

## **Plague in India / by Charles Creighton.**

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BY

CHARLES CREIGHTON, M. D.

FROM THE SMITHSONIAN REPORT FOR 1905, PAGES 309-338.

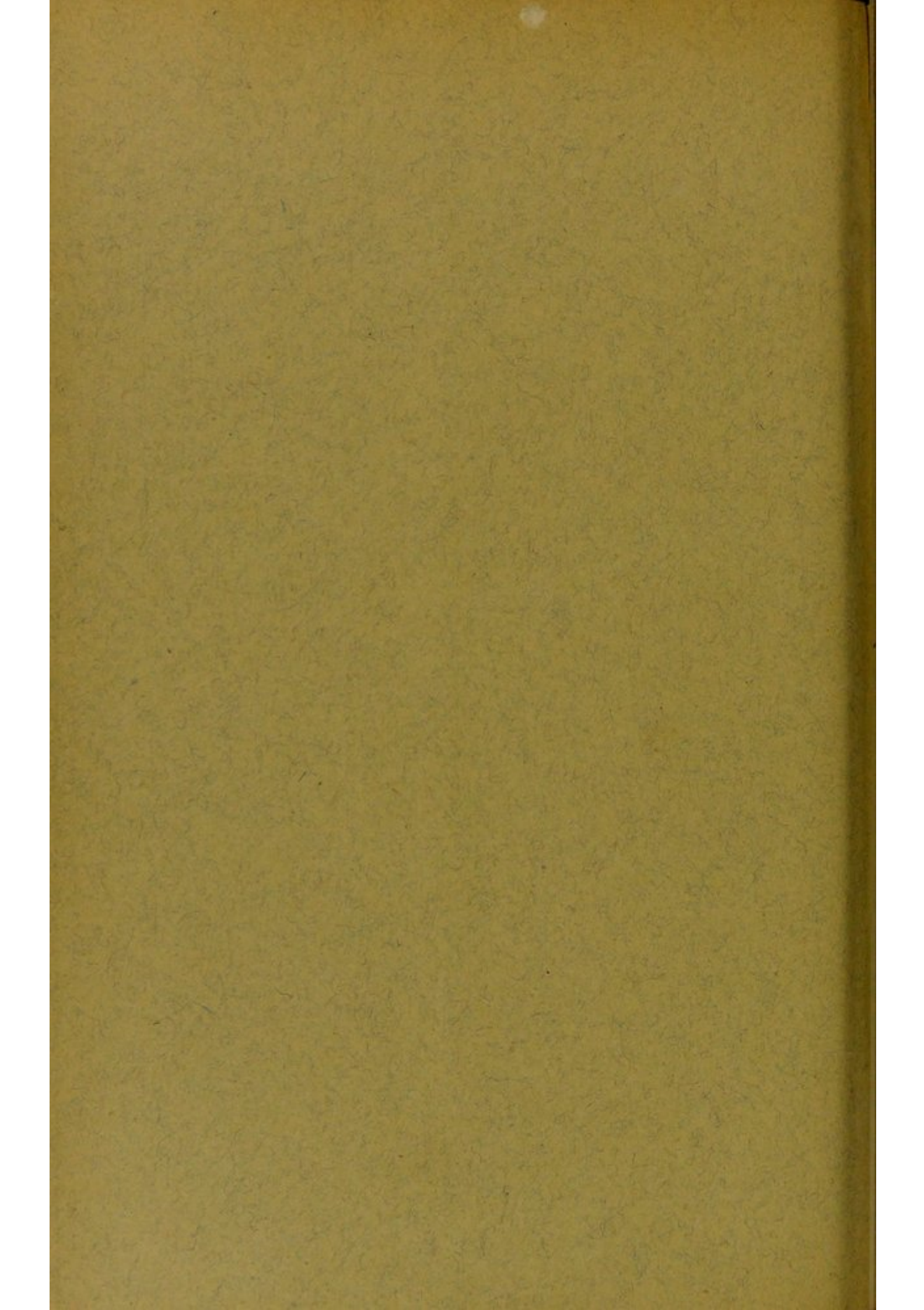


(No. 1683.)



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## PLAGUE IN INDIA.<sup>a</sup>

By CHARLES CREIGHTON, M. D.<sup>b</sup>

Eight years ago the subject of plague in India was brought before this society in a paper by Mr. Herbert Birdwood, which dealt with the first epidemic in Bombay city in 1896-97 (Journal, February 28, 189, vol. XLVI, p. 305). Mr. Birdwood's intimate account of the beginnings of the infection, of its rapid extension, and of the efforts made to cope with it will remain a document of importance, both by reason of the fresh impression of so novel an experience in an Indian city under British rule and also because it was the first chapter of what is likely to prove a long history. At the date of the paper a second plague season in Bombay had begun, which proved to be more disastrous than the first; the cities of Poona and Karachi were also infected severely, and there were many minor centers along the whole coast northward to Cutch, and in the transmontane districts of Satara and Sholapur to the south, as well as two small spots of plague more than a thousand miles away in the northwest—one around Hurdwar and the other in villages of the Jullundur doab. By that time the government of India was naturally alarmed at a threatened invasion of the whole country, and appointed, in August, 1898, a commission of five to conduct an investigation specially defined as of a scientific character, into origins and ways of spreading, as well as into the mode of treatment by serum inoculation and the mode of prevention by inoculating a solution of dead bacteria. That commission is now ancient history, so that I am at liberty to remark that there was not a single epidemiologist upon it, and that its "scientific character" was ruined by two causes—first, because the two medical members who wrote the report put aside such evidence as did not come within their bacteriological point of view, and, secondly, because the two departmental members were

<sup>a</sup> Reprinted by permission, with author's corrections, from Journal of the Society of Arts, London, Vol. LIII, No. 2743, Friday, June 16, 1905. Read before the Indian section of the Society of Arts on May 18, 1905.

<sup>b</sup> Author of a History of Epidemics in Britain.



disinclined to look into the errors of omissions of sanitation which had prepared the way for plague, especially in Bombay city. However, the witnesses contrived to say a good many things, *proprio motu*, which make the three volumes of evidence valuable and interesting reading.

#### PRESENT AREA.

When the commission began its work in November, 1898, the centers of infection were many and widely scattered, so that sittings to take evidence were held at places as far apart as Bangalore and Lahore in one direction, Calcutta and Karachi in the other. But the infected area was still comparatively small. There was no plague in the Madras Presidency, none in Bengal excepting at Calcutta, none in the United Provinces excepting over a small part of the district of Saharanpur, and none in the Punjab excepting in one small spot of the Jullundur doab. During the next six years the area has been extended enormously, but still within notable limits. The Madras Presidency has continued almost entirely free, and, what is more remarkable, also the whole of Orissa, Lower Bengal, and Assam. It is the northwestern plains that have become the chosen seat of plague, from the Jhelum River in the north to a point on the Ganges about 300 miles above Calcutta, while the original area in the Bombay Presidency has extended.

Those regions of India which have been proved by an experience of nine years to be the great seats of plague are shaded on the map. (Fig. 1.) They look somewhat compact and continuous in two divisions—one the plains of the northwest, the other the alluvial valleys of the Deccan and Gujarat. This does not profess to be an exhaustive map of plague. For example, there have been many deaths from first to last in the native States of Mysore, Hyderabad, Indore, and Rajputana, and in the British Central Provinces, but far more in the cities, such as Bangalore, Indore, and Jubbulpore, than in the villages. Also in Sind, Karachi was not the only place infected at first, although it remains almost the only place now. If I had shaded every one of those extensive and sparsely populated tracts of country where plague has ever been in those years, I should have produced a confusing, if not a misleading effect. Without being exhaustive, the blue coloring in the map on the wall shows fairly enough where the interest really lies, and it covers those parts of the Bombay Presidency and of the northwest to which I limited myself during a recent tour of three months, which was undertaken at the instance of the Leigh Browne trust.



## SOME FIGURES.

I do not intend to be statistical, but a few round figures may be given to bear out this coloring of certain regions on the map. First, as to the dark area in the south of the Bombay Presidency. The three districts of Satara, Belgaum, and Dharwar, and the native State of Kolhapur have each returned an almost equal total of plague deaths during the last four years, viz, 120,000, being an average of 30,000 a

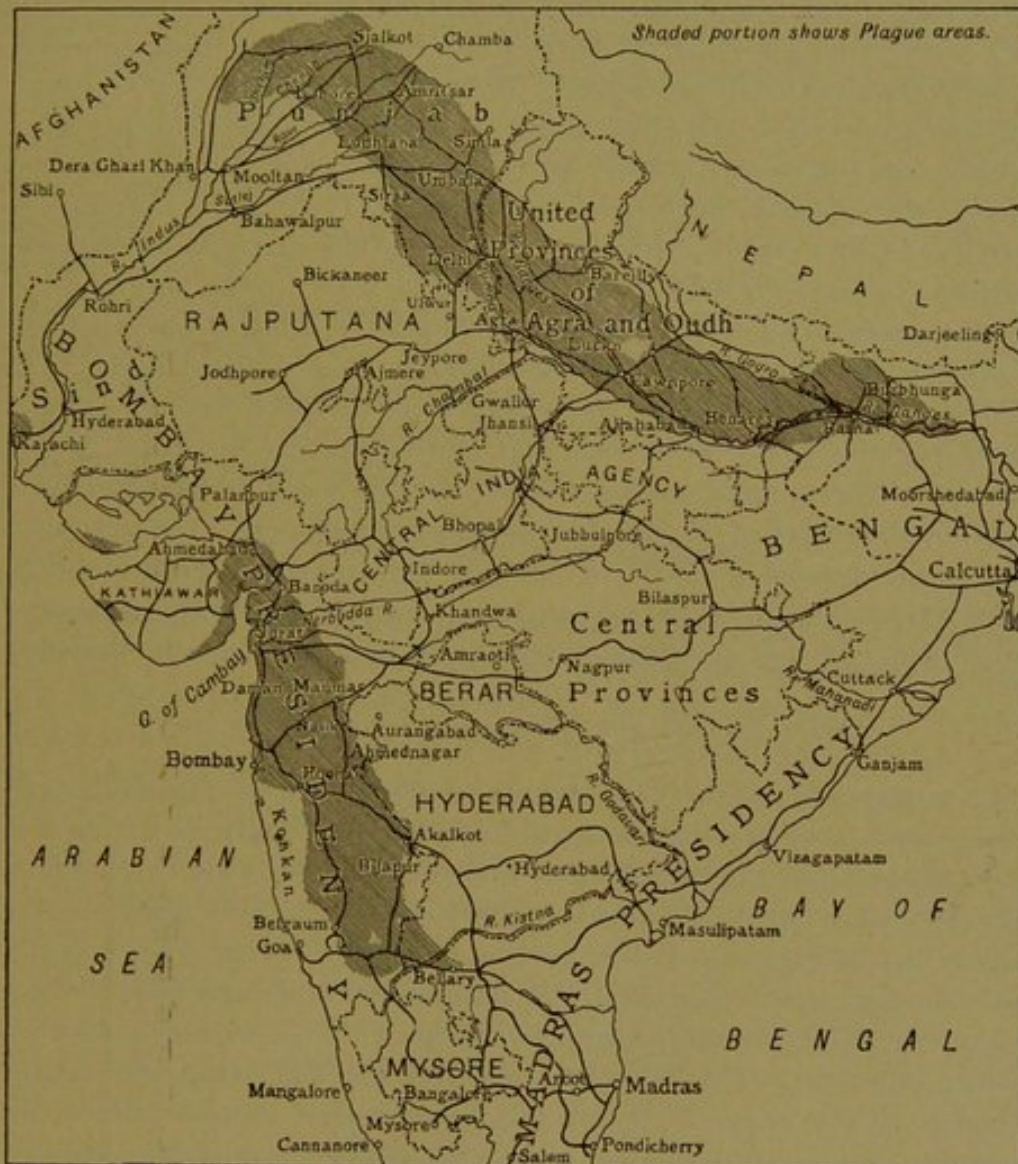


FIG. 1.—Map of India showing plague areas.

year for each in a population of about a million. The adjoining district of Bijapur had over 20,000 in each of the two last seasons, while Sholapur and Khandesh have each had one season of 25,000 in the more recent period. But in the Punjab those large annual totals have been exceeded in several districts. Sialkote had 50,000 deaths the season before last, Ludhiana almost the same number three years ago,



Gujranwala 30,000 last year, and 45,000 the year before, while the oldest centers of infection in the Punjab, the adjacent districts of Jullunder and Hoshiarpur have shown a steady increase for three years running, reaching last year to 30,000 plague deaths in the one and 25,000 in the other, with the promise of quite as many this season when the returns are completed. For a single week last year in the end of April or the beginning of May, which is the height of the plague season in the Punjab, four of the districts returned 4,000 each, while half a dozen more returned from 2,000 to 3,000. In the United Provinces until this year no district has come near to those enormous weekly maxima; but at length Muttra has reached 4,000 plague deaths in a week, while Ghazipur and Agra have each had a highest weekly total of about 1,600. In Behar the worst district has been Saran, the poorest and most crowded part of India, which has reached 2,000 a week, while two or three other districts of the same Patna division have had each over 1,000 a week at the height of the plague season. Last year the plague deaths in all India totaled over a million, of which nearly 400,000 came from the villages of the Punjab and 300,000 from the villages of the Bombay Presidency. Last year the worst week was that ending the 2d of April, with a total of 46,320 plague deaths. This year the week ending the 1st of April had a total of 57,702, the increase being more than accounted for by the unusual severity of the infection in certain districts of the Agra Province, and in the adjoining districts of the Delhi division of the Punjab, as well as by the extension of area eastward in Behar.

#### PLAGUE AN OLD AND WELL-UNDERSTOOD INFECTION.

To an epidemiologist this enormous prevalence of plague steadily from year to year among the rural population of India is perhaps the most remarkable phenomenon in his science. It is all the more remarkable that we have never thought of India as a great seat of plague in former times, such as Lower Egypt, Syria, and Irak had been during many centuries of Mohammedan rule, and that we were beginning to look upon plague as a thing of the past everywhere. In writing the article on "Quarantine" for the *Encyclopædia Britannica* twenty years ago I gave nearly all the space to yellow fever and cholera, remarking of plague that "for many years it has ceased to have any practical interest in this connection," although it had been the original object of all the quarantine laws of Europe. And to show that I was not singular the paragraph on port quarantine in the Bombay Sanitary Commissioner's Report for 1887 has this sentence: "Plague and yellow fever have never to my knowledge existed in Bombay, and are not in present circumstances ever likely to be there met with" (T. G. Hewlett, l. c., p. 82). The outbreak in Bom-



bay nine years ago was a surprise; but the greatest surprise of all, in a historical sense, has been the endemic settlement of the infection in the plains. This is, indeed, a real novelty of the present situation to epidemiologists, as well as a very serious practical matter; but for the rest plague is a very ancient disease, and, I take leave to say, very well known in its type and in its habits to those who are competent in such matters. There is just as little mystery about plague and just as much as there is about cholera, or yellow fever, or typhus, or enteric, and there is actually less mystery about it than about those everyday domestic incidents, measles and scarlatina. What, then, is the meaning of the claptrap about "our ignorance of plague?" So far as I can understand it has arisen from the fashion which the public and the newspapers have adopted of thinking bacterially about diseases. Bacteriologists, when asked to explain plague, are found to be not so lucid as usual. They are at fault in the pursuit of the bacillus outside the body. It runs to earth and gets lost in a crowd of other bacteria in the soil, or disguises itself as a saprophytic mold, or perishes outright in the struggle for existence, although there is no doubt about the infection remaining in the ground all the same. Hence, perhaps, the impression that more bacteriology is necessary before anything practical can be done.

#### RECENT SCIENTIFIC DEVELOPMENTS.

As plague is not found to be contagious from person to person except in its pneumonic variety, everyone sees that the interest must center in the infection outside the body. In that connection research in India has added only two novelties to the older body of doctrine, both of them of the minor kind. No one can deny, although some would if they could, that the regular way of receiving the infection of plague is by the breath; but inasmuch as rats in a laboratory can be made to take plague, or something like it, by inserting a culture of bacilli at a puncture of the skin, so it is sought to prove that there may be something corresponding in human experience. One theory started in India is that the infection may enter through wounds of the feet, as the people of that country so often uncover their feet ceremonially and so many of them go barefoot for want of shoes. This theory is of course inapplicable to European plague, for example, the great plague of London in 1665. But there is another theory devised to give moral support to the inoculation experiment on rats, which implicates the rat himself; it is that the fleas which infest the rat may introduce infection through flea bites on the human skin. The Austrian plague commission, which was the first in the field at Bombay in 1897, had already considered whether mosquitoes might



not carry plague infection, for example, in the plague hospital (where they abounded), from a patient to a nurse; but they found that it was not so, although everyone was bitten.

Various other insects were next thought of, and at length the interest has centered in fleas as possible carriers of infection from the rat. Researches of a very minute and technical kind were started by this hypothesis on the lines of the well-known microscopic researches on mosquitoes. Captain Liston has conducted, in India, a large amount of research upon the fleas which infest the rat. The question next arises whether those are the same species of fleas which produce the human flea-bites; then there is the question whether those who take plague had been bitten by fleas in matter of fact; and, lastly, the question of microbes in the fleas. All this is, no doubt, a very promising field of academic inquiry; and I am given to understand that the scientific expedition which has been announced with a flourish of trumpets as about to proceed to India "to make a thorough investigation into the causes and origin of plague" is really going out to work in the laboratory at Kasauli, with a view to settling all those open questions in the hypothesis of flea-bites.

#### PLAGUE LOCALITIES.

Just as in a well-known paper read before a certain scientific club, "the theory of tittlebats" was joined naturally to their habitat, the Hampstead Ponds, so I would wish to pass, with no abrupt transition, from the bacteriology of plague to the localities of it. Before I started on my recent expedition, I spent several months in getting up the gazetteers of the districts which I meant to visit, partly to become acquainted with a strange country and partly to note any facts as to population, poverty, kind of soil, height of ground water, canal irrigation, rainfall, or the like, which might throw light upon the incidence of plague upon some localities rather than on others. There was probably some reason why the villages of lower Bengal should have escaped plague absolutely, while those of Behar have had several bad seasons of it, or why the districts of Oudh should have had so much less plague than those of the Agra province, or why the Punjab districts of Hoshiarpur and Gurdaspur have each lost 80,000 by it, but the district of Kangra none, although it has an incessant traffic with them by the old and new Dharmasala roads. But the contrast which seemed, on paper, to be the best worth investigating was that between the Bombay coast districts of Kolaba and Ratnagiri, and the districts across the Ghats from Satara to Dharwar.



## PLAGUE-FREE VILLAGES OF THE KONKAN.

Take for comparison the district of Ratnagiri and the adjoining district of Satara. The coast district might seem to be in some respects the more liable of the two; it has a denser population, there is a constant traffic of the people between it and Bombay City (which is said to contain 100,000 natives of Ratnagiri, working class and middle class), and it is as much an agricultural district as Satara, with about the same number of village communities and one-third more houses per square mile. Again, in matter of fact, plague has been introduced into the numerous small harbors along the coast dozens of times. But it has never taken hold of the villages, and has been so little indigenous in the coast places that the annual average of deaths for the whole district from first to last has been only 400, while that of Satara for the last four years has been nearly 30,000.

## PLAGUE IN TWO ADJOINING DISTRICTS.

RATNAGIRI DISTRICT.		SATARA DISTRICT.	
Population.....1,105,000		Population .....1,225,000	
Villages.....1,297		Villages .....1,329	
Persons per square mile 270		Persons per square mile 240	
Year.	Plague deaths.	Plague deaths.	
1896-7	305	128	
1897-8	351	12,124	
1898-9	246	8,646	
1899-1900	276	7,953	
1900-1	151	182	
1901-2	379	34,583	
1902-3	558	36,826	
1903-4	733	16,169	
1904-5	190	a 26,275	

a To February.

Clearly there is something in the Ratnagiri villages unfavorable to plague, and something in the Satara villages peculiarly favorable to it. I have visited both, and shall give briefly what I believe to be the relevant points of difference. The Konkan is a rocky region. Looking down upon it in that magnificent view from one of the "points" of Mahableshwar, one might take it to be a great barren land of red rock, but after descending some miles by the zigzag mountain road, one comes to patches of cultivation and to scattered hamlets, and at the end of 25 miles to a large village surrounded by cultivated fields.

The map of the district shows that there are many such villages hidden in the foldings of the hills, and built usually along a stream. My notes relate to a village on the Savitri River, 9 miles from the



creek of the sea in which it ends. Everything is built of stone. There is an extensive ghât of dressed stone with steps down to a pool of the river. Facing the ghât is the village bazaar, the roadway paved with stone, the houses of one, two, or three stories with stone walls and tiled roofs, raised some 4 or 5 feet above the road on plinths of dressed stone, and sometimes with stone steps below the plinths; the houses of the bazaar in a continuous row with doors close together, but the rest of the village more dispersed along the main road and side roads, at one point forming a hamlet, while another part of the village is in scattered houses across the river. The ground-floor rooms are as dark as they usually are in India, with a fire burning on the floor at the far end. The cattle are usually in the house, or in a veranda, but sometimes in a shed of the small compound.

So far as concerned the want of light and air, and the keeping of

cattle indoors, these Konkan village houses did not seem to be worse or better than elsewhere. Their masonry construction, their high plinths and paved roadways were proper to a region where stone is easily got and where the heavy monsoon rains—100 inches average in the year—make durable structure necessary. The other distinctive character of the Konkan villages is the more open order of their houses and small home-steads, which may extend



FIG. 2.—Villages of Ratnagiri.

a mile or more along one or both sides of a stream, some villages having only one long paved street with a row of houses on either side, like many of our own villages. This peculiarity of the Konkan villages can be seen everywhere upon the large scale maps of the Kolaba and Ratnagiri districts (fig. 2). On the scale of 1 inch to the mile it is possible to show the extent of the village site more accurately than by the conventional dot or small circle or ordinary maps. This lantern slide shows a bit of Ratnagiri district around the head of one of the numerous creeks which run up 20 miles from the sea. It will be observed that the small squares, or rhombs, or other geometrical figures, by which cartographers indicate home-steads or clusters of houses, are peppered all over the surface, so that the houses of one village along a stream almost join on to those of



the village above or below it. Toward the southern end of the district the villages break up definitely into scattered hamlets.

What has been said of Ratnagiri is true equally of the State of Sawantwari adjoining it, which has had only 5 plague deaths several years ago, besides some 50 deaths among fugitives from neighboring plague districts. Also the Portuguese territory of Goa, with a far denser country population than any of the British districts to the east of the Ghats, but scattered in innumerable small clusters of houses or bamboo huts beside their gardens and fruit groves, is reported to have had no plague, although it is in constant communication with Bombay by sea and with Dharwar and Belgaum by hill roads and the railway.

#### PLAGUE-STRICKEN VILLAGES EAST OF THE GHATS.

Let us now leave this populous coast region, happily free from plague, or almost free, and cross the Ghats to the eastward. The easiest of the mountain roads is the one that ascends from the coast to the hill station of Mahableshwar and descends on the eastern side to the Southern Maratha Railway at Wathar, a distance of 70 miles. An hour or two below Mahableshwar one comes in sight of an altogether different kind of country and a different type of village from those west of the Ghats. First, there is the

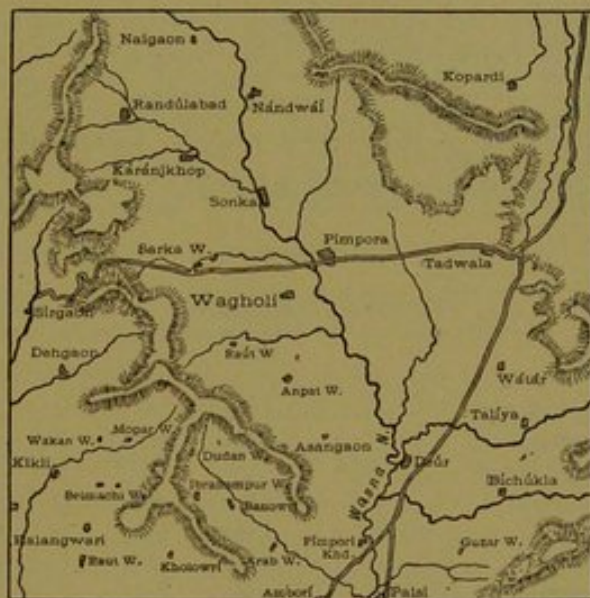


FIG. 3.—Villages of Satara.

upper basin of the Krishna River, with gigantic precipitous sides of red rock and a perfectly flat bottom, shaped like one of those oval bath tubs that are in common use in India. This lies in the district of Satara and taluka of Wai, which was full of plague last cold weather, some of the plague villages being in sight on the flat plain below the carriage road. After passing through the plague-stricken town of Wai the road continues due east over characteristic Deccan country, which is shown in this lantern slide extracted from the survey map 1 inch to the mile (fig. 3). It will be seen that the villages are now large, compact squares at intervals of several miles on a flat ground absolutely bare of intermediate houses or hamlets. In this small piece of map are included villages whose names recur several years in the plague returns. I shall not give particulars of any of



these Satara villages, as I have others from districts farther south. But the type is the same in all those black-soil valleys of the Deccan watered by the Krishna and its numerous affluents. What Sir Thomas More said of the towns of his mediæval Utopia may be said of them:

Whoso knoweth one of them knoweth them all, they be all so like one to another, as far forth as the nature of the place permitteth.

They are all mud villages inclosed within a ring fence of bushes, sometimes with gates and remains of a wall. Many of them are large, with populations up to 4,000 or over, comparatively few of those that recur in the plague lists having their population, as given on the margin, under four figures. In the first season of plague among them, 1898, some villages lost more than a fourth part of their inhabitants in two or three months. Thus the village of Shelwadi, taluka of Navalgund, district of Dharwar, with a population of 4,222, had 1,126 plague deaths in eight weeks of October, November, and December. In the following table I have taken out the figures for a cluster of seven villages in the taluka of Hubli, to show the severity of their first plague season and the extent to which they have suffered in subsequent years:

*Deaths from plague in seven villages near Hubli from 1898 to 1904.*

Village.	Popula- tion in 1891.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	Total.
Byahatti .....	3,589	799	36	.....	75	229	271	43	1,453
Ingalhalli .....	2,203	810	.....	.....	60	186	202	35	1,293
Bhandiwad .....	1,306	485	22	.....	44	1	27	17	596
Kusugal .....	2,548	773	84	.....	101	123	80	.....	1,161
Unkal .....	3,915	349	98	.....	342	261	126	.....	1,176
Hebsur .....	2,713	270	.....	.....	.....	334	155	.....	759
Yarguppi .....	1,702	356	.....	.....	10	81	125	.....	572

Two villages which I visited, one 12 miles from Belgaum, the other 7 miles from Dharwar, will serve as samples of the large villages in the black-soil basin of the Krishna, each of them having had five epidemics in the course of seven years.

#### A BELGAUM VILLAGE.

The Belgaum village was considered a rich one, the bulk of the cultivators being prosperous Lingayats. The population in 1891 had been 4,586, it had an area of 2,600 acres, and it was the cattle market for the extensive pastures on the hills and downs to the northwest. The 800 houses of the village covered 64 acres, about 600 of them occupied by Lingayats and other castes of Hindus, 200 by Mohammedan butchers and cattle dealers in a separate quarter. It was inclosed by a



ring of bushes, outside which was the invariable mudhole or so-called tank, with the Hindu burning ghât and the Mohammedan burial place on its high bank. The houses stood upon a series of slight elevations and declivities, in fairly wide streets or lanes; they were close together in rows, but there was no extreme congestion. They were nearly all built of mud upon earthen foundations, but some were raised a foot or two on stone plinths, and had a few courses of stone in their walls above the plinths; the stone being procurable from a quarry in a hill 3 miles distant. As it was the dry season, there was much dust everywhere, and a general look of sordidness unrelieved by a single amenity excepting an occasional carved doorway and two or three verandas. Some of the houses had been rebuilt within a few years, one last year on the old foundations. Some had considerable back yards, very ill kept, but most had no curtilage whatever. Yet in a perambulation of the village site one met with nothing strikingly offensive to sight or smell.

There had been 147 deaths from plague from August to October, but no new cases for six weeks, and the only evidence of the recent visitation was a number of padlocked doors. This outbreak was the fifth since 1898, and the slightest hitherto. I have compiled from the records the following table, showing the whole history of plague in this village:

*Five outbreaks of plague in a village near Belgaum.*

[Population, 4,586.]

Year.	Worst months.	Plague deaths.
1898..	June-August .....	375
1899..	August, September.....	741
1900..	.....	.....
1901..	July, August .....	336
1902..	September, October .....	225
1903..	.....	.....
1904..	August, September .....	147
	Total .....	1,824

The enormous loss of life in 1899—over 700—was felt in the census of 1901, which showed a great reduction from that of 1891, and the aggregate loss of two-fifths of the population in seven years must have left a good many houses empty. I examined only two of these, in which there had been deaths a few weeks before. They were both old and crumbling, built of sheer mud, without plinths, standing side to side on a slight declivity of the main street. Each consisted of a single square room, without window or back door, with an oil mill occupying the center of the worn earthen floor, the occupants of both having



been oilmen. The party wall between them was of mud, only 6 or 7 feet high, and crumbling at the top, so that the houses were open to each other across the whole pitch of the begrimed roof. Plague deaths had occurred in both, and in one of them five had died out of a family of six. There were several other padlocked doors on the opposite side of the street and at intervals in the rows of houses elsewhere. Most of the houses, I was told, had been visited in one or other of the five epidemics, those which escaped in one season being invaded in another, whilst some houses had had the infection in them time after time.

While the infection had crept about to all parts of this village site, it was the unanimous opinion that it always began in a certain quarter, the high ground on the northern side, next to the high road, which was the particular quarter of the Mohammedan butchers and cattle dealers. The Lingayat cultivators had a bitter grievance against their Mussulman neighbors, which they tried to interest me in, having mistaken me for a person of authority. Slaughtering of cattle, sheep, and goats, curing of meat for the Bombay market, dressing of hides, and the like, were the chief industries of that quarter of the village. There was no regular slaughterhouse, but each householder used his house or the space before or behind it for killing in, the flayed carcasses and skins being in evidence as one walked past; and of course the whole soil of this elevated corner of the village was saturated with the blood and offal of many years and swarmed with rats, as shambles always do. A year or two before, the sanitary inspector from Belgaum, a native official of the third rank, had made a report upon the nuisance, recommending that the Mohammedans should be removed to a new site outside the village, which could have been found for them with the greatest ease not far off; but the commissioner had not moved in the matter, and the anger of the Lingayat farmers was unappeased.

#### A DHARWAR VILLAGE.

I shall take next a somewhat different sample of these villages, which also has had five epidemics of plague in the last seven years, but not so severe, and curiously enough always three or four months later in the season, as this table shows:



*Five outbreaks of plague in a village near Dharwar.*

[Population, 4,661.]

Year.	Worst month.	Plague deaths.
1898.....	December .....	101
1899.....	.....	.....
1900-1....	January, February .....	229
1901-2....	.....	.....
1902-3....	January, February .....	175
1903-4....	March .....	185
1904-5....	January .....	32
	Total .....	722

This village was a purely agricultural one, with no cattle trade, which is the common type on the rich black plain, or desh, extending eastward from Dharwar. The road all the way from the city passed through an unbroken expanse of wheat, jowar, and cotton, many of the wheat fields being of 20 acres. The area of the village in question was about 2,000 acres, but much of it was in the hands of a few large farmers. The patel of the village, a headman in stature as well as in name, farmed 100 acres, another resident farmed 200, and several who were resident in Dharwar City were also large owners and occupiers. About a fourth part of the villagers were laborers who held no land, many having lost it by mortgaging to the wealthier villagers or to pleaders in Dharwar, who had thus acquired their large farms. The village had once been defended by a wall and still retained two gates. Although it contained a number of well-to-do farmers, it did not contain a single pakka dwelling house. The houses were all of mud, many of them raised about a foot above the road on plinths of stone, which was got from a hill overlooking the village on the north. There was only one masonry structure—a variegated marble hall with open-top galleries for public meetings, which had been built recently by subscription. The streets or lanes were fairly wide, unpaved, and deep in dust. Few of the houses had verandas, and they were all equally common or mean. The usual ground plan was three rooms, one behind the other, with a back door opposite the street door, but without windows, the cattle being kept in the apartment next the street. All round the backs of the houses ran a space which was inclosed in places, traversed by not overclean foot-paths and overgrown with bushes; but in the dry weather it was not notably filthy, and there appeared to be no particular need for what is called village sanitation; at least, one did not see where the sanitation was to begin, so long as the streets were unpaved, and the whole village, except the marble hall, built of mud. At the date of my visit in December the fifth epidemic of plague had only just begun, but it



appears from the subsequent printed returns that 14 died of plague in December and 18 in January, while a continuance until March was probable, according to precedent.

#### PLAGUE VILLAGES OF THE NORTHWEST.

Time will not allow me to describe in detail other plague villages, and I regret especially that I must pass over the much better type of village in Gujarat, in which the houses are mostly built of brick (but sometimes repaired with mud), raised on plinths, commodious, and not without traces of taste. Leaving the Bombay Presidency, and coming next to the northwest, which is now by far the worst seat of plague, the many thousands of villages which have had the infection in them are of a very uniform type. As one goes westward, the compact fort-like aggregate of mud walls and flat roofs becomes more distinctive, and throughout the whole of the Punjab that is the type. We have left behind the more open and irregular formation of the small Bengali village, with clumps of trees or bushes between the several homesteads, patches of kitchen garden among the trees, and creepers overrunning the verandas. High-pitched tiled roofs succeed, and after these thatched roofs with broad drooping eaves, until at length we come west of Allahabad to the naked mud walls and flat roofs of the northwest, without a single amenity that the eye can rest on, and in many cases without even a tree beside the village well. The interior of these villages is not unlike that which I have already described for districts of the south, but the houses are often huddled together, with narrow, winding lanes between the rows, and sometimes in compact blocks, back to back and side to side, with no intervals at all. I shall take an extreme instance from a large and wealthy village of Jullundur. Jullundur is one of the most fortunately situated districts of the Punjab, and its villagers are proverbially well satisfied with their lot in life. They have a soil renowned for its fertility, and they have water so easily reached by wells wherever they may sink them, that they can dispense with irrigation canals, and need not pay 2 or 3 rupees an acre for watering their crops. If they are poor, it is because the pressure of population is great, being, indeed, about 600 to the square mile, and the highest in the Punjab; but the signs of poverty, or at all events of distress, are not at all obvious to the passer-by, and the people are of good physique. The district was the first in the Punjab to be infected with plague, and in the last four years it has lost 100,000 by that cause; at the time of my visit, those who were dying were said to be robust men and women in the flower of their age.



## A PLAGUE VILLAGE OF JULLUNDUR.

The particular village which I am about to describe had a past history of plague, but I am unable to give it, as the Punjab government does not tabulate and print its returns from villages, as the Bombay government has done from the beginning. Its population was about 3,000, and it had lost about 250 by plague in the months of March and April preceding (1904). The greater number of those deaths had come from a square block of houses (and from one or more like it) which had the most remarkable construction that I saw anywhere in India. It was literally a hive of some thirty or forty mud cells. A narrow passage ran around the square, with doors at intervals in the dead wall. Entering by a door near a corner of the square one came into a room, which somehow held a cow or bullock as well as the family, and had a hatch-like opening in the flat roof with a ladder to ascend by. On reaching the roof one found that it was a continuous expanse of thirty or forty small squares like those of a chessboard, marked off from each other only by ridges of mud, which one had to step across in walking a distance of some thirty or forty yards to descend by another ladder at the opposite corner. Each of the thirty or forty square roofs had a round hole in the middle, invariably covered by an earthenware cap like an inverted flowerpot. Close to this mud block, separated from it only by the 6-foot passage, was a group of ten or fifteen brick houses two and three stories high, with windows, balconies, and the usual features of the pakka houses of towns; this was the only masonry quarter of the village, holding about a twentieth of the population. I could not learn whether its residents had escaped altogether the infection which was so violent in the mud block next to it, but it was certain that most of the plague cases had been in the latter, or in another like it, some cells being pointed out in which as many as four persons had died. Most or all of the apartments were now retenanted, and there had been no sign of a revival of the infection down to the middle of January last. In another village, at the other end of Jullundur district, I mounted the roof of a block of houses in the Mohammedan quarter, thinking to find a continuous expanse like the former, but in that instance there were cattle pens and one or two alleys in the midst of it.

## PLAGUE IN THE NEW VILLAGES OF THE CHENAB COLONY.

Having been told that the new regulation villages of the Chenab and Jhelum colonies had had plague in them equally with the old Punjab villages, which was not at all what one would have expected in recently occupied sites, I visited both colonies to see how the matter



really stood. I found from the printed figures of 1904 that the district of Jhang, which included fully three-fourths of the Chenab colony (now the Lyallpur district) had had 4,000 deaths from plague, nearly all in April and May, 1904, which was only a tithe of the rate of other Punjab districts equally populous, and that the southern tahsil of Gujranwala, which included the rest of the new Chenab villages, had had far less plague than the three other tahsils, where the villages were old. Still, there had been plague in the new villages, one of those which I visited having had 30 deaths in the month of December, 1903, with a prospect of more if the villagers had not cleared out into the jungle, and another near it, but built two years earlier, before the regulation plan was adopted, having had 60 deaths. There are more than 1,000 such new villages in the Chenab colony, which have been built within the last twelve or thirteen years. The colonists are in great part retired sepoy of the Sikh regiments, with their subadars, or native officers, as the lumbarbars of villages. Sepoys received grants of 18 acres, some officers a square of 28 acres, others two such squares, paying a small land tax, as well as so much per acre for the use of the canal water for irrigating their fields. The land is now nearly all taken up, and is producing heavy crops of wheat, cotton, and sugar, the export of wheat from this district being one of the largest from India, as the railway traffic showed.

The regulation village which I visited, about 6 miles across country from the railway, was a great improvement in some respects upon the ordinary hugger-mugger of an old Punjabi village. It was laid out in regular squares with wide roads between. The compounds were roomy, with the dwelling houses kept apart from the cattle sheds. A certain elevation had been prescribed for all dwelling houses, perhaps 10 feet or more, just as our own local boards have raised the height of all new country cottages. But the public works department had left the colonists a free hand in the matter of building materials, and they had built their villages of sheer mud. In the village I am referring to there was not a single kiln-burnt brick, except in the facing of the village well, and, so far as I could see, there were not even sun-dried bricks in the walls of houses. The whole village was a hasty pudding of crude mud walls, some of which were already cracked. When I asked to see some house in which there had been plague, I was shown a closed door a few feet behind the chair of state in which I was seated at the crossroads of the village. It was a small corner house or shop, apparently a single room without a window, in which two cooks had died of plague. The mud wall was cracked in places and had one or two round holes in it which looked suspiciously like rat holes. All the new villages of the colony are built of mud, except those few which have the good fortune to be stations on the railway.



## PLAGUE IN THE OLD VILLAGES OF SHAHPUR.

The other irrigation colony, between the Chenab and the Jhelum rivers, is now being planted throughout the jungle of Shahpur district, following the lines of the Jhelum Canal. Last year Shahpur had the enormous mortality of 33,000 from plague among 524,000 people, most of it in the time of the wheat harvest. I suppose that some small part of it occurred in the new villages, but if the instances which I saw were fair samples most of it must have come from old villages, of which there are many within the valley of the Jhelum, depending, as of old, on wells and on the rainfall for their harvests. The three villages which I saw at close quarters were within a few miles of each other, all raised conspicuously above the dead level of the plain on conical mounds of black earth. Their mud houses covered the sides and summit of these mounds, which were doubtless formed by the débris of former villages upon the same site, and may have been growing by accretions of rubbish ever since the time when Alexander overthrew Porus on a battlefield not many miles distant. They looked the filthiest and most dilapidated villages that I had seen anywhere, and were credibly said to be swarming with rats. Each of them had lost about a fourth part of the population by plague the year before.

Before I leave the villages, which have nine-tenths of all the practical interest for plague, I will give a few minutes to two questions about them. First, is there any real need or excuse for all this mud building? and, secondly, are the large, compact, fort-like villages necessary and likely to continue?

## MUD WALLS.

First, as to the almost universal mud walls and roofs in the north-west. In the Punjab districts which suffer the extremes of heat and cold, the excuse is made that mud walls are the coolest in the hot weather and the warmest in the cold. But the more general explanation is undoubtedly the ease and small cost with which mud houses can be run up. On that point I may be permitted to quote a few sentences by the late Mr. Frederick Growse, who gave much attention to Indian architecture and did much to revive the native building arts in his collectorate of Bulandshar.

Replying to a circular of the year 1888 on the question of village sanitation, he wrote:

Under such supervision an ordinary Indian village would in the course of a few years be less repulsive in appearance than it is at present, but I doubt whether the death returns would be materially reduced. \* \* \* The real scourge of the country is fever. This is felt all the year round, and will con-



tinue to be so until the people adopt a more rational style of house building. At present the ordinary mode of procedure is to dig a pit, and with the clay extracted from it to raise a wall on its margin and roof it over for a habitation, the floor either remaining several feet below the surface of the ground outside or being partly filled up with the first rubbish that comes to hand. \* \* \* In no country, however barbarous, is such a style of building in vogue. It has been adopted in these provinces on account of the tenacity of the ordinary clay soil, which thus lends itself readily to the purpose. But if in other countries, where poverty is as much felt as in India, building materials have invariably to be brought from a distance, the same necessity should be recognized here.

Again, referring to the district of Fatehpur, he says:

Thus for want of skilled labor the villages are all exceptionally mean-looking collections of mud hovels, and the towns which sprang up under the Oudh Nawabs are all in decay. \* \* \* If the standard of living is low, it is more so from habit than from absolute lack of means; large sums are yearly expended on the only public works which a Hindoo ordinarily recognizes, namely, temples and bathing tanks.

The alluvium of the whole northwest makes a sufficiently tenacious clay, and the black soil of the Deccan valleys is even more sticky. The former can easily be burnt into bricks, while there is always red soil suited for brickmaking, or a stone quarry at no great distance from the black cotton soil. When I asked the lumbar dar of one of the new villages in the Chenab colony, "Why do you not have pakka houses?" he answered, "We are very poor men." But, as Mr. Growse said, the poor standard of living is more from habit than absolute lack of means; other countries, where poverty is as much felt as in India (and more felt than in the Chenab colony), employ village masons and carpenters, and they have shown their progress in well-being first of all in the improved housing of the peasantry. This has been the recognized test in Ireland in the last fifty years, and in Scotland the great advance in the latter part of the eighteenth century was shown in nothing so much as the disappearance of such "auld clay biggins," as Burns was born in. Yet in India mud villages have entered on a new lease under the auspices of the public works department.

#### SANITARY ADVANTAGES OF HAMLETS.

As to the large, compact, fort-like villages which are peculiarly the seats of plague infection, it passes as an axiom in India that small villages and hamlets may be almost left to take care of themselves in a sanitary respect. The axiom is embodied in the Government Revenue Handbook, and it recurs time after time in the replies to two circulars on village sanitation issued in 1888 and 1893. What was thus obvious in times of cholera is not less obvious in the present time of plague. The advantages of hamlets are even more marked in the latter, for the Bheels of western Khandesh, who were among



the chief victims of cholera in the last famine, are said never to have plague in their rude hamlets or movable camps, although the infection has been disastrous in the settled villages of eastern Khandesh. The same escape from plague of small and movable hamlets was remarked by Colvill in his tour through the plague districts of Mesopotamia in 1874. The trouble always and everywhere has been from crowded sites too long inhabited without drainage. The more compact the site or the greater the congestion of houses upon it the more will the soil be filled with organic impurities. It is well known that soil has the property of breaking up organic matters by oxidation and nitrification; that it filters off and retains organic substances suspended or dissolved in water, arrests the action of ferments, and retains bacteria in its upper layers. But if the upper stratum be saturated with organic matters beyond the power of the soil to enter into combination with them, each new accretion sinks down more or less slowly to the deeper layers unchanged, there to undergo putrefaction or reduction by ferments, so that beyond a certain point the self-cleansing action of the soil breaks down. The limit of endurance is passed constantly in old inhabited sites, whereas in fields pastured by cattle or sheep or manured for cropping the wholesome chemistry of the soil goes on from season to season without check. That the infection of plague resides in the ground is now accepted by every practical man in India who has been on plague duty, and is perceived intuitively by the people themselves.

#### CENTERS OF PLAGUE IN OUDH.

Such being the correct scientific theory of plague, one may find in it one reason why those parts of India which have the rural population least congested in particular spots should have had little plague or none. I have given the instance of the Konkan somewhat fully and have a few remarks to make about Oudh. The Oudh landscape is always pleasing. There are other provinces, such as Gujarat, which may dispute with Oudh the title to be the Garden of India, but it is certainly the garden of the northwestern plains. It is the province of hamlets or small villages and of a resident nobility and gentry. Plague has not been absent from Oudh, for two or three of the districts in the south and east, along the Ganges, have had large mortalities. As the government of the United Provinces does not print full details of the villages infected with plague, one has to find out by personal inquiry, and I was advised to choose Fyzabad as a characteristic part of Oudh. In the week before, that district had returned 110 deaths from plague, and the question was, What kind of villages did these come from? One of the four tahsils of the district had to be taken as a sample, and the Fyzabad tahsil was the most



convenient. It appeared that a full half of all the plague deaths in it were being returned by one village, 10 miles from the city, which I went to see, accompanied by the tahsildar. It was a large market village of over 4,000 people and 700 houses, with very little agriculture (chiefly sugar cane) and much cattle trade, more than half the population being Mohammedans. The Sanitary Inspection Book, one of those ordered by Government circular of 1893 to be kept in large villages, contained at various dates severe strictures upon the squalid conditions, especially of 2 of its 9 mahallas, and remarks on the slaughtering of cattle by certain butchers in their houses, and on the common practice of killing sheep and goats in dwelling houses. There had been plague in it two years ago, and at the time of our visit one whole quarter of the village was evacuated, owing to dead rats having been found and to plague cases thereafter. This quarter consisted of the same two mahallas which had been censured as specially squalid long before plague appeared. There had been 65 deaths so far and two fresh cases that day. The other chief center of plague in the tahsil was also a large market village, with a population chiefly Mohammedan. A few other villages had been returning plague deaths, but none of them more than 10 in all, and it did not appear that any of the hamlets had plague. The largest purely agricultural village, with 1,600 people and 2,400 acres, of which fully half were cultivated, was distributed in 10 hamlets and had no plague. On an average the Oudh districts have had hardly more than a third as much plague per head of population as the districts of the Agra province, a ratio which is inversely as the number of hamlets and is most probably dependent thereon.

#### HAMLETS V. LARGE VILLAGES.

Are there any reasons why the more wholesome kind of country life which is found in Oudh should not be extended to other parts of the northwest? I quote a few sentences to show that the plan or type of large compact villages is neither ancient nor immovably fixed even now. In the Gazetteer, of Muzaffarnagar, it is stated:

When Sikh, Rohilla, Gujar, and Marhatta together, or in turn, ravaged the district, no small community could exist, and the settlers fell back on the strong villages from which they had gone forth. After the final pacification in 1805, colonies were again sent out, but so gradually that the beginning of not a few flourishing villages is still remembered.

Again, as to the tendency to return to hamlets and their sanitary advantages, Mr. Adams, formerly collector of Benares, wrote in 1888:

The sanitary commissioner has not, I think, taken note of the manner in which, in many parts of these provinces, the villages are splitting up. The villagers in old days clustered together for mutual protection, but now they find they can live close to their fields, and hamlets have sprung up all over the country.



But they are not springing up in the black soil valleys of the Decan, nor in the Punjab, except in cases of feud between one part of a village and another; and it will appear from what I am about to read, from the pen of Mr. Alan Cadell, that there are reasons why the large villages should remain large:

The crowding of the population into large villages is to a certain extent disadvantageous, but the power which the large cultivating communities have acquired from their numbers and their wealth is of great service to them in resisting the encroachments of the landlords; and the people must feel that they would lose in unity and defensive power if they were scattered over several hamlets instead of being collected together in the old ancestral village. The fact, too, that nearly all the best land is held by occupancy tenants, whose fields are situated all over two and even three estates, makes it still more unlikely that any large number of tenants will leave their present dwellings, for to do so would, while bringing them nearer some fields, take them away farther than before from others, and to effect changes of hereditary fields is always difficult and generally impossible.

#### PLAGUE IN THE CITIES.

The circumstances of Bombay are so special, if not unique, that it would take a whole hour to discuss them. Therefore I shall not begin upon them, however inviting the theme. Poona, infected from Bombay, has had severe plague every season for nine years, and more of it per head of population than Bombay itself; the sanitary problem is complex there also, and can not even be stated in a sentence or two. Karachi and Calcutta I did not visit. I will come to Benares, as a good sample of the northwestern cities.

#### BENARES.

The mahallas or wards into which Benares is divided fall into two classes—the pakka, or masonry mahals, and the kaccha, or mud mahals. The separation of the two is sharper, I believe, than in any other Indian city, and will be readily understood from the situation of the masonry mahals. They are that famous range of houses, temples, and terraces which crowns the high bank of the Ganges for a space of nearly 2 miles. Some 50,000 or 60,000 of the population are housed there, and twice as many more in the kaccha or mud-built suburbs which extend back from the riverside quarter over a radius of 2 or 3 miles. These kaccha mahals, however, are not all equally mean in construction; for example, the road, 3 miles long, which runs from near the cantonment to the railway bridge over the Ganges is lined on both sides all the way with houses or shops of brick raised on plinths. The pakka mahals along the river are built of stone which had been brought some 20 miles down the Ganges, from the extensive quarries near Mirzapur.



There are no carriage ways through this region, but only a maze of narrow alleys, with houses on either hand three or four stories high, and innumerable temples—a perfect rabbit warren, like the closes of the High street, Canongate, and Cowgate of Old Edinburgh. What strikes one most in the not unexciting passage through this maze is the solidity and durability of the structure everywhere. The walls are of stone, the courtyards and floors are paved with stone, the alleys are laid crosswise with long slabs of stone, which form at the same time the roofs of a network of sewers. In this dense mass of humanity, constantly mixing with pilgrims from all parts of India, there has been hardly any plague. I make this statement on the authority of the police inspector who accompanied me, as well as of the collector, Mr. Radice, who wrote as follows: "In the five years we have had plague (this is the fifth) the pakka mahals have been almost entirely free;" and in the sketch plan showing the incidence of the infection on the several quarters of the city, which he was good enough to make for me, he has marked only one small spot in the riverside quarter, the Gaighat, which had some plague in 1903. On the other hand, the mud-built suburbs and the villages to the west of the city have had much plague; for example, this year a maximum of nearly 400 deaths in a week in March. In driving through them one could tell at a glance where the plague was likely to have been; thus, on the way from the cantonment to the city, a certain *gip* in the road is lined on both sides with mud houses of exceptionally mean appearance, which is found, on reference to the plan, to be the Tiliabagh, marked as having had plague "every year."

#### CITIES OF THE NORTHWEST.

In all the other cities of the northwest, which have had much plague, there are extensive quarters of mud-built houses—in Allahabad, Cawnpore, Agra, Lucknow, Bareilly. In Lucknow, beautified as it is with palaces and fine houses, the relative extent of the kaccha mahals seemed to be enormous, and the mud walls of so dusty and friable a kind that the heavy rain of December had been breaking them down. Lucknow this year has had up to 480 plague deaths in a week, a ratio higher than Bombay. I shall give a single illustration of plague in Agra. One of the patients in the plague hospital, a convalescent, was a little girl, the sole survivor of a plague-stricken family of nine. On proceeding with the assistant medical officer to see the house where this tragedy had happened, we found it to be a dilapidated and abandoned mud hut, one of a compact group of three standing at the roadside on the edge of a small pit, from which the earth to build them had doubtless been dug.



The three large cities of the Punjab—Delhi, Amritsar, and Lahore—have had remarkably little plague. Delhi, which is situated in a stony region, appeared to be nearly all pakka built, with the exception of a few lanes around a celebrated black mosque of the fourteenth century; and even the villages round Delhi are built of a kind of conglomerate of stone and clay. Amritsar also is a well-built brick city, and in Lahore there are no such extensive quarters of mud-built houses as in Allahabad and Lucknow. The smaller towns and market villages have in some instances furnished a large part of all the plague deaths credited to a rural area. I was told by the civil surgeon at Ghazipur that the largest totals in his district this year were coming in from certain towns or market centers which had a considerable Mohammedan population; and in the district of Muttra I saw for myself two such market towns with much plague in them, one of them, population of 9,000, having had 400 deaths in the four weeks preceding, and a maximum of 25 the day before; while the other, with a population of 6,000, had 19 new cases reported that morning. It is the melancholy fate of those old country towns of the Mohammedan period, originally well built, with brick houses and paved streets, and in some cases with fine sarais or forts, to have fallen into decay of trade and dilapidation of buildings, the houses often "pakka without, but kaccha within," as explained to me of an old two-storied brick house at a village near Benares, in which the rats had been found dead, and, two or three weeks after, the whole of the inmates, to the number of 18, had died.

#### MEANS OF AVOIDING PLAGUE—EVACUATION.

According to everyone's belief and experience in India, there is only one thing to be done when plague appears in a place, or the rats begin to fall, namely, to clear out, or, at all events, to avoid spending the night there. Hence the strange spectacle every evening about sunset, in the city of Bijapur, of the whole population, save the inmates of half a dozen bungalows, to the number of some 20,000, quitting the bazaars, workshops, and offices, and making their way outside the walls to a large camp on the downs around the railway station. This phenomenon is the more suggestive at Bijapur, as the city was deserted once before, two hundred years ago, and most probably for the same reason as now, namely, plague, and continued to be in great part deserted until it was made the administrative headquarters of the district about thirty years ago. Also in the country round Bijapur the people have learned the lesson of evacuation very thoroughly. I went through an old fortified village of 3,000 people 5 miles to the west of it, without finding a living creature; the streets were deserted, and the doors of all the houses padlocked, the whole of the



inhabitants being in camp near their fields about a quarter of a mile away. They had taken alarm from the number of dead rats found, and the deaths of 36 persons in October, November, and December, and from the recollection of their first plague epidemic two years before, when 171 died in the village. At Bijapur City I was told by a high native official that, if the infection became active another year, the temporary camp round the railway station would become a permanent residential suburb, so that the area within the walls would be deserted for the second time in its history. This evacuation is at the people's own initiative and at their own expense, which many of them can ill afford. The same thing was going on at Belgaum, where several thousands went out to camp in the evening and returned to their work in the bazaars and offices in the morning.

At Dharwar a small beginning had been made toward permanent evacuation. The government had given a piece of vacant ground to the municipality, which had sold it by auction in lots at a very low price, and a new street of some forty houses, called Gibb street, after the collector, had been run up. At Poona 7,000 or more were in camp along the sides of suburban roads, or on the various maidans of the city. At Bombay there were three large health camps along the seaward side of the island as far north as Mahim. In a group of villages of the Baroda State near Naosari, the cultivators had built lofty and commodious huts near their wells and fields, to which they had removed their bedsteads, chests, and other furniture, and in which they and their children and their bullocks were not unhappy. The weather after the rains is so fine throughout the Bombay Presidency that there is no hardship whatever in camping out.

It is otherwise in the earlier part of the plague season of the northwest, of which I shall give a single instance from the Punjab. I went one day with the medical officer on plague duty to a group of villages 12 or 14 miles from Jullundur. At one of these, a small village of some 200 people, there had been many deaths from plague two years before, and on the day of our visit there were more persons lying sick or recovering in their houses than I had seen anywhere in so small a space except in the hospital at Bombay. After we had gone round the village, a palaver was held with about a dozen of the men and youths, who stood in a semicircle near the village well, the women drawing the water all the while. Their spokesman was a sturdy little Jat who knew his mind, spoke to the point, and bore himself with the aplomb of a man of affairs. They had been asked in advance to consider whether they would not submit to inoculation, and had decided so peremptorily in the negative that the matter was not so much as mentioned again. The only question discussed was evacuation. The spokesman pointed out various practical difficulties in the way of a general camping out, to which Cap-



tain Bradley replied, and at length it came to this, that the whole village might remove to a camp on a certain piece of waste ground within sight of where we stood if some help were forthcoming for the poorer villagers; it was all a question of expense, and as I was again mistaken for the commissioner, I was looked at in a significant way as we took our leave. But to show how many are the difficulties in the Punjab, next day a storm of wind and rain broke which lasted thirty-six hours and was followed by two or three weeks of intense cold. Camping out was of course impossible, and the effects of the cold snap were seen in the abrupt rise of the plague figures about a fortnight after from all parts of the Punjab and the United Provinces.

#### SCIENTIFIC THEORY OF EVACUATION.

Evacuation of plague-infected houses or village sites had been adopted by the people themselves, without any scientific advice, before the present plague; for example, by the hillmen in Kumaun, and by the Marwaris, who, as White reported in 1836, "instantly quitted a house on seeing a dead rat." The rats themselves, although in India they are the symbols of sagacity, are usually surprised by the underground venom, and are often seen trying to escape in a state of delirium. A scientific explanation of the common practice may be found, first, by including plague fully and frankly among the soil poisons, as I did in my *History of Epidemics in Britain*, fourteen years ago, and, secondly, by applying to it the laws of soil infection which have been worked out by Pettenkofer and his school. An infection of the soil makes itself felt most inside dwelling houses, and most of all overnight, because there is a natural movement of the ground air toward the walled space. This was shown by the fact that an escape of gas from a main in the street would travel horizontally through the pores of the ground toward the house opposite, and be sucked up into it, sometimes to the danger of the inmates. Von Fodor observed the stratum of air next the floor of an unoccupied cellar at Budapest day and night for a whole year, and found that it always contained more carbonic acid than the ground air outside, having attracted it from the soil around. In disused cellars, vaults, or covered wells, the accumulation of carbonic acid is sometimes so great as to asphyxiate those who enter them first. One reason for the ground air streaming to and rising through the basement or floor of a house is that the ground beneath is drier and more permeable, affording a free upward passage unless there be a concrete foundation or a masonry plinth or stone paving. Another reason is that the air inside a house is warmer and lighter, so that it yields to the pressure of colder and heavier air outside and is thrown into an ascending



current. The penetration of the house by ground air is a peculiar risk in India for several reasons. Where the walls are of mud, as they are in the great majority of plague villages, and have no masonry plinth to rest upon, their porous substance is really a part of the soil, so that the inmates have the ground air not only rising from the floor, but carried up in the walls as if in a ventilating shaft. A dwelling house warmed all day by the sun and by the fire kept up for cooking becomes like an exhausted receiver for the ground air to rise into. If one visits the old chawls at Bombay, in which there has been so much plague, you find the narrow, dark rooms on the ground floor to be heated like an oven even at 8 in the morning.

The intuitive perceptions of the people correspond with the scientific theory of a soil poison. They know that the chief risk of taking plague is from spending the night in an infected place, and generally that they incur the greatest risk when confined most to the dwelling houses by cold, domestic duties, or other cause. One very important thing I must pass over for want of time, namely, the injurious effect of a high level of the ground water and of its seasonal fluctuations in a filth-sodden soil. In the new chawls at Bombay, built by the improvement trust, nothing seemed to me to promise more for the future health than the solid masonry of the foundations, floors, and passages. The advantages of concrete foundations have been proved often in similar circumstances, although in Hongkong they have been only a palliative in plague.

#### PROBABLE FUTURE OF PLAGUE IN INDIA.

I come lastly to the question, Is there anything to be learned as to its probable duration from historical precedents and from its own course during nine years? One was sometimes asked whether the natural time for plague in India to last was not seven or eight years. The origin of the idea is what is recorded of two former plagues in India—one in the reign of the Emperor Jehangir, 1616, of which it is said that "it continued to devastate the country for eight years," the other in the reign of Aurungzeb, 1688, which "lasted seven or eight years." Each of these epidemics of bubonic plague is authenticated twice over by good contemporary authorities, along with some interesting particulars which I have no time to quote. The earlier of the two began in the Punjab at Lahore and "destroyed many villages and parganas;" the later, seventy years after, was felt most in October and November, 1688, in the city of Bijapur, which Aurungzeb had just captured and in which his army was encamped, including 15,000 cavalry; but it is said to have lasted seven or eight years and to have extended over the Deccan and as far as Ahmedabad and



Surat. The next outbreak in India fell to be described by three British writers. It happened in Cutch and Kathiawar from 1815 to 1821, in peculiar circumstances of aggravation within walled towns, arising out of famine and the mode of collecting the tribute from the recalcitrant petty chieftains of those territories by the army of the Gaekwar, and it came to an end almost coincidentally with the new order of things in 1821. The only other epidemic before the present was also a limited one, in Marwar, especially in the town of Pali, which lasted from 1836 to 1839, and may have been a revival of plague which is said to have been indigenous in Marwar "from a remote period."

Turning from those Indian precedents to the much more continuous and extensive plagues of Europe, we find an uninterrupted history in one country or another and in one city or another for more than three hundred years—from the year 1347 to the latter half of the seventeenth century, when the infection disappeared almost simultaneously from all the countries of western Europe. The chief difference between the European plague period and the one which is now running its course in India is that the former did not involve the villages, but only the towns, except in its first great wave, from 1347 to 1350, which swamped country and town alike with an almost unheard-of mortality, and excepting, perhaps, two or three general but minor revivals at intervals in the latter half of the fourteenth century; for the rest, it continued an infection of the towns, and in these it commonly broke out at long intervals—twenty or forty years—excepting in such capitals as London, where it was seldom dormant for a series of years until it was about to cease altogether.

It is not surprising that plague in India should be chiefly an affair of the villages, because that has been also the experience with cholera. So much was that a village infection that Anglo-Indian writers who were at home when cholera reached this country in 1831 prophesied that it would fall most upon the enormously congested rural population of Ireland. But it spared the Irish villages and hamlets almost absolutely, although it attacked the Irish cities severely. European precedents being thus inapplicable to India as to villages, we are thrown back upon the lessons that may be learned from the history of plague in India itself during the last nine years. It is only from the Bombay Presidency that we have data minute enough to be of much use, from which it appears that the huge totals of plague deaths year after year are not so hopeless as they look. When they are analyzed—and it is no small labor to analyze them—it is found that the aggregate of each year has been made up by items from somewhat different places. The cities of Bombay, Poona, and Karachi have been steady, but in the mofussil all the districts have



not suffered severely in the same year, the *tálukas* within a given district have been affected some one year, some another, and the villages of a given *táluka* have been affected in a kind of rotation. I have shown on the screen the tables of nine villages, which on the whole agree in proving that each village has had one very severe outbreak, usually the first, that there have been years absolutely clear, and that the subsequent outbreaks have been much less extensive than the original one. It is in the very notion or definition of the word "epidemic" that there shall be intermissions; the word "endemic" means a more steady prevalence from year to year—but in that notion also the steadiness is only in the aggregate of a whole country or province, not in the several counties or parishes of it. It is probable that all the villages of Bombay Presidency by this time have had their worst experience of plague, and that in each village plague has visited all the houses in turn, or as many of them as it is ever likely to visit. The Bombay figures for the season just ended are encouraging. Whether it be owing to the resolute practice of evacuation on the first signs of plague or because the invasion is subsiding naturally, the returns since January have been only about one-third those of the three or four years preceding for the corresponding weeks. It looks as if the maximum had been reached and passed, both for each locality and in the aggregate of the whole Presidency, and that there is to be a pause. Such pauses occur in all epidemic infections. We account for them by a phrase or formula that the infection has exhausted all the "susceptible subjects," and we explain the return of the epidemic after an interval of years by the fact that a new generation has grown up which contains more "susceptible subjects."

What can be proved from the admirably full statistics of the Bombay Presidency may be perceived in a way in the Punjab. Thus, in Jullundur, in January this year, I learned that the average was being kept up to that of former years chiefly by returns from a certain group of villages in the southwest which were having plague in them for the first time. The province as a whole is to have more plague deaths this year than it has had hitherto; but it would certainly have shown a decrease but for the very large items of three districts in the Delhi division—Gurgaon, Rohtak, and Hissar—which are having their first severe epidemic. The prognosis for the Punjab should be that the infection has reached its height and done its worst for the time in the districts first attacked and that it will soon begin to show a decline in the aggregate, following in the wake of Bombay Presidency.

This is the first year in which the United Provinces and Behar have returned such large totals as we have been accustomed to for several



years in Bombay and the Punjab, and as one of them has a population nearly twice as great as these two latter together, it is unsafe to prophesy what heights plague may not reach in them before it begins to decline. In any case we may reckon with plague domesticated in the soil of tens of thousands of villages, making an endemic area larger than that of cholera was ever estimated to be, and from such an endemic area we may expect future outbreaks at intervals of years, if not from year to year. In England, for thirty or forty years after the great invasion of plague in 1348, a poet of the time compared the state of sickness to "the rain that raineth where we rest should" to the drip through a leaky roof, a chronic state of discomfort and uneasiness.

The three centuries of plague in European towns came to an end without any conscious effort to check the infection anywhere, so far as one knows. The most probable explanation is that the towns had emerged slowly from their mediæval life, which was peculiarly favorable to plague, having thrown down their walls and gates and gradually shifted the pressure of population to new sites, which, however, were often befouled by the accumulated refuse of the old walled city, and therefore apt to retain the infection many years longer. The curious statutes of 32 and 35, Henry VIII, on the decay of practically all the chief towns of England and Wales, bear out that hypothesis, according to the reading of their preamble adopted by Nicholls and Froude. At all events mediæval limits were outgrown in all the towns of Europe, and, after a transition period of a century or more, plague died out by reason of changed conditions.

India at the present day contains more traces of changed sites than any country in the world, and some of these changes have actually occurred under British rule. Sometimes the changes of site have been caused by a river deserting its old channel and leaving a city too far from the traffic, but there are undoubted instances of sites abandoned owing to chronic sickness. The British cantonments afford instances in the past and may afford more in the future. Dacca and Berhampore were both condemned, the latter in 1833 after an original outlay of £300,000; they were healthy stations at first and became sickly by degrees until they were untenable. What has been happening in India from time immemorial, both to town sites and to village sites through the pressure of events, may be anticipated by a deliberate policy in order to hasten the disappearance of plague. In some of the towns of the Deccan and Gujarat new suburbs are actually springing up for the richer class to avoid the infection. For the villages it is not out of the question that some law might be made to prevent rebuilding on the same foundation when the mud walls crumble, as they do periodically; but of such a law the essential condition would be the



helping hand of the State to provide new sites. At one time I held that a progressive change of the village site to a clean soil, along with the break-up of a larger village into several hamlets, would be an effectual if very slow means of getting rid of plague. But after seeing a good many of those dreadful mud villages I have come to think that it is their miserable structure that is the real reason why the Indian plains are cursed with plague, and that there can be no real cure without a more civilized kind of dwelling and a great revival of the native building arts as village industries.