varying from one to three days, under suspicion of plague. Total number treated and detained was 700. Of the 630 admitted cases, 97 were suffering from other diseases, 229 were convalescents transferred from other plague hospitals, and 304 were acute plague cases.

This report is in reference to the 304 cases of undoubted plague that came under personal observation :—

Admitted . .	304	Of these 149 were men, 66 women, and 89 children (53 boys and 36 girls).
Recovered . .	108	
Died . .	196	
General mortality per cent.	64·5	

	Total.	Males.	Females.	Died.	Recovered
Europeans . .	1	—	1	1	—
Native Christians	66	38	28	44	22
Jews . .	4	1	3	3	1
Parsis . .	6	4	2	4	2
Mahomedans .	16	14	2	8	8
Hindus . .	211	148	63	136	75
Total .	304	205	99	196	108

Infants.	2–5 yrs.	5–10	10–20	20–30	30–40	40–50	50–60	60–70	70 & upwds.
8	5	17	61	85	56	34	26	10	2

The youngest patient was aged 10 months; the eldest 96 years.

Analysis of Mortality.

Period after Admission to Hospital at which Death took place in 196 Cases.

MORIBUND.	DAYS.																	
(5 mts.—22 hrs.)	1	2	3	4	5	6	7	8	10	13	15	16	18	21	22	28	29	37
66	17	38	8	24	10	9	5	6	3	1	2	1	1	1	1	1	1	1

Ages and Occupations of Plague Cases Treated at Parel Hospital, Bombay.

Compiled by Surgn.-Capt. G. S. Thomson, M.B., I.M.S., *Civil Surgeon, Satara.*

Occupation.	No.	Died.	Recovered.
School children	58	33	25
Domestics	50	32	18
Labourers	49	38	11
Mill hands	34	20	14
Clerks	11	9	2
Sweepers	9	2	7
Police	9	6	3
Cooks	7	3	4
Washermen	7	5	2
Merchants	5	2	3
Grooms	5	3	2
Hamals	5	3	2
Gardeners	5	4	1
Beggars	5	2	3
Bootmakers	4	3	1
Fitters	4	3	1
Ayahs	3	2	1
Milk-sellers	3	2	1
Messengers	3	3	0
Carpenters	3	2	1
Sepoys	3	3	0
Fakirs	2	2	0
Toddy-sellers	2	2	0
Barbers	2	1	1
Fish-sellers	2	1	1

Occupation.	No.	Died.	Recovered.
Goldsmiths	2	2	0
Nurse	1	1	0
House-agent	1	0	1
Engineer	1	1	0
Dyer	1	1	0
Butcher	1	1	0
Salt-seller	1	1	0
Bread-seller	1	0	1
Watchman	1	0	1
Turner	1	1	0
Boilerman	1	1	0
Vegetable-seller	1	0	1
Medical man	1	1	0
Totals	304	196	108

Ages of 304 *Plague Patients in Parel Hospital arranged in Quinquennial Periods, showing Deaths, Recoveries, and Sex in each.*

Ages in years or under.	Total Attacks.	Males.		Females.	
		Died.	Recovered.	Died.	Recovered.
5	13	4	3	3	3
10	29	8	11	7	3
15	31	11	8	9	3
20	39	11	13	12	3
25	54	33	11	7	3
30	35	13	10	9	3
35	26	9	8	5	4
40	24	13	3	5	3
45	13	7	3	2	1
50	19	8	4	6	1
55	8	6	0	1	1
60	9	3	1	2	3
65	1	1	0	0	0
70	2	0	0	1	1
96 years	1	0	0	0	1
Totals	304	127	75	69	33

Attacks	304
Deaths	196
Recoveries	108

Dates of Recovery of 108 *Plague Cases at Parel Hospital, Bombay, February to July,* 1897.

SURGEON-CAPTAIN G. S. THOMSON, I.M.S., *Plague Duty, Satara.*

Day after admission	3	4	5	6	7	8	9	11	12	13	15
No. recovered	5	4	5	2	3	2	2	3	3	1	9

Day after admission	17	18	19	20	21	22	23	24	25	26	27
No. recovered	1	4	3	2	2	4	3	1	5	2	1

Day after admission	28	29	30	32	33	34	35	37	38	39	40	41	43
No. recovered	2	1	1	1	1	2	1	1	3	2	1	3	3

Day after admission	44	45	46	47	48	51	58	64	65	93	100
No. recovered	1	1	1	2	1	3	2	1	1	1	1

Otherwise disposed of or transferred to other hospitals, 4
Total . . . 108

One patient deserted on the twenty-third day. No patient was discharged until the temperature had remained normal for at least four days. Those discharged in less than ten days *officially* in hospital had been kept under observation for some time previous to admission, or had had plague and were admitted practically in a convalescent state, and detained until their clothing had been disinfected and their dwellings were ready for reoccupation.

Mortality.	Men.	Women.	Children.	Boys.	Girls.
64·5 %	68·6 %	71 %	52·8 %	42·5 %	64·3 %

Situation of Bubo.	Total.	Percentage.	Males.	Females.	Died.	Recovered.	Mortality per cent.
Right axilla	47	15·5	30	17	34	13	72·4
Left axilla	32	10·5	16	16	24	8	75
Right femoral	59	19·6	45	14	33	26	56
Left femoral	31	10·2	18	13	14	17	45·2
Right inguinal	17	5·6	11	6	10	7	59
Left inguinal	32	10·5	25	7	21	11	65·6
Right cervical	8	2·6	7	1	6	2	75
Left cervical	4	1·3	2	2	2	2	50
Right parotid	7	2·3	3	4	5	2	71·4
Left parotid	1	0·3	1	—	—	1	—
Multiple	24	7·9	15	9	14	10	58·3
No buboes	42	13·8	29	13	33	9	78·6

Right side—150, of which 12 were multiple.
Left side—108, of which 8 were multiple.
Both sides—4, of which 4 were multiple.

In upper part of the body—109, of which 10 were multiple.
In lower part of the body—149, of which 10 were multiple.
In both upper and lower—4, of which 4 were multiple.

Distribution of Bubo.	Men.	Women.	Boys.	Girls.
Right axilla . .	18	7	12	10
Left axilla . .	9	14	7	2
Right femoral . .	35	11	10	3
Left femoral . .	13	7	5	6
Right inguinal . .	5	2	6	4
Left inguinal . .	17	6	8	1
Right cervical . .	6	—	1	1
Left cervical . .	1	—	1	2
Right parotid . .	3	3	—	1
Left parotid . .	—	—	1	—
Multiple . .	13	6	2	3
No buboes . .	29	10	—	3
Total . .	149	66	53	36

Buboes in unusual situation:—

	Cases.
Right popliteal and right calf of leg (and left axilla) .	1
Left popliteal (and left femoral)	1
Right brachial (and right axilla)	1
Right forearm	1
Scalp	2
Mammary gland	3

Varieties of Plague.

Plague cases vary very much in severity, and some are so mild that it is only by the appearance of a bubo that one can know the patient is attacked by this specific disease.

(I.) *Nervous.*—The most common form might be called nervous, from the presence of delirium, headache, cerebral vomiting, giddiness, sleeplessness, stupor, coma, and death by cardiac syncope from derangement of the functions of the central nervous system.

(II.) *Pneumonic.* — This form is characterised by broncho-pneumonia or primary lobar pneumonia, cough, delirium, serous expectoration occasionally tinged yellow with blood, very few physical signs in the chest, expectoration containing large numbers of specific plague bacilli, absence of pulse-respiration buboes, absence of dyspnœa, and of disturbance of the pulse; respiration ratio as in acute pneumonia, slight pain, irregular temperature, early cardiac failure and death.

In Parel nine cases of this variety of plague were diagnosed as primary plague pneumonia and all of them died.

There were 19 instances of secondary pneumonia, of which 17 died and 2 recovered, and 4 had double broncho-pneumonia amongst the 17 that died.

(III.) *Abdominal.*—This is characterised by early prostration, irregular remittent temperature, early abdominal distention, delirium, typhoid state (picking at bedclothes, sinking down in the bed, involuntary passage of evacuations), simple diarrhœa of a thin, watery, and very offensive kind, aspect dull and stricken, absence of eruption, late appearance of bubo, and death by coma.

Predisposing Causes of Plague.

Occupation.—Occupation in itself did not predispose to the disease. Most of the hospital patients were very poor labouring-class people. Dhobies are said to be particularly exempt from plague; yet seven were admitted. Fatigue, destitution, filth, poverty, and overcrowding seemed to be the chief predisposing factors, and the horribly filthy condition of the person and clothing of most patients was indescribable.

The exciting cause, no doubt, as will be referred to under bacteriology, was the specific plague bacillus of Kitasato and Yersin.

Contagion.—There can be no doubt of the contagious nature of plague under certain insanitary conditions. When one case of plague came from a house, in twenty-five instances a second succeeding case came from the same house; in three instances a third, and in one instance a fourth case. How the first case arises it is impossible to state. It is remarkable that many instances of the death of rats in the house, infected room, or neighbourhood were brought to notice by the voluntary declarations of the friends, and this circumstance is the more notable when the degree of intelligence and lethargic mental attitude of the informants are considered. In twenty-nine instances more than one case occurred in the same family. How the poison is transmitted is an indeterminable point, from the few opportunities of witnessing its actual spread in hospital. The disease is certainly most infectious in the acute stage. Once the temperature becomes normal the risk of infection is over. No instance of the spread of the disease from convalescents to patients near them under observation or suffering from other diseases was met with. The body of a patient dead of plague does not seem to be capable of communicating the disease except by inoculation, of which one example was seen.

One attack does not confer immunity from another, as one patient had a second and fatal attack, and one had a relapse. The second attacked was a woman aged forty; convalescent eighteen days; attacked twenty-seven days after the initial symptoms of the primary attack; and died five days afterwards. The primary attack lasted nine days, and the fatal one five days, and in the latter she developed a fresh bubo in a different site from the original one, had fever, delirium, stupor, coma, and unconsciousness. The general characters of an acute attack were present in the tongue, pulse, respiration, skin, eyes, intestinal canal, typhoid state, and mental condition. Her temperature had been normal eighteen days when the fatal attack came on. The incubation period could be fixed at two days in one case, five in another, seven in another, and ten in another. In the inoculated example, due to a wound* incurred in the course of making a post-mortem examination (not a Parel Hospital case), the incubation period was within three days.

That the disease is not infectious in hospitals is a well-established fact from experience in the Parel Hospital. In upwards of 240 instances the friends of the patients attended their sick, and in twenty instances scarcely even left the bedside, and in not a single instance did the disease spread to the friends. Out of more than 140 attendants on the sick belonging to the hospital staff from time to time, only one sweeper was attacked, and he had been constantly helping in the post-mortem room, and had a very mild attack, with small axillary bubo. Temperature 100° F. at highest. He resumed his duties on the fifth day afterwards. In three cases amongst hospital orderlies other and special sources of contagion existed, very likely to lead to direct inoculation, and are, therefore, not considered instances of spread of the disease from mere attendance on the sick. One nurse belonging to another hospital, whose case is given in detail, was admitted.

The conclusion drawn is that one of the safest places during an epidemic is the ward of a sanitary plague hospital, something more than mere exposure to contagion being necessary to develop the disease—most probably overcrowding, destitution, deficient cubic space, ventilation, and sunlight, and a filthy and general insanitary condition of person, clothing, habitation, and its surroundings.

Further specific proof of the non-contagiousness of plague in hospital was furnished by one instance in which a mother, ill with the disease, suckled her infant and it

* Dr. Sticker, of the German Plague Commission.

escaped; by one instance, in which an infant with plague was nourished on the mother's milk, and she was not attacked; and by one instance in which a brother slept in the same bed with his stricken brother, and did not contract the disease from him.

Diagnosis of Plague.

In an epidemic the diagnosis of plague is to some extent aided by presupposition. In cases in which no buboes can be felt—comprising 13 to 14 per cent. of those observed at Parel—the diagnosis must depend on the general symptoms and signs, and in cases likely to prove fatal by confirmatory bacteriological evidences. At other times some non-bubonic cases are likely to escape detection.

In those cases the buboes cannot be got at, if in all cases they exist, for bacteriological examination, and mere blood cultures generally failed to demonstrate plague bacilli, even in undoubted bubonic plague patients who afterwards recovered. The following points guide one in arriving at a diagnosis:—

1. Character of the tongue.
2. High temperature, with hot, *dry* skin.
3. Injection of conjunctivæ usually met with.
4. Delirium, sleeplessness, headache, vomiting.
5. Sudden onset without premonitory symptoms.
6. Dull, heavy, apathetic look.
7. Pulse full, soft, compressible, and dicrotic.
8. Marked mental hebetude and lethargy.

All doubt is removed on the appearance of the bubo with some or most of the preceding symptoms and signs; and no one sign or symptom can be relied on as pathognomonic of plague, but the general clinical phenomena must be viewed together and the diagnosis arrived at from the patient's condition as a whole.

The diseases most liable to be mistaken for plague, judging by those suspected cases sent into hospital, are ague, remittent fever, syphilis, pneumonia, epilepsy, cerebral apoplexy, uræmic coma from advanced kidney disease, ulcer with sympathetic (simple) inflammation of lymph glands, and diarrhœa, debility, marasmus, and phthisis.

Rate of Mortality.

1. Age did not seem to influence the rate of mortality.

2. *Sex.*—The female sex showed an excess of mortality; 71 per cent. of the females over eighteen years of age died, whereas the men above that age showed a death-rate of 68·6 per cent. of those attacked; and female children gave 64·3 per cent. of deaths to attacks, as against 42·5 per cent. in boys.

No diminution in mortality or virulence was apparent during the decline of the recent epidemic, and some of the cases admitted in the last week were as virulent and fatal as at any period of the epidemic.

3. *Situation of Buboes.*—Under this head it is a remarkable fact that cases without palpable buboes were most fatal, averaging 78·6 per cent. Many of such cases died early of convulsions, coma, and syncope, overwhelmed by toxic products suddenly attacking the great nerve centres, as it were, before there was time for an inflated gland to arise.

The next most fatal were L axillary and R cervical in the same proportions, then R axillary and R parotid in nearly the same ratio, next came inguinal, and next femoral; and multiple seemed to be least fatal.

Buboes on the R side had 66·7 per cent. mortality.
" " L " 58·3 " "
" in the Upper part of the body 69·3 per cent. mortality.
" " Lower " " 57·2 " "

The nearer the head the more fatal the case, and those with buboes in the neck, and especially in its anterior aspect, were very fatal.

4. *Race.*—

(*a*) Native Christians had a mortality of 75 per cent. admissions. In males 63·2 per cent. died, and in females 71·4 per cent.

(*b*) Jews had a mortality of 75 per cent. admissions, but only 4 cases in all.

(*c*) Parsis had a mortality of 75 per cent. admissions, but only 6 cases in all.

(*d*) Mahomedans had a mortality of 50 per cent. exactly.

(*e*) Hindus had a mortality of 64·5 per cent.; and males amongst Hindus died at the rate of 65·5 per cent., and females of 65·1 per cent.

The general excess of female mortality was due to the number of pregnant females who aborted, and to the influence of the catamenial discharge; and the disproportionate number of deaths from convulsions amongst young female children who showed an excess of mortality as compared with boys in the proportion of 64·3 to 42·5 per cent.

In persons who are very fat the prognosis is unfavourable.

Mental depression and fatigue, and previous privation add to the mortality.

The following are bad omens:—Pulse over 120; respiration over 30; sleeplessness lasting several days; early and violent delirium; great prostration; carphology; subsultus; twitchings and convulsions; hiccough, "typhoid state"; uræmic symptoms; presence of complications, especially broncho-pneumonia; hypostatic congestion of the lungs; laryngitis; dysentery; meningitis and pneumonia.

The only favourable prognosis that can be relied on is the absence of the unfavourable symptoms noted above, and the fact that the patient has come early under treatment and is kept lying down, until his temperature has been normal four days. Most patients who survive eight days without developing complications recover.

Free excretion of urea and uric acid and the absence of albumen, blood, and renal casts in the urine are favourable signs, and a return to the normal quantity secreted and the presence of chlorides, one of the first signs of amendment.

A change in the patient's manner and countenance often heralds his recovery; the expression is less stupid, and he becomes rational, takes notice, and the conjunctivæ become less injected.

Many cases died who appeared to be recovering, and on the other hand some recovered whose death appeared inevitable.

Although the general mortality was 64·5 per cent., it must be pointed out that 66 were moribund on admission, 17 died during their first day in hospital and 38 during their second day. Excluding those 121 deaths under 48 hours in hospital, the rate of mortality was 41 per cent. of cases treated.

By further excluding cases treated by M. Yersin's serum, which are dealt with separately, the mortality of cases under hospital treatment was only 30·8 per cent. of admissions who lived over 48 hours in hospital.

Finally, there can be no doubt that the disease is a very malignant one, many cases dying suddenly before reaching hospital even when compulsory segregation was enforced.

Clinical Description.

The onset of an attack of plague is usually very sudden, the patient being struck down with the following premonitory symptoms. He is seized with rigor or a feeling of chilliness, followed by frontal headache, nausea and vomiting, lassitude and disinclination for exertion. The vomiting is of cerebral origin, bilious in character, and may be frequently repeated without bringing any relief to the patient's feeling of illness.

The tongue is large, pale (often teeth-indented) and evenly coated first with a thin white, and later with a yellowish-brown fur.

This fur is confined to the dorsum of the tongue, the tip and edges and under part of the tongue being bright red and clean, and the amount of furring increases towards the back of the organ.

Thirst is generally complained of, but the appetite is good, and the taste not perverted. The bowels in natives have been invariably constipated, and the urine scanty, highly-coloured and febrile in character, with some albumen and casts.

The pulse is over 100, full, soft, and bounding, at an early stage of the disease, becoming later, frequent, small, markedly dicrotic, and very compressible, and finally anacrotic, running, and imperceptible and rarely irregular or intermittent.

The respirations are accelerated, averaging over 30 per minute, and there may be slight cough.

The face is suffused and muddy; the conjunctivæ injected and the eyes watery, and the general expression dull, heavy, and stupid. Usually there is giddiness, restlessness, and loss of sleep, or snatches of sleep broken by slight delirium and confusion of the memory and intellect. The delirium varies in character. It may be acute, wild, raving, or wild and busy, resembling *delirium tremens.* In the former the patient shouts, talks incoherently, is violent, and tosses about so that it is with difficulty he can be restrained or kept in bed.

Delirium of a wild, violent nature is rapidly followed by collapse, and if accompanied with refusal to take medicine, food, and stimulants, usually ends in death at an early period. Sometimes the delirium is never acute, confined to slight incoherence between sleeping and waking; and many fatal cases of undoubted plague never develop delirium.

Generally along with the delirium there is sleeplessness, and the patient's attention can be momentarily arrested by speaking loudly to him, but he soon lapses into incoherent muttering.

His cerebration seems to be at a low level, and there is a want of power to concentrate the thoughts for any length of time on any one subject, so that he soon becomes wearied, fails to keep up a connected conversation, and only partially utters replies to questions; in fact, there is a general subjection of the mental faculties: hebetude and lethargy.

The symptoms of nervous excitement may last for days—indeed, in one case they lasted nearly continuously for days, and became more marked towards evening and in the night-time—or may pass into nervous depression and stupor. The prostration is now marked, the patient lying in the dorsal decubitus, sighing, muttering slightly, or still and motionless, as if overwhelmed with some toxic cerebral poison, and utterly indifferent to all surroundings.

Tremors, subsultus, tossing of the arms aimlessly before the face and picking at the bedclothes supervene. The eyes are firmly closed, the pupils contracted, the conjunctivæ markedly injected, and the countenance stupid and vacant; deafness is also generally present. The tongue becomes dry, brownish, and rough in two lines on each side of the central *râphè*, with thick whitey-brown fur, chipping in flakes, which leave raw red patches often showing fissures; it is protruded slowly and with difficulty, and the patient often forgets to withdraw it for a time until loudly spoken to. It is rarely tremulous. *Sordes* collect on the teeth and lips, and constipation continues. In this state the patient may continue for some hours or several days, and even recover. But usually the stupor passes into fatal coma, or the pulse becomes frequent (140–160), small, weak, or scarcely perceptible, the surface cold, especially the extremities, and the case ends fatally in coma and syncope. On the other hand there may be an amendment, and the patient returns to consciousness and life. He is extremely debilitated and at first bewildered, but soon gets in touch with his surroundings. The pulse may become normal and the temperature fall, generally by lysis, which is by far the more favourable termination in this disease, or rarely by crisis; the tongue becomes clean and moist; and without any critical accompaniment, such as diarrhœa, perspiration, or increased flow of urine, the patient may rapidly regain his senses and no permanent blot remain.

It must be remembered that the disease presents great varieties, from the most mild and hardly recognisable forms to the most severe, and one can seldom tell from the symptoms alone whether a given case is going to turn out favourably or fatally. In mild cases the pulse may never go above 100, or the temperature above 101, and slight (or no) confusion of the intellect, headache, and sleeplessness be the only symptoms of cerebral derangement. The diagnosis can only be made by the discovery of an inflamed and perhaps only slightly enlarged lymphatic gland, and by a bacteriological examination microscopically, and by cultivation of the extracted matter from this gland.

Principal Symptoms of Plague.

Physiognomy.—The physiognomy of a plague patient, when this phenomenon is present, as was found in about half the cases at Parel, is peculiar and striking and will often direct attention to the nature of the disease from which he is suffering. The countenance is dull, vacant, and anxious, and the eyelids and mouth are kept half open. The patient has a furtive look, rarely meets his eyelids in winking, and seldom performs that act; gazes about him vacantly and does not seem to care to talk or to notice persons or things about him. In addition, the conjunctivæ are injected, often markedly so: the eyes suffused and the pupils usually normal.

The Temperature.—The temperature in plague is elevated from a very early period of the disease. Some cases seen within ten hours of the initial rigor showed a rise up to 103·4° F., and no case has been met with in which symptoms of plague were present without an accompanying rise of temperature, so that it may be defined as a febrile disease. The temperature is of a remittent type, with slight ranges of 1 or 2 degrees, but sometimes sudden rises up to 107·4° F. even, and there is usually an evening exacerbation noticeable.

The maximum is attained on the second or third day, and in the natural uncomplicated course of the disease there is usually a slight remission from the fifth to the seventh day. This remission was noted in some of the earliest cases uninfluenced by antipyretic treatment, and seems peculiar to plague. The temperature can be only very temporarily influenced by drugs, and antifebrin and phenacetin were employed in a few cases on trial, but not with encouraging results, so that their use was abandoned. Tepid sponging repeated every time the temperature touched 103·5° F., and the application of the ice-bag and administration of diaphoretic mixture with stimulants came to be looked upon with most favour in combating this symptom.

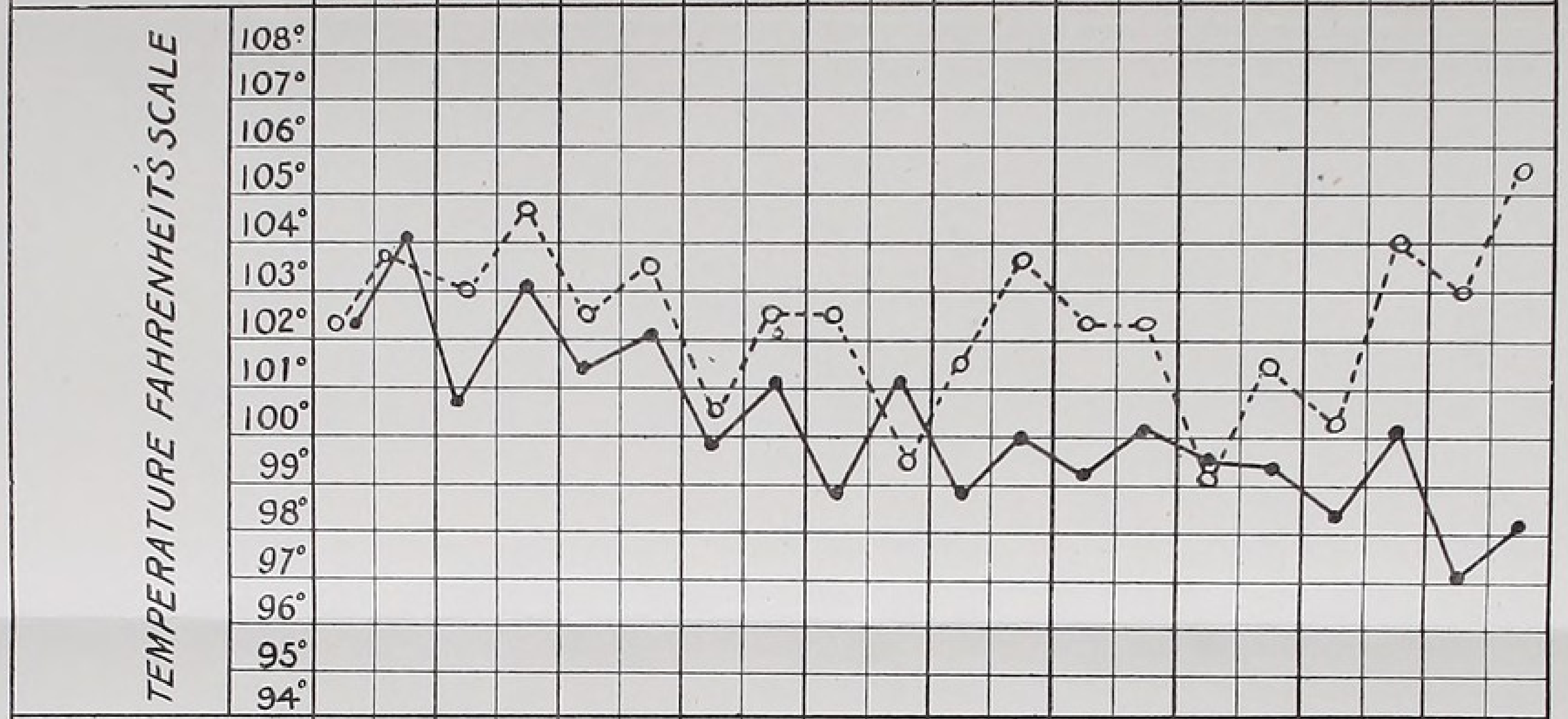
A fall of temperature by lysis from the fifth to the seventh day is a favourable symptom; and very often the use of some medicament, or resort to one of the methods of surgical interference with the local expression of the disease, by excising or injecting the inflamed gland, has been credited with an unwarrantable influence on the temperature curve. A decided rise of the temperature during the course of the disease after the seventh day is mostly due to the advent of some complication, such as secondary broncho-pneumonia, boils, lymphangitis, or septicæmia, and indicates prolonged convalescence or an unfavourable issue.

Marked elevation of temperature does not of itself mean an abnormally severe or necessarily fatal case, and in some cases the temperature has reached 106·4° F., and yet the patient has recovered. On the other hand, cases may be severe and even fatal, mostly from toxic nervous symptoms, when the temperature has never reached 103° F. In fatal cases the temperature has ranged as high as 107° F. at, and even after, death. The average of cases ranged between 102° F. to 105° F., and the lowest had 100° F. only. As a rule, the temperature is 102–105; pulse 110–120; respiration 20–30.

The Skin.—The skin is almost invariably dry and hot; yet very rarely perspiration was noted on the forehead or chest, and in this respect the disease presents a marked contrast to the freely perspiring and moist skin of ague and remittent fever, which have frequently been sent in to hospital under suspicion of being plague.

Average Record of Temperature in Plague

Recovered 27 Cases —
Died 75 " ----



Days of Disease		1		2		3		4		5		6		7		8		9		10	
		M	E	M	E	M	E	M	E	M	E	M	E	M	E	M	E	M	E	M	E
Nº of Observations.		3	5	7	9	11	13	15	17	19	21	23	25	12	19	21	27	21	23	20	25
		8	10	12	15	20	25	27	30	30	35	40	42	45	50	50	53	39	41	26	23
Tempre	Highest	105	105	103·6	105	103·8	104	102·4	104	101	105	102·4	103	103	103·4	101·8	102	101	102	101	102
	Lowest	100	103	99	101	99	100	97	98·4	96	97	97	97	96·4	97	97	97	96·4	98·4	96	97
Tempre	Highest	103	106	105	105·6	103	104	104	105	103	102	104	106·8	103	104	103	105	101	104	103	105·4
	Lowest	101	101	101	104	102	102·4	97	100	101	97	99	101	102	101	97	98	99	104	103	105·4

An eruption on the skin of any distinctive character, although frequently looked for, was not found. In a few cases at most fugitive erythematous, or urticarial rashes, or mosquito bites, or lichen tropicus were discovered. *Sudamina* were rarely seen, and *purpura* spots, *vibices*, and desquamation conspicuous by their absence.

In a small number of instances abrasions, and in five cases a distinct vesicle, were found on the extremity or part of the body in which the primary bubo was situated.

The lymphatics, however, leading from those vesicles never were found inflamed. In all five cases the contents of the vesicles, when examined microscopically and by bacteriological cultivation, yielded positive evidence of the presence of the bacillus of plague. From such absolutely positive results one may state that the source of infection has been by inoculation through the skin, perhaps by an abrasion or small cut, but that this is the invariable and only mode by which the bacillus gains an entrance is open to grave doubt. The lymphatic gland in anatomical connection with the vesicle was inflamed and tender in each of those cases, and was the only one affected as far as could be made out.

The occurrence of boils was frequently noted as a sequela, and true carbuncles were never met with in any of the Parel patients. An acute necrosis of the skin, subcutaneous tissue, and gland occurred in three instances, but was not of such clinical features as to arouse the idea of carbuncle in the mind of the observers. It is to be further noted that in every such instance the patient or his friends had applied some irritant over the gland, usually a mixture of marking-nut, chunam, and ghoor (molasses).

That carbuncles are met with in plague one can hardly doubt; but the experience of the Parel cases would lead one to conclude that their appearance is not a characteristic or, by any means, a diagnostic of plague. That they were carefully looked out for at Parel with the assistance of other investigators precludes the idea that their presence could have been overlooked.

In some cases a peculiar earthy, cellar-like odour was detectable from the patients' skin and breath. It is a remarkable fact that this odour was quite familiar to the nurses, and noted independently by one of the very intelligent nursing sisters, who thought it was confined to fatal cases. The smell was quite distinct from that due to involuntary passing of the motions or urine in the bed, and was observed in some cases in which the patient had perfect control over his evacuations. Generally cases ending in fatal septicæmia evolved this odour from the skin and breath, but a few patients, in which its presence was unmistakable, recovered.

The Pulse.—As a rule, the pulse is over 100 per minute, and a slow pulse was not met with in a single case of plague. It may reach 120 to 140, or even 170, per minute during the course of the disease. Seen early in the disease, the patient will be found to have a frequent (110 to 120), full, bounding, soft, and compressible pulse which is markedly dicrotic and presents a want of vehemence in the stroke. A gradual fall in the frequency of the pulse-rate is a favourable sign, and a great rise after a fall means some complication supervening. There does not appear to be any definite pulse-respiration ratio, although at first both are elevated, and finally it becomes very rapid and often imperceptible before death.

A marked character of the pulse, on which some interesting observations were made both during the fever and in convalescence, was the influence of posture on its frequency and force. The frequency became increased by as many as 20 to 32 beats per minute, and it became small, weak, almost thready and irregular (and all this seemed to be due to the great prostration of the nervous system) when the patient was helped gently and carefully to sit up. The heart's sounds were constantly found to be normal, although the impulse was diffused and strong. No murmurs were detected in any patient at Parel at any stage of the malady, and the heart at the post-mortem showed no valvular lesions or visible alteration of its musculature. Softening of the structures was conspicuous by its absence, and yet the alarming suddenness of death in patients convalescing from an attack of plague seemed to foreshadow such pathological change. In all probability the syncope met with in such cases is secondary to toxic degeneration of the central nervous mechanism, and is due to sudden vaso-motor paralysis. No fact in the clinical phenomena of plague remains more indelibly impressed on the mind than the extremely frequent and alarmingly sudden and unexpected death of patients who are apparently well on the road to recovery. The pulse may be normal in frequency and force, the temperature normal for some days, and yet some slight exertion, such as sitting up prematurely in bed, may lead to fatal syncope, and nothing was found in two such cases in the heart itself to account for the result.

Respiratory System.—The respiration usually exceeds 25 in the beginning of an ordinary case, and that without any lung complication, and often rises to 30 or even 48 up to 60 per minute. In grave cases it is hurried, sighing, and often irregular, and sometimes the alæ nasi can be seen to take part in the respiratory act. When there is coma the breathing may be blowing, with the mouth closed, and the cheeks puffing, and the respirations irregular.

Hypostatic congestion of the lungs is met with as a complication of plague, and is usual in fatal cases, congestion taking place in the most dependent parts of the lungs as the power of the circulation wanes. When this supervenes the respirations mount up to 30 or 40, and up to 60 or upwards per minute, and are hurried and laboured, whilst at the same time the temperature may be nearly normal, and cold extremities and stupor, deepening into coma, close the scene. In this condition there may be only slight, if any, cough or expectoration, and physical examination alone reveals to the physician the dangerous condition of the patient. This condition demands the free exhibition of diffusible stimulants and strychnine with tincture of strophanthus and carbonate of ammonia, on which most reliance can be placed.

Digestive System.—The tongue from the very first is coated with a whitish, thin, silvery fur, confined to the dorsum and increasing in depth towards the root of the organ, and most marked on each side of the *râphè*, while the underneath part and tip and edges of the tongue are red and clean, with prominent fungiform papillæ and the whole tongue moist. The fur becomes yellow, then brown and cracked, and falling off in flakes which expose a clean, raw, red, irritable-looking surface. In no case did the tongue appear black, or contracted into a ball, or bleeding and ulcerated, or fissured. The amount of furring showed no relation to the severity of the case. During convalescence the tongue becomes clean at the sides, and the fur slowly and gradually disappears. In fatal cases the tongue is tremulous, protruded with difficulty, and dry and flaky.

In severe cases brown *sordes* collect upon the lips and teeth, if the patient survives some days, and fatal cases towards the end of the first week usually show such phenomena. The gums may be soft and spongy, rarely ulcerated, and hemorrhages were never seen.

The appetite is not impaired; indeed, the patient can take food fairly well throughout. Of course, cases with coma, stupor, and wild delirium refuse food, and do badly as a rule. Convalescence is not ushered in, therefore, with any improvement in the appetite or ravenous craving for food. Thirst is present in nearly all cases, but is rarely excessive; and sometimes most thirst was complained of in cases of a mild type and without high temperature or excessive secretion of urine or sweat. It is one of the earliest symptoms of the disease, and the patient often mentions it as part of the initial history of the attack. Sometimes dysphagia is present, and this was noted especially in cases where the glands in the anterior triangle of the neck were enlarged and surrounded with a good deal of infiltration and œdema. Such cases rapidly proved fatal, and œdema of the glottis and marked inflammation of the pharynx and trachea were found in post-mortem.

Nausea and vomiting are common early symptoms. One or other or both were present in 60 per cent. of the acute cases admitted. The vomited matter was bilious in character, frequently repeated, affording no relief, and occurring independently of the injection of food, medicines, or stimulants. It was undoubtedly of cerebral origin, due probably to the action of toxines on the nervous centres. Sometimes vomiting persisted, and was a troublesome symptom even during convalescence. In its treatment camphorodyne, bromide of ammonium, hydrocyanic acid, and ice (to suck) were found useful.

Tympanitis was not a frequent symptom. In puerperal cases, which aborted, it was very marked. The abdomen is not distended, but generally soft, flat, or flaccid. In the puerperal cases it was associated with tenderness and cerebral depression and prostration, but not with diarrhœa. Gurgling was only detected in one case, and that was of the abdominal or typhoid type, and in a European, and was accompanied by frequent, very offensive, acid motions, and was general over the abdomen and not localised in the right iliac fossa. Abdominal pain was seldom present and scarcely ever complained of; and tenderness only occasionally noticed. The liver and spleen were in some cases found enlarged, but more frequently those organs could not be palpated clinically. The spleen is more generally found enlarged than the liver, and in the majority of the post-mortems this was apparent.

Constipation in natives was invariably found to prevail in the early stage of the disease; indeed, diarrhœa was only present in one case of enteric type in a European. The constipation was so obstinate as to require a calomel jalap purgative in most instances, and this became part of the routine hospital treatment. Many cases, fatal or otherwise, ran their course without diarrhœa supervening. During convalescence diarrhœa sometimes came on as a sequela, or associated or followed by dysentery. The motions in plague are usually acid, and were not in a single instance found to contain bacilli, although carefully looked for both before and after the administration of purgatives and at different intervals by the members of the German Plague Commission.

The Urine.—The urine is diminished in quantity, and in three severe cases it was completely suppressed. It is usually reddish-brown or darker than normal in the early stage; and in convalescence the colour becomes pale and limpid and the quantity increased. The reaction was acid, and the specific gravity from 1,015 to 1,030 in 30 acute cases specially examined, and the average of urea, uric acid, and chlorides diminished, and albumen one-twentieth to one-tenth present in 33 per cent. of the cases. Tube casts were found in the sediment of 15 per cent. of the cases examined in the forms of granular epithelial and hyaline plugs. Albumen was tested for by heat and nitric acid—the ordinary clinical tests—and during the period extending from the third to the tenth day of the disease; and was not found during convalescence. Bile pigments were generally present.

The urine, with one exception, and that a fatal case, yielded negative bacteriological results, and in no case was blood passed in or with the urine.

In only three cases was retention of urine present, necessitating the use of the catheter; and all of them had grave cerebral symptoms and ended fatally.

Nervous Symptoms.—One of the earliest and most constant symptoms of plague is headache. It was found at some stage, in 94 per cent. of acute cases, was severe, and the patient complained of it during the first few days in the majority of such cases. Headache is most often frontal or temporal in seat, rarely vertical or occipital, and is of a dull, heavy character; sometimes intense, or ill-defined and throbbing, and in still fewer cases it may be absent.

Giddiness in most cases is complained of as a very early symptom along with headache, and prevents the patient from sitting up, walking about, or attending to his duties. It is very rarely, indeed, that pains in the loins, back, or limbs are met with, so that the disease can hardly be simulated by small-pox backache.

Delirium and obscuration of the mental faculties are almost invariably met with at some period in this disease, although mild cases are met with which never become delirious or show mental confusion. The character and amount of delirium vary greatly, and present no relation to the severity of the attack. Of one hundred consecutive cases mental aberration or delirium was present in seventy-four at some period. The patient is apathetic, hesitating, stupid, and his mental faculties blunted and confused, whilst he appears irritable and does not like to be disturbed. The delirium appears early, often at the very beginning of the disease, and is most marked at night throughout. Sometimes patients appear wakeful and delirious by night, and stupid, drowsy, and comatose by day. If the patient is about to recover, delirium ceases. Some cases develop late maniacal delirium during convalescence, refuse food, and die of marasmus in spite of forced feeding. When delirium is present headache is not a prominent symptom, or else the patient is too mentally confused to complain of it.

Most commonly the delirium is of a low, muttering type; when left to himself the patient is restless and irritable, and, when roused, answers in a slow, hesitating, rambling, and incoherent manner, and with great effort apparently.

Some patients are fidgety, tossing their limbs about, drawing up their leg and shooting it out fully extended again, move about in bed, try to get up without definite object, laugh, sigh, moan, and have busy delirium like the *delirium tremens* of the drunkard.

Occasionally there is wild, fierce, maniacal delirium. The patient is sleepless, rolls his head about, shouts, refuses all nourishment, and is restrained with great difficulty. The muscular power of such a patient may be surprising, and one young girl required considerable strength to keep her in bed. This form of delirium soon ends in collapse, profound muscular and nervous prostration and death. This wild form of delirium was mostly seen in young and strongly-built, muscular patients, and the few who recovered from such a state remembered nothing of it, the mind appearing to remain a perfect blank.

Sleeplessness was noted in 90 per cent. of acute cases, and is one of the earliest symptoms, and may be present for several days and nights in succession. It is a favourable sign when a patient sleeps well and naturally. Somnolence, apart from stupor and coma, was not met with; and coma-vigil not observed.

Prostration and loss of muscular tone are early developed, but these would appear to depend on implication of the nerve centres; and in some cases the patient has voluntarily walked some distance to the hospital, to die in a day or two of extreme nervous prostration.

As a rule, prostration increases with the advance of the disease, and is marked in those who have had delirium and great excitement and struggling when unconscious. Prostration may develop quite suddenly and prove rapidly fatal in persons who but an hour before were apparently quite on the way to ultimate recovery. Should a patient recover from such a prostrate condition, there are great lassitude, weakness, and want of energy for a long time, following it. Along with the prostration there is usually dorsal decubitus.

The general absence of involuntary discharge of fæces and urine and the only occasional retention of urine show that muscular paralysis does not often exist; whilst conjunctivitis and ulceration of the corneæ from inability to close the eyelids point to nervous centres poisoned by the products of the specific bacillus.

Subsultus tendinum and spasmodic contractions of the hands, arms, and face are seen in severe cases, and in one case the spasms succeeded each other at the rate of eighteen to twenty per minute, and affected the flexors and abductors of both upper extremities. In this case double axillary buboes appeared within the first twenty-four hours simultaneously.

Convulsions, in very young children, seemed to take the place of delirium, and the little patients in four instances expired apparently from the very severity of the convulsions, overwhelmed with acute toxæmia before an inflamed gland had developed.

Other forms of spasmodic movements were seen in some fatal cases in the fumbling at the bedclothes, and aimless tossing of the arms; and, in a few patients, hiccough, from which few patients recovered. Convulsions usually ended in coma and death, and in three cases the convulsions were noted during the death agony.

The marked prominence of nervous symptoms shows that the brunt of the disease falls on the nerve centres, and that the toxines absorbed from the primarily inflamed gland into the blood, or, in pneumonic cases, formed directly in the blood, act injuriously by a sort of selective affinity on the nervous system. The great frequency of nervous sequelæ confirms this to demonstration.

Special Senses.

Eyes.—The conjunctivæ are generally injected, and in more than half the acute cases were markedly so, at the beginning of the disease, and the eyes suffused. There may be leashes of inflamed and engorged vessels often noticed at the two canthi, especially where the pressure of the lids is wanting. This injection of the ocular conjunctivæ is a valuable diagnostic sign as it is met with early, and generally in cases in which a characteristic bubo has not appeared.

Acute conjunctivitis was seen in five cases, hypopyon in one case, and ecchemosis in two cases, whilst ulceration, panophthalmitis, and chemosis were among the sequelæ which developed in seven convalescents.

Photophobia did not appear to be present, and patients never complained of it.

The pupils were most frequently normal, next most frequently contracted, and very seldom dilated or unequal.

Ears.—Deafness is generally present; as the patient, when addressed in the ordinary tone of voice, will often ask to have the question repeated, and even then only understands when he is spoken to loudly and distinctly.

Patients who had not been getting quinine appeared to suffer, and syringing of the ears did not lessen the deafness: of which the explanation is difficult. The dulness of the mental faculties may be the cause of this apparent deafness.

Otorrhœa did not occur in a single case, nor was inflammation of the meatus or membranæ tympani seen.

Smell.—Parosmia and epistaxis were never seen at any time.

Taste.—The sense of taste is not affected, and patients usually partake of whatever is given them with apparent relish. Very occasionally a patient complained of an acid bitter taste in the mouth; but none ever mentioned a bad taste.

Sensibility and Touch.—Perversions of the sense of touch were never noted.

Complications and Sequelæ of Plague.

Many cases develop complications and sequelæ which prolong the course of the primary fever and delay convalescence, and ultimately turn the chances of recovery against the patient and cause his death.

The most frequent complication was broncho-pneumonia, which developed in a course of the disease in nineteen cases, seventeen ending fatally. The disease began insidiously, and between the fourth and eighth day, cough and slight expectoration being present. Pain in the chest is seldom complained of. Very often a rise in the temperature and quickened breathing were the first indications of its onset.

Of the 19 cases, 12 were men, 5 women, and 2 children. The physical signs were confined to a small area, and slight. Bronchitis was only noticed in two cases.

Pneumonia as a primary affection was seen in nine cases. In none of the primary pneumonia cases were tangible buboes found. The disease began as pneumonia, but the temperature was not very high, and only a few scattered patches in one lobe generally were detectable on auscultation. Expectoration was sero-mucoid, scanty, and occasionally tinged with blood. The sputum was rich in bacilli, and yielded pure cultures by growth on agar-agar. All primary pneumonia cases at Parel Hospital ended fatally.

One case developed left pneumo-thorax, which proved fatal thirty-seven days after admission, and this was the latest day on which an acute case died in Parel Hospital. Pleurisy is not a common complication and is latent, no sharp pain being complained of, and the effused fluid quickly absorbed, never becoming purulent in the two cases noted; these both ended in recovery.

Phthisis came on in two cases during convalescence, and carried off the patients. Rapid emaciation and debility, profuse sweating, purulent expectoration and hectic fever, but no hæmoptysis, were the prominent symptoms.

Laryngitis occurred in five cases and proved to be a serious complication. In all instances a bubo in the anterior part of the neck, or beneath the sterno-mastoid or in the parotid region, accompanied or preceded the laryngitis, and all ended fatally by œdema of the glottis, and enormous œdema of the subcutaneous cellular tissue of the neck below the jaw and in front of the throat. In most cases this swelling came on rapidly and changed —by partially obscuring—the features of the sufferer.

Diseases of the Nervous System.

Meningitis.—True meningitis came under notice in two cases, and both ended fatally. Inflammation of the membranes of the brain was discovered at the post-mortems.

The frequent presence of symptoms of cerebral disturbance and the rarity of true meningeal inflammation would seem to prove that the symptoms depend on toxæmia.

Imbecility and mania are rarely developed after plague. Only two convalescents showed signs of imbecility in the form of delirium, refusal to take food, marasmus, dementia, and death; and one patient transferred from another hospital had mania as a late sequela.

As a rule the mental faculties are completely restored after the first few days of convalescence, so that organic brain lesion must be rare.

There was no fever or headache accompanying the imbecility, but anæmia and mental depression.

Tonics, stimulants, and sedatives to induce sleep—preferably opium—benefited such cases.

Paralysis.—Paralysis is frequently seen as a sequela of plague. In Parel seven patients developed aphasia in from ten days to thirty days after the beginning of convalescence. All recovered speech before being discharged, and the longest period during which a patient remained aphasic was one month. Recovery was gradual, but complete in every instance.

Hemiplegia occurred in five patients, and they all recovered muscular power except one, who was transferred after ninety-three days in hospital to a home for the indigent poor. Paraplegia was seen in three patients during convalescence—facial paralysis twice, and local paralysis affecting the upper arm on one side in two cases. All recovered.

Spastic paraplegia developed in one man two months after convalescence, and he ultimately was discharged cured.

In all twenty patients had paralysis of different sorts, and all recovered, so that gross lesions of the nerve centres could hardly have been the exciting cause. One is rather inclined to attribute such sequelæ to toxines acting on the nerve centres or nuclei of origin of the affected nerves.

Diseases of the Digestive System.

Pharyngitis.—Inflammation of the pharynx causing difficulty in swallowing, interfering with nutrition, and leading to œdema glottidis was a marked complication twice.

Ulceration of the mucous lining of the palate was seen once.

Hæmatemesis was never observed, nor was malæna met with, and considering the engorged state of the gastro-epiploic vessels met with after death, and the numerous gastric and intestinal petechiæ, this seems an unexpected clinical record.

Diarrhœa was only met with in one case of the abdominal enteric type in a European, accompanied with tympanitis, frequent fœtid watery motions, and ending fatally on the sixth day of the disease.

Dysentery, as a sequela, was marked in twelve cases leading to great anæmia, profound debility, and tardy convalescence, and death in three instances.

Jaundice was never met with in Parel Hospital.

Diseases of the Urinary Organs.—Albuminuria was noted in 50 per cent. of the cases examined, and tube casts in 25 per cent. of those. Hæmaturia occurred only once, associated with suppression of urine, uræmia, and death. Cystitis was never met with.

Complications of Menstruation and the Puerperal State.—Menstruation is often induced by an attack of plague, and is occasionally profuse. In seven females this state was set up by their developing plague. Five of them died and two recovered. In one case menstruation had been absent some six months, and was brought on twice during the life of the patient in hospital, and ultimately this patient succumbed. The impression remains on one's mind that the presence of the catamenia during the acute stage of plague is a complication of grave omen.

Pregnancy.—Four pregnant women were admitted for plague. Every one of them aborted and died. Three were at the sixth month and one at the fourth month of pregnancy. All the fœtuses were dead, and in two instances their skin was desquamating. Three of the fœtuses were examined post-mortem, and hemorrhagic petechiæ were found in the cerebral membranes, stomach, intestines, and elsewhere, but no plague bacilli could be demonstrated anywhere in their bodies by microscopic examination or bacteriological culture methods. It would appear that the toxic products in the blood of the mother can gain an entrance into the tissues of the fœtus and cause its death, and discharge from the uterus prematurely. Abortion took place in one case on the first day of attack; mother four months pregnant. In two others abortion came on during the second day, and in the remaining case on the third day of the attack, the mothers being six months pregnant. In one six months' case the mother's temperature and general condition were favourable for recovery, but, in spite of opium in large doses, miscarriage came on and precipitated a fatal issue. The mothers died at the following dates:—One on the fifth day, one on the third day, one on the fourth day, and one on the twenty-second day of the disease; the latter from septicæmia. Unless this experience be exceptional, pregnancy must be looked upon as a very alarming and generally fatal complication of plague.

Diseases of the Skin and Cellular Tissue.—Bed sores only developed in one case at the end of twenty days, and this patient was particularly helpless and unable to move in bed or help herself in any way owing to paralysis. The seat of the bed sores was over the sacrum. No case developed gangrene as a sequela. Lymphangitis occurred in seven cases, led to abscess, which had to be opened, and protracted convalescence. In one case a month elapsed before the lymphangitis developed itself; most of the others came on between the tenth and twentieth day of convalescence. It was a remarkable phenomenon that the temperature was seldom elevated. In two patients only did it touch 99·8° F., and pain in the affected part was often the only symptom complained of. The lower extremities in the calf of one leg was the seat in five instances, once in the neck, and once in the parotid region. In no instance did the pus of the abscesses yield plague bacilli, although every such case was carefully examined with this object.

Boils are a frequent sequela, fifteen patients having one or more boils at some period of their convalescence. Boils usually appeared about the tenth day. The most frequent seat was the scalp; next the legs; and next the upper extremities.

One patient had fifteen boils at one time, thirteen on the scalp, one on the face over the parotid gland, and one on the side of the neck; and they all appeared between the fifteenth and twentieth day. This patient died; the other fourteen recovered.

The boils could not be attributed to any want of fresh vegetable in the dietary, as 4 oz. of vegetables were given two days in the week, and 1 oz. of limejuice twice weekly to each of the patients.

One patient had twenty-one consecutive boils and ultimately recovered, although convalescence was complicated by double broncho-pneumonia as well.

Syphilis was present in four patients admitted, of whom one died and three recovered.

Buboes in Plague.—A tabular statement of the sites of buboes has been already given. They are usually accompanied by some pain. Indeed, very often the onset of pain is the first thing to direct the patient's attention to the inflamed gland. Tenderness is an almost invariable sign, and œdema surrounding the bubo. A large amount of surrounding œdema is an unfavourable symptom. The skin over the bubo is generally freely movable, seldom inflamed, and still less frequently over-painful. The bubo is generally found to be tender, rather than painful, and even exquisitely tender patients seldom cried out with pain, but winced when the bubo is touched. Buboes never preceded the onset of general symptoms in any of the cases met with. They usually came on rapidly in the majority of cases (70 per cent. of those with buboes) on the second day; next most frequently on the third day (15 per cent.); next on the fourth day, 12 per cent.; and on the fifth day 2 per cent.; and in two cases did not appear till the sixth day from the onset of the initial symptom. Both these last cases were of a malarial remittent type, and were kept in a separate ward. Bacteriological evidence confirmed the diagnosis, and both ended fatally.

A reference to the table will show the fallacy of depending on the appearance of so-called characteristic buboes in this disease and the use of the term "bubonic fever" to be a misnomer. All cases without buboes—other than primary pneumonias—were shown by examination post-mortem or by bacteriological test to be plague wherever an opportunity to do so could be got. The majority of buboes left to take a natural course subsided without suppurating. In only 7 per cent. of acute bubonic cases, in which no irritant application had been used, and to which sedative liniments or ointments had been applied, did suppuration ensue, whilst, as was generally the case when such irritants had been used, suppuration was the rule. Patients liked to busy themselves with treatment of the local expression of the disease, and poultices, marking nut, iodine, or nitrate of silver were very constantly used.

Many observers think that the vis medicatrix naturæ in plague is by suppuration of the inflamed gland; but nature's trend in this disease is to place the patient on the burning ghat. It is overlooked that at least 60 per cent. of plague patients die before there has been time for suppuration, and how many die before reaching hospital, struck down suddenly, no one can estimate. No doubt, if the patient survives long enough, suppuration may occur, especially when poultices or irritants have been used. It would appear that such conclusions as that suppuration is beneficial, result from a study of virtually selected cases; and the safer and juster conclusion is that, because the patient has survived long enough, his bubo has suppurated, and not that because of the suppuration he has recovered.

In some instances patients with buboes were sent into hospital, who were proved by bacteriological methods not to have plague. Two instances of sympathetic buboes, due to ulcer of the leg, were of such a nature, and one case of syphilis; none of which on puncture and cultivation of the contents of the inflamed glands gave any characteristic growth.

As regards treatment of buboes, an emollient sedative application, such as glycerine and belladonna, is generally useful. Poulticing and incisions were not practised, but in patients received from other hospitals ample opportunity was afforded for studying the results of such modes of treatment as seemed to delay convalescence considerably and lead to anæmia and debility. Excision of the bubo was entertained, but not considered prudent. To promote absorption equal parts of creosote and glycerine seemed the best application.

This was rubbed in on alternate days, in one drachm at a time in some cases, and generally with good effect. Iodine was of no use in procuring absorption. An ointment of oleate of mercury (10 per cent.) gave satisfactory results in hastening the absorption of the buboes.

Opening the buboes, except when this is absolutely necessary, is to be deprecated, as wounds in plague patients heal very tardily, and if opened at all, this should be done freely and the wound immediately deluged with antiseptics, and treated antiseptically to avoid the absorption of noxious products.

Treatment.—Prophylactic and Rational.

The removal of the defective sanitary condition which gives rise to the disease, the segregation of the sick in hospitals, and of their friends in observation camps until the period of incubation is over, and the disinfection of habitations, fomites of all kinds, and personal hygiene.

The value of segregation can be appreciated by a consideration of the facts of the contagiousness of plague in habitations and its almost non-contagiousness in hospitals.

In the treatment of plague, symptoms can be relieved and the chances of a favourable termination promoted; but little can be done to shorten its course or ensure recovery.

If the patient can be kept alive till the eighth day without complications supervening, the disease will have exhausted itself and the patient recover.

The success of any treatment depends on early and good nursing, and keeping the patient lying down until the temperature has been normal for at least four days. *The injudicious breach of this rule, viz. that the patient should not even sit up for any purpose, led to the death of twenty convalescents by syncope in spite of urgent and repeated warnings.*

Abundance of fresh air is of next importance, and in Parel each patient had nearly 2,000 cubic feet of air space and free perflation of air.

On admission, the patient was undressed, well washed (including the head) with hot water and carbolic soap, and a change of clothing provided. Those who seemed too weak for general bathing were carefully sponged all over. Personal clothing too filthy or worthless was burned at once. Valuable clothing was disinfected by steeping in 1 in 2,000 perchloride of mercury solution before being sent to be washed.

Every patient on admission got rum mixture as a stimulant and some sago congee, if required in the opinion of the medical attendant. The patient was put into a fresh bed in the appropriate acute ward, and the presence of at least one attendant constantly enforced. As a routine to adults, five grains of calomel and thirty grains of compound jalap powder were administered.

The patients were fed four times in the day, and acute cases had always a supply of sago congee, Brand's Essence of Mutton, or Virol, or Liebig's Extract of Meat, and rum up to eight ounces in the day, and especially at night.

Symptoms were treated by appropriate remedies as they arose. The fever was best combated by sponging and the ice-cap. Antipyretics, such as antifebrin and phenacetin, were not found suitable, and had only a transient effect in reducing high temperature.

Stimulants were well borne, and it seemed almost impossible to intoxicate plague patients with large doses of alcohol—up to eight ounces in the day in several instances. Even in boys and patients unaccustomed to alcohol, this quantum failed to induce drunkenness.

Medicinal stimulants and tonics, especially nervine stimulants, were most useful. In acute cases a routine dose was—

Rx. acidi nitro-hydrochlorici dil.	m. 20	Three times daily.
Quininæ sulphatis . .	gr. 5	
Liquor strychninæ . .	m. 5	
Spirit chloroformi . .	m. 20	
Aquæ camphoræ ad . .	℥ 1	

Among other useful drugs employed were ammonia carbonate, citrate of caffeine, tincture of strophanthus, tincture of digitalis and nitrate of pilocarpine (for uræmic symptoms).

For the relief of distressing symptoms.—Headache was treated by the ice-cap, blisters occasionally (but not found remedial), evaporating lotions, and especially camphorodyne, bromide of ammonium, and opiates.

Sleeplessness was combated by liq. opii (sedatives) or liq. morphine, bromides and camphorodyne.

Vomiting was usually checked by bismuth, mucilage, and hydrocyanic acid, in effervescing draughts. Pulmonary congestion by diffusible stimulants, turpentine stupes, blisters, and alcoholic stimulants; with digitalis.

As a special mode of treatment, liq. hydrargyri perchloridi was resorted to from a conviction of the value of such a powerful disinfectant in specific disease, and the likelihood of its being useful as an intestinal disinfectant and bactericide.

At first it was given in drachm doses, well diluted, three times daily; later in half-ounce doses every two hours for four doses; and then in the same quantities every eight hours. In no case of plague did these enormous doses induce salivation, although this phenomenon was carefully sought for.

One doubtful case became salivated slightly after the third dose, and the bubo in this case was proved to be sympathetic from an ulcer on the foot. The bubo in the groin of the corresponding leg was punctured antiseptically and the contents examined microscopically and by bacteriological cultures, and found not to contain the specific micro-organism of plague. This mode of treatment is therefore both diagnostic and rational.

The drug was also given by hypodermic injection below the situation of the inflamed gland in five cases, and four of these recovered and one died. The general result of the hospital treatment may be attributed to this mode of medication (with remedies for prominent symptoms and complications), and gave 69·2 per cent. of recoveries, excluding cases moribund on admission, and those treated by MM. Yersin and Haffkine.

The hospital staff and skilled and intelligent nurses had great confidence in the perchloride of mercury treatment; but it is only right to state that many cases treated early and vigorously with this drug died, after perhaps temporary benefit and prolonged life.

In one remarkable case, which died six days after admission from double broncho-pneumonia, and under full doses of mercury, the German Scientific Plague Mission Experts found plague bacilli on three different days in the blood cultures, and the day before death, and at the post-mortem, not a single plague bacillus could be demonstrated in the blood or any of the organs. Their conviction was that the patient died from the severe complication, and had his vitality been greater and no complication supervened, he would certainly not have died of plague, all the bacilli being destroyed.

No after untoward symptoms developed in convalescents after mercurial treatment in such heroic doses.

The discovery of a curative remedy for plague remains yet to be demonstrated.

Generalities.—The excreta were received into bed-pans already sprinkled with 15 per cent. carbolic powder, and before removal from the ward a solution of 1 in 2,000 perchloride of mercury was poured over the mass. This solution was coloured blue by aniline and kept in a separate place to distinguish it and prevent accidental poisoning. The fluid and solid portions were separated and stored in suitable receptacles mixed with phenyle 1 in 30, and the fluid portion removed in the conservancy cart. The solid excreta, already disinfected again by phenyle, were mixed with dry sawdust, thrown on stable litter, dried in the sun, deposited on layers of charcoal, and destroyed in the incinerator.

All bandages and dressings were destroyed by fire after being soiled once.

Dead bodies were wrapped in a sheet soaked in perchloride of mercury and immediately removed to the mortuary.

The bedding was disinfected before being washed and again taken into use, the straw stuffing of pillows and mattresses burnt, and the cots re-whitewashed.

Discharges from patients soiling the floor were at once disinfected with carbolic powder and swept up and removed, and the place further disinfected with perchoride solution and whitewashed or scrubbed.

Patients in hospital were allowed to sit up when the temperature had been normal four days, and then moved into the convalescent wards. They were not discharged as a rule until ten days afterwards at the earliest. The majority of patients were discharged twenty-three days after admission. The shortest stay in hospital was nine days, the longest one hundred, before convalescence was established. One convalescent deserted on the twenty-third day.

Before discharge each patient received a warm bath with carbolic soap, a perfectly new suit of clothing, a small gratuity, and a certificate of recovery from infectious diseases, stating the number of days in hospital.

As measures of personal hygienic precautions, the hands of attendants were dipped in mercurial solution, a special complete suit of hospital clothing put on before going on duty, and on coming off duty disinfected and dried in the sun; and a bath twice daily, containing a little phenyle, enjoined.

The Röntgen rays were tried on five patients, and two of them died and three recovered. They were used for periods of half an hour over the bubo. Patients seemed slightly benefited. The apparatus was presented by the Maharaj Tagore, but unfortunately opportunities to test its efficacy did not occur, and when the installation was ready further plague cases ceased to be received into hospital.

Bacteriology of Plague.

The following points were personally verified in the bacteriological investigation of plague at Parel, or communicated by the German Experts.

Professor Dieudonné states: "In cover-glass preparations, *in fatal cases*, the specific micro-organism was discovered. In only one case that recovered was the bacillus demonstrated, and this was in a child four years old with right parotid bubo, in whose blood bacilli were found four times out of five examinations. In no case was the bacillus found in the fæces or urine. In every case it was discoverable in the contents of the inflamed lymphatic gland and in pneumonic cases in the expectoration. It was not found in the pus from buboes, or abscesses following lymphangitis; and repeated examination failed to discover it in the blood or buboes of convalescents when the temperature reached normal."

Verified Personally.

The micro-organism is 1 mm. by 2 or 3 mms. Both ends stain deeply with aniline dyes. It is a short, thick rod with rounded ends as seen by $\frac{1}{12}$ oil-immersion lens. It is non-motile in hanging-drop preparations. It is decolorised by Gram's method.

It grows on agar-agar and gelatine. It takes twenty-four to forty-eight hours for characteristic whitish grey (pin-head size) colonies to form, and they have iridescent borders.

Spores are not formed, and it does not liquefy the media. Viewed by transmitted light, the growth has a stippled, granular appearance like the back of the looking-glass. The growth on agar is alkaline.

Involuted forms, in the shape of small cocci, large cocci, pyriform bodies, dumbbell-like forms, but without a handle, and swollen bodies were produced on salt solution four per cent. in agar, also by $\frac{1}{200000}$ of perchloride of mercury in agar, and by dipping into 25 per cent. sterile salt solution momentarily and touching the agar surface at one spot (blob culture on pure agar) in twenty-four hours.

When involution-form cultures were reinoculated on to pure agar, they reverted to the ordinary type met with.

The virulence of involuted forms was not investigated owing to want of opportunity. The optimum temperature is 37° C.

Heat up to 120° F. killed the cultures on agar, and an old agar tube resterilised failed to produce a growth *on three occasions* when reinoculated.

Exposure to strong sunlight for a few minutes killed the bacilli, but mere staining them without heating did not seem to do so.

Alkaline bouillon containing fat produced flake-like islands underneath the surface, which fall to the bottom like vermicelli choppings on shaking the containing flask. This growth appeared in twenty-four to forty-eight hours, and continued to grow and develop fresh festooned flakes for upwards of a month.

The growth on agar is sticky and viscid, and non-adherent to the medium.

Bacilli were *not* found in the lochial discharges of aborted females, nor in the catamenial discharge, nor in the bodies of the products of conception in three out of four fœtuses examined.

Numerous bacilli were found in the inflamed gland by rubbing a cover-slip on a freshly-cut (sterile) surface, drying the slip, and staining in the ordinary basic aniline dyes.

A beautiful double stain for tissues with specific plague bacilli consists of alcoholic solution of eosin followed by methyl blue, the tissue being fixed by alcohol without heat, and the slide gently washed in water, between the two additions of dyes.

Post-mortem Appearances.

In all thirty-six autopsies were performed at Parel, the smallness of the number being explained by the difficulty of obtaining leave to make post-mortems on natives of India, owing to the objections of their relatives. No case was examined without full consent of the deceased's friends, and most of the bodies were unclaimed.

Summarising, the appearances noted were:—

Rigor mortis of short duration and not well marked.

Emaciation, not pronounced, owing to rapidity of death. No particular tendency to rapid putrefaction.

Discolorations of the skin and cuticular eruptions or abrasions absent. Boils and wounds, the result of sequelæ or opened abscesses, and inflamed glands occasionally found. Blood darker and more fluid than natural. Cerebral membranes congested and the sinuses full of dark, thin blood. Pia mater and brain substance œdematous, with numerous punctiform hemorrhages. Petechiæ on the membranes often noted, especially on the pia and dura mater of the vault. Ventricular serum above normal amount. Actual cerebral apoplexy never seen.

Pharynx and œsophagus generally normal; at most slight redness and congestion of the mucous membrane of the former. Stomach hyperæmic, and vessels much congested, especially at the greater cardiac end; numerous hemorrhagic petechiæ in the mucous coat along the lines of congested blood-vessels. Erosions of the surface at the pyloric end in some cases, and mammilation and soft œdema of the mucous membrane in others.

The duodenum had generally a normal appearance, a few punctiform hemorrhages and small petechiæ excepted.

The ileum and large intestine presented numerous petechiæ and patches of congestion, and the solitary and agminated glands usually swollen, especially in the lower part of the ileum. No ulceration of Peyer's patches found.

The mesenteric and retro-peritoneal glands were more or less affected in nearly all cases, being enlarged, dark greyish or red in colour, but seldom showing hemorrhagic infiltration or suppurating foci.

The spleen was enlarged, dark brown, blue, grey, or red on surface, acutely congested and with petechiæ on the capsule, and hemorrhages in the stroma.

Liver enlarged with pale yellow necrotic patches superficially, with small hemorrhages under the capsule. Petechiæ were commonly found on the upper surface on each side of the suspensory ligament. On section its substance was bloody, soft, and friable.

The gall bladder contained bile, and showed many minute petechiæ on its serous and mucous coats and in the bile-ducts.

The pericardium often showed petechiæ, and occasionally some were found on the endocardium. The heart substance was invariably healthy and no valvular lesions discoverable.

The larynx was of a dark purplish red hue on the surface, and the mucous membrane œdematous and congested with sero-mucoid exudation and œdema glottidis in some instances.

The lungs were usually congested and œdematous, especially the lower lobes; and frothy, bloody exudation oozed out on section. Pneumonic cases had inflamed patches at the margins and on the front of the lobe affected. The patches were airless, friable, and surrounded by rings of engorged and congested lung. Pleurisy was seldom found. Petechiæ and ecchymoses were frequent on the visceral pleura, and rare on the parietal.

Pleural effusion and adherent pluræ met with in one case.

The most constant pathological appearance was the presence of hemorrhages in great numbers in the capsule and pelves of the kidney; and engorgement of the renal organs with blood; and infiltration of the peri-renal tissues and absence of the normal fatty surroundings.

The capsule was loose; cortex increased, and dark red; and pyramids prominent and congested.

The buboes consisted of inflamed lymphatic glands with hemorrhagic foci, and surrounding connective tissue œdematous and infiltrated with blood and serum. The morbid alterations were more noted in external than internal buboes, even when the latter were the only ones present.

The blood-vessels and lymphatics in the neighbourhood of the buboes were infiltrated and sometimes adhered to the inflamed superjacent mass of altered gland tissue.

Very often a matted mass of inflamed glands was found leading up along the blood-vessels from the primary external bubo; and in one instance this condition was found extending from the femoral glands along the iliac vessels and aorta to the diaphragm. The mesenteric glands in vascular relation with the affected intestines were invariably enlarged.

In puerperal cases that aborted hemorrhagic infiltration between the layers of the broad ligament, inflammatory œdema of the round ligaments and ovaries, and petechiæ, and softening of the mucous and serous membranes of the sub-involuted uterus were noticeable.

In one such case a piece of adherent placenta was found at the uterine ostium of the right Fallopian tube. Hemorrhages in the sheaths of the blood-vessels were frequent, and infective infiltration extending from the femoral bubo in nearest relation along the veins.

Medical Report of Parel Plague Hospital, dated July 4th, by Surg.-Capt. G. S. Thomson, I.M.S.—*(continued).*

M. HAFFKINE'S CASES.

The first acute plague case admitted was treated by M. Haffkine with his curative serum. A clerk, aged twenty-three years, ill since 10 p.m. on February 24th, was admitted on 25th at 7 a.m., and injected at 11 a.m. with 10 c.c. of serum ; again injected at 11 a.m. on February 26th by 10 c.c. of serum. He died at 2 p.m. on February 27th. This was an ordinary, mild case of plague. After the injections his temperature rose to 106·4° F., and the pain in the right femoral bubo became very great ; this patient, indeed, complained more of violent pain than any ever seen in hospital. His delirium increased with jactitation, rapid respiration, vomiting, unconsciousness, stupor, and coma ending in death.

Two cases (one given in detail) were admitted with plague following prophylactic injection by Haffkine's serum. The other case was a male, aged twenty years, Ganu Govind, admitted April 2nd with plague and a huge left inguinal bubo. He had applied marking-nut, and the bubo subsequently increased and sloughed out *en masse.*

He had been injected once in the left arm about a month before being attacked, and a small hard nodule was detectable at the point of inoculation. The case was a mild one of the common type, and ended in recovery on the fifty-eighth day after admission, convalescence being delayed by the deep ulcer in the groin. The acute symptoms subsided on the fifth day, and he had no sequelæ or complications except the ulcer. Another case was seen amongst transfers from other hospitals ; affected ten or eleven days after the first and only inoculation, and he recovered.

The cases seen at Parel were mild and recovered : but the number met with is too limited to draw any definite conclusions from them.

History of a Case Prophylactically Injected by M. Haffkine's Serum.

Registered No. 417, Ardesir Jijibhai, male, aged ten, school-boy, admitted April 30th at 5 p.m. from Mombadevi, Dhanji Shera Street, No. 93 house, and discharged on May 7th.

Came from Pydowni district, Bombay, where he resides with his father, who looks after his education himself, the boy not having been sent to school, owing to the epidemic of plague, for some months past. No plague cases had occurred in the house he lived in; some had occurred in the neighbourhood, but not for a long time; and he had not been in contact with plague patients or any known source of infection. No dead rats had been found in the house or its surroundings. He had been inoculated on April 24th with 1 c.c. of Haffkine's serum in the left arm, which was followed by slight fever, and he did not sleep that night owing to pain in the arm; but there was no vomiting, thirst, diarrhœa, or any other symptom, and next day he was quite well.

At 5 p.m. on April 29th (that is, six days after inoculation) he became ill with fever, headache, and prostration. There was no vomiting, delirium, and the bowels were moved twice; he slept well the previous night. At 7 p.m. a small bubo appeared in the left groin—painful and tender. He was not thirsty, but took to his bed owing to pain in the groin and giddiness, and a medical man was sent for, who saw him at 8 p.m. and gave him medicine. At this time the temperature was 102° F. according to the father's statement.

This morning, after a restless night without delirium, he took some light refreshment, consisting of tea, milk, and eggs, with a little bread, and his temperature was 103° F. At 2 p.m. M. Haffkine saw the boy and found his temperature 102° F., and advised his father to take him to hospital. At this time he had no appetite, was prostrate, and stayed in bed till he was conveyed to Parel Hospital, where he complained of headache, pain in the left groin, and thirst. The swelling in the left groin was very hot and tender.

Present State.—A slim, fairly well-nourished Parsee boy, quite conscious and intelligent. No characteristic fæces present. Eyes not injected, pupils normal. Skin warm and perspiring, with prickly heat, eruption, and sudamina.

Tongue thickly coated with white fur, tip and edges clean, fungiform papillæ prominent, especially near the tip. Gums spongy and slightly swollen. Peculiar fœtid odour from the breath. Veins of neck pulsating. Cardiac sounds strong, loud, and healthy; chest normal, lungs healthy. Liver and spleen not felt. A bubo, the size of a bean, just below the level of Poupart's ligament, near its middle on the left side, very tender, and, being well defined, plainly visible. The skin over the inflamed gland is hot and tender. The bubo can be moved a little, and the skin is not adherent to it, nor is there any œdema surrounding it. There is a small, tender, shot-like gland in the left axilla close to the pectoral wall.

Remains of a speckled rash, like mosquito bites and prickly heat scratchings, can be seen on both sides of the ankles and legs of both lower extremities; but there are no apparent wounds. Temperature, 102; pulse, 132, soft and compressible, but regular; respiration, 36. Chiefly complains of headache, thirst, anorexia, and pain in the groin.

May 1st.—Temperature, 100°; pulse, 20; respiration, 36. Slept well during the night. Bowels moved four times—thin, greenish yellow in colour, and bad smelling, following a purge consisting of calomel 5 grains, and pulv. jalap. co. 30 grains at 6 p.m.; bubo very tender. No delirium or incoherence in speech. Headache less, and he says he feels better. Given large doses of perchloride of mercury and stimulants since admission; two drs. of liq. hydrargyri every two hours and stimulant mixture (equal parts rum and water) one ounce every three hours. Blood examined for plague bacilli, but none discovered. Urine slightly cloudy with albumen, by heat test; bile pigments present.

At 5 p.m.—Temperature, 101° F.; pulse, 124; respiration, 30. He vomited three times since morning, but was otherwise well.

May 2nd, 8 a.m.—Temperature, 99·6° F.; pulse, 100; respiration, 36. Pulse full, soft, forcible, and large. Tongue clean, except towards the posterior part on each side of the central line. No headache, slept from two till six with the aid of a draught containing morphine and bromide; skin warm and clammy. Appears drowsy. Bubo in left axilla not detected. Bubo in left groin longer, more standing out in relief from its surroundings, no œdema over or around it. Sudamina present, rash-like eruption faded.

May 3rd, 8 a.m.—Temperature, 99° F.; pulse, 96; respiration, 20. Patient slept well. Tongue has two patches of yellow dry fur at the back. Bowels confined, urine passed naturally, normal in appearance, and to clinical test. Feels thirsty and tired. Quiet, conscious, and intelligent. At the evening visit his temperature was normal, bubo less in size and no longer painful. Skin dry. Tongue dry and clean. No headache. Pulse and respiration normal. Convalescent.

May 4th.—The bubo was absorbed and the patient practically well, having made a rapid recovery from a mild attack of plague. He was allowed to go home on May 7th, 1897.

Nominal Roll of M. Yersin's Cases, Temperature, Chart,

PATIENTS INJECTED WITH M. YERSIN'S

SERIAL NO.	REG. NO.	CASTE.	OCCUPATION.	NAME.	SEX.	AGE.	DAY OF DISEASE.
1	102	N. Christian ..	Medical Practitioner ..	C. D. Nunes ..	Male.	51	4.5
2	104	,,	——	B. Nunes ..	,,	1½	2
3	105	,,	——	R. T. Nunes ..	,,	18	3
4	100	——	Coolie	D. Pandu ..	,,	40	2
5	109	——	Clerk	S. Bappu ..	,,	24	3.4
6	110	——	Mill-hand	S. B. Kadam ..	,,	18	3.5
7	112	——	,, ...	P. Deabaro ..	,,	60	2
8	113	——	,, ...	R. Mukunda ..	,,	25	2
9	114	N. Christian ..	Schoolboy	J. D. DeSouza ..	,,	13	36 hours.
10	115	——	——	P. Rama ..	,,	7	2
11	117	N. Christian ..	Domestic	R. Fernandez ..	,,	25	(?*)
12	120	——	Hamal	M. Daya ..	,,	30	2
13	124	——	Schoolboy	R. Nurunda ..	,,	9	1
14	132	——	Sweeper	S. Jiwa	,,	9	2
15	133	——	,, ...	B. Jetha	,,	25	2
16	138	——	Clerk	R. G. Shanker ..	,,	28	36 hours.
17	139	——	Mill-hand	T. Mhadu ..	,,	18	2
18	150	——	Gardener	M. Soma	,,	30	26 hours.
19	151	——	Masal	K. Harka ..	,,	22	4.5
20	165	——	——	L. Rodriguez ..	,,	12	3.9 hours.
21	170	——	Merchant	A. K. Telis ..	,,	60	9 hours.
22	173	——	Cook	M. Edalji ..	,,	45	3
23	301	——	——	D. Edalji ..	,,	11	27 hours.
24	—	——	——	Hasanbhai ..	,,	32	7 ,,
25	331	——	——	C. Murzelo ..	,,	32	24 ,,
26	413	——	——	K. B. Satwaji ..	,,	4	42 ,,

etails in one Case, Summary, and Analysis of Cases.

ERUM IN PAREL PLAGUE HOSPITAL.

DATE, HOUR, AND AMOUNT INJECTED.		TOTAL AMOUNT OF SERUM.	RESULT AND REMARKS.
6.3.97 at 6½ p.m. 30 c.c.		50 c.c.	Died at 7 p.m. on 8.3.97.
7.3.97 at 8½ a.m. 20 ,,			
6.3.97 at 7½ p.m. 10 ,,	7.3.97 at 8½ a.m. 10 c.c.	30 ,,	Recovered on 25.4.97.
7.3.97 at 6½ p.m. 10 ,,			
6.3.97 at 7½ p.m. 20 ,,	8.3.97 at 4½ p.m. 20 ,,	40 ,,	Died at 3 p.m. on 23.3.97. Meningitis.
7.3.97 at 8½ a.m. 30 ,,	8.3.97 at 8½ a.m. 20 ,,	50 ,,	Recovered on 21.3.97.
7.3.97 at 9 a.m. 20 ,,	8.3.97 at 8 a.m. 10 ,,	60 ,,	Died at 11 p.m. on 11.3.97.
7.3.97 at 6 p.m. 10 ,,	8.3.97 at 4 p.m. 20 ,,		
7.3.97 at 8½ a.m. 20 ,,		30 ,,	Died at 1 a.m. on 8.3.97.
7.3.97 at 6 p.m. 10 ,,			
7.3.97 at 5½ p.m. 30 ,,	12.3.97 at 3 a.m. 40 ,,	100 ,,	Died at 10 p.m. on 12.3.97.
11.3.97 at 8 a.m. 30 ,,			
8.3.97 at 5 p.m. 30 ,,		30 ,,	Died at 9.45 p.m. on 8.3.97.
8.3.97 at 4½ p.m. 40 ,,	10.3.97 at 4 p.m. 40 ,,	80 ,,	Died at 4 p.m. on 20.3.97.
8 3.97 at 6 p.m. 30 ,,	9.3.97 at 8 a.m. 30 ,,	60 ,,	Recovered on 25.3.97.
8.3.97 at 5½ p.m. 20 ,,		20 ,,	* Injected prophylactically.
8.3.97 at 4 p.m. 40 ,,		40 ,,	Died at 4 a.m. on 11.3.97.
9.3.97 at 5 p.m. 40 ,,	12.3.97 at 8 a.m. 40 ,,	190 ,,	Recovered on 14.4.97.
10.3.97 at 8 a.m. 40 ,,	13.3.97 at 8 a.m. 30 ,,		
11.3 97 at 8 a.m. 40 ,,			
10.3.97 at 4½ p.m. 40 ,,	13.3.97 at 8 a.m. 30 ,,	110 ,,	Recovered on 31.3.97.
11.3.97 at 8 a.m. 40 ,,			
12.3.97 at 8 a.m. 30 ,,	13.3.97 at 8 a.m. 40 ,,	110 ,,	Recovered on 4.4.97.
12.3.97 at 5 p.m. 40 ,,			
11.3.97 at 4 p.m. 40 ,,	12.3.97 at 4 p.m. 50 ,,	90 ,,	Died at 12 p.m. on 13.3.97.
11.3.97 at 4 p.m. 50 ,,	13.3.97 at 8 a.m. 50 ,,	230 ,,	Recovered on 29.3.97.
12.3.97 at 8 a.m. 50 ,,	16.3.97 at 8 a.m. 30 ,,		
12.3.97 at 4 p.m. 50 ,,			
12.3.97 at 4 p.m. 40 ,,		40 ,,	Died at 11 p.m. on 12.3.97.
12.3.97 at 4 p.m. 40 ,,		40 ,,	Recovered on 12.4.97.
15.3.97 at 11 a.m. 40 ,,		40 ,,	Died at 8 p.m. on 15.3.97.
16.3.97 at 1 a.m. 40 ,,	18.3.97 at 5 p.m. 50 ,,	140 ,,	Recovered on 21.4.97.
16.3.97 at 9 a.m. 50 ,,			
16.3.97 at 4 p.m. 60 ,,		60 ,,	Recovered on 9.4.97.
31.3.97 at 4 p.m. 50 ,,		50 ,,	Died at 9 a.m. on 1.4.97.
4.4.97 at 11 a.m. 50 ,,		50 ,,	Recovered in Clare Road Hpl.
7.4.97 at 10 a.m. 50 ,,	8.4.97 at 9 a.m. 50 ,,	100 ,,	Died at 3 p.m. on 9.4.97.
72.4.97 at 6 p.m. 40 ,,		40 ,,	Died at 8 a.m. on 2.5.97.

Detailed History of Last Case injected with M. Yersin's Paris Serum.

Reg. No. 413, Kasi-bin-satwaji, Hindu, female, age four years, admitted on April 27th, 1897, at 2 p.m., to Parel Hospital from a chawl at Sewri.

History.—April 25th.—At 12 midnight she had a rigor with headache and hot skin, but no vomiting, diarrhœa, or delirium, and for the remainder of the night was restless, thirsty, and feverish. She had been playing about and was in her usual health up till the hour of attack noted.

April 26th.—During the day she was up and playing with other children ; but seemed stupid, quiet, and slightly hot to the touch ; and the same night she was restless, sleepless, tossing her head and arms about, and had stupor at times. The urine was scanty and febrile, and the bowels moved naturally once.

At 5 p.m. she complained of pain below the left ear, and a swelling was noticed in this situation between 8 and 9 a.m on the morning of April 27th. She continued to be feverish and stupid, and at times wandering in her talk, and was brought to the hospital.

Present State.—A well-nourished young female child, drowsy, eyes half closed, pupils contracted, can be roused to answer questions when spoken to loudly ; is irritable, and appears to want to be left alone. Tosses her head from side to side. The eyes are not injected. Tongue covered with a thick white fur increased towards the posterior part of its dorsum ; edges and tip clean and red. Respirations easy, 40 per minute. Skin hot, head and neck perspiring ; rest of surface hot and dry. Is very irritable when touched. Heart and lungs normal, abdomen soft and flaccid, liver palpable in right hypochondrium, extending two inches below the rib-margin in the nipple line, and half-way between the xiphoid cartilage and the umbilicus. The bubo consists of a soft swelling, hard in its deeper parts below and behind the angle of the left jaw, about one inch in diameter in size. Skin over bubo soft and giving a sodden feel, equal to soft œdema. Two small shot-like glands in the right groin ; no glands palpable elsewhere, and those in the right groin are not tender, inflamed, or painful. No eruptions or wounds noticeable. Patient complains of headache and pain in the inflamed cervical gland. Temperature, 104 ; pulse, 132, soft and compressible and markedly small and dicrotic in character, beats very regularly, but feebly.

At 6 p.m. 40 c.c. of the Pasteur Institute antipest serum, prepared by M. Roux and supplied by M. Yersin, were injected in the flanks as practised by M. Yersin for plague cases. Temperature, 104·4° F.; pulse, 130; respiration, 44. In three hours after there was no change in the general condition of the patient, and the local conditions were, if anything, more acute. Temperature, 104·8° F.; pulse, 136; respiration, 40.

April 28th at 8 a.m.—Temperature, 99·4° F.; pulse, 120; respiration, 36; skin cool. Tongue with less fur, headache less. Slept a little during the night without delirium; bowels constipated. Bubo painful and very tender, and surrounding œdema increased, extending over the angle of the jaw and sterno-mastoid. Urine of a febrile character containing a little ($\frac{1}{20}$) albumen passed three times. Thirst less, but is very weak, prostrate, and irritable.

At 5 p.m.—Temperature, 103·4° F.; pulse, 144; respiration, 36. Pulse small, compressible, and very feeble. Patient very drowsy, irritable, tossing restlessly about in bed, trying to get up at times. Bowels moved thrice and motions bad smelling, green, and watery, especially the two last passed. Tongue cleaner. Bubo shows much more œdema, and is distinctly larger and very painful and tender. Skin hot and dry. Thirst very great. Headache has returned. Refuses food, medicine, and stimulants. Breath fœtid. Urine scanty, high coloured, and depositing urates. Eyes sunken and voice low and weak, and she appears to be greatly prostrated.

April 29th at 9 a.m.—Temperature, 101° F.; pulse, 142; respiration, 24.

Bubo much larger, measuring 3″ × 3″, with much surrounding œdema, and very tender; and the front part of the neck below the left side of the lower jaw is swollen and infiltrated by soft œdematous inflammation. Tongue covered with brownish fur, very dry and rough. Pulse small, weak, and running. Slept two hours after 20 ms. liq. morphinæ and grs. 30 ammon. brom. Bowels moved once, urine passed, very thirsty. Swelling, tenderness, and hardness over upper part of right sterno-mastoid, where a fresh bubo has developed. Patient is conscious, but stupid and drowsy. Headache less, cannot swallow food or stimulant, asks for water and again rejects it. All attempts at swallowing cause regurgitation through the nostrils. Skin hot and dry, abdomen distended.

Nothing abnormal in chest or abdomen is detectable. Feeding by nutrient enemata resorted to.

In the evening eyes sunken, tongue increasedly furred, voice weak, very irritable, skin very hot, thirst excessive, looks sinking, and gasps for breath at times. At 6 p.m., temperature, 105·2° F.; pulse, 144, weak and anacrotic; respiration. 60, sighing and irregular. Buboes very tender. Eyes half open. Patient semi-comatose. Bowels moved once; yellowish, thin, and very fœtid. Urine passed naturally in bed-pan. Fed regularly by enema.

April 30th.—Temperature, 102° F.; pulse, 144; respiration, 36. Buboes have appeared in each groin, and that beneath the right sterno-mastoid is larger and œdema extends from it to the angle of the jaw. Swelling of neck—collar-like, soft, and baggy. Tongue furred, slightly moist. Respirations laboured, short and stertorous. Bubo at left side of neck larger, and skin over it hot and œdematous, with browny hardness in deep parts. Eyes sunken. Bowels and bladder evacuated last night, but not since 10 p.m. Thirst present; very irritable and prostrate. Fed by enema as before.

At 6 p.m.—Temperature, 104·8° F.; pulse, 144; respiration, 60. Skin very hot, cries out, is restless, irritable, slept a little during the day. Bubo on left side of neck much larger and more indurated; two buboes can be felt beneath the margin of the right sterno-mastoid. The buboes in right groin are pea-like, in left groin shot-like, having diminished since morning a little. Refuses stimulants and water by the mouth as swallowing is impossible, the liquid visibly regurgitating. Enemata continued, and stomach-tube resorted to by the nurse.

May 1st.—Temperature, 103·4° F.; pulse, 120; respiration, 24. Patient is very drowsy, unconscious, comatose, swelling of neck enormous, respirations stertorous, patient evidently sinking. Died of syncope at 8 a.m. on May 2nd, 1897, having remained in the same state of coma for 24 hours.

Analysis of M. Yersin's Cases.

In all twenty-seven persons were injected at Parel Hospital with M. Yersin's serum. One is excluded from the tabular statement as it certainly was not a plague case. Injected at his own urgent request; he died of remittent fever two days afterwards. One patient sent specially to be injected from Clive Road Hospital may be excluded, but was reported as recovered and is shown in the table. One person was injected prophylactically, and did not develop plague during forty-one days under observation in a separate ward. It is to be noted that this woman's child remained in the ward with her and did not develop plague, although not prophylactically injected.

Case No. 3 in the series had cerebro-spinal meningitis, and an osseous tumour was found compressing the medulla and spinal cord against the basilar slope of the occipital bone and margins of the foramen magnum, to which death was due.

Of the remaining 23 cases of undoubted plague, 13 died and 10 recovered; mortality, per cent. 56·5.

Known day of disease.	Died.	Recovered.	Percentage of mortality.
1st day	2	2	50·0
2nd ,,	8	6	57·2
3rd and 4th day	4	1	80·0
4th and 5th ,,	1	1	60·0
Definitely known in hours 3–42	7	1	87·5

The temperature charts, with the actual times of taking observations, show in red when the patients were injected, the amount of serum, and the exact temperature at the time of injection. The temperature, pulse, and respirations were recorded and taken personally immediately before injection in each case.

The most obvious effect was a marked fall in the temperature. In a few cases the fever increased, and in a few no effect was produced.

Patients seemed less liable to complications, but No. 9 in the series developed double broncho-pneumonia on the fourth day in hospital, and after 80 c.c. of serum had been injected. The pneumonia came on two days after the last injection, and he died eight days later.

Delirium seemed to be lessened by the serum. No improvement in the general condition of the patients could be seen, and the inflamed glands were certainly *not* favourably affected.

In one case, given in detail, in which the latest Pasteur Institute serum was used, the patient was not benefited in any way. (This serum had the guarantee of M. Roux and M. Yersin.) On the contrary fresh buboes appeared, and the primary bubo became larger, more inflamed with increased surrounding œdema, and the little patient died. This patient was injected exactly forty-two hours from the initial rigor, had a full dose of 40 c.c.—a large quantity for a child four years old. It was not a severe type of the disease, but in every way a most suitable case for curative serum treatment according to the dicta of M. Yersin.

The serum was perfectly innocuous and unirritating. Two patients developed temporary urticaria, and one slight synovitis of one knee joint after injection.

In cases that recovered, convalescence was no quicker than under ordinary methods of treatment, and suppuration of the inflamed glands, if they had been previously irritated, was not prevented.

Patients once put on serum treatment got no other drugs except sleeping draughts or purgatives as occasion demanded.

The general mortality was slightly better than under hospital routine treatment, in the proportion of 56·5 to 64·5, but in the latter were 66 moribund on admission; and if these 66 are excluded (and 28 cases treated otherwise), the proportion of deaths amongst M. Yersin's cases to hospital cases stands at 56·5 to 33·5 per cent. of cases treated.

Case No. 1 in the series had hypostatic pneumonia, and had been ill four or five days when injected. None of the others had complications at the time the serum treatment was begun. The cases generally were of the ordinary mild type, and the last of the series *specially selected for early treatment* show no favourable results over those treated at a later stage of the disease. If anything, serum cases received more nursing and general attention than other cases.

No. 13 in the series had recurrence of the urticaria on and off up till two months after recovery.

Plague—Mild, Ordinary Type: Recovery.

Registered No. 352, Hindu, male, aged 14; occupation, schoolboy; ill one day; residence, Dadur; admitted April 11th, 1897, at 1.30 p.m.

Patient was quite well during the day of the 10th instant, and at 10 a.m. got into the train to go on a journey, and at 11 p.m. on the 11th his temperature was found to be 106° F.; some delirium; tongue furred and bowels constipated; and he was sent to hospital.

On admission, temperature, 102·4° F.; pulse, 138; respiration, 40; slightly delirious. Tongue coated with thin silvery white fur, red at tip and edges. No injection of conjunctivæ. Boy intelligent and conscious when spoken to sharply. Shivered and vomited twice at 10 p.m. on 10th in the train.

Present state on April 12th at 8 a.m., temperature, 105° F.;

pulse, 140; respiration, 36. A fairly well-nourished, bright intelligent boy; seems rather quiet and disinclined to talk; answers questions very slowly, and seems dull of apprehension and weary.

Face quite normal, eyes half open, mouth wide open, gums slightly spongy, pupils normal, conjunctivæ not injected, eyes slightly suffused. Looks prostrate and stricken. Skin hot and dry, with urticarial eruption on neck and shoulders, but no visible abrasions or wounds. Dorsal decubitus.

Tongue evenly coated with white, putty-like fur, edges clean. Pulse, 140, soft and compressible, and want of sharpness in the beat. Liver and spleen, heart and lungs normal, and abdomen soft. Buboes in the right femoral and right inguinal region: the former vertical, the size of a bean, well-defined, movable, tender, and with little œdema surrounding it; the latter ill-defined, oblique, hard, matted with surrounding œdematous tissues. Skin over buboes hot and tender. Patient complains of headache, giddiness, weakness, and thirst. Buboes appeared at 5 a.m.

On 13th temperature, 104·4° F.; pulse, 140; respiration, 32. Slightly delirious, did not sleep more than two hours. Appetite good and tongue cleaner. No pain in bubo. Perspires slightly.

On 14th temperature, 101·6° F. at 2 a.m.; pulse, 74; respiration, 30; and at 8 a.m. he looked bright, conscious, and intelligent. Tongue less furred, bowels moved four times, with gurgling and griping after calomel and jalap purge. Motions greenish and bad smelling. Urine copious and natural. Pulse slow and regular, conjunctivæ not injected. Seems deaf. Slept well. No delirium.

On 15th temperature, 102° F.; pulse, 108; respiration, 34. Tongue cleaner. Buboes less tender; sleepless; vomited once after jalap powder; bowels constipated. Complains of weakness, headache, and want of sleep.

On 16th at 10 a.m. temperature, 103° F.; pulse, 108; respiration, 34. Buboes painful and tender, larger, and ill-defined. Injected 50 minims of liq. perchloride hydrargyri below the buboes. Tongue furred, yellowish-brown, dry. Eyes normal. Breath sounds harsh. Rash on neck and shoulders like urticaria and prickly-heat. Slightly delirious and incoherent. At 5 p.m. temperature, 105; pulse, 132; respiration, 48. Tongue dirty, gums not swollen or spongy, nor breath fœtid. Restless; wandering at times; thirsty; no pain in the head; eyes normal; no pain on taking a deep breath. Heart and lungs show no signs of involvement by disease. Upper inguinal gland on right side larger, harder, and very tender.

On 17th at 8 a.m., temperature, 101·2° F.; pulse, 132; respiration, 42. No headache, skin moist, slept well. No salivation. Vesicular and pustular rash on neck, back, and shoulders. Buboes less indurated, not painful, or tender. Drowsy and dazed-looking. No delirium, taste sweetish. Rash disappeared from right side, still present on back, forehead, neck, and shoulders. Anæmia present, tongue clean at fore part, pulse regular, full; respiration easy, but rapid. At 5 p.m., temperature, 102·2° F.; pulse, 96; respiration, 30. Tongue clean. Convalescent on 18th. Temperature, 99·4° F.; pulse, 96; respiration, 26. Glands swollen. At 8 a.m. on 19th, temperature, 99·2° F.; pulse, 96; quite well. No pain anywhere, appetite good, slept well. Bowels moved four times in past 24 hours—semi-solid natural motions.

At 8 a.m. on 19th, the notes read: temperature, 99·4° F.; pulse, 98; respiration, 22. Slept very well, quite conscious and intelligent, rash disappeared, skin soft, moist, and slightly perspiring. Tongue clean. Talks, looks about him, and takes an interest in his surroundings. No thirst or headache complained of now. Buboes thin, flat, waferlike nodules, not tender. At 5 p.m., temperature, 99·2° F.; pulse, 96; respiration, 20. Slept during the day, is weak and anæmic. Skin normal. Tongue quite clean; motions three in 24 hours, of natural character. Feels and looks quite well.

On 21st, temperature, 99° F.; pulse, 90 to 96; respiration, 20 to 22. No headache. Tongue quite clean. No rash. Buboes just tangible. No salivation, tenderness of gums, or fœtidness of breath; no pain or tenderness on meeting the teeth sharply together. Sleeps well, appetite good, anæmia less. Can sit up without the characters (tone, force, volume or rapidity of the pulse) being altered materially.

Discharged on April 25th, 1897. Rash gone, buboes disappeared, induration at their site quite absorbed.

Plague with Delirium, Stupor, Coma, and Death on 7th Day.

Register No. 370, Jew, ill one day, Aaron Solomon, aged 33 years, dealer, admitted April 16th, 1897, at 1 p.m., died at 3.40 p.m. on April 22nd, 1897.

Patient came from Alibag to Bombay on April 16th. His illness began at 4 a.m. on 16th with shivering, fever, and vomiting. The day previous he had been quite well, and not in contact with plague cases. No dead rats had been seen in his house, but some cases of plague had been in the neighbourhood lately. He was restless, irritable, sleepless, had headache, severe and frontal, constipated, skin hot and dry, much thirst, and what he terms "staining" of the eyes up till 8 a.m., when he felt burning pain, swelling and tenderness in the right groin, and came to hospital.

On admission at 1 p.m. on 16th, his temperature was 103° F.; pulse, 108, soft and compressible; respiration, 30. Tongue covered with white fur, bowels constipated, conjunctivæ injected, pupils normal, skin hot and dry, and urine febrile in character and diminished in quantity.

Present State.—April 16th, 1897, at 8 a.m. Temperature, 104·6° F.; pulse, 108, full and bounding; respiration, 36, irregular and sighing. Patient is a strong, well-developed young man with a peculiar, anxious, apathetic aspect. He lies on his back, is dull and quiet, conscious when roused, but answers questions very slowly, seems wearied and unable to fix his thoughts for any length of time on any given subject. Left to himself he scarcely speaks to his friends, lies in a stupid yet restless state, drawing his legs up towards his body and shooting them out full length again, rolls his head on the pillow, moans, sighs, and asks for water frequently. He is irritable, dazed, with staring, startled look. Eyes half open, winking seldom and imperfectly. Complains of severe frontal headache, constipation, and thirst. He vomited bilious matter twice this morning, and his bowels were moved twice after calomel and jalap. Skin hot and dry, breath fœtid, a peculiar earthy smell from the person on turning down the bedclothes; tongue furred in the centre, clean and red at the tip and edges. Tongue large, rather dry, and teeth-indented. Fur thin, whitish, even layer, as if moist putty had been smeared over the dorsum of the tongue and adhered to it. No eruptions or wounds discovered. Liver and spleen not felt. Heart and lungs normal. Abdomen flaccid, bladder not distended. Extremities burning hot. No delirium at present, but he has been wandering and muttering during the night, and slept very little, if at all. A bubo is seen and felt in the right femoral region; almond size, exquisitely tender, isolatable, horizontal in situation. Skin over bubo hot and burning. Pulse now 110 to 120, full and bounding. Feels giddy when he tries to sit up, against which he has been warned. Put on full doses of mercury solution. At 5 p.m. the same day, temperature, 104° F.; pulse, 120; respiration, 36. Delirium and stupor and jactitation marked. 50 minims of liq. hydrargyri injected below inflamed gland.

At 7 a.m. on April 17th, temperature, 103·2° F.; pulse, 120; respiration, 26. Tongue with light white fur on dorsum, increasing towards pharynx, and fungiform papillæ showing. Cephalalgia less. Passed six bad-smelling, greenish motions after calomel and jalap purge; vomited four times. No sleep during the night, but no delirium; voice low and weak. Feels prostrate, irritable, and depressed; tosses his limbs about, looks weary, groans, sighs, and answers questions with difficulty, and appears to be deaf. Bubo tender, and œdema over it obscures its outlines. At 4 to 6 p.m. on 17th, temperature 104° F.; pulse, 132; respiration, 26. Jactitation and "typhoid state" marked. Eyes closed, muttering delirium, picking and fumbling at the bedclothes. Conscious for a short time when roused, but soon lapses into delirium and incoherence. Breath and body odour fœtid. Heart sounds normal, but accentuated. Slight dry cough, pain and tenderness in right flank, signs of hypostatic congestion discovered at both bases. Turpentine stupes and free stimulation ordered. Bowels constipated, urine small in quantity with $\frac{1}{10}$ albumen. Vomits frequently, headache complained of on inquiry. Body hot, tongue furred, does not evince interest in anything when awake.

On 19th, temperature, 102·6° F.; pulse, 108, weak and compressible; respiration, 36, sighing and irregular. Headache gone. Slept not more than one hour during the night. Bubo not painful, but tender, and size of almond, surrounding œdema greater. Tongue yellowish white, furred, and drier. No sordes on lips or teeth. Noisy; busy delirium during the day. Not so restless. Giddiness, thirst, and weakness complained of when roused to answer questions. Causing the patient to sit up with support made his pulse 130 to 140, and weak and irregular, rapid and compressible.

On 19th, temperature, 102° F.; pulse, 144; respiration, 48. Eyes half open and seldom closed; stupid, dull, apathetic. Tongue cleaner, but drier. Sordes on lips and teeth. Headache less. Slept towards morning with the aid of camphorodyne and bromides. Less restless. Delirious at times. Prostration increased. Bubo harder and larger, measuring $1\frac{1}{2}'' \times 1''$, and very tender.

On 20th, temperature, 101·6° F.; pulse, 108, very weak, almost thready; respiration, 36. Breath sounds at bases obscured by mucous rales in parts. Tongue clean at sides, but fur thicker in centre of dorsum. Skin clammy, extremities cold. Expression stricken. Weary and disinclined to talk. Drowsy, with dorsal decubitus. Bubo larger and more oblique and very tender. Slept very little. Delirious on and off the whole day. Bowels constipated, urine passed naturally at 4 p.m.

On 21st, temperature, 103° F.; pulse, 120-130 ; respiration, 48. Passed a restless night. Thirst and delirium markedly increased. Skin perspiring ; extremities cold. Bubo larger, harder, more distinct. Patient very drowsy and restless. This evening stupor and complete unconsciousness came on with sighing, irregular respiration, cold extremities, low muttering delirium, and general symptoms of the so-called "typhoid state," from which, in spite of vigorous efforts and treatment, he never rallied, and died on the evening of April 22nd, 1897.

Plague, Sudden Collapse, and Death.

Register No. 396, Hindu, male, age 22, labourer, admitted April 22nd, at 8 a.m., died at 6 p.m. on 23rd, ill two days.

Case from Bhoiwada, house No. 134. There had been no plague in his chawl. On the 22nd at 3 p.m. he became ill with headache, shivering, vomiting, and constipation ; and he lay down, became unconscious and stupid, and knows not how he got to hospital. At 9 a.m., on 22nd, temperature, 103·8° F. ; pulse, 128 ; respiration, 36.

Present State.—A strong, muscular man with dull stricken look. Eyes closed, mouth open, fœtid odour from skin and breath ; lying on his back. Eyes suffused and injected, especially at both canthi, when uncovered. Patient unconscious and drowsy ; pupils normal. Tongue thickly coated with even putty-like fur, red at tip and edges. Body and extremities hot and dry, skin of face clammy, refuses food. Dorsal decubitus : irritable and restless when touched ; breathes quietly. Liver in the nipple line extends to the upper margin of fifth rib. Cardiac impulse normal in position, can be seen and felt, sounds muffled, no murmurs. Breath sounds harsh in front, and at base of right lung mucous rales detected.

Liver and spleen not felt in abdominal regions ; abdomen flaccid. An old scar (one week's duration ?) on right knee, no eruptions or wounds found. A bubo is felt on right femoral region, size of a walnut, very tender as he winces when it is touched ; a good deal of œdema around, and skin movable over it, but hot and burning.

Small, shot-like, but soft and non-tender glands felt in left groin ; none elsewhere. Temperature, 103·4° F. ; pulse, 120–132 ; respiration, 48 at 4 p.m. ; on 22nd pulse soft and very compressible, patient in same state as noted in the morning, unconscious and delirious.

On 23rd, at 7 a.m., temperature, 104·6° F. ; pulse, 120–130 ; respiration, 60 ; and he became conscious at 5 a.m., slept till roused, and then gave an account of his illness. Is intelligent, shows his tongue, which is furred, white, and large and moist. He complains of pain in the right groin and headache chiefly. Feels prostrate and weary. Eyes clear, not injected, but suffused and muddy-looking, pupils widely dilated. Bowels constipated ; passed urine this morning.

Bubo more distinct, harder, and very tender ; seems convalescent. Blood cultures on agar disclosed the presence of specific plague bacilli, and the case was watched with great interest, as all such blood-infected patients had hitherto died.

At 3.30 p.m., on 23rd, he was conscious and intelligent. Took nourishment and wanted to sit up in bed. Temperature, 104° F. ; pulse, 128 ; respiration, 40 ; and looked doing well and as last noted.

On visiting him again at 5.30 p.m., however, a marked and sudden change in his condition was apparent, eyes greatly injected, pupils contracted, breathing, gasping, noisy, hurried, 72 per minute, pulse running, thready, and hardly perceptible. Patient unconscious, collapsed, unable to swallow. Ether was given twice hypodermically, and hot bottles and turpentine stupes applied, but all were of no avail to rouse the patient from his state of stupor and coma, as he expired at 6 p.m. the same day.

Plague, simulating Enteric Fever.

Register No. 469, Sister E——, age 45, European, ill since May 2nd, when she had a rigor at noon whilst at work in the Plague Hospital, where she has been doing duty for nearly six weeks. She had to give up her work owing to giddiness, trembling, chilliness, headache, repeated vomiting of bilious matter, and prostration. The same symptoms were repeated on 3rd instant, especially vomiting, so that she could not retain her food, and she felt sleepless and was very restless and depressed. On the 4th diarrhœa of a thin, yellowish, fœtid, watery character came on, and she had six such motions in the 24 hours with much griping and gurgling. She was slightly delirious, had fever, and repeated vomiting, and nausea was constantly present. She was kept under observation at Mahim Hospital and sent to Parel under suspicion of developing plague.

On admission, on the 5th, her temperature was 104·6° F.; pulse, 144; respiration 36; tongue covered with a light yellowish, brown fur, moist, tip and edges clean. Skin hot and clammy. Bad odour from breath and peculiar heavy earthy smell from bedclothes when they are turned down. Headache, frontal or vertical in seat, complained of very much. Patient is drowsy, wants to sleep but cannot. Heart and lungs normal. Liver and spleen normal. No eruptions, wounds, or buboes. Bowels moved three times to-day, thin, yellowish, and very bad smelling. Complete anorexia; vomiting abated under treatment. Patient looks and feels ill. Eyes not injected, abdomen tympanitic and tender, and gurgling detected in various parts not confined to the iliac fossa. Pulse large, soft, and compressible. Decubitus dorsal. Diaphoretic mixture, stimulants and quinine prescribed, and the patient kept in a separate ward under observation. On 6th, temperature, 104° F.; pulse, 120; respiration, 30; slept fairly well with a sedative draught. Headache less, very prostrate, tongue large, soft, teeth-indented, and covered with dry yellowish brown fur, except at edges, which are red and clean. Bowels moved three times; motions as before in appearance. Dorsal decubitus and sinking down the bed; no delirium. Enteric spots looked for, but not seen; the same evening temperature, 102° F.; pulse, 130; respiration, 30; prostrate, and complains of aching lumbar pain and pains in the limbs. On 7th, temperature, 99° F.; pulse, 120; respiration, 30; slept well; bowels moved six times. Camphorodyne and intestinal antiseptics given, and diet as in enteric being continued; no other change in her condition noticeable. General appearance of "typhoid state." On 8th, temperature, 103° F.; pulse, 120–132; respiration, 24; nothing abnormal in chest; skin moist, tongue furred, headache less, slept a little, but had delirium between sleeping and waking periods. Bowels moved three times during the night, distinctly yellowish and suggestive of enteric motions, very fœtid, acid in reaction; complete anorexia, and some incoherence present. Fumbling and picking at bedclothes.

This evening tenderness is felt at the inner end of Poupart's ligament in the left groin, and she groans when pressed in the left groin. No buboes felt, however, in this groin or elsewhere ; a vesicle has appeared on the right loin. Its contents have been examined for plague bacilli with negative results, and repeated attempts by skilled bacteriologists of the German Plague Mission have failed to demonstrate plague bacilli in the blood of this patient. On 9th, temperature, 101·6° F. ; pulse, 144 ; respiration, 36 at 8 a.m., and she is very prostrate. Tongue more furred in the centre, no headache, three motions as before, liver not enlarged or tender, abdomen distended and tender all over, eyes not injected, pupils normal. Face has a heavy apathetic look, delirium at times and marked incoherence in speech, feels tongue heavy, sighs, groans, sinks down in the bed. No typhoid spots. An enlarged hard linear 3″ × 2″ ring of inflamed gland tissue felt along both Poupart's ligaments near the inner side of each groin, slightly above the level of the groin and partly extending over the abdomen.

Skin over the swellings dry, hot and tender, œdema masks the differentiation of the individual glands in the groins ; no buboes elsewhere ; blood cultures sterile.

On 10th, at 9 a.m., temperature, 103·2° F. ; pulse, 144 ; respiration, 48 ; stupor deepening into coma present. Very prostrate. Tongue furred. Sordes on lips. No sleep owing to delirium during the night. Vesicle the size of a pea has broken down into an ulcer on right loin. Its contents sterile. Pulse very weak, running in character. Eyes half open, expression vacant, incoherent and delirious. Vertical cephalalgia. Lethargy. Buboes in both groins, thick and brawny and very tender, with considerable surrounding œdema. Bowels moved once and urine passed involuntarily in bed. Vesicle surrounded by red inflamed spots ; mental hebetude marked.

On 10th, at 6 p.m., temperature, 103° F.; pulse, 140; respiration, 48 ; tongue dirty brown with fungiform papillæ prominent. Prostrate and comatose. *Subsultus tendinum* present. Passed three motions involuntarily in bed, very fœtid, thin and yellowish. Patient continued to grow worse and died at 11 p.m. on May 11th, not having recovered consciousness during the last 24 hours.

No bacteriological examination of the contents of the inflamed glands could be obtained.

Plague-like Remittent Fever at first, late appearance of Bubo and Broncho-Pneumonia.

Register No. 355, female, aged 22, from Dadar, admitted 12th April, 1897, at 11.30 a.m.

Became suddenly ill at 8 a.m. on 11th April with vomiting, headache, chilliness, and fever, but had no inflamed gland. Her grandmother had died of plague in the same chawl, and nine or ten dead rats had been found there; and during the last month or so nine people had died of plague in the same chawl.

Present State.—Patient is a well-nourished, young, unmarried woman. Slightly drowsy. Conjunctivæ not injected. Pupils normal, eyes suffused. Tongue coated with thick, white, patchy fur at sides. Pulse 112, soft and compressible. Skin hot and dry. No delirium, slight frontal headache. Restless and drowsy. Dull and apathetic. Did not sleep last night, was incoherent, and rambling in low muttering state.

Nothing abnormal in liver, spleen, heart, lungs, or abdomen. No rash, wounds, abrasions, or buboes can be found, and she remained in this state up till the 14th at 11 a.m., when temperature, 104° F.; pulse, 120; respiration, 32; and a well-defined bubo can be seen and felt in the left axilla. At 4 p.m. the bubo was larger, harder, size of walnut or small orange, on the pectoral margins of left axilla, very tender and well-defined.

Patient anæmic with hurried respiration, dorsal decubitus, restless, drowsy, and slightly delirious. Tongue with thick, yellowish brown, patchy fur. Skin of body hot and dry, extremities cool.

Eyes partly closed, mouth wide open. Expression vacant. Pupils contracted and eyes turned upwards and inwards. No sordes. Abdomen flaccid. Liver and spleen not felt. Respiration deep, pectoral in type. Feels thirsty, drowsy, and complains of pain in the left axilla. Patient has not menstruated for the last seven months. Breath sounds normal.

On 15th in much the same state as last noted. Restlessness, jactitation, low muttering delirium, and no sleep at night. Bowels constipated. Tongue furred. Teeth covered with sordes, and lips dry.

On the 16th at 8 a.m. a bubo noted along the anterior border of the right *trapezius*, isolated, bean-like, and very tender, also two small buboes in the submaxillary region on right side. The whole body pains. No delirium at present, but slight incoherence. Headache temporal in situation complained of and much thirst. Tongue clearing in patches in centre and front, leaving raw, red, nonfissured areas. Left axillary bubo larger and very tender with œdema, obscuring its limits. No complications. Patient menstruating for the first time since September last. Injected 60 minims of hydrarg. perchlor. at 10 a.m. in left arm below bubo. Same day at 5 p.m. temperature, 104·6° F.; pulse, 120, very compressible; respiration, 40. Cephalalgia frontal and severe. Bubo less tender. Patient sleepless, thirsty, without appetite. Motions and urine passed naturally. Tongue with thick brownish white fur, chipping off in large flakes, leaving raw, red areas.

At 9 a.m. on 17th, temperature, 105·4° F.; pulse, 120; respiration, 36. Breathing hurried and painful in right side. Slight cough and *muco-serous* expectoration, tinged with blood at times.

Physical signs of broncho-pneumonia in patches. Patient prostrate, sighing, and moaning, and delirious at times. Conjunctivæ injected, especially at canthi, more delirious at night. No sleep. Constant cough. Menstrual discharge profuse, fœtid, does not contain specific micro-organisms of plague.

At 7 p.m., temperature, 105·4° F. (fell to 102° F. 6 a.m. when broncho-pneumonia was developed); pulse, 130; respiration, 36, quick and shallow. Pain in right side. Expectoration and cough constant. Sputa yellowish red at times. Tongue with two patches of raw, red appearance, the size of sixpence each. Drowsy, slept with delirium between, for half an hour at most; very thirsty and prostrate. Anorexia complete. Unconscious and with low muttering delirium, but can be roused to answer questions. Bowels constipated, urine passed naturally. Very anæmic. Left axillary gland very tender.

On 18th, cough and pain in chest markedly increased. Tongue and general symptoms and signs unimproved. Menstruation profuse and still fœtid in spite of frequent injections of Condy's fluid, borax lotion, and sublimate. Patient was found sitting up gasping for breath, and the pulse became small, short, rapid, irregular, and almost indistinguishable.

On 20th, the notes read: Prostrate, anæmic, unconscious, and delirious. Mucous rales at both bases behind. Expectoration muco-purulent and blood-tinged. Respirations, gasping, irregular, 40 per minute; in the evening 66 per minute. Bubo exquisitely tender and œdema obscuring it.

On 21st, semi-conscious. Respirations, gasping and gurgling, 60 per minute. Eyes staring, injected, wide open, with pupils dilated. Much jactitation. Immense swelling of tissues around neck, under-jaw, obscuring features. Tongue crusted brown, sordes on lips and teeth, and "typhoid state" generally, and death with stupor and profound coma at 2.30 p.m.

Plague complicated by Pregnancy; Death on Twenty-second Day.

Register No. 374, Hindu, female, age 30, coolie (labourer), admitted April 17th, 1897, at 2 p.m., from Sewri; ill one day.

History on the night of 16th.—Patient had an hysterical fit, followed by shivering, fever, headache, vomiting, and delirium. Bowels constipated three days, and buboes appeared at 10 a.m. on 17th in the left femoral region. Present state 5 p.m., 17th—Dorsal decubitus; eyes suffused and muddy. Eyes and mouth open; patient can answer questions incoherently; seems in a state of delirium tremens. Tongue coated with thick, even white fur, increasing towards the back. No sordes. Skin very hot and dry; temperature, 105·4° F.; pulse, 144, full and bounding; respiration, 60. Liver and spleen not enlarged. Heart and lungs normal. Uterus felt two fingers-breadth below umbilicus. Belly painful, and pressure over uterus causes her to screw up her mouth and eyes as if in pain, and she does this at times when left alone, possibly from initiatory uterine contractions. Uterus tender, but rhythmical contraction not made out. Patient pregnant six months. Bubo the size of a haricot bean in left Scarpa's triangle at its upper and inner part, very tender, with surrounding œdema. Patient feels thirsty, and complains of headache when roused. A vesicle on dorsum of left foot, very tender; size of two-anna piece.

No eruptions on 18th morning. Temperature, 103·2° F.; pulse, 116; respiration, 46. Tongue furred, delirious, pain in abdomen, eyes injected, gland tender, with increased soft œdema around. Bowels moved twice. Pulse soft and compressible, laughs senselessly. Talks incoherently. Busy delirium present. Says she has no headache, but belly pains at times.

18th V.—Temperature, 103° F.; pulse, 120; respiration, 46. Delirious, restless, and laughing in a pleased, unconscious manner. Eyes injected and open, pupils normal.

Bubo larger, walnut size, hard and very tender. Morphine, $\frac{1}{4}$ grain given, and opium 2 grains, as uterus was tender and contracting rhythmically. Aborted at 5 p.m. Fœtus six months, examined at 6 p.m. by German Commission experts, who did not find plague bacilli in its tissues or blood. The mother's blood gave micro-organisms by cultivation on agar. Bacilli found in vesicle on dorsum of left foot.

On 19th morning, temperature, 102·4° F. ; pulse, 130–140 ; respiration, 54. Tongue covered with dirty brown dry fur. Busy delirium and carphology. No sleep. Pain in abdomen. Eyes injected, pupils normal. Abdomen distended and very tympanitic. Jactitation. Lochial discharge not fœtid. Injections of Condy and boric used three times daily. Bubo size of hen's egg, with increased surrounding œdema, and very hard and tender. Urine passed unconsciously in bed. Liver dulness obliterated.

19th V.—Temperature, 102·6° F. ; pulse, 132 ; respiration, 36. Quiet and sleeping. Abdomen very distended, obliterating liver dulness. Passed one motion. Tongue cleaner. Eyes less injected. Seems sensible when roused, but soon lapses into busy delirium, like that of delirium tremens.

On 20th morning, temperature, 100·6° F. ; pulse, 120 ; respiration, 48. Seems conscious and better. Tongue clear, bowels regular ; lochia not offensive.

20th V.—Temperature, 100·6° F. ; pulse, 108 ; respiration, 48. Takes food, slept five hours, groans and moans in her sleep. She is conscious and intelligent. Passed two very offensive motions, and vomited twice after food. Discharge suddenly stopped.

On 21st–24th.—Restless, refuses food. Tongue furred at back. Eyes injected. Babbling delirium. Abdominal distention disappeared. Bubo smaller and less painful ; and she seems worse generally.

On 25th morning, temperature, 100° F. ; pulse, 90 ; respiration, 36. Prostrate, restless ; has to be fed by enemata, as she refuses food, etc. Does not sleep. Tosses about in delirium, at times quiet, busy and rambling. Bubo tender ; abdomen flaccid. Lochia again appear, and offensive. Uterus washed out with 1 in 5,000 sublimate. Passed three very offensive motions.

25th V.—Temperature, 100·8° F. ; pulse, 108 ; respiration, 30. Conscious, takes food, lochia without smell.

On 26th.—Slept, skin cool, conscious, takes food. Passed three offensive motions, and in the evening temperature fell to subnormal, lochia ceased and pulse became 100, very weak and thready. Respiration, 40–48. Vesicle on left foot has become an ulcer four annas in size.

From 26th–29th was quiet and intelligent; slept with morphine injections. Tongue dry, with brownish yellow fur and flaky patches peeling off it. Recognises friends. Leucorrhœa. Feels better and stronger. Bubo larger and more distant from the subsidence of œdema. Takes food. Bowels regular. Urine passed.

On 30th.—Temperature, 103·8° F.; pulse, 120, soft and very compressible; respiration, 48.

No sleep the previous night. Wandering in busy delirium. Tongue flaky, very weak and prostrate. Complete anorexia. Bubo smaller and less tender.

1st–4th May.—Prostrate and delirious. Abdomen again distended. Urine has to be drawn off by catheter. Passes motions involuntarily, which are very fœtid. Vomits food, milk, and bilious matter.

Temperature, 104·4° F.–103° F.; pulse, 110–120; respiration, 44–54; and patient continued to lose ground, became exhausted, developed a bed sore on the right sacrum, had very fœtid breath, sordes on lips and teeth. Pulse, 160, very weak and running, and not to be felt at last; respiration, 60–66; and temperature ran up to 107·2° F. just before death at 4 p.m. on May 8th, 1897.

For the septicæmic condition, which frequent lavage of the uterus and vagina by antiseptics failed to prevent, quinine in large doses, salicylate of soda and boric acid were tried, and liq. hydrarg. perchloride in full doses.

Plague—Pneumonic Variety; Death on Third Day.

Register No. 350, male, aged 25, sepoy of four years' service, employed as cook orderly for six weeks in Parel Hospital. Attacked April 10th, at 8 a.m.; admitted on 11th, at 7 a.m., when disease was diagnosed by microscopic examination, and culture growth on agar as plague pneumonia. Died April 13th, at 12.15 a.m.

History.—Suddenly attacked by giddiness, headache, repeated vomiting, fever, prostration, and delirium at 8 a.m. on 10th instant, when temperature was 102·2° F.; pulse, 132; respiration, 28; as taken by the hospital assistant. At 9 a.m.—Present state: Eyes markedly injected. Skin very hot and dry, jactitation marked. Delirium of a noisy character present; wants to get up out of bed and run away, and is restrained with difficulty. Can be roused and his attention arrested momentarily. Says he has severe headache, frontal in site. Talks incoherently, and only partly utters sentences and words.

Complains of pain in right side of chest (fourth to the ninth rib) between mid axillary and anterior axillary lines, where dulness and moist crepitation is detected in small patches, not more than the area of the palm of one hand being involved, and that only in some parts. Tongue coated with brownish white fur, red at tip and edges. Tongue large, teeth-indented at sides and moist. No sordes, dorsal decubitus, and prostration marked. Expectoration and cough frequent, sputa sero-mucous, frothy, and tinged with blood. Cover-glass preparations showed numerous plague bacilli present. Pulse soft, full, but remarkably compressible. Bowels constipated, urine passed high coloured, febrile, deficient in chlorides, and slightly albuminous. Pupils dilated. Eyes always open, fixed, and staring. Mouth half open. No buboes discoverable anywhere. No rash or wounds. Temperature (at this time), 105° F.; pulse, 128; respiration, 28.

On the 11th, morning.—Slept only one hour during the night, very delirious, and almost uncontrollable. Cough and expectoration constant; pain in right side, headache, and thirst complained of greatly.

Physical signs of pneumonia scattered and not well marked. Finger pricked and blood examined and bacilli found in it.

Tongue brown and dry. Skin very burningly hot. Perspiring about head and neck. No buboes found. Eyes markedly injected. Very incoherent. Floccitation and carphology present and great jactitation.

On 12th no change; all symptoms aggravated. No buboes; prostration and "typhoid state" increased. Expectoration as before, and cough more frequent, if possible, than previously. Sinks down in bed, is dull, apathetic, and drowsy. At 6 p.m. collapsed, and did not rally till 8 p.m. in spite of ether, hot bottles, stimulants, and strychnine; and at 11 p.m. was markedly collapsed. Temperature, subnormal; pulse, 148; respiration, 48. Pulse could hardly be felt, small, very weak and thready; skin of body generally, and especially of extremities, cold, and death ensued at a few minutes after midnight. No buboes discovered after death externally, but no post-mortem could be obtained to determine the presence or absence of internal buboes.

The blood after death showed myriads of plague bacilli.

Report on Ranchatra Plague Hospital, 1897–8 *Epidemic.*

ADMISSIONS.

	Males.	Females.	Total.	Males and Females.	Percentage.
Under 10 years	31	32	63	Males under 10	8·0
Adults	171	156	327	Adult males	43·8
				Females under 10	8·2
				Adult females	40·0
Total	202	188	390	Total	100

DEATHS.

	Males.	Females.	Total.	Males and Females.	Percentage mortality out of 100 treated.
Under 10 years	20	25	45	Males under 10	5·1
Adults	148	121	269	Adult males	38·0
				Females under 10	6·4
				Adult females	31·0
Total	168	146	314	Total	80·5

RECOVERIES.

	Males.	Females.	Total.	Males and Females.	Percentage.
Under 10 years	11	7	18	Males under 10	2·8
Adults	22	35	57	Adult males	5·7
				Females under 10	1·8
				Adult females	9·0
Total	33	42	75	Total	19·3

OTHERWISE DISPOSED.

	Males.	Females.	Total.	Males and Females.	Percentage.
Under 10 years	–	–	–	Adult males	0·2
Adults	1	–	1		
Total	1	–	1	Total	0·2

ADMISSIONS.

Total treated.	Hospital Medicine.	Refused Medicine.	Percentage of Hospital Medicine.	Percentage of Refused Medicine.
390	256	134	65·6	34·4

DEATHS.

Total deaths.	Hospital Medicine.	Refused Medicine.	Percentage mortality in those who took Hospital Medicine.	Percentage mortality in those who refused Hospital Medicine.
314	197	117	77·4	87·4

RECOVERIES.

Total Recoveries.	Hospital Medicine.	Refused Medicine.	Percentage Recoveries of Hospital Medicine.	Percentage Recoveries in Refused Medicine.
75	58	17	22·2	12·6

OTHERWISE DISPOSED.

Total otherwise disposed.	Hospital Medicine.	Refused Medicine.	Percentage amongst Hospital Medicine.	Percentage amongst Refused Medicine.
1	1	...	0·4	...

Age.	Admitted.			Died.			Recovered.			Otherwise Disposed.			Mortality Percentage.
Years.	M.	F.	Ttl.	M.	F.	Ttl.	M.	F.	Ttl.	M.	F.	Ttl.	
Under 2 .	2	2	4	1	—	1	1	2	3	—	—	—	25·0
2 to 10 .	37	32	69	24	27	51	13	5	18	—	—	—	73·9
11 to 20 .	46	43	89	40	38	78	6	5	11	—	—	—	87·6
21 to 30 .	46	41	87	39	29	68	7	12	19	—	—	—	78·1
31 to 40 .	25	29	54	22	21	43	2	8	10	1	—	1	80
41 to 50 .	21	19	40	19	12	31	2	7	9	—	—	—	77·5
51 to 60 .	18	12	30	17	9	26	1	3	4	—	—	—	86·6
61 to 70 .	7	8	15	6	8	14	1	—	1	—	—	—	93·3
71 to 80 .	—	—	—	—	—	—	—	—	—	—	—	—	—
81 to 90 .	—	1	1	—	1	1	—	—	—	—	—	—	100
91 to 100 .	—	1	1	—	1	1	—	—	—	—	—	—	100
Total	202	188	390	168	146	314	33	42	75	1	—	1	

Situation of gland.	Total treated.	Died.	Recovered.	Otherwise.	Percentage Mortality.
Non-bubonic	141	121	19	1	85·8
Left groin	67	46	21	—	68·6
Right groin	65	52	13	—	80·0
Right neck	31	28	3	—	90·3
Right axilla	25	22	3	—	88·0
Left axilla	24	22	2	—	91·6
Left neck	24	14	10	—	58·3
Pneumonic	9	7	2	—	77·7
Right parotid	3	1	2	—	33·1
Left breast	1	1	—	—	100
Total	390	314	75	1	

Name of Caste.	Total number treated.	Died.	Recovered.	Otherwise disposed.
Brahman	112	102	10	—
Maratha	144	108	35	1
Mussulman	36	27	9	—
Gujar	18	11	7	—
Marwari	3	3	—	—
Kostee (weaver)	2	1	1	—
Dhobu	2	2	—	—
Jingur (umbrella repairer)	1	1	—	—
Tailor	13	11	2	—
Teli (oilman)	4	4	—	—
Grocer	7	7	—	—
Chambhar (cobbler)	3	3	—	—
Bhangi	4	4	—	—
Coppersmith	1	1	—	—
Mang	1	1	—	—
Linguyat	3	3	—	—
Jangam	2	2	—	—
Goldsmith	6	6	—	—
Blacksmith	1	1	—	—
Carpenter	2	2	—	—
Lonaru (collier)	1	1	—	—
Kasar (bangdi seller)	2	2	—	—
Fisherman	1	1	—	—
Mhar	3	2	1	—
Barber	10	3	7	—
Gondhali (singer)	1	1	—	—
Dhor (tanner)	3	1	2	—
Gurawa (worshipper)	1	—	1	—
Kamathi	1	1	—	—
Kumbhar (potter)	2	2	—	—
Total	390	314	75	1

Occupation.	Total number treated.	Died.	Recovered.	Otherwise disposed.
Butcher	4	3	1	—
Barber	3	1	2	—
Blanket-maker	3	2	2	—
Bangdi seller	2	2	—	—
Bhangi	4	4	—	—
Beggar	4	4	—	—
Cultivator	5	4	1	—
Corn seller	1	1	—	—
Collier	1	1	—	—
Coppersmith	3	3	—	—
Carpenter	1	1	—	—
Cobbler	3	3	—	—
Dooli bearer	2	1	1	—
Disinfecting coolie	3	2	1	—
Fruit seller	1	1	—	—
Fisherman	2	2	—	—
Goldsmith	3	3	—	—
Grocer	7	7	—	—
Hakini	1	1	—	—
Inumdar	2	1	1	—
Kurkun	13	13	—	—
Labourer	9	6	3	—
Mason	2	2	—	—
Mendicant	5	5	—	—
Mhar	1	—	1	—
Mabe	5	5	—	—
Nil	193	144	48	1
Oilmen	5	5	—	—
Police constables	11	11	—	—
Pensioner	6	6	—	—
Peon	4	3	1	—
Pilgrim	2	1	1	—
Porter	1	1	—	—
Printer	1	1	—	—
Student	20	17	3	—
Service	6	5	1	—
Singer	1	1	—	—
Silkweaver	3	3	—	—
Schoolmaster	2	2	—	—
Stamp vendor	2	2	—	—
Showman	2	2	—	—
Trader	20	17	3	—
Tanner	3	1	2	—
Tailor	11	9	2	—
Tanworker	1	—	1	—
Toe-ring maker	1	1	—	—
Weaver	2	1	1	—
Washerman	3	3	—	—
Total	390	314	75	1

Year.	Month.	No.
1897	January	1
,,	February	1
,,	March	1
,,	April	1
,,	May	–
,,	June	–
,,	July	1
,,	August	4
,,	September	4
,,	October	5
,,	November	38
,,	December	152
1898	January	130
,,	February	52
Total		390

SEGREGATED PERSONS.

DAYS.

1	2	3	4	5	6	7	8	9	10	12
R. D.	R. D.	R. D.	R. D.	R. D.	R. D.	R. D.	R. D.	R. D.	R. D.	R. D.
3 3	1 8	– 6	2 6	1 4	3 7	– 4	1 4	3 3	– 2	– 1
6	9	6	8	5	10	4	5	6	2	1
Total										62

R. = Recovered. D. = Died.

Report on Wadha Camp and Hospital, 1898–9, *by Dr. G. U. Smith.*

Appended are some tables prepared from the records of Wadha Camp, where, during the last quarter of 1898, 520 persons were under segregation and 132 cases of plague under treatment.

Table A gives the total mortality, also the number of attacks and deaths for each of the various types of the disease.

The percentage death-rate is 66·6 per cent.

Table B exhibits the situation of the bubo in the 107 cases where buboes were observed. By "mixed" is meant multiple buboes, *e.g.* in groin and axilla.

In Table C attacks and deaths are arranged under headings of age.

Pneumonia and Plague.—In addition to the six cases of primary pneumonic plague, fourteen others developed secondary pneumonia and all proved fatal.

The Incubation Period.—It is a difficult matter to determine the period of incubation with any certainty; the average duration is unknown, but it is well established that incubation may take a few hours only. The maximum period is not yet determined; recent experience points to a longer interval than is usually allowed, and authentic cases have been recorded which leave small room for doubt that it may be prolonged to sixteen days.

Below examples of prolonged incubation are given.

Ten days' segregation insufficient.—I consider the ten days usually allowed in segregation camps to be too short a time, and think the term of segregation, as well as of surveillance of arrivals in unaffected towns, might with advantage be extended to twenty days.

Housing of Patients.—For the accommodation of plague patients plague huts or hospitals have to be constructed; they may either take the form of sheds divided into compartments by partitions, or of separate chapars. In my opinion the chapar is the most suitable. It is cheap, readily taken to pieces for exposure of the interior to sun and air, and it affords the privacy on which the people lay great store. It was the rule at Wadha Camp, whenever a case of plague occurred amongst the segregated, to remove and disinfect the inmates, isolate the sick, and put the rest of the family into a new chapar. The hut in which the case occurred was left vacant as long as possible, the walls (matting) being removed, and only the framework left standing, so as to allow the sun and air to play freely on the floor of the hut.

Medical Treatment.—The medical treatment of plague patients at Wadha was what is termed "expectant treatment." The chief drugs employed were strychnine, carbonate of ammonia, and alcohol. There was little response, and the course of the disease was not materially influenced. Some apparently hopeless cases recovered without treatment (medicinal). The fears and suspicions of patients and their friends hindered proper treatment. Many refused to use the cots provided. There was much difficulty in inducing the patients to take milk, and they seem to regard it as injurious in fever. The friends of the patient invariably applied marking-nut freely over the bubo.

As far as I am aware, the therapeutic treatment of plague has not advanced in the past two years. There was no remedy then, there is none now. There is no occasion of reproach to the medical profession in this fact, since the nature of the activities and products of the plague organism when implanted in the human tissues still await investigation.

The average time under treatment of the recovered cases was one month.

Duration of Fatal Cases.—The average duration of fatal cases was 4½ days. Following is a summary of the fatal cases and the duration :—

12 hours	6 cases
1 day	11 ,,
2 days	10 ,,
3 ,,	18 ,,
4 ,,	7 ,,
5 ,,	7 ,,
6 ,,	7 ,,
7 ,,	13 ,,
1–2 weeks	6 ,,
2–3 ,,	3 ,,

Plague contracted in Hospital.—Three cases of suspicious fever were admitted to camp which proved to be not plague. One of these cases apparently contracted plague in the hospital shed. He was admitted to hospital with a temperature of 103°. It fell to normal next day and remained so for seven days, during which time he occupied a hut in the camp, after being duly disinfected. On the seventh day he again had fever, and this turned out to be a genuine attack of plague, with bubo in the right groin, and lasting a fortnight.

Symptoms.—No full account of the symptoms of the cases of plague admitted to Wadha Hospital need be given, since they were the ordinary symptoms usually observed. None of the patients had undergone inoculation against plague. Vomiting was a common early symptom, diarrhœa a rare one. The bubo never appeared before the rise of temperature, and in some cases was delayed for some days. The fatal cases terminated often in collapse, in exhaustion if prolonged, in convulsions in the case of children, and a few in profound coma. The course of the temperature was either irregular or continued. Almost all recoveries were ushered in by a gradual fall of temperature. The peculiar smell described as emanating from plague patients was noticed in a few instances.

Effect on Pregnancy.—There was one case of abortion followed by the recovery of the woman. Two women in camp gave birth to viable children whilst suffering from plague. Mother and child died in each case. The children showed no signs of plague.

Complications.—The principal complications besides the pneumonia already mentioned were :—

Pleurisy (1), chorea (2), meningitis (1), simple mania (1), bed sores (3), black blister (1), suppression of urine (1), temporary aphasia (2), ophthalmia (2), and iritis (1).

Immunity of the Camp Servants.—Camp servants and others on duty at Wadha escaped with the exception of a corpse-bearer, who died of plague after one day's illness.

One of the patients admitted to Wadha was a kárkún on duty at one of the nákás.

Incidence on the Segregated.—Each patient was allowed one attendant, usually a near relation. Several of these relatives contracted plague whilst in camp, and I think some of them got the disease from the sick whom they attended. A list is appended of the cases of plague occurring amongst segregated persons. Most of those who were segregated for a considerable interval prior to being attacked were, during part of that interval, in attendance on sick relatives. Upon the death of the patient, the attendant was always disinfected. The number of days between the death of the relative and the onset of plague in the attendant represents the minimum incubation period for the case.

Plague in a Sadar Bázár and a Karanja family.—The history of two families who suffered severely from plague is also given in the form of tabular statements (see pp. 88, 89). They afford examples of a virulent type of plague, rapidly fatal, without buboes in the cases that lasted twenty-four hours or less, of prolonged incubation, and of the probable transmission of the disease by direct contact.

TABLE A.

Type.	Attacks.	Deaths.
Bubonic	107	69
Non-bubonic	25	19
Total	132	88

A sub-division of the above principal types follows:—

Type.		Attacks.	Deaths.
Bubonic	Single	94	63
	Multiple	13	6
Non-bubonic	Pneumonic	6	6
	Toxæmic	19	13

TABLE B.

Site.	Number of Cases.	Percentage.
Groin	63	58·9
Axilla	24	22·4
Neck	5	4·8
Parotid region	1	0·9
Poplitial region	1	0·9
Mixed	13	12·1

The mixed situation of buboes include:—

2 cases of buboes in both groins.
4 ,, ,, in axilla and groin.
2 ,, ,, in axilla, groin, and neck.
2 ,, ,, in neck and groin.
2 ,, ,, in right and left parotid regions.
1 case of ,, in axilla and above the oberaum.

TABLE C.

Age.	Attacks.	Deaths.
Under 5 years	10	6
5 years up to 15	38	26
15 years up to 25	17	8
25 years up to 40	30	17
40 years up to 60	25	21
Over 60 years	12	10

Report on Budhwar Plague Hospital 1897–8 *Epidemic.*

ADMISSIONS.

	Males.	Females.	Total.	Males and Females.	Percentage.
Under 10 years	8	13	21	Males under 10	4·7
Adults	70	79	149	Adult males	41·2
				Females under 10	7·6
				Adult females	46·5
Total	78	92	170	Total	100

DEATHS.

	Males.	Females.	Total.	Males and Females.	Percentage.
Under 10 years	8	8	16	Males under 10	4·7
Adults	58	59	117	Adult males	34·1
				Females under 10	4·7
				Adult females	34·7
Total	66	67	133	Total	78·2

RECOVERIES.

	Males.	Females.	Total.	Males and Females.	Percentage.
Under 10 years	–	5	5	Males under 10	–
Adults	11	19	30	Adult males	6·5
				Females under 10	3·0
				Adult females	11·2
Total	11	24	35	Total	20·7

OTHERWISE DISPOSED OF.

	Males.	Females.	Total.		Percentage.
Under 10 years	–	–	–	Males and females together.	1·1
Adults	1	1	2		
Total	1	1	2	Total	1·1

ADMISSIONS.

Total treated.	Hospital Medicine.	Refused Medicine.	Percentage of Hospital Medicine.	Percentage of Refused Medicine.
170	63	107	37·0	63·0

DEATHS.

Total Deaths.	Hospital Medicine.	Refused Medicine.	Percentage mortality with Hospital Medicine.	Percentage mortality in those who refused Hospital Medicine.
133	37	96	58·7	89·7

RECOVERIES.

Total Recoveries.	Hospital Medicine.	Refused Medicine.	Percentage Recoveries with Hospital Medicine.	Percentage Recoveries in those who refused Hospital Medicine.
35	26	9	41·3	8·4

OTHERWISE DISPOSED OF.

Total otherwise disposed.	Hospital Medicine.	Refused Medicine.	Percentage otherwise disposed of amongst those who took Hospital Medicine.	Percentage otherwise disposed of amongst those who refused Medicine.
2	—	2	—	1·9

Years.	Admitted.			Died.			Recovered.			Otherwise disposed of.			Percentage mortality.
	M.	F.	Ttl.	M.	F.	Ttl.	M.	F.	Ttl.	M.	F.	Ttl.	
Under 2	—	2	2	—	2	2	—	—	—	—	—	—	100
2 to 10	12	16	28	11	10	21	1	6	7	—	—	—	75
11 to 20	24	19	43	19	15	34	5	4	9	—	—	—	79·4
21 to 30	16	11	27	14	5	19	2	6	8	—	—	—	70·3
31 to 40	3	10	13	2	7	9	—	2	2	1	1	2	69·2
41 to 50	5	7	12	5	6	11	—	1	1	—	—	—	91·6
51 to 60	7	13	20	7	9	16	—	4	4	—	—	—	80·0
61 to 70	4	8	12	3	8	11	1	—	1	—	—	—	91·6
71 to 80	5	5	10	4	4	8	1	1	2	—	—	—	80·0
81 to 90	2	1	3	1	1	2	1	—	1	—	—	—	33·3
91 to 100	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	78	92	170	66	67	133	11	24	35	1	1	2	

Situation of gland, etc.	Admitted.	Died.	Re-covered.	Otherwise disposed of.	Percentage of mortality.
Non-bubonic	48	39	8	1	81·2
Left groin	24	16	8	—	66·6
Right groin	21	17	4	—	80·0
Left axilla	20	16	4	—	80·0
Right neck	11	9	1	1	81·8
Right axilla	9	6	3	—	66·6
Left neck	6	6	—	—	100
Both groins	4	4	—	—	100
Both sides of neck	4	4	—	—	100
Pneumonic	3	3	—	—	100
Right axilla and left groin	2	1	1	—	50
Left axilla and left groin	2	1	1	—	50
Both axilla	1	—	1	—	—
Both groins and left axilla	1	1	—	—	—
Both sides of neck, left groin and right axilla	1	1	—	—	—
Both sides of neck and right axilla	1	1	—	—	—
Both sides of neck and right groin	1	1	—	—	—
Both sides of neck and both groins	1	—	1	—	—
Both groins and left axilla	1	1	—	—	—
Both axilla and left groin	1	—	1	—	—
Right side of neck and left groin	1	—	1	—	—
Right side of neck and right groin	1	1	—	—	—
Left side of neck and right groin	1	1	—	—	—
Right axilla and left neck	1	1	—	—	—
Left axilla and right groin	1	1	—	—	—
Right side of chest	1	1	—	—	—
Below the angle of right side of jaw	1	—	1	—	—
Both axilla, both sides of neck, left groin and small-pox	1	1	—	—	—
Total	170	133	35	2	—

Caste.	Admitted.	Died.	Recovered.	Otherwise disposed of.
Brahman	54	42	11	1
Maratha	58	45	13	—
Mussulman	17	12	5	—
Gujar	3	3	—	—
Wani (grocer)	10	8	1	1
Sonar (goldsmith)	2	1	1	—
Shimpi (tailor)	6	4	2	—
Sutar (carpenter)	2	2	—	—
Kasar (bangdi seller)	6	5	1	—
Pardishi	1	1	—	—
Marwadi	1	1	—	—
Teli (oilman)	2	1	1	—
Nhavi (barber)	1	1	—	—
Bhoi (fisherman)	2	2	—	—
Tamboli (pansupari seller)	1	1	—	—
Karanjkar	2	2	—	—
Sangar (blanket maker)	1	1	—	—
Dhanjar (shepherd)	1	1	—	—
Total	170	133	35	2

Occupation.	Admitted.	Died.	Recovered.	Discharged otherwise.
Brass Smith	1	1	—	—
Broker	2	2	—	—
Carpenter	2	2	—	—
Dealer	7	6	1	—
Disinfecting coolie	4	3	1	—
Karkun	5	4	1	—
Labourer	4	2	1	1
Lampman	1	1	—	—
Nil	132	102	29	1
Oilman	1	1	—	—
Pansupari seller	1	1	—	—
Private servant	3	2	1	—
Prostitute	1	1	—	—
Student	2	2	—	—
Sweeper	3	2	1	—
Weaver	1	1	—	—
Total	170	133	35	2

Number of men, and on what day they became ill after coming into Segr. Camp, Budhwar, Satara.

MARCH 29TH, 1898.

Days	1	2	3	4	5	6	7	8	9	10	Total.	Cured.	Died.
Nos.	1	6	3	2	4	1	1	3	0	2	23	7	16
Recovered	1	2	0	0	2	0	1	0	0	1	7	—	—

Distribution by Age.

MARCH, 1898.

Age.	Admitted. M.	Admitted. F.	Died. M.	Died. F.	Recovered. M.	Recovered. F.	Remaining. M.	Remaining. F.
2 to 10 years	1	1	1	—	—	1	—	—
11 to 20 ,,	4	2	4	2	—	—	—	—
21 to 30 ,,	7	4	4	4	3	—	—	—
31 to 40 ,,	2	3	2	1	—	1	—	1
41 to 50 ,,	2	3	2	1	—	2	—	—
51 to 60 ,,	1	1	1	1	—	—	—	—
61 to 70 ,,	1	1	1	1	—	—	—	—
Total	18	15	15	10	3	4	—	1
	33		25		7		1	

Distribution as Mentioned Below.

Age and Sex.	Admitted.	Died.	Recovered.	Remaining.
Males under 10	1	1	—	—
Males, aged 10 and above	17	14	3	—
Females under 10	1	—	1	—
Females, aged 10 and above	14	10	3	1
Total males	18	15	3	—
Total females	15	10	4	—
Grand total	33	25	7	1

Hospital Medicine and Refused Medicine.

Hospital Medicine and Refused Medicine.	Admitted.	Died.	Recovered.	Remaining.
Hospital Medicine	21	17	4	—
Refused Medicine	12	8	3	1
Total	33	25	7	1

Distribution by Caste.

Caste.	Admitted.	Died.	Recovered.	Remaining.
Maratha	15	13	2	—
Bhangi	1	—	1	—
Potter	1	1	—	—
Brahman	3	3	—	—
Burud	1	—	1	—
Christian	1	—	1	—
Tailor	1	1	—	—
Mali	4	3	1	—
Pardishi	1	1	—	—
Mussulman	1	1	—	—
Linguyat	1	—	1	—
Mang	3	2	—	1
Total	33	25	7	1

Occupation.	Admitted.	Died.	Recovered.	Remaining.
Bhangi	1	—	1	—
Burud	1	—	1	—
Disinfecting coolie	1	1	—	—
Farmer	2	2	—	—
Mang	2	2	—	—
Mali	5	3	2	—
Karkun	1	1	—	—
Nil	13	11	1	1
Potter (female)	1	1	—	—
Police	2	1	1	—
Service	1	1	—	—
Schoolmaster	1	—	1	—
Tailor	1	1	—	—
Pulse selling	1	1	—	—
Total	33	25	7	1

Situation of Gland.

Situation.	Admitted.	Died.	Recovered.	Remaining.
Right groin	12	9	3	—
Left groin	9	7	2	—
Pneumonic	4	3	1	—
Non-bubonic	3	1	1	1
Right axilla	1	1	—	—
Right arm	1	1	—	—
Left parotid	1	1	—	—
Left axilla	1	1	—	—
Right neck	1	1	—	—
Totals	33	25	7	1

Peths.

Name.	Admitted.	Recovered.
Karanja	13	1
Segregation	6	—
Godoli Camp	1	1
Pratapganj	1	1
Budhwar Hospital	4	2
Wadha Camp	1	1
Sadar Bazar	2	1
Budhwar Peth	1	—
Shanwar	1	—
Bhowani	1	1
Kesarkar	1	—
Faruskhaun	1	—
Totals	33	7

Distribution of Plague Attacks and Deaths according to Municipal Divisions, Satara, 1897–8.

Name of Peth or Division.	Population. 1891 census.	Population. March 1, 1898.	Males. Attacked.	Males. Died.	Males. Recovered.	Females. Attacked.	Females. Died.	Females. Recovered.
Mangalwar .	2,350	209	37	33	4	17	14	3
Bhowani . .	1,137	139	11	9	2	8	6	2
Ramacha Got .	1,250	72	11	9	2	9	8	1
Vyaukatpura .	963	35	18	16	2	19	17	2
Somar . .	1,811	123	22	20	2	32	27	5
Shukarwár .	941	191	14	13	1	7	4	3
Guruwar . .	2,916	91	18	15	3	32	28	4
Machi . .	250	98	20	17	3	18	17	1
Budhwar . .	932	120	7	6	1	10	10	0
Sadashiv . .	706	16	10	10	0	5	3	2
Chimaupura .	520	6	10	10	0	8	5	3
Pratapganj .	737	169	3	3	0	11	8	3
Malar, Raviwar, and Durga .	872	816	6	5	1	3	2	1
Shanwar . .	3,785	243	53	50	3	47	40	7
Yadagopal. .	1,084	232	18	18	0	23	22	1
Karanja Basappa, Rajunathpura and Rajaspura, Panta's Got and Kesarkar	3,902	1,204	12	12	0	13	9	4
Segregation Camps—								
Wadha	...	...	3	3	0	5	5	0
Budhwar	...	...	12	10	2	24	14	10
Godoli	...	...	14	14	0	17	12	5
Ranchatri	...	...	54	44	10	46	34	12
In the fields around the city	...	...	13	9	4	5	3	21
Imported cases .	...	...	24	18	6	15	12	3
			390	344	46	374	300	74

Imported cases of Plague at Satara during the Epidemic of 1897–8.

Admitted—

Ages.	5-10	10-15	15-20	20-30	30-40	40-50	50-60	60-70		Totals.
Males	0	6	2	11	4	2	0	1	...	26
Females	0	0	0	5	1	1	2	2	...	11
Children	3	0	0	0	0	0	0	0	...	3
										40

Died—

Ages.	5–10	10–15	15–20	20–30	30–40	40–50	50–60	60–70	Totals.
Males .	0	4	2	8	3	1	0	1 ...	19
Females	0	0	0	3	1	1	2	2 ...	9
Children	2	0	0	0	0	0	0	0 ...	2
									30

Recovered—

Ages.	5–10	10–15	15–20	20–30	30–40	40–50	50–60	60–70	Totals.
Males .	0	2	0	3	1	1	0	0 ...	7
Females	0	0	0	0	0	0	0	0 ...	2
Children	1	0	0	0	0	0	0	0 ...	1
									10

Mortality—75 per cent.

Statement showing Recoveries and Deaths by sex from birth to sixty years or upwards in Satara City during the Plague Epidemic of 1897–8, *up till March,* 1898, *both indigenous and imported cases:—*

Recoveries—

	Under 1 year		1–5		5–10		10–15		15–20		20–30		30–40		40–50		50–60		Upwards.	
Sexes .	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
Numbers .	0	2	5	4	5	11	7	2	5	7	11	18	4	14	2	10	0	7	4	2

Totals—Males, 43 ; Females, 77. Total Recoveries, 120.

Deaths—

Numbers .	2	0	10	5	36	42	41	26	34	27	83	56	53	45	37	29	30	30	21	37

Totals—Males, 347 ; Females, 297. Total Deaths, 644.

Percentage mortality at age periods approximately—

50	60	83	88	84	83	84	85	89	91

Grand total Attacks, 764.

Sex mortality at age periods approximately—

100	0	66	56	88	80	85	93	87	79	88	76	93	76	95	74	100	81	84	95

Mortality average (all ages): Males, 89 ; Females, 79.

For every 100 males attacked, about 97 females were attacked; but as this includes 40 imported cases, the large proportion of whom were males, the attacks would be about equally distributed among the sexes. It will be noted that the population of Satara consisted of 13,009 males and 12,740 females by the 1891 census; yet the relative proportions must have varied considerably from time to time during the epidemic, and so many fled, it is impossible to enumerate the numbers exposed to attack or their relative number in males and females or by age periods. It is doubtful if an equal number of each sex remained exposed to infection for equal times or lived under similar insanitary conditions. The very small number of infants attacked is remarkable. The age period for plague is that of manhood (20 to 30) giving the largest number of attacks in both sexes.

INSTANCE OF IMMEDIATE AND COMPLETE EVACUATION.

BORGAON. POPULATION, 953.

Plague first appeared here on October 18th, 1898, when a woman was found to be suffering from it. Her house and those immediately adjoining were forthwith evacuated. On the 22nd another plague case occurred, and in this house dead rats were found.

Then the village was completely evacuated and the houses sealed on October 28th, 1898. The effect of this was the complete stoppage of the plague inside one month, during which interval only 10 cases and 8 deaths occurred.

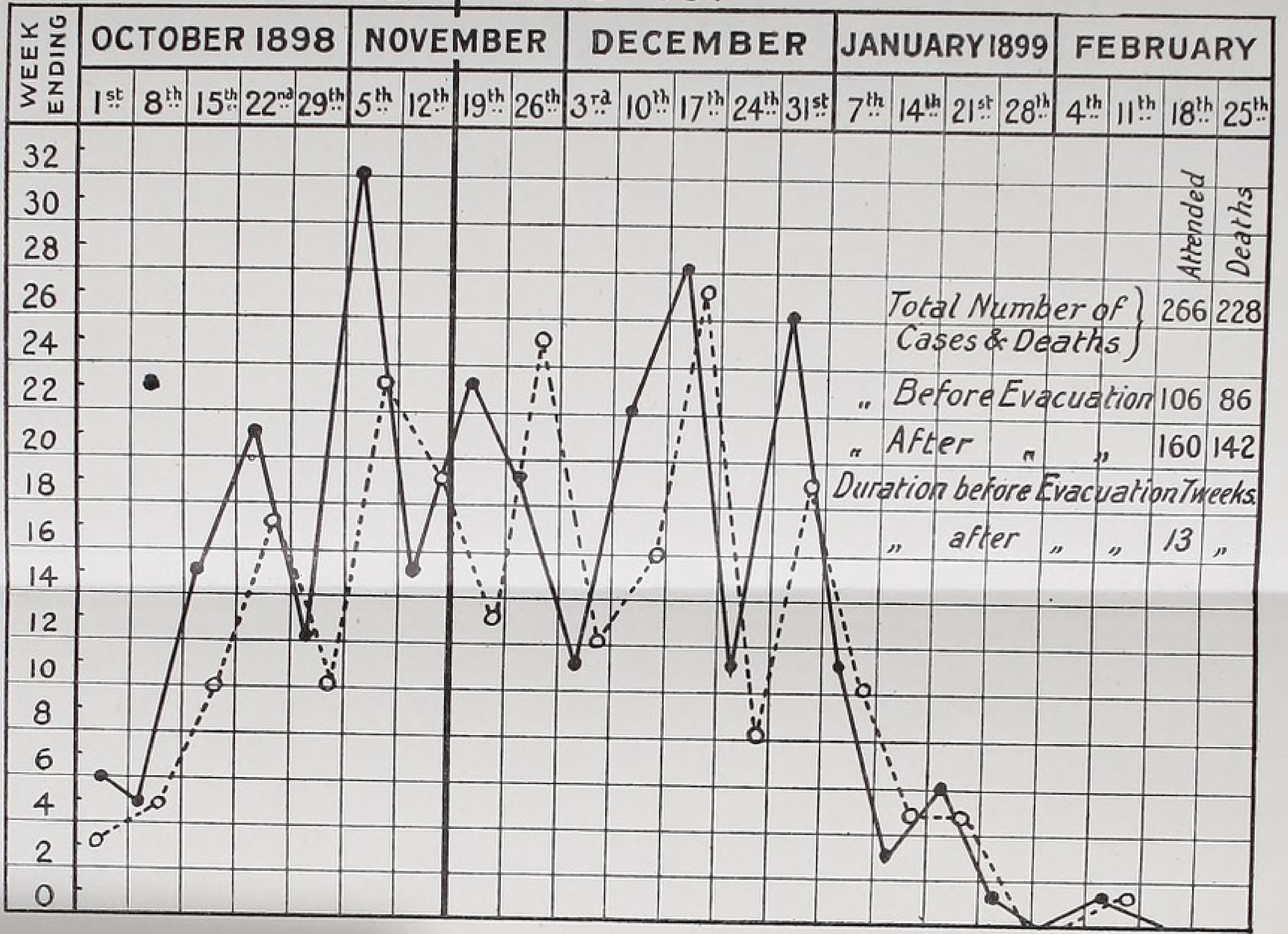
Total cases . . .	13	Deaths . .	9
Before complete evacuation .	3	,, . .	1
After ,, ,, .	10	,, . .	8
Duration before evacuation . . .			2 weeks.
,, after ,, . . .			4 ,,

SUMMARY OF CASES.

	Cases.		Deaths.
For week ending 4.11.98 . . .	7	...	3
,, ,, 11.11.98 . . .	3	...	4
,, ,, 18.11.98 . . .	—	...	—
,, ,, 25.11.98 . . .	2	...	1
,, ,, 2.12.98 . . .	1	...	1
	13		9

PLAGUE CHART OF RAHIMTPUR

Date of Evacuation 12.11.98. FOR 1898 - 99. Population 6,670.



FAILURE OF PARTIAL EVACUATION.

LIMB. POPULATION, 4,587.

This town furnished a good example of partial evacuation being unsuccessful in stopping plague, and also the necessity of the hearty and intelligent co-operation of the people to ensure success. The first plague attacks occurred in Limb on August 6th, 10th, and 17th, 1898—4 in all—but were not reported till the 17th idem, as the people thought it was only ordinary fever. All the cases were in one house. Immediately on this being reported the infected house and fifty others in its neighbourhood were evacuated.

A lull followed this clearance, no case occurring till August 29th, when two cases were reported amongst the people segregated in the fields, followed by one case on the 30th and another on the 31st, and on the latter day plague reappeared in the town about 150 yards from the evacuated area.

Another partial evacuation of 16 houses took place. Three days after this another case appeared about 100 yards from the area last evacuated, and again evacuation—of 8 houses—was resorted to; and after two more partial evacuations had been tried on October 4th an order was given for total evacuation of the town. Complete evacuation took place by October 10th.

Great concealment of plague cases had been going on, and dead rats had been found in many places. The first fortnight the people were in their fields the number of cases increased. This was due to three reasons, definitely verified, which defeated the benefit of complete evacuation and led to plague continuing among them till March, 1899.

1. The people built themselves huts almost as air-tight as the insanitary houses they were compelled to evacuate.

2. They were strongly impregnated by plague poison at the date of evacuation, it having been spread into nearly every house by rats dead of plague and concealment.

3. They spread themselves over a large area, for

Government huts of a sanitary type were not available, and were thus out of control, which led to concealment of cases.

They were ultimately, about the first week in December, brought within a workable area and their huts made sanitary, and a marked improvement was very soon apparent, resulting in the extinction of the epidemic.

Total number of cases	545	Deaths	434
Before complete evacuation	70	,,	67
After ,, ,,	475	,,	367
Duration before evacuation			10 weeks
,, after ,,			23 ,,

Plague Preventive Measures.

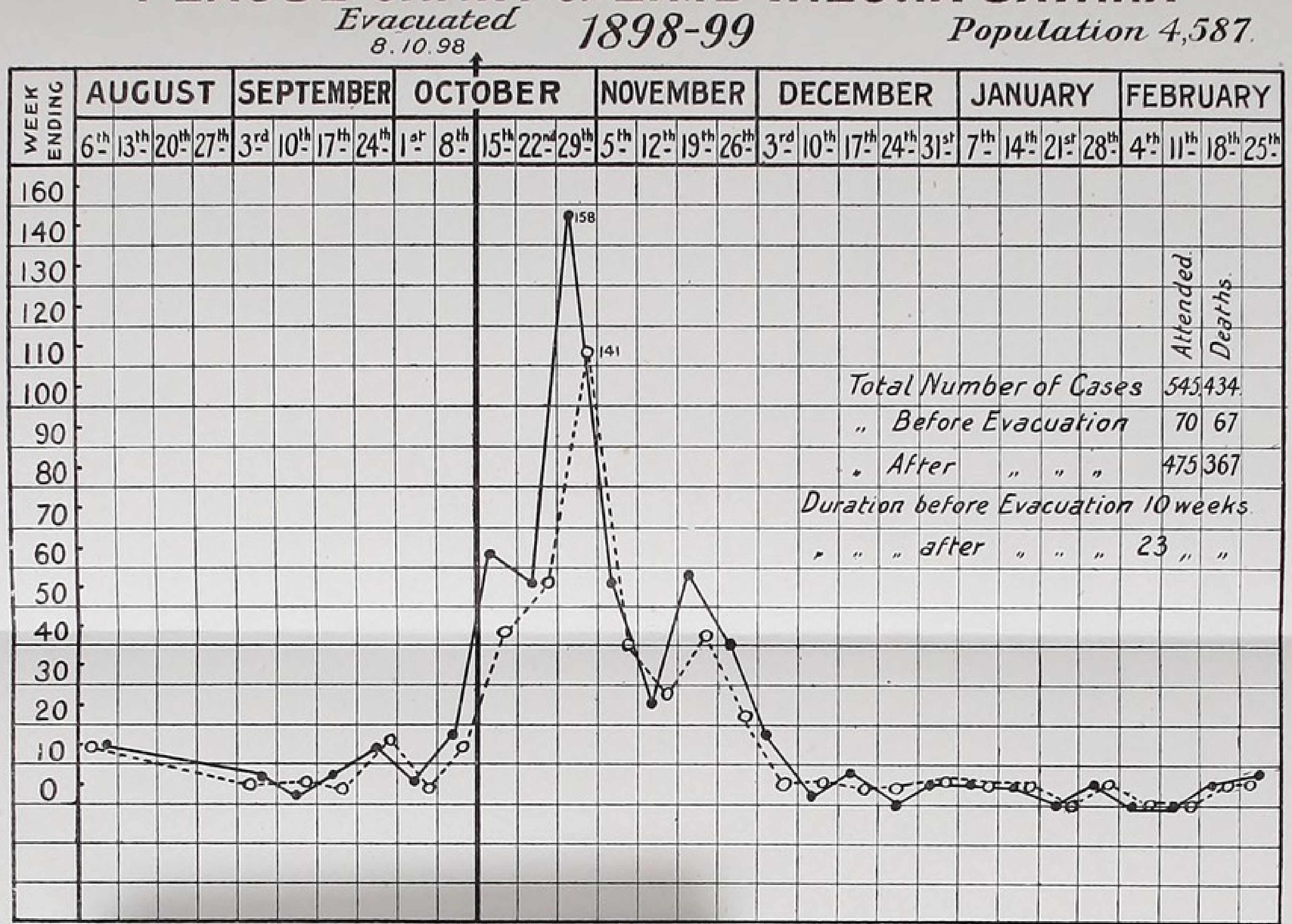
Endeavours to prevent plague epidemics have been tried in many countries, and a vast amount of practical experience has accumulated on this subject. Ideally all measures in this direction are perfect where not based on imperfect knowledge of the disease to be dealt with.

They might be compared to attempts, firstly, to keep seed out of a suitable soil, or, secondly, to pursue the seed that had gained entrance and destroy it so as to prevent its germinating, or, thirdly, to alter the soil so that it may become no longer suitable nidus, but rather inimical to the growth of seed, however introduced.

Under the first heading would range quarantine, medical inspection, evacuation, isolation of the sick, segregation of contacts, etc.; under the second, disinfection, whether by natural or artificial agents and chemicals; and under the third, removal or alteration of those insanitary conditions which practical experience, etc., show to be at the root of the spread and continuance of the disease.

Quarantine has generally failed to keep plague out of a locality once the populace are seized with panic and flee from a plague-stricken centre. No system of quarantine for plague is germ-proof, as the disease is pathogenic for animals as well as man, and has an ectanthropic existence in the soil of which bacteriologists are beginning

Plague Chart of Limb Taluka Satara



G
ar
ca

be
sa
ap

tr
ex
m
in

se
se
p
th
in

in
o
b
t
d
r

a
f
t
f
e

to have some knowledge, and unless all those sources of infection can be effectually blocked, the coercion, oppression, restrictions to trade, etc., which a cordon and quarantine involve, are inferior to more radical and effectual measures, and not worth the trouble and expense entailed. In India quarantine, perhaps, deterred those actually suffering from travelling, and lessened the chances of infection spreading; but in spite of this and other measures the disease spread to many and distant parts.

Quarantine leads to mischievous results, gives opportunities for oppression and extortion, is ineffectual, and distracts the attention of the public from the real safeguard of radical sanitary improvement. Besides, in practical experience, quarantine has proved a broken reed. In spite of fifteen days' detention and a belief in quarantine rather than in sanitation, plague visited Mauritius in 1899.

The horrors of quarantine are nearly as bad as the terror induced by plague when it prevails as an epidemic; and at Marseilles in 1720 the strictest quarantine failed to prevent an epidemic.

Whether a country should adopt quarantine depends on its internal sanitary condition. In a small place with few cases of disease and physical helps, or in a walled town, a system of quarantine may keep out infection. In spite of very rigorous detention under observation on the Damaun frontier, plague spread to Damaun in epidemic force in 1897–8. Ideally, detention during a period covering the incubatory stage of plague, combined with medical inspection, would seem perfect; but as this only takes cognisance of one of the methods of plague diffusion, it has almost invariably failed when relied upon solely. To many it may seem that the realisation of such a measure of improved sanitation generally as would render a large city plague-proof, is not within measurable distance. It is at present like the voice of one crying in the wilderness; but the formation of a mass of public opinion on the side of the only reliable mode of escape from such a terrible and dreaded scourge should not be unattainable. Medical men should be agents in hastening that

> "far-off divine event
> To which the whole creation moves."

Plague was the disease against which quarantine rules were chiefly enforced. The advantages appeared theoretically so great in protecting a country from pest, by an arbitrary system, inflicting enormous commercial loss on outside nations, that the lessons of experience failed to banish it in favour of a more rational and reliable system of protection.

The imposition of quarantine against plague is based upon the traditional doctrine regarding that disease, and is inconsistent with the latest and most accurate observations on its diffusion.

The huddling together of panic-stricken people in large bodies on the confines of an infected area, without proper sanitary arrangements, tends to produce conditions favourable to the spread of the disease in epidemic force; and the history of such attempts, in the majority of instances, is a history of failure.

On an alarm of plague, an establishment for the carrying out of quarantine has to be got together hurriedly, and many of them come from a possibly infected locality, and thus convey the very infection they are designed to keep out.

Again, it is well-nigh impossible to detain (for the safe period) repeatedly those whose public duties require them to visit infected places. Plague was introduced by a policeman on duty into one centre of infection in Satara, and by an inhabitant of a non-infected area visiting an infected village. Rigid quarantine, no matter how carefully devised and theoretically perfect, cannot be absolutely protective, as the loopholes of dishonesty defeat its regulations, and the conveyers of infection, other than individuals and their effects, are not provided for by this means of defence.

"No city can live a life apart; to put a cordon round one is to add to the rigours of the epidemic that of famine."—Montenegro.

We know that famine, war, slaughter, sieges by aggravating the conditions we have proved to be necessary for pest, increase the spread of the disease. Historical examples will be found in "The Relief of Leyden," as described by Motley in *The Rise of the Dutch Republic*, and in "The Siege of Jerusalem" in Gibbon's *Decline and Fall*.

Medical inspection forms a less irksome measure than a system of rigid quarantine against plague invasion; but as this disease has an incubation period of ten days or more, and practically no premonitory symptoms by which it may be diagnosed, it cannot be regarded as absolutely reliable. At the same time, medical inspection cannot be pronounced altogether useless, as it certainly deters people from resorting to centres where it is relied on as the first line of defence.

In Indian experience, the benefits of medical inspection in limiting plague have not been commensurate with the cost entailed, and the disease spread in spite of it.

The history of the introduction of plague into Satara shows that strict medical inspection—by medical officers with previous plague experience even, cannot be relied on; for the first indigenous case and centre of infection was caused by an inhabitant of this part of the town visiting and sleeping in an infected village. He conveyed infection to his daughter, who had not been out of that part, and although he was examined the day before she took ill he presented no symptoms of plague and developed a fatal attack the next morning.

The same was true of another centre, where a policeman with mild plague pneumonia passed inspection posts and was detained subsequently under suspicion. He recovered—the only case that had primary plague pneumonia and survived. There were no means of testing the sputa bacteriologically at that time, but the virulence of the infection conveyed and the origin of other cases first in the house in which he had slept for two nights, confirms the view that he had introduced and suffered from pest. Not one of the hospital attendants on this case caught the disease, although he was treated in a separate ward—well-ventilated and spacious—of a general hospital.

Isolation of Sick.—Acting on the idea that one of the most fertile sources of spreading infection is the diseased patient, efforts have been made to prevent the spread of plague by isolation of the sick.

As the disease is only infectious under certain insanitary conditions, isolation must be a needless and roundabout method of meeting the indication from causation. As noted in Parel Hospital, the attendants on those sick are not very prone to catch the disease.

Out of 431 contacts at Ranchatra Hospital and Plague Camp this year (1898–1899 epidemic), many of whom were attendants on most of the 122 patients admitted, only 18 developed plague, and no doubt most of those had caught infection in their houses before having been segregated.

In the same hospital and camp last year 1,550 segregated contacts gave 100 plague attacks, and many of them had acted as attendants on the 390 patients admitted.

Thus, from 1 out of every 15 to 1 out of every 25 contacts only are liable to get plague. Had no evacuation or segregation been carried out most of the contacts must, from experience in Sangli, where such measures were not adopted, have died.

Were the disease universally infectious, as had been up till recently believed, a much larger proportion of the contacts "who were also attendants on their sick friends" must have succumbed.

In the various plague hospitals in Satara, upwards of 140 ward-boys, nurses, and persons whose duties brought them into close contact with the sick, have remained practically immune, although engaged continuously for upwards of six months in most instances.

Provided an attendant breathes pure air constantly he may safely continue to perform plague duty, except when the patient is suffering from primary plague pneumonia, and the virulence of even that malignant form of plague seems to be mitigated by an abundance of fresh air.

There can be no objections to allow a patient to be kept at home in a large well-ventilated apartment, but the fact of his having been attacked argues some breach of elementary sanitary law in the structure of the house, its cubic space, and means of ventilation.

As the germ of plague seems to have an ectanthropic existence, and isolation of the sick cannot stop this life of the bacillus, whereas alteration of the conditions under which it is known to gain extraordinary virulence is easily attainable, the provision of more healthy and airy habitations, which robs the germ of its devastating power, is the object to be aimed at.

"Whether a disease be directly or indirectly contagious, or both, will depend primarily on the nature of the organism which causes the disease. The less parasitic, and therefore the more saprophytic, the infective organisms the greater will be the chances of transmitting the lesion by indirect contact, for in this case the organisms can thrive more or less well for a considerable time outside the animal body.

"This is a matter of some practical importance, because a disease which is exclusively directly contagious can be stamped out by isolation alone; while in a disease both directly and indirectly contagious isolation alone is of no (?) avail; or, to express the matter in bacteriological terms, isolation can only prevent infective lesions due to obligatory parasites, and not lesions due to facultative saprophytes or facultative parasites.

"It stands to reason that isolation in such cases must be quite ineffectual, and that preventive measures must be directed to the habitat of the organisms and against their further diffusion."—Kanthack, in Clifford Allbutt's *System of Medicine*, vol. i. pp. 541–2.

Segregation of contacts is resorted to on the presumption that the sick person is the chief source of infection, but as this has been proved by experience to be conditioned by his insanitary surroundings, and is a minor item in spreading the disease, its necessity is not compulsory. The beneficial effects of segregation can be attained by altering the conditions that make the habitation dangerous to the health of both patient and friends in contact with him. The permanent benefits derived from such obvious and practical means would render places less sickly at all times, and enable them to resist the invasion of plague epidemics.

The fact that a case of plague breaks out in a house proves that there is some insanitary condition existent there, either in deficient means of admitting fresh air and sunshine, or abuse of such provisions by the ignorance, neglect, or faulty habits of its occupants; or to its filthy condition; or to its being overcrowded, especially at night. And that the house is the important factor favouring the incidence of plague is further borne out by the fact that the first usually to be attacked are the women and children, who spend most of the day indoors, whereas the breadwinner, who goes to his labours in the fresh air, spending perhaps most of his day out of doors, is exempt, or at any rate the last to be attacked.

In so far as segregation tends to improve the social condition of insanitary householders temporarily it lessens the incidence of plague. When the life-saving knowledge of the value of fresh air is popularised everyone will very readily provide this vital necessity, and the inconveniences of all such temporary expedients as evacuation, isolation of sick, and segregation of contacts be abolished.

That they are very useful measures in dealing with an outbreak of plague speedily there is abundant proof, but the grounds on which their usefulness depends should point the moral of ideal sanitary reform, and lead to the abandonment of such measures as the be-all and end-all of plague administration. In no case can they take rank as permanent means for prevention of irruption of this disease.

Experience in pest hospitals would almost lead one to conclude that the disease is not contagious till a certain number of patients are confined together. If segregation leads to confining all who are sick in one place, in ill-ventilated apartments, without perhaps proper attention to cleanliness, it often produces what it was meant to prevent. The very means taken to insulate the sick by natives causes the attendants to be seized; contagion and virulence become increased, which seemed to fully justify the precautions used, yet were entirely owing to them alone.

Free ventilation, plenty of cubic space, cleanliness may be fully confided in alone, where seclusion is inconvenient or impracticable and disinfection impossible. Separation of the sick from one another, as far as possible, is a duty not less incumbent than that of cutting off communication between them and the healthy; and it has this great advantage that alarm is lessened and the depression produced by fear so far obviated.

We have never seen a single orderly attending those ill with the disease, or any of the other patients in hospital, often indiscriminately mixed together, contract the disease except under circumstances of insanitation produced by their own neglect. The fever only becomes contagious by accumulation of people in ill-ventilated and dirty apartments. If disinfection is adopted as a substitute for thorough ventilation it is injurious; if only superadded it is superfluous.

Evacuation.—The evacuation of infected houses is one of the most useful temporary measures for mitigating plague, as it is found to diminish the number of attacks amongst the members of the patient's household. For comparison, in recent times instances are adduced where there was no evacuation at Bhowinda in Thana district with, at the beginning of the plague epidemic, a population of 7,800, and 1,739 were attacked and 1,187 died of plague. Practically 90 per cent. of the sick were treated in their own houses, and 68·25 per cent. of them died, and the epidemic lasted eighteen weeks. In Limb complete evacuation failed to check the epidemic, which lasted twenty-three weeks after leaving the village site, because the most important factor to secure the benefits of complete evacuation had not been attained. One cannot emphasise too strongly that properly constructed and arranged huts should be ready for the whole population of the area to be evacuated. It is useless removing from structurally insanitary houses to huts equally air-tight and insanitary. In the instance of Borgaon complete evacuation stayed the epidemic in five weeks, and the hutting of the people was properly supervised. Evacuation of not only infected houses, but of the whole infected locality, has been practised from ancient times, and is resorted to habitually in the endemic area in the Himalayan villages. One must have a lively and intelligent comprehension of the meaning of evacuation and the grounds on which its undoubted value rests.

Evacuation secures (1) removal of the inhabitants from the infected site, (2) thereby diminishing overcrowding, (3) removal into fresh air in a non-infected area when ideally carried out, thus acting on what has been shown to be the strong etiological factor in the propagation of the disease. The *rationale* attempted of the disease, therefore, is equally elucidatory—of the failure as of the success—of the *methodus medendi* recommended here.

Partial evacuation of a large town or city fails to stamp out plague epidemics, as, being chiefly a soil infection, the diffusion of the disease to non-evacuated areas is not precluded, and from experience we find that it spreads after partial evacuation by ants, rats, squirrels, etc., natural habitat of the germ in the soil ; and those agents diffuse the germ even in completely evacuated sites, as is proved by the discovery of rats dead of plague in the empty houses which had not been infected by cases among their inhabitants before complete evacuation.

At the most, therefore, evacuation is only a temporary measure, and in large cities and commercial towns is impracticable, and ruinously expensive to carry out completely. Its benefits can be more readily and cheaply secured on a permanent basis by making all houses plague proof by improved ventilation and sanitation. Sanitary cities with well-ventilated dwellings and ample cubic space are the factors to aim at in not only the suppression, but also the prevention of plague, and such conditions render the spread of plague practically impossible.

Calcutta Plague, by Major Deane.

"A micro-organism has been discovered in plague patients, which is more or less reasonably looked on as the specific cause.

"The same organism has not yet been discovered outside the human body, or the bodies of animals affected with plague; so whether it exists in the same form in nature, or undergoes evolution from some other in the body, are matters to be determined. Speculations as to whether it is a spore-bearing organism or not are of no practical use in attempting to deal with the prevention of the disease. Our only guide at present is the one common to those of the other infectious fevers, for which no micro-organism has yet been identified, either in the body or out of it—practical observation. Observation plainly shows it to have an exanthropic existence. Laboratory experiments with the organism, as known, tend to show certain more or less uniform properties. But all such experiments under artificial conditions are but, at the best, unreliable guides as to what happens under natural conditions.

"We can only judge of the most probable conditions by observing the effects as presented to us by nature. In this way we may deduce a course of action. We are not debarred from action because we cannot trace the ultimate cause. Were it so, we might forego the practice of medicine altogether. Many conditions come before us every day in practice the causes of which are mere guesses, but nature points the way to dealing with them.

"We need be no more ashamed of our ignorance about plague than about scarlet fever or small-pox and vaccination. The prophylaxis of one against the other in the latter instance is an observed fact of nature, but we know nothing as to the explanation, and, after all, observing nature's facts is the highest form of science.

"To mention a few results of the laboratory experiments :—

"The plague bacillus is short-lived in a test-tube, and readily devitalises in sunlight; it is readily destroyed by antiseptics; will live only a few days when artificially introduced into grain; it cannot be cultivated under the circumstances of putrefaction. The explanation given of its non-discovery in an exanthropic form is that other bacilli grow more rapidly and prevent the culture of the plague bacillus. Perhaps. Some of the experimental bacteriological results seem at variance with practical experience, and none of them are of any use in dealing with the disease. Indeed, it is of more importance to study the conditions appertaining to man, who is the sufferer from the disease, under which it prevails. Such study will lead to an abatement of the conditions favouring the growth of the disease, but the specific cause will remain, though inoperative. It cannot be supposed that the cause of typhus fever has been killed in England. The microbe, if one at all, is there, but it cannot, or does not, develop under the altered conditions, and the nature of the specific cause is a question subordinate to measures of improved dwellings, decrease of overcrowding, supply of fresh air, and access of sunshine.

"There is abundance of evidence to show that under conditions of light and air plague has a very low contagious power: indeed, so low is it that it may practically be ignored. Experience at all hospitals and plague camps is unanimous on the point, and details need not be given here.

"It is more difficult to determine to what extent the disease is transmitted from the sick to the healthy under the conditions obtaining in the people's own quarters—conditions which are often a mixture of darkness, stagnant air, filth, and overcrowding; but I think something can be learnt from the experience here, at all events sufficient to give a hint as to how to deal with the disease.

"Specific diseases, according to most recent knowledge, will not arise *de novo*, even under insanitation, though not so many years ago the opposite view was held. Insanitary conditions, as we understand them, are not even necessary to the prevalence of an infectious disease. Witness only typhoid fever among British troops in modern barracks and in cantonments generally, and influenza in all classes of society from the garret to the palace.

"Again, one must face the question of cosmic influences in determining the course of plague, like all epidemic diseases; and as regards that part of the subject, the wisest man at present is he who acknowledges boldly an agnostic position. Facts, observed facts of nature, are what we want, but how hard they are to read. We must disabuse our minds entirely of any theories when starting to investigate the subject. Enough facts have been observed in Calcutta to justify a course of action calculated to do no harm, and suggesting possibilities of immense good. One need not despair of light being thrown on the causation of plague when one remembers that the two greatest triumphs of preventive and therapeutic medicine were respectively proclaimed by men who, in the course of their work for daily bread, observed facts of nature's own, of which no explanation has been given, which many had seen before them, and had yet not discovered their significance. Untold millions had seen objects fall to the ground before Newton observed the apple. What is nature's fact about plague? Echo answers What?

"It is well to realise what it is we have to deal with. We are face to face with a disease of which there have been a greater number of epidemics than of any other, and of an incomparably wider extent. It has devastated whole countries, changed the destinies of cities, and after persisting in varying degrees of virulence for many years, has disappeared, perhaps to return later. It has run its course unchecked, and its amenability to treatment has consistently remained a minus quantity. Its method of entry into a country, supposing it to have been introduced, has never been discovered, nor the quarter whence it came. It is quite a matter of speculation whether an outbreak in one country involves the necessary introduction of infection from another. It is no stretch of the imagination to suppose the infection may be more or less ubiquitous, and subject to cycles of latency and virulence, under conditions which remain to be solved.

"The mystery attendant on the appearance and disappearance of plague is no greater than that of influenza.

"It is by no means essential, either to the prevention or treatment of a disease, that the *causa causans* should be known. Moreover, preventive measures were successfully adopted against widespread and fatal diseases long before the specific cause was found, for example, consumption and cholera, allowing that the specific microbe has been found for the latter, which is uncertain. The ravages of consumption were being lessened, as the result of practical observation, long before Koch discovered the tubercle bacillus, and such discovery has not altered the line of direction which was being followed. Dr. Snow, in 1854, in London, long before Koch discovered the bacillus which, he said, was the cause of cholera, had brilliantly demonstrated the non-contagiousness of that disease, the means by which it was spread, and the method of preventing it, and the discovery of the common bacillus has not enhanced the value, nor modified the teaching, of Snow's demonstration, which stands as a monument of observation.

"Other diseases, for which no specific organism has ever been discovered, have either almost disappeared, or ceased to be objects of terror. Again, simply due to measures, the result of practical observation; typhus fever and small-pox for example.

"On the other hand, an extensive knowledge of an organism, giving rise to a disease, does not lead to diminished prevalence thereof. Witness diphtheria, which has been largely on the increase of late years, and since the discovery of the specific bacillus. One more instance, typhoid fever. A bacillus has been identified as the presumable cause, though it is not always to be found, as in the late Maidstone famous epidemic. Of late years, at least in India, the disease has become more prevalent and defied every sanitary suggestion.

"Other zymotic diseases, as scarlet fever, measles, and whooping cough, for which no organism has been discovered, have lessened inappreciably of late years, though a certain amount of control can be obtained over them in limited areas as the result of observation. As I said before, a large element of direct contagion enters into their mode of spread and lends itself to effective preventive measures.

"These remarks are not without their object, which is, first, to show that, even if the exciting cause of plague were discovered, there are no hopes that the prevention of it would be furthered thereby; and secondly, that because it has not yet been discovered we need sit with folded hands and await that consummation, however desirable it may be. We cannot study the conditions of the specific cause in a state of nature (supposing the bacillus, as known to exist in plague-stricken bodies, to be its natural form), but we can observe and study the conditions under which human beings become susceptible to its influence. We have enough facts now at our command to recommend a reasonable line of action and to render us independent of actions based on theories. Such observation and study of other infectious diseases, with undiscovered specific causes, have led to untold blessings, and surely we may expect that the same will in time lead to some amelioration of the disease we are considering. We can hope to learn nothing of the subject, except by interrogating nature through our bodily senses; and experience often teaches what reason cannot. As regards plague, like many other things, we have to realise that *causa latet, res est notissima:* the cause is hidden, the effect most plain.

"I will now consider the result of observation, so far as it has gone in Calcutta, in its bearing on measures of prevention. In this connection there is no object in discussing measures which might be feasible in a European country, such as compulsory notification of diseases, which is enforced by Act of Parliament in England. Other measures, such as complete separation of the sick from the healthy, and means adapted for detecting the first case, can be carried out there which are impracticable in this country.

"When a clear idea exists of what has to be dealt with, and what object has to be aimed at, the means at hand must then be adjusted and modified to suit the actual circumstances. What may be feasible at one time and in one place may be utterly impracticable at another time and under different circumstances. The greatest amount of good with the least amount of harm of any kind must be aimed at. The history of plague is not without instances of a theoretical amount of good with an immense amount of harm ensuing on attempts to deal with it.

"In this country (and I am confining myself now strictly to India) we are defeated at the outset in attacking the disease, in that the first desideratum in dealing with an infectious disease, which also contains even a very slight, if any, element of contagion, cannot be fulfilled. The desideratum is to intercept the first case, find the source of infection, and cut off the supply. The source of the supply is unknown, and when the disease has been recognised, infection has been implanted over more or less wide areas; *and then it comes to a question of dealing with that infection, and isolating one individual case and segregating the contacts, even if feasible, will no longer meet the requirements.* Such attempts have been made, and the results may be read in current literature. Improvement in those measures has been arrived at through their failures.

"If we should be lucky enough ever to find the first case, either in a town or village, by all means isolate it completely and destroy every vestige of clothing, bedding, etc., and do the same to every person who was with the case. But, unless the first case is so intercepted, the circumstances become entirely altered. Here, in Calcutta, the disease was occurring in several quarters of the town, directly it became known to be an infected place. Experience shows it to be an infectious disease to a much greater degree than contagious; and the object, in such a state of general distribution, is to localise the cases. Once infection is known to exist in several localities, isolation of sick and segregation of contacts in a disease like plague among the population of this country is useless, and indeed is not practicable. Such measures cannot be, and have not been, carried out with any approach to completeness, and the attempt has been the means of raising the opposition of the people, and with no effect on the plague. Forcible measures necessary to combat opposition, which has arisen on the part of the people, do not offer much hope of success, at the same time, of repressing the plague. Unless measures directed against it have a tendency to carry the people with them, they are not likely to meet with a large measure of success. The greatest amount of opposition, passive and active, to plague measures has been caused by dread of removal to hospitals and segregation camps, which has also led to concealment of patients and surreptitious disposal of corpses, and, moreover, to riots with loss of life. Experience here demonstrates the uselessness and mischief of attempting such measures.

"I have shown that such methods could not be expected to stop an epidemic of plague, and experience has abundantly proved it.

"I have described the methods of finding and dealing with cases, and indeed the procedure obtaining here may well be taken as the present best solution of the question of dealing with plague in a large city.

"Leave the cases where they are. If they want to go to hospital, let them go. Discourage contacts to leave the house. Disinfect the room in which the case occurred, and, if alive, as soon as practicable, and perhaps again after death. Experience here has demonstrated that evacuation of premises is unnecessary, and indeed calculated to do more harm than good.

"The best procedure is that obtaining here, once plague has appeared in a city. It is not pretended that it can stop an epidemic when rising, and no measures have done so. And the only conceivable measures likely to do so are the disinfecting operations mentioned above. It is perfectly clear the procedure here does any good as regards plague that can be done at present, and, what is of great importance, does no harm.

"The sanitary measures which might, and probably would, prevent infection even gaining a hold at all are in the future, and they are of such a nature that generations are required for their accomplishment. Plague and typhus fever have been, it is fair to say, in a great measure driven from England by improved sanitary conditions, especially as regards dwellings and overcrowding; but consider the time occupied by those improvements, which are still daily going on. Improved dwellings and less overcrowding in this country will doubtless, in time, have the same effect, but at present we must deal with things as they are, and a further consideration of the possible in the future is beyond the scope of this report."

It has been asserted that there is little fear of the spread of this disease or its flourishing under western civilisation. That statement we beg to traverse. Whilst it is true our civilisation would give great scope for putting "stamping-out" plans into action, many parts of our great cities would, if unreformed, become nurseries of the disease. If the educated people, however, had a real grasp of the true causes that produce and propagate such an alarming epidemic disease, it would not be necessary to attack any opinion or run counter to any prejudice. Nothing need be done to allay public anxiety and alarm; even although—which is hardly possible—every house held a patient, isolation need not be forced upon an intelligent community. They would soon ensure their own safety by adopting the necessary precautions, with the direful results, as an object lesson before them, in the experiences of pest in India. Civilisation is the knowledge and observance of natural laws. The savage must learn them or be extinguished; the cultivated must observe them or die. The stampers-out with their worthless panaceas would soon be hoist with their own petard in a community where knowledge of the laws of pest was imperatively demanded by education in progress that is necessary to existence.

A few simple rules in plain language would be required for the less educated. We found the following embody our ideas suitably :—

"THE TRUE PEST PREVENTATIVES."

1. Live day and night in pure air. Do not cover the face with blankets when sleeping, or shut all the windows, etc., as shutting out the air means calling in the pest.

2. Do not live overcrowded. Where many people are crowded together in an enclosed space the air becomes impure, and this impure air is a great feast for pest.

3. Do not live filthily. Consider well what constitutes filth, and wherein is cleanliness. Everyone, even the dirtiest, is clean in his own opinion. Filth spoils the air near it, renders it less able to support life, but such air favours the growth of pest germs.

4. Keep your houses constantly well ventilated, and exposed to sunshine as much as possible. When the rays of the sun have free access and perfect ventilation exists, pest is never at all found to prevail. Defective ventilation, overcrowding, and filth are the three roots of this upas tree of pest.

All act by devitalising the air, therefore we may truly say pest is "a-want-of-fresh-air disease."

5. Those who thoroughly understand and always obey the above maxims need never dread preventable pest, run away from it, or spend time, energy, and money on useless measures, as whatever science professes to teach as necessary in addition to the above sanitary precautions are useless, supererogatory, and based on an incomplete induction.

By the appearance of pest in a community hitherto blind to the benefits of hygiene, the science of sanitation, under guidance of enlightened instructors, receives a fresh impetus; and sanitary reforms for the permanent well-being of people scourged by easily preventable diseases like pest, cholera, ringworm, itch, skin diseases, worms, etc., will be readily acquiesced in and heartily espoused ; good results spring from apparent catastrophe and present evil by leading to reform of death-dealing habits, the fruits of ignorance, heredity, and want of sanitary education.

The doctrine thus sketched, if impartially considered and fairly tested; clearly accounts for every phenomenon and fact of the disease and the rational method of suppressing it.

Founded in nature and truth, it has proved itself in various ways. Its practical application involves no contradictions; however various the routes may appear, they tend all ultimately to one point, and explain how different means have attained the same end, so finally mark out the best path to pursue in dealing with pest.

PEST BIBLIOGRAPHY.

The following works have been consulted :—

1. *Tractatus de Averteuda Peste.* Cardinal Gastaldi. Bologna, 1684.
2. *Treatise of Plague.* Lodge. London, 1603.
3. *Loimotomia.* George Thomson. London, 1666.
4. *Loimologia.* Hodges. London, 1672.
5. *The Plague in London.* De Foe. London, 1665.
6. "Loimologia," in *Tropical Climates.* Johnson. London, 1818.
7. *Indian Annals of Medical Science.* Francis and Pearson. No. II., 1854.
8. *Library of Medicine.* Tweedie's and Russell. London, 1854.
9. *Mahamari.* Hutchinson. Indian Medical Congress, 1894.
10. *Indian Annals of Medical Science.* Scriven. No. III, 1854.
11. Dr. J. N. Radcliffe's *Reports.* 1875–80.
12. "Plague," in Arndt's *System of Medicine.* Winterburn. Philadelphia, 1886.
13. Dr. J. F. Payne's Articles on Plague in Quain's *Dictionary* and in the *Encyclopædia Britannica,* which gives full list of literature.
14. *The Plague in India,* 1896–7. Nathan. Simla, 1898.
15. *Report of Bombay Plague.* Gatacre. Bombay, 1898.
16. *Report of Bombay Plague.* Campbell. Bombay, 1898.
17. *Municipal Commissioner's Report.* Snow. Bombay, 1897.
18. *Plague Administration—Bombay Presidency.* Couchman. Bombay, 1897.
19. *Report on Plague.* Lorans. Mauritius, 1898.

20. *Preliminary Notice of the Bacillus.* Kitasato. *Indian Medico Chirurgical Review* (Reprint), 1896.

21. *Report on Plague in Hong Kong.* Wilm. 1896.

22. On Bubonic Plague, in *Annals Pasteur Institute.* Yersin. Paris, 1894–5.

23. *Plague in Bombay.* Dyson and Calvert, 1897.

24. *The Venice Convention Rules.* 1897.

25. *Transactions Bombay Medical and Physical Society.*

26. *Indian Medical Gazette.*

27. *Report on Disinfectants.* Hankin. 1897.

28. *Bombay Gazetteer.* Vol. iv. Campbell.

29. *Hirsh and Hecker's Works.* New Syd. Soc. Babington.

30. *Report of the Plague Research Committee.* Lyons. Bombay, 1897.

31. *The Value of Perchloride, etc., for Floors.* Marsh. Glasgow, 1899.

32. *The Imperial German Commission's Report.* Koch and Gaffky, etc. Berlin, 1899.

33. *Plague Epidemics in Russia.* Clemow.

34. *Experiments on Disinfectants.* Haffkine, etc. Bombay, 1899.

35. *Municipal Commissioner's Report.* Harvey. Bombay, 1899.

36. *Report on Plague in Sind.* Bainbridge. Karachi, 1897.

37. *Report of Egyptian Commission.* Rodgers and Bitter.

38. *Report of Russian Commission.* Wyssokowitz and Labolotony.

39. *Report of Bacteriologist to Government.* Hankin. 1898.

40. *Reports of Plague in Jullunder, etc.* James. 1899 and 1898.

41. *Reports of Plague in Hong Kong.* Lowson. 1894.

42. *Reports of the Bombay Plague.* Condon. Bombay, 1900.

43. *Reports of the Calcutta Plague.* Deane, Nield Cook, and Green. Calcutta, 1900.

44. *Report on Plague Hospitals.* Wilkins. .Bombay, 1900.

45. *Medicine.* Gregory. London, 1839.

46. *Bubonic Plague.* Montenegro, by Munro. London, 1900.

47. *Plague.* Cantlie. London, 1900.

48. *Plague.* Haffkine and Klein. 1901.
49. *Things Chinese—Plague.* Ball. London, 1900.
50. *Chinese Imperial Maritime Customs Reports.* Various.
51. *Plague in Mongolia and N. China.* Matignon.
52. *Plague in Canton.* Rennie. 1894.
53. *Tropical Diseases.* Manson. London, 1900.
54. *Report of Sanitary Commissioner, India, for* 1899. Calcutta, 1900.
55. *Bacteria.* Newman. London, 1900.
56. *La Peste et son Microbe.* Netter. Paris, 1900.
57. *Statistics of Inoculations.* Bannerman. Bombay, 1900.
58. *The Plague.* Haffkine and Klein. London. 1901.

WILLIAM BRENDON & SON
PRINTERS PLYMOUTH