

## ENDEMIC PLAGUE IN INDIA.

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INTRODUCTION.—The phenomena of nature are exhibited in India on a colossal scale. A cyclone sweeps over a tract of country, and in a few hours its teeming populations are houseless. A storm-wave, engulfing hundreds of smaller craft in its onward course, raises the lordlier vessels from their supposed haven of refuge on the bosom of the sacred Bhagiruttee,\* and deposits them on its banks alongside. The heavens discharge hailstones of more than regulation cricket-ball size and weight; and rain descends, not in inches but in feet. Famines destroy the human race by untold millions; and disease frequently assumes the characters of a pestilence. Two of the severest scourges known to man, viz., cholera and the plague, find congenial homes in India. It is of the latter disease, especially as it exists in a part of the Himalayahs, that I propose now to give a brief sketch.

I was one of two medical officers of the Indian Army who were nominated in 1853 to investigate this plague; and Dr. Pearson my coadjutor and myself were thus engaged for two consecutive years; at the end of which time the former was permanently appointed as superintendent of the measures considered necessary for its repression, in addition to other duties affecting the welfare of the people generally, e.g., in promoting vaccination. Dr. Pearson, who has recently retired, was employed on this duty for upwards of twenty-five years.

The result of our joint proceedings was recorded, by permission of the Medical Board, in the *Indian Annals of Medical Science*, vol. i, 1854; but I am not aware that, with the exception of a valuable paper read by Surgeon-General John Murray, on the 10th April 1878, before a meeting of this Society, and recorded in the second part of the fourth volume of its *Transactions*, any separate account of this endemic plague

\* Synonymous with the Hooghly river off Calcutta.

of India has ever appeared in any of the professional periodicals published in this country.

*Physical Geography and Geology.*—Before proceeding further it may be well to refer briefly to the physical geography and geology of the country in which this scourge maintains its ground, and to the people that inhabit it. On looking at a map of India, we find, situated in the great Himalayan chain, in 29 deg. 45 min. N.L. and 79 deg. 45 min. E.L., the district known as Kumaon, with, extending in a N.W. direction into 30 deg. N.L. and 78 deg. 40 min. E.L., the attached sub-district of Gurhwal.\* Kumaon and Gurhwal cover a space of about 11,000 square miles, half of which only is fit for cultivation. Of this half, three-fifths are always covered with snow; one-fifth *is* cultivated; and the remainder *is not*. The population, especially in Gurhwal, where, in former years, the people endured great tyranny from their rulers the Ghoorkhas—many being annually carried off under the operation of a slave tax—has now become sparse and scattered. This tract of country, the only part of the Himalayahs where *mahamurree* has ever appeared—low forms of fever are common enough throughout the entire mountainous chain—is bounded, on the north by the watershed line of the main range and the Thibetan frontier; by the plains of India on the south; by the Alaknunda, one of the two main streams (that unite to form the Ganges) dividing it from the rest of the mountainous districts, on the west; and, on the east, by the great river Sardah (or Kalee) that separates it from the adjoining kingdom of Nepaul. The direction of the several mountain chains, including the main range and the inferior peaks, is from about N.W. to S.E. There is a general parallelism throughout, and the strike of the several strata is pretty much in the same direction. At the immediate base of these magnificent hills (a distance of from 80 to 90 miles intervening between this point and the line of maximum elevation) lies an equally magnificent forest, from 10 to 15 miles in breadth, which would require the genius and pen of a Humboldt justly to describe. No natural rivers are found in this region, and, until the officers of the British Government provided a more or less permanent supply of water through the medium of canals, there was no cultivation. Torrents, which rush impetuously down from the mountains, are met with in the rainy season; but the hill rivers, on reaching the commencement of the forest, are

\* From Gurh, a fortress, there being so many fastnesses capable of being so used.

immediately absorbed into it, and, passing onwards underneath the surface to the plains, reappear in the moist tract which—of almost equal breadth with its dry neighbour—is remarkable for its swampy character, especially marked during the rains. This tract, covered with tall reeds and grasses, and intersected by sluggish streams, often doubling back upon themselves—a mixed swamp and prairie—is known as the *Turae*\* proper, in contradistinction to the dry forest, which is called the *Bhabur*.† The latter, whose surface consists of a few feet of earth resting on a dry bed of shingle, boulders and sand, indicating the bed of a former sea,—with a splendid climate in the cold months, but *intensely hot* in the hot season,—without, comparatively any malarious influences,—has no permanent population; whilst the former, essentially alluvial, without a trace of rock, fragmentary or otherwise, and *full of malaria*, can boast only of a few wretched villages, inhabited by a miserably attenuated population.

*Elevation*.—The average altitude of the mountain ridges is about 7,000 feet above the level of the sea. Some of the snow-clad peaks attain an elevation of 23,000 feet and upwards. Nunda Devi, the highest in the range in this part of the Himalayas, is more than 26,000 feet high.

*Geology*.—The mountains generally are composed of rocks of igneous origin, with, reckoning from the south, argillaceous schists, grit, and limestone. The lines of igneous action follow, for the most part, the direction of the strike. Proceeding northwards, we come upon a tract of some breadth, consisting mainly of mica schist, with a burst of granite along its central part. Still further north we find slates, limestones, quartzites, these also being traversed by lines of igneous action. In these lines iron and copper have been discovered. The eruptive rocks consist largely of greenstone, associated with black basalt, passing into schists and conglomerates. Breccias, known as ash or “volcanic grit”, are not uncommon. Here, too, steatite, and an occasional magnesian bed are found. In all this part of the mountains there are no fossils. To the north of the great snowy peaks, at 14,000 feet, we come upon palæozoic strata (their lowest beds being of silurian age), with limestones, argillaceous shales, followed by oolitic beds, and Oxford clay. Characteristic fossils—from silu-

\* From *turæ*, Persian for moisture, or from *tale*, Sanscrit for down below, foot of.

† Not known why so called. Supposed by some, though incorrectly, to be taken from a kind of grass called Bhawur; but this does not grow in the Bhabur; it is found only in the lower hills.

rian to tertiary formations—are here found, throughout. On the Thibetan plateau (120 miles in length, from fifty to sixty miles in breadth, and from 14,000 to 18,000 feet above the sea's level)—a great tertiary deposit, on which are found boulders, gravel, clay, and mud (the ancient bed of a sea)—we meet with bones of the elephant, rhinoceros, horse, hippotherium, and several ruminants. The outer ranges of the smaller hills, running parallel with the higher, and consisting mostly of sandstone and conglomerate, are—to the west of Hurdwar, where they are known as the Sewalik range—famous for the palæontological discoveries of Colonel Cantley and Dr. Falconer.

*Ethnology.*—Whatever be the exact ethnological position of these several hill tribes—it has been affirmed that they are of mixed Thibetan and Hindoo birth—it is evident that the Kumaonees and Gurhwalees, who call themselves Khas-yas, a race of Kshatriyas, who are widely distributed throughout the Indian Himalayahs, are essentially of Hindoo origin. They claim to be descended from the Rajpoots, though they are far removed from the finest specimens of that race, whose *habitat*, so to speak, is Rajpootana, in the West of India.

The people of Kumaon and Gurhwal are, for the most part, agricultural, the inferior castes being the artizans of the country. They are much attached to their homes, offers of high pay to do work, or carry loads, away from them, presenting no attractions. They would convey a load from their own village to the next for nothing, rather than earn a shilling (a large sum to them) by undertaking what would involve absence from home for a night! In this respect they differ from some other hill races; the Kumaonees and Gurhwalees (especially the former), who live near the principal European locations, as Nynsee Tal, Almorah, and Ranee Khet, do, indeed, collect together, in the visitors' season, to act as coolies, and convey baggage to and from the plains. But the influence of their overseers is necessary to secure their presence regularly. They are timid and credulous, and the least cause for alarm drives them away to their villages.

In physique, the Kumaonee is inferior to the Gurhwalee (whose countenance occasionally resembles the Tartar type) and is more like the Hindoo of the plains: and yet mahamurree is usually more prevalent amongst the former. But the personal cleanliness of the Kumaonee is much greater; he lives in a better class of house, and his general

\* The military division of the four principal castes existing in India.

surroundings are less insanitary; though, in many cases, there is but little difference in this last respect between them.

There is one essential distinction in the clothing of these hill people. The Kumaonee's garments are of cotton, the Gurhwalee's being of wool; and as these are often worn threadbare, this fact, added to want of individual cleanliness, and the absorbing capacity of the material, gives strength to the conclusion that personal filth invites the disease. Between the mountainous regions proper, and the great Thibetan plateau, is situated the country called Bhot, where the climate is very inhospitable, and the crops that are grown there (consisting of amaranth, barley, buckwheat, and wheat) are, consequently, very poor and uncertain. Here are located the Bhotiyah villages, inhabited by a hill tribe who, also Hindoos, closely resemble the people of Thibet. The Bhotiyahs (such is their name), short in stature, but of a powerful physique, are the carriers of the hills (for this privilege they pay tribute to the Thibetan Government); taking down to the plains of India the produce of Thibet (or, as it is locally called, Hoondes, or snow country), consisting mainly of borax and salt (the greater part of which is consumed in the hills), wool (pashm or shawl wool), woollen cloths, and shawls of superior quality, silks, ponies, cows' tails, etc., and bringing back cloths of various kinds, sugar, hardware, tobacco, spices, and miscellaneous commodities. They also carry into Hoondes, which has no agricultural produce, the grain that is largely grown in the villages to the immediate south of those inhabited by themselves. These goods are conveyed on the backs of sheep, or, where the loads are heavier, of jubboos\* and goats, guarded by large dogs, whose watchful fidelity, as evinced by their incessant barking through the livelong night, greatly disturbs the rest of the weary and unappreciating traveller in his tent.

The Bhotiyah villages are located north of the great peaks, at elevations of from 7,000 to 12,000 feet above the level of the sea; and, so far as I know, the plague has never appeared in them, nor amongst the Bhotiyahs in their transit through the hills, any more than it has (of late years, at any rate) amongst the pilgrims from the plains. These last annually visit the several shrines established at the origins of the sacred rivers; as at Jumnotri, the origin of the Jumna, and Gungotri, the origin of the Ganges, etc. They sometimes assemble in large numbers at these shrines; and, from wear and tear of travel, are obviously predisposed to the invasions of epidemic disease.

\* The jubboo is a cross between the yak of Thibet and the cow.

*Outbreak of Mahamurree at Kedarnath.*—It is probable that it was at one of these large gatherings where the recorded outbreak (at Kedarnath, in 1823) of mahamurree occurred; though the natives themselves attribute it to Divine vengeance, which thus manifested itself as a punishment for improper administration, on the part of the high priest, of religious rites. The combination of insanitary conditions doubtless existed in full force at Kedarnath and at such gatherings in those, as also in later, days; and altitude would not avail against them. We know how those conditions have operated, in more recent times, at fairs and pilgrim resorts in the plains.

*Local Nomenclature of the Plague.*—The local names by which the plague in the Himalayahs is known, are mahamurree, from *Maha*, a Sanscrit word, signifying great, and *Murree*, the meaning of which is not very clear. It may be derived from the Sanscrit *Mara*, dead; and thus the word would imply *great death*. It is also called *Pootkia rog*, and *Gola rog*. Of the derivation of the former I am not aware, unless it be from the plant, so called, that is used for treating the malady; or it may be *vice versâ*, the plant being so named from its use. It may be connected with the bursting of the buboes, etc.; the Sanscrit verb, *phutna*, meaning, to burst. *Gola* is of Sanscrit origin, signifying ball (referring to the glandular swellings). *Rog* is Sanscrit for disease.

There is no reason why mahamurree should not have existed at a much earlier date than 1823. Doubtless, with the prolonged sojourn of a people (whose filthy habits are probably unsurpassed by those of any nation in the world) on the same soil, which would thus, year after year, be made a very hot bed of pollution, the disease became intensified, and spread.

*Advance of the Plague Southwards.*—From Kedarnath it gradually extended itself downwards. For many years, however, it was limited to certain northern portions of the district, known, locally, as Pergunnahs Nagpoor and Budhan. Eventually, it descended to within fifteen miles of Almorah, the modern capital of Kumaon.

It would appear that mahamurree first attracted official attention in February 1836; but, beyond a "report", nothing was done. Again, during the rains in 1849, the magisterial authority in Gurhwal brought the existence of the disease to Government notice. So severe had it now become, that the inhabitants were fleeing from their homes in terror, and the annual revenue was not forthcoming. In April of the following year, the medical administrative

officer of the Circle visited, by order of Government, some of the affected spots; and, though he did not then realise the identity of mahamurree with plague, Dr. Renny saw that a fever of unusual severity had established itself as a plague spot in the land, and that a searching enquiry, in view to, if possible, its removal, was urgently called for. Thus, it came about that Dr. Pearson and myself were appointed, in 1853, to undertake such an enquiry on an organised plan, some preliminary observations having been made, in October 1851, by the former, in conjunction with the (then called) sub-assistant-surgeon of Almorah, Baboo Sree Nath Mookerjee; supplemented by yet other observation, of a month's duration, by Dr. Pearson and myself. *It was time for an organised enquiry.* In 1834, an outbreak of mahamurree had caused 633 deaths in Gurhwal—a large mortality in so thinly populated a district. In 1849-50, 111 victims had succumbed in nine villages. The maximum death-rate was estimated at 88, and the minimum at 25, per cent! The worst outbreak occurred in 1852. The disease burst forth in that year almost simultaneously (though contagion, as a factor, was distinctly traceable in two or three) in twenty villages, where formerly one only had been visited. The increasing intensity of the disease, added to its southward march, inspired the authorities with justifiable alarm.

Having thus given a slight outline of the former history of mahamurree, I proceed (*a*) to describe the disease as it has been seen by various observers and by myself: (*b*) to suggest what may be the probable cause of it: and, (*c*) finally, to offer a few remarks as to the most suitable remedial measures.

*Symptoms.*—Mahamurree, usually ushered in with shivering, is essentially a fever of a most virulent and fatal type, marked by rapid and extreme prostration, great præcordial oppression, and associated, in many cases, with glandular swellings, the suppuration of which is regarded as critical. A white chalky, laterally fissured, but unswollen, tongue, occasionally resembling the strawberry tongue of scarlatina; with headache, accompanied not infrequently by passive delirium and imaginary noises within the brain; a peculiar mixture of muddiness and lustre in the eyes; and constipation (though, now and then, there is diarrhœa) are marked features in the disease. There is sometimes acute pain in the loins, with scanty and high-coloured urine. Strangury is more rarely noticed. The character of the pulse varies. In one case it would be 90 and full, though

very compressible: in another so weak and rapid, that it was difficult to count it. Where perspiration supervened, either naturally or as the result of remedies, it was considered highly favourable. I have known the perspiration, in a case of recovery, literally pour from the surface of the body—the patient being, when in health, a hale, hearty man. Vomiting was not a common symptom, but the natives thought well of it when it occurred. A wish for bitter things would be often expressed. The course of an attack would sometimes be startlingly brief. It was not at all uncommon for an individual to be suffering in the morning from nothing, apparently, but malaise; yet, in twenty-four hours, that sufferer would be a corpse, so overpowering was the depressing effect of the poison upon the nervous system. The greater number of the cases proved fatal on the third day.

*Glandular Swellings.*—Where there were glandular swellings, these usually appeared on the fourth day (but sometimes much later) either in the inguinal, or femoral, or auxiliary, or cervical region. Occasionally, they were seen immediately below the ear. Except in the rapidly fatal cases, the fifth was the critical day. If the patient tided over this day, he was probably safe; though there was anxiety till the eighth. When glandular swellings appeared the alarm became greater, and their suppuration was eagerly watched for. Their recession was a bad sign. The natives would push a large heated needle through these swellings, to promote the formation of pus. It may be mentioned here that this, and the internal exhibition of the milky juice of the *pootkia* (a species of *euphorbium*), to cause evacuations from the bowels, which were usually costive, constituted all the native treatment of mahamurree.

*Petechiæ.*—It does not appear, from the writings of the several observers of the disease, that petechiæ were ever seen. I myself did not notice them in any one of the ten cases gathered from the fifty villages that Dr. Pearson and I saw together, or separately. Dr. Pearson, whose experience of mahamurree has extended over more than a quarter of a century, informs me, in a letter recently received, that he has occasionally met with petechiæ. The dusky skin of the natives of these hills would make the detection of spots somewhat difficult, especially where a layer or so of dirt was super-imposed. Still, as they have been looked for by several observers, and seen, so far as I know, only by one, it seems evident that they are not very common.

*Hæmorrhages.*—So with hæmorrhages. These are met

with, if at all, in the quickly fatal cases; but hæmorrhage is not an ordinary accompaniment. When seen it is in the form of hæmoptysis.

*What is Mahamurree?*—In answer to the question “What is mahamurree?” the most experienced observers have no hesitation in saying “Plague”; a genuine specimen of the *pestis septica*, or Egyptian (or Levantine) plague. I believe that Dr. Murchison correctly defined it when he wrote: “Plague is perhaps the typhus of warm climates.....differing only in intensity from the effects of climate and other collateral circumstances.” He adds, “this disease closely resembles, if it be not identical with, bubonic plague;” and Pettenkoffer is of the same opinion.

Dr. Morehead, in his valuable *Clinical Researches on Disease in India*, thinks that mahamurree and Pali plague—a disease to which I shall refer later on—are adynamic remittent fevers of suspected infectious character. Malaria, he says, may be the original agent; but let there be overcrowding and you get the poison of typhus in addition. However well this definition may apply to some forms of fever that have appeared in India, I venture to affirm that it is not applicable to mahamurree. Neither intermission nor remission have been observed in the course of an attack. Sulphate of quinine has had no appreciable effect upon one, as in fevers of malarious origin; and the general expression of the countenance has always been pathognomonic. Moreover, the chief distinguishing features of plague are present, viz., the rapid course of the disease, the glandular swellings, with occasional hæmorrhage; and the excessive mortality, with the absence, often, of any prominent symptoms.

*Post-mortem Examinations.*—As before stated, Dr. Pearson and I, when working together, placed on record the particulars of ten cases (amongst which there were only two recoveries), which I refrain from repeating here, as the symptoms which they severally embodied have been already enumerated. We made four *post mortem* examinations; but beyond general and excessive congestion, which existed in every organ in the body, from the brain (in which it was most prominent) downwards, we found nothing; there was no special lesion. In the lungs, however, of the rat which we examined, there were on the surface what looked like carbonaceous patches—*islands of hæmorrhagic effusion.*

*Cause of Mahamurree.*—We come now to the questions “How does mahamurree originate? and how is it propagated?” I am afraid that we have no better answer to the first question than we had thirty years ago. We now

*know* indeed, as we presumed then, that insanitation fosters the disease and doubtless invites outbreaks: for a relaxation of hygienic regulations (partly as the result of the mutiny of 1857, and partly, it must be added, in consequence of the chief civil authorities in Kumaon not believing in and therefore not rigidly enforcing them) always has been followed by the reappearance of the disease in as virulent a form as ever. From 1854 to 1857, during which period, owing to the energy of Mr. (now Sir John) Strachey in Gurhwal, sanitary progress was there most vigorous and effective, the plague was comparatively quiescent: but, in 1859, and again in 1860, it visited the northern Pergunnahs in Kumaon with great severity; and, in these years, 1,000 persons died from the disease. Again, in 1876-77 there occurred 291 cases, of which 277 were fatal—a death rate of about 95 per cent.! (The official returns show that 3,600 deaths from mahamurree have occurred since its first appearance in 1823.) Until hygienic measures were adopted, the general uncleanness of the people in their persons and *entourage* was incredible. A small stone dwelling (built upon a surface 13 feet square) consisting of two rooms, each about 5 feet high, one above another,—the upper chimneyless and practically windowless; tenanted by the entire family of often more than half-a-dozen in number, and by the huge baskets containing the family grain; the lower compartment (a wooden floor, full of cracks serving as media for the effluvium from below, dividing the two) being occupied by the family herds, consisting of cows, goats, and pigs; a row of such dwellings (sometimes they are single, or double, spread over an irregular surface) similarly tenanted, and flanked at either extremity by the ancestral heap of manure from which streamlets of liquid filth were flowing in different directions; the cottages covered with cucurbitaceous creepers, as, cucumbers, pumpkins, melons, and the like; a small forest of hemp, some 8 or 10 feet high, luxuriating in the immediate neighbourhood of the village; a growth of underwood, including nettles, etc., between the two, and more or less surrounding the latter; and unwashed Paterfamilias, seated in front of his fig-tree, having submitted his head to be divested by a faithful spouse of the light infantry skirmishing in his unkempt hair! Conceive such a village situated towards the base of a mountainous slope, well within the range of whatever noxious influences may emanate from the valley below; located where there would be the veriest minimum of ventilation; and we cannot be surprised if, when sickness

does come, it should run rampant. The atmosphere and peculiar smell in these locations must be *encountered* to be appreciated. They are *sui generis*, and are very suggestive of disease.

*Caprice of Mahamurree.*—The caprice, as it is the fashion to call it, of mahamurree is, like the caprice of cholera, sometimes displayed in a singular manner. There may be two villages placed under apparently precisely similar circumstances; and the one shall be attacked, the other not. I have two such in my recollection. Both situated on the same mountain steep and imbedded in the same jungle, with the same N.N.E. aspect, were only five hundred yards apart; and yet, at every visitation of mahamurree, whilst one has always escaped, the other—Kunowlee—has not. Doubtless there is some condition, the nature of which has not yet been fathomed, that secures the exemption.

*Death of Rats.*—One very singular circumstance is the almost invariable death of the rats\* of the village, which occurs on the eve of an outbreak of mahamurree. One would suppose that, as these animals only die in a particular way, and in some numbers at such times, the natives would at once take warning and vacate their villages; but no—they linger on until one of themselves falls a victim, and then occurs a universal exodus into the jungle, all obligations from ties of kindred being lost sight of in their personal terror; though we witnessed some notable exceptions to this general display of selfishness. Beyond letting the village remain uninhabited, for a time, the people would take no steps to improve its healthiness. At the end of a few months they would go back and live in it as if nothing had happened.

*Mode of a Rat's Death.*—The manner of a rat's death was remarkable: the animal would emerge from its hole on to the floor, stagger, perform an involuntary gyration or two, bring up blood, and die. More commonly the rats were found in the morning lying dead near the sleepers. On more than one occasion a rag has been found between the clenched teeth of the rat. I am not aware that any of

\* A similar preliminary mortality amongst the rats occurs in Yunnan, in Western China, where the disease, evidently plague, has been endemic for some years past, especially since the occurrence of the massacres which accompanied the outbreak and suppression of the Mahometan rebellion in that province; the surrounding provinces remaining entirely free from it. Here the plague is invariably preceded by a great mortality among the rats and other animals living in drains and in holes in the ground. As soon as this premonitory warning is recognised, the people .....purify their houses, abstain from pork, and in some cases fly from the threatened district.

the professional observers ever *saw* a rat die, and as thus stated ; but, as the same statement was universally made by the natives, there is no reason to discredit it. And we saw rats dead.

*Examination of the Grain.*—An idea having prevailed in some quarters that diseased grain (that in common use is the *Eleusine Coracana* known locally as *Mundooa*) might be a factor in the generation of mahamurree, we carefully examined it, as stowed away in the baskets, from top to bottom ; but it was good throughout, without any trace of fungus or any disease whatever. The pultaceous mass of food (consisting of grain) found in the rat's stomach seemed particularly wholesome. And, on their return home from the jungles, the survivors, if they find any grain left by the bears—who generally, however, make a pretty good clearance—entertain no scruples about using it again. Indeed, they sometimes take it into the jungle with them. Doubtless it is diseased sometimes ; and the people, who cannot afford to throw it away, do eat it in that state : but I very much doubt its ever lighting up mahamurree : and, if we admit it as a cause of the disease, it should be in universal operation.

*Death of other Animals.*—From the alleged fact of snakes and jackals being found dead, as well as rats, the diseased grain theory found supporters, who argued that, as the rat eat the grain, and the snake eat the rat, and the jackal eat the snake, the grain, somewhat on the principle of the house that Jack built, would be the original offender. According to this theory the cats ought especially to succumb ; but none, I believe, die at these times more than at others. Those that we saw were, in common with the dogs of the villages, somewhat thin. Disease amongst animals on the appearance of a pestilence is, of course, no new fact. On the contrary, it has been noticed since the time of Livy's writings—the animals suffering first in the order of sequence. Arejula states that, on an outbreak of yellow fever at Cadiz in 1800, the dogs died first, then the cats, then the horses, then the poultry ; and, lastly, canaries, from the bills of which, in some cases, blood issued. I may mention here that Dr. Pearson, in his long experience, saw no connection between mahamurree and the disorders of cattle. The cattle suffered occasionally from foot and mouth disease, but not especially in mahamurree years. During the outbreaks of this disease, and before, they, as a rule, remained healthy, as did the sheep and the goats. Dr. Watson (who succeeded Dr. Pearson) attributes their

immunity from the plague to the fact of their eating only grass and no grain. He gives, in support of the grain theory, the case of rats, in the neighbourhood of a water-mill, beginning to die only when some grain had been taken from a village to be ground. With the exception of rats, and much more rarely, snakes,\* the death of animals in connection with mahamurree was not a marked feature. If one animal, eating another plague-infected, should die, how much more the bears who, it is alleged, consume the bodies of the villagers that have died of mahamurree? Certain it is that bears are often carnivorously disposed; and that they were observed in greater numbers than usual in outbreaks of this plague. I myself saw, one moonlight night, what appeared to be a small family of bears pass the bamboo scaffolding on which I was seated—they were too far for a shot—and the plague-stricken corpses rapidly disappeared. No dead bears were ever seen.

*Escape of Pilgrims.*—A colour has been given to the diseased-grain theory in consequence of the pilgrims, who annually visit the hill shrines in large numbers, eating other than the village grain (their own, which they carry with them, whilst it lasts) and escaping. But, in the northern villages (those immediately below the snows, where grain is largely grown for consumption in Hoondes, as already mentioned) there is a considerable traffic in grain with the pilgrims, who here replenish their stores. Dr. Watson says that they do not eat the common grain of the hills, in which a poisonous fungus is apt to form, but wheat, barley, rice, and pulse, in which it does not. Dr. Watson speaks of two pilgrims dying from mahamurree; but I do not think that he saw them. I have written for the favour of being furnished with particulars. The immunity of the pilgrims is probably attributable very much to the circumstance of their holding, with the exception just mentioned, little or no intercourse with the hill villagers. The roads to the shrines, as a rule, skirt the villages; they do not frequently pass through them. An infected village would, of course, be studiously avoided. The pilgrims from the plains, whence these worshippers come, are Hindoos, who think much of themselves, and look down upon their Hindoo brethren of the mountains. Of even a Brahmin amongst them they would sneering say, "Oh! he is only a *hill* Brahmin." Hence the communication with each other is, except where absolutely necessary, very limited. Moreover, the body-clothing of the

\* Possibly more dead snakes might have been found, if looked for, in their holes.

pilgrims is made of cotton. During their progress in the hills (short of the snow) the temperature is rarely below 75 deg., and it is a curious fact that, in the upper regions, where there might be danger, as Okermuth, on the Kedarnath road, and Joshimuth, on that to Budrinath, the two\* pergunnahs, through which the pilgrims pass, are uniformly free from mahamurree, though it may be raging in neighbouring pergunnahs†.

To return to the question, "What is the essential cause of mahamurree?" I trust I may be pardoned for quoting here the views of Dr. Murchison on the origin of disease, appealing as they do to our common sense. He says, "The poisons of all diseases must have originated at one time or another independently of a pre-existing case. Contagion necessarily implies the presence of two individuals, the giver and the receiver of the morbid germ. It is self-evident, then, that in the first sufferer from any disease its origin must have been *de novo*; and there is no reason why the unknown causes of the first case may not operate at the present day. The history of medicine, moreover, shows that new contagious diseases have from time to time appeared, while old ones have died out." Murchison adds, speaking of typhus, "Although in a large proportion of cases, especially during epidemics, the specific poison is derived from persons previously infected (contagion), it is, I believe, equally true that it may be generated independently." He then describes the conditions under which typhus may originate, the conditions which, in the most essential points, are rife in Gurhwal, viz., "overcrowding of squalid human beings, and deficient ventilation; in other words, the poison is generated by the concentration of the exhalations from living beings, whose bodies and clothing are in a state of great filth." "The great predisposing cause", Murchison continues, "is defective nutrition." Now, the aspect of a Gurhwallee does not convey the idea of want of stamina, and yet he has but little. His food, he will tell you, consists of *Mundooa ke rotee awr sheeshna ke say*, i.e., of unleavened cakes of the eleusine above referred to, and boiled nettles for vegetables. The nitrogenous element in this combination is not abundant.

*Climatic.*—Mahamurree, flourishing in a plague latitude, is a temperate climate disease, occurring for the most part, says Dr. Pearson, during the hot and rainy season; though, under favourable circumstances, it has, like other hot-weather diseases, appeared (and with virulence) in the

\* Dasoli and Painkhunda.

† See Dr. Watson's report.

cold weather. Its usual habit is to break out towards the close of the rainy season, and to continue, often, till the end of December, when it remains quiescent. It may again show itself in March or April, and continue till May, when it abates, and, for the time, disappears. Good asserts, and Sir G. Blane supports him, that, in Europe and Africa, the plague is destroyed or suspended between 60 deg. and 80 deg. Copland gives lower figures, viz., from 35 deg. to 75 deg. But mahamurree has appeared within a considerable range of temperature. I have seen it with the thermometer, in my tent, varying from 83 deg. to 95 deg., rising, in a grass hut, to 105 deg. But the atmosphere was more or less damp. It is very probable that, with a perfectly dry air, and the thermometer at 75 deg., or above it, the poison would be inert. Extremes of temperature, combined with moisture, are, as is well known, not unfavourable to the development of disease. But dry cold is bracing, and the healthiest season of the year in India is the hottest, when the dry hot winds are blowing their hardest. Kumaon and Gurhwal, as already stated, are in plague latitudes, as also are the plains of Upper India; but the native inhabitants of the latter escape mahamurree, it is alleged, in consequence of the great heat. Their personal cleanliness, and a better sanitary condition (though in many places there is room for improvement in this respect), doubtless conduce greatly to their immunity.

*Poison in the Soil.*—I strongly incline to the belief that the poison of mahamurree exists, in great force, in the soil, which becomes at every visitation more and more impregnated with it, owing to the filthy habits of the people. They contribute to its accumulation in every possible way. The very plague corpses are committed—those that are meddled with at all—to the earth, which is nothing but a rocky sub-soil, and most unsuitable for such interment; and they excavate it to a depth of not more than two feet, in immediate proximity moreover to their homes! A far better plan would be cremation (which might be adopted with cholera and small-pox cases also) on the banks of a stream leading (as so many of them do) to a sacred river. The death of rats and snakes favours the view of the poison emanating from the soil, but whether this be associated with electrical or volcanic changes in the rocks, or earthquakes, or the development of sulphuretted hydrogen, we do not, as yet, know. Dr. Planck, the Sanitary Commissioner of the N.W. Provinces, who was deputed to investigate, in conjunction with Dr. Pearson, the outbreak of mahamurree

in 1876, believes that the rats die of suffocation. He comments upon the fact of these rats being unlike the large animal of Norway origin that frequents our sewers. They are grey and of a more delicate constitution. He discredits the diseased grain theory, as the rats are not found dead in their holes. I am not aware, however, whether these have ever been thoroughly searched.

*Contagion.*—The infecting power of mahamurree is undoubted: indeed, it has been spoken of as “intensely communicable”. Amongst the numerous instances, illustrative of this truth, I may mention the following. At a village called Bintola, in November 1876, the child of the headman sickened with mahamurree, and died on the third day. This was the first case. Two other children in the same family also sickened shortly afterwards, and died. The unfortunate father owned two contiguous houses—his homestead; and his family consisted of fourteen souls. During November and December thirteen succumbed to the disease, which, in each case, set in with similar symptoms; shivering, intense fever, with delirium, followed by insensibility and death, which occurred on the third or fourth day. In the three houses adjoining those belonging to the headman lived three families, consisting likewise of fourteen persons. The women of these families helped to move the children of the headman. Soon, the disease, attacking them, carried off twelve of *their* number; passed on to the rest of the village and, in the two months, destroyed, out of thirty-one attacked, twenty-seven lives, including those in the huts to which the stricken ones had fled. Into another village—Balt—went a woman from her own (which was uninfected) to nurse the children of the headman *there*. She caught the disease, returned home and carried it with her; for almost immediately on her arrival mahamurree broke out.

*Immunity of Europeans.*—It is remarkable that no European has ever been attacked by mahamurree; yet, in the discharge of their duty, several medical officers have been exposed to the contagion. Dr. Watson, who succeeded Dr. Pearson, maintains that, if the doctor visits a patient in his house, or hut, on a cold damp evening, after sunset, and sits in it for a minute or two, and feels the pulse, he is almost sure to contract the disease, which will appear within twenty-four hours. A professional examination may be made with impunity, adds Dr. Watson, if the sun be shining and the air warm. Doubtless, this view is correct. Dr. Pearson and myself were careful to keep to windward of the patient, and to wash our hands (which we kept free

from abrasions) after contact with him; and we made a point of oiling them when performing the *post mortem* examinations. But Europeans, when travelling in these hills, are not under the conditions that predispose to an attack of mahamurree; and, with ordinary precautions, would be very unlikely to catch it.

*Pali Plague.*—The Himalayahs are not the only place in India where plague has appeared. It has raged with great virulence, though more temporarily, in the West of India, in the Bombay Presidency. Its first advent there was, it is believed, in May 1815, in Guzerat, Kuttywar, and Cutch, after three years of severe famine. It reappeared, the following January, February, and March, in the same locality, whence it migrated to Scinde. It seems to have remained in these parts till 1819, when it disappeared; and we hear no more of the disease till July 1836, when it broke out with violence at a town called Pali, in Marwar, whence the name by which it has subsequently been known—*Pali Plague*. Although not altogether a new disease, it first attracted official attention in 1836, the very year in which mahamurree was first brought to the notice of Government. It was remarked by a Gooroo (or priest)—“This seems to be a new disease, but it was known to the past generation;” a statement which points to the outbreak of 1815, extending over four years, till 1819. From Pali the disease radiated within a circuit of thirty miles, extending in October even as far as Joudhpoor. Under the energetic supervision of Major Dixon, then superintendent of Ajmere the capital of Rajpootana, quarantine was established; and the plague did not reach any other states in the province, the intervening hilly country of Mhairwarah helping to exclude them. One town, however, viz., Dewar, was affected, owing to infringement of the quarantine regulations. Interested traders persuaded the inhabitants to conduct porters carrying the bales of merchandise into Dewar, where the disease immediately afterwards broke out; passing over, in March (1837), to Deogurh in Meywar, in which district thirty-two villages in all were attacked. With the setting in of the hot season, in that same year, the plague declined, and has not since been heard of, as such, in that part of India. Medical officers, one and all, unhesitatingly called it infective plague. Whilst this plague was raging in Rajpootana, in Jilwara common remittent fever was very prevalent: in the intermediate space occupied by Jeypoor the intermittent of the country was rife; whilst, in Rohilcund—the district ex-

tending to the foot of the hills where mahamurree was doing its work—a deadly infecting epidemic resembling yellow fever was decimating the country. The concurrent existence of these several epidemics seems to show that the general meteorological (?) conditions were such as to call into action the operation of influences peculiar to each locality: malarious fevers in one, yellow fever in another, typhus in a third, and plague in a fourth. As before mentioned, no doubt was felt as to the nature of the Pali disease. An attack would be ushered in by shivering, with hot skin, great debility, universal tremor—so marked a symptom in mahamurree; great thirst, a white-coated tongue, fiery red papillæ showing through the coating in some cases at the edge; insensibility on the second day, followed by an early death. No petechiæ were seen, but glandular swellings were common. The mortality was usually 50 per cent., rising as high as 75. Convalescence, in the recovered cases, was very slow. The treatment adopted by the natives was even more simple than that for mahamurree. It merely consisted of hot stimulating fomentations to the glandular swellings. Said a barber-surgeon to one of the medical enquirers: “I never meddle with patients till after the fifth day.”

*Origin of Pali Plague.*—Once started, the Pali plague was highly contagious: but the question was, how was it started? Was it imported? Some believed that it came from Egypt: but if so, it surely should have appeared first in the line of direct communication and traffic, as Bombay? but it was never seen in Bombay at all! The influence of decaying vegetation must be excluded, as there was none: neither was there any pestilential air from neighbouring jheels; which did not exist. Moreover, the fever was not of the kind that is generated by these causes. The soil was everywhere sandy and dry; and the towns were either built on such soil, or on the rocky bank of a running stream. It is far more probable that the Pali plague originated, like mahamurree, from animal poison, the conditions under which the people of Kuttywar, etc., lived, being pretty much the same as those affecting their fellow sufferers in the hills.

*Sanitary.*—The people were filthy beyond conception. They wore a large quantity of clothing, which was seldom changed. It was sometimes even allowed to rot on the person. As in the hills, the family herds lived under the same roof as their masters; and the dwellings, as also the bazaars and alleys, were always over-crowded.

*Commenced amongst the Chippahs.*—We find that the Pali plague invariably appeared amongst one class of people, viz., the Chippahs, or cloth-printers of Pali: that it then attacked others, who fled and formed fresh foci of contagion. The Chippahs principally had dealings with the bunnyahs, or intermediate small traders, who thus became the carriers of the poison. Why should the cotton-printers be the first to suffer? Because, it is urged, they imported the merchandise from Surat, on the coast; because they unpacked it; and because it consisted of goods brought, in part, from plague countries; whence it would, therefore, contain the fomites of contagion. Surat has commercial intercourse with Egypt, the Red Sea, and the Persian Gulf. In Kuttywar, as at Pali, these importers of cotton goods also *worked* in cotton—they made cotton cloths. From whatever source the poison came, the avocation of the Chippahs invited its advent amongst themselves, raw cotton affording a favourable nidus for its abode, just as the woollen dress of the Gurhwallee more readily gave a lodging to the poison of mahamurree, than did the cotton garment of the Kumaonee. Cotton raw, and cotton made up, are of course two very different things. The theory of packed goods transporting the poison, and disseminating it when those goods reached their destination and were unpacked, has been recently maintained by Professor Hirsch, the celebrated authority on infectious disorders, who, in a discourse delivered last year before the Medical Association of Berlin, expressed his belief that the poison of the plague which broke out at the end of 1878 in Vetlianka in Astrakhan, resided in the packed goods that were being conveyed from Mesopotamia to Armenia; and that, when these goods, having become the spoil of the Cossacks, were taken by the latter to their homes, and there opened out, this poison became diffused.

*Pali Plague and Mahamurree.*—The questions not unnaturally arise—Are Pali plague and mahamurree identical? And “is it possible that the latter was imported into Kumaon and Gurhwal from the West of India, where the former had been so virulent?” Although neither Dr. Pearson nor myself (nor, I believe, other enquirers into the origin of mahamurree) believe in this importation, I am bound to admit the possibility; and I do so the more readily, because I would gladly defer to the opinion of so distinguished a writer as Dr. John Murray, who states, in the paper above referred to, “this contagious fever spread northward, by Jeypore, to the Doab, extended to Rohilcund,

at the base of the Himalayahs, where Kumaon and Gurhwal are situated. . . . . A pilgrim from Kuttuywar, proceeding to Kedarnuth, may have conveyed the infection in his clothes or person, and thus communicated the disease to the head priest and his assistant Brahmins."

*Communication between Kumaon and Gurhwal and the West of India.*—On referring to the map of India, we find that a distance of between 700 and 800 miles separates the birth-place of the plague in the West of India from Kumaon and Gurhwal, the plains of Northern India intervening: and I am not aware of any regular direct communication between the two. The Bhotiyahs—the carriers of the hills before referred to—annually descend into the plains during the cold season, and visit some of the principal towns there, as Allahabad, Agra, Delhi, etc., going, now that they have, in a great measure, overcome their dread of small-pox, as far as Calcutta. But I believe that they have never yet penetrated into the presidencies of Madras and Bombay. Railway facilities may, in the future, enable them to do so; but, without these facilities, it would be next to impossible, their time being so limited. The Bhotiyahs are always anxious to be back in the hills before the hot weather sets in. But, even if they did traffic with the West of India, the merchandize they bring is conveyed past and through the hill villages, in which mahamuree has appeared, into Thibet, where the bales are opened, and where the plague has never been. I once met with a curious instance of the occasional intercourse that is brought about through the medium of merchandise between remote districts. Goître is not uncommon amongst the Bhotiyahs, who purchase, at a high price, in view to removing it, a semi-leathery substance, which, obtained originally in Surat, is now and then met with amongst the heterogeneous wares of a venturesome itinerant pedlar, who occasionally finds his way into their villages. The Bhotiyahs look upon this as the best remedy for goître in existence. It is taken internally. Curious to know what this thing could be, I put a small piece into a saucer half full of water. It swelled out into a *fucus*, containing, of course, iodine. But even this sort of communication, which would be exceptional, does not account for the systematic importation of plague-poison into those villages of Kumaon and Gurhwal where mahamuree breaks out. If imported at all, the importers would be pilgrims. But pilgrimages are made annually, as heretofore, to the same shrines, the insanitary surroundings being, so far as I am

aware, the same as ever ; and yet there has been no outbreak of mahamurree there for more than half a century. Dr. Murray writes, speaking of the outbreak at Kedarnath : "The disease, thence arisen, spread to the villages or religious assignments connected with the temple, and afterwards extended to the villages in the route of pilgrimage." This passage conveys the idea that pilgrims introduced the disease into Kumaon and Gurhwal—an idea, however, which has not been entertained by the local authorities, at any rate, in recent times. I have already remarked upon the personal immunity of the pilgrims in the present day : and my attention was especially drawn to the fact by the local authorities, when I was first associated with Dr. Pearson. That Mahamurree broke out at Kedarnath amongst a body of travel-worn and attenuated pilgrims, in consequence of local conditions then and there existing, one can readily believe ; but that a pilgrim conveyed the poison on his person a distance of 800 miles in, say, forty days—giving twenty miles a day as his rate of travelling (sickness or other detaining causes might have made the time longer)—without communicating it *en route* is, I think, with great respect for Dr. Murray's views, less conceivable than that the disease originated from local causes, which are always more or less in operation in these hills—causes which are known to generate virulent disease without any aid from without :—witness the typhus-stricken survivors of the Black Hole tragedy in Calcutta ; the outbreaks of the same disease in some jails ; and of blood-poisoning in overcrowded hospitals and emigrant ships.

*Exportation of Mahamurree.*—Whilst discussing the question of importation, we must not lose sight of one that is quite as important, viz., the exportation of mahamurree. Dr. Pearson informs me that he has never heard of it since the time when we worked together. A disease, having very much the same general character as mahamurree, appeared in one or two villages at the immediate foot of the hills in which mahamurree was raging ; and the civil surgeon\* in charge believed in its having been brought from those hills, and in its being conveyed, through contagion, from one village to another. The infected villages were in an insanitary state, and rats died, though not, as in the hills and at Yunnan in Western China, in the first instance. They died after the appearance of the disease amongst the human population.

Whilst, from the past history and general characteristics

\* Dr. Stiven.

of mahamurree, we may reasonably infer that there is but little fear of its appearance in localities unsuitable for its reception, the fact of its having broken out in localities that are suitable (aye, even in those that apparently are not—witness some of the cleanliest villages in Kumaon), the inevitable conclusion is forced upon us, that the only safeguard is thorough sanitation in all its forms.

*Quiescence of Pali Plague.*—The present inactivity of the Pali plague is a point of some interest. For forty-three years it has not been heard of. What are we to infer from this? Are the localities in which it broke out before in a more wholesome state than they were in then? Has there been any change in the commercial relations with plague-infected countries? Or is everything in the *status quo ante*? I have solicited the favour of information on these points from the Sanitary Commissioner with the Government of India: but, pending the receipt of a reply, I venture to think that, as no fermentation can take place in saccharine solutions without the fulfilment of the conditions necessary to the setting up of that process, so, doubtless, there is some deficiency beyond our ken in those that lead to the development of diseases like the plague.

*Remedial Measures.*—The remedial measures within our reach are, in two words, *improved hygiene*; which consists of what is personal, and of what affects the surroundings.

*Personal.*—As reformation is not very probable in the case of adults in vice, we can hardly hope for any great results by preaching cleanliness to the present generation of Kumaonees and Gurhwalees. But we may educate the young; and suitable books have accordingly been published, for use in the Government schools. The natives of India, generally, are fond of tales that abound in proverbs; and a work of this kind, in two parts, has been specially prepared for these mountaineers. It is called “The story of Furnkhabad and Budrenath”. The first part tells all about small-pox and vaccination; the second, of the advantages of cleanliness in warding off such diseases as mahamurree. So well did the authorities think of this little work, and so popular did it become, that, when all the copies were destroyed in the Mutiny of 1857, the Government had it reprinted. The recent introduction of a *Sanitary Primer*, as a text book, into the Government schools, is an important step in the right direction.

*Surroundings.*—But, whilst we can only recommend personal cleanliness, we can enforce cleanly surroundings. We can, *e.g.*, insist upon periodical whitewashing with lime or

clay ; upon better ventilation ; upon the proper disposal of all kinds of filth and the prevention of decay in it ; upon the curtailment of the low growing vegetation ; upon the cremation of the dead ; and on the burning of sulphur \* in anticipated outbreaks of the disease ; and upon the location of the cattle away from human habitations. There is more opposition to this last measure than to any ; involving, as it undoubtedly does, danger from tigers in the wilder parts of the country. Stone enclosures, which are safest, are, if made to be of any use, expensive. Still they (or in districts where stone is less abundant some substitute) should be insisted upon, Government making the expenditure lighter by remitting a portion of the revenue. I very much fear that, until the people themselves become hygienically wise, there never will be any heart in their co-operation with the authorities, and that this Augean stable will remain but half cleansed. When sanitary reform was first introduced, so little did the villagers believe in it that, preferring, moreover, the old groove, they simply disobeyed the instructions of the Government directly the medical officer's back was turned ; and it was only when Dr. Pearson was invested with magisterial authority and power to enforce his own orders that they were complied with. So far, mahamurree has only been scotched ; but the efficacy of sanitary measures has been clearly demonstrated (two or three years after their introduction Dr. Pearson wrote to me saying, "mahamurree is practically extinct") ; and we have, therefore, every reason to hope that, as leprosy—once so rife in England—and other pestilential diseases have, with the advancing tide of civilisation, disappeared from our midst, so, when they come to acquire clearer views on the subject, mahamurree may become to the Kumaonee and Gurhwalee as much matters of history as these diseases have become to us.

*Medicinal.*—From the exhibition of drugs, there has been no result sufficiently satisfactory to justify confidence in any. Hyposulphites, as suggested by Dr. Watson, would doubtless be found useful. Regulation of the secretions, promotion of suppuration in the glandular swellings, aperi-

\* When the inquiry was instituted in 1852-53, it was considered necessary to destroy the infected villages by fire, compensation being awarded. But, if the same ground is to be re-occupied, burning sulphur would answer the same purpose. I believe that nothing short of rebuilding on improved principles on a fresh site would be of much permanent use. A combination of *gutting*, destroying the wood-work by fire, and to which the natives themselves are partial, and sulphur-burning (this last, to be effective, must be done *very thoroughly*), would doubtless make the purification of the infected spot as complete as possible.

ents when called for, with general support of the system, is the most promising line of treatment. Whatever benefit might accrue from medicines would be much diminished by the delay in their administration. By the time a medical officer could hear of a case, and reach it, nature would have decided the issue one way or the other. To obviate this disadvantage the people have, from time to time, been provided with a few medicines and a memorandum of instructions how to use them. In preparing this memorandum, the opportunity was taken to draw their attention to the value of certain local remedies growing within their reach.

*Summary.*—Briefly to sum up. 1. Mahamurree is bubonic plague. 2. It is endemic, caused by an animal poison, which is generated by the operation of local conditions. 3. It is quite distinct from—and, as a rule, in no way modified by—the types of fever that are caused by malaria. The usual malarious fevers of India, intermittents and remittents, prevail in these hills from time to time, but they have no connection with mahamurree. 4. Cholera also appears occasionally, but neither is there any relation, vicarious or otherwise, between it and mahamurree. 5. The cattle suffer in some years from foot and mouth disease, but not, it is said, more in mahamurree than in other years. 6. Mahamurree is highly contagious (I use the term synonymously with infectious); and, once in existence, is rapidly propagated from person to person and from place to place, the development of the disease being limited, however, to those persons and those places where the soil—*i.e.*, the conditions favourable thereto—is suitable. 7. Dry heat and cold, especially the former, are unfavourable to the development of mahamurree, which may appear at any temperature and season, though the poison becomes comparatively inert in the dry, hot weather. It ceases, too, during the heavy rains. 8. When once the disease is established, medicines are of little or no avail. To eliminate the poison, to counteract its virulence, and to support the strength, is the most promising line of treatment. 9. It having been proved that sanitary measures are of decided efficacy, our main efforts should be directed to their rigorous enforcement, by which, the people themselves joining heartily in the work, we can alone hope for the eradication of this plague from the paradise of India.

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