

- Cantlie, J. A. Lecture on the Spread of Plague. *Lancet*, 1897, January 2, p. 4.
- Cobb, R., and Simpson, W. J. R. *Pestis ambulans*. *Ind. Med. Gaz.*, Nov., 1896.
- Drake-Brockman, H. E. Treatment of Bubo by Compression. *B. M. J.*, 1889, Sept. 28, p. 719.
- Godding, C. C. On Non-Venereal Rubo. *B. M. J.*, 1896, Sept. 26, p. 842.
- Lesueur-Florent. Les adénites d'apparence palustre. *Arch. Med. Nav.*, 1896, Jail, p. 64.
- Martin, L. Ueber die malaria der Tropen-länder. Berlin, 1889, p. 36.
- Nagel, O. Klimatische Bubonen. *Münch. Med. Woch.*, 1898, No. 9, p. 260.
- Ruber, J. Ein Fall von Bubo Malaricus. *Pester Med. Chir. Presse*, 1879, No. 47.
- Ruge, R. Die der Zanzibar Küste Leistendrusenentzündungen. *Arch. f. Derm. u. Syph.*, 36, 1896, p. 3.
- Scheube, B. Ueber Klimatische Bubonen. *Deutsch. Arch. f. Klin. Med.*, LXIV, 1899, p. 182.
- Scheube, B. Die Krankheiten der warmen Länder, 1900, p. 255.
- Schön, E. Arb. a. d. Kais. Gesundheitsamte, XIII, 1897, p. 170.
- Segard, Contribution à la géographie médicale. *Arch. de Med. Nav.*, 1886, p. 24.
- Skinner, B. M. *Brit. Med. Journal*, 1897, January 9, p. 78.

THE RECENT OUTBREAK OF MAHAMARI (PLAGUE) IN GARHWAL.*

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THE following is a detailed report of an enquiry made by me into an outbreak of *mahamari* in Garhwal, together with a history of the disease in former epidemics, and an account of the bacteriological investigations carried out by Mr. E. H. Hankin, Bacteriologist to the Government, and myself with cultures obtained by me from cases that occurred in the course of an outbreak at the village Buransi, *patti* Chaprakot, *pargana* Chandpur, district Garhwal, in January 1902.

On December 26th, 1901, I received telegraphic instructions from the Government of India, through the Government, North-Western Provinces and Oudh, to hold myself in readiness to proceed to Garhwal to investigate and report on an outbreak of *mahamari* which had been continuing in certain *pattis* north of Pauri since October, and on 28th December 1901, I received orders to proceed to Garhwal and report on this outbreak and, if possible, to take cultures from cases for the purposes of bacteriological examination. For some years endeavours had been made to observe cases and get cultures, but, in spite of many attempts to do so, no one had up to this time been successful in obtaining

cultures of hill plague. The British Plague Commission were much interested in this form of the disease, and in a letter No. 990, dated 31st March 1899, the Secretary of the Commission deputed two officers, Lieutenants H. J. Walton and S. R. Douglas, I.M.S., to tour about the hills, make a census of the *mahamari*-infected districts, and endeavour to secure cultures for bacteriological examination, in order that it might be settled once and for all what the exact nature of the disease was, and whether it was true plague or not. They were unfortunate, no cases of *mahamari* occurring that year, nor did any cases occur either in Garhwal or Kumaun between April 1897 and October 1901 (present outbreak), and, moreover, the period April to July during which these officers were in Kumaun was not a time when the disease was likely to occur.

The home of hill plague appears to be the southern slopes of the Himalayas; it is almost entirely confined to that part of the Himalayan region comprised in the hill districts of Kumaun and British Garhwal. Elsewhere it has not been noticed: the Kashmir mountains, the Pamir region, as also Thibet, Nepal, Sikkim, and the hills beyond Darjeeling are all free of the disease. The area where this disease prevails is therefore little more than 11,000 square miles with a population of a million persons, with an average of 72 persons to the square mile, who inhabit scattered villages situated on the mountain sides at an elevation of 3,000 to 12,000 feet above sea-level.

The surroundings where this fell disease prevails are picturesque in the extreme. Ranges of mountains, overtopped by the snows of the higher Himalayas, give a background to a picture that nature could hardly improve on.

The slopes of these hills are well wooded with pine trees, and scattered about are prettily situated villages with white and red houses dotted here and there among the trees. Each row of houses has a terraced front, and from this frontage down to the mountain stream that runs at the bottom of the hill, terrace upon terrace, tier upon tier, are the fields carefully banked up and laboriously constructed. But when one approaches the villages and houses, one learns the extreme filth these people live in. They are quite indifferent to it, and do not wish for anything better. They have enough to eat—famine rarely visits them,—a roof to shelter them, and the finest air and water nature can provide. They are quiet, contented, and happy. It is only when disease in the form of plague visits them that they are disturbed in the even tenour of their way, and then a very great fear possesses them so that they voluntarily abandon their houses and live in the jungle.

The Garhwali, specially the lower castes, are indescribably filthy in their habits. The better class wash at the change of the moon once a month, but the Doms probably never wash. The rigorous climate does not conduce to personal cleanliness. A typical Garhwal village consists of 12 to 24 houses perched on the side of a steep hill; they are all stone built, with slate, stone, or *chappar* roofs, and many are double-storeyed. In days gone by the cattle inhabited the lower storey and the family the upper, but cattle are not allowed in the houses, and since the issue of the *mahamari* rules are placed in *goshalas* 50 yards away from houses: the rooms are 8 to 10 feet square, and the roof so low that it is impossible to stand upright in any part. There are no apertures for ventilation except by the door and an occasional window, and these are all closed up as soon as the sun sets. In the rooms are generally stores of grain and implements of all sorts, while the house itself

* [Being extracts from a Report to the Government of the United Provinces. We have been obliged to omit the portions dealing with the previous history of the disease in Garhwal, confining the paper to the description of the recent outbreak.—ED., *J. M. G.*]

is surrounded by high hemp plants, which obstruct the light and impede free ventilation of air. The general surroundings of the village are indescribably foul, and the precincts being usually one large latrine. The men all wear a woollen blanket and a cloth, the women merely a skirt and bodice. Their food consists of *chapatis* made of the coarser grains, with some chillies, salt, and vegetables. They rarely indulge in such luxuries as milk, *ghi*, or sugar. The disease appears to be confined to the hemp-growing parganas (*bhanganun*).

The extraordinary regularity and frequency with which the outbreaks occur every few years, with a period of total cessation between, and the fact of the outbreak being always limited in extent, leads one to believe that there must be some local causation for the outbreak, and that the bacillus must have some dwelling place in the interim. Although the people are extremely filthy, this of itself, as Dr. Pearson and Sir H. Ramsay astutely remarked in 1852, is not sufficient to re-start the disease. Its recrudescence in sporadic form from time to time points to the fact that there must be a medium for the specific germ, and that when a certain something is added, very possibly a re-incubation in the body of a rat, a revivifying occurs, and the germ again becomes active and the disease breaks out, at first sporadically, and then as an epidemic. All outbreaks have been extremely fatal. 95 or 96 per cent. perishing of the scourge. As stated elsewhere, it is the habit of these hill people in cases of cholera and plague to bury adults of both sexes for a period of six months and to then exhume the remains and, in accordance with the Shastras, burn these and perform the *kirya karam*. Children of both sexes who are unmarried, and male children who have not been invested with the sacred thread (*janeo*), are under all circumstances buried, and their remains never exhumed. These people think that the smoke from the funeral pyre is infectious by inhalation. The custom is therefore to bury, as above stated, for six months in moist earth, and then exhume and burn in the orthodox manner. When the body has been placed in moist earth, it remains undecomposed for a long time, and I am thoroughly of the opinion, which I have expressed to the Deputy Commissioner, that the exhumation is attended with serious danger, in that the bacillus, either in the remains or in the earth, finds a chance of escape and can be conveyed to a distance either by men or animals, and by its passage through the body of a rat becomes widespread and active. The danger being fully explained to the villagers of Buransi, they expressed their willingness to fall in with our suggestions and refrain from unearthing the remains, and to content themselves with building a fire over the grave and look upon it as equivalent to the ordinary *gatti*. In addition, they have with apparent willingness accepted my assurance that the disease is not spread by smoke, and have agreed in future when an adult dies to burn the body then and there. It remains to be seen if they will be as good as their word. This and other matters are embodied in the new *mahamari* rules (1902) I have drawn up and submitted to Government through the Commissioner of Kumaun.

Outbreak of plague at Buransi.—As regards the present outbreak, as soon as information was received on November 22nd from the *patwari* at Buransi by the Deputy Commissioner, Garhwál, Assistant Surgeon Gobind Narain Das at Srinagar was telegraphed for and sent direct to Buransi to enquire and report as to the suspected cases. Buransi village has an elevation of 4,300 feet above sea-level and is situated in the Bali Chaprakot *patti*, Chandpur *pargana*, 22 miles north-west of Pauri. The village is perched on the side of a steep hill, with a stream running at the foot of the hill. There are some 70 houses and 400 inhabitants, which consist of Rajputs, Bráhmans (Biths), and Doms. The Dom settlement, where the disease first broke out, is apart from the rest of the village. Bali Chaprakot has an unenviable reputation for *mahamari* and has had frequent outbreaks, the last being in the spring of 1894, when the village Gadoli was attacked, 7 persons dying in two

households. On arrival of the Assistant Surgeon on the 25th, the facts were elicited that on or about October 12th Birkhu's son, a young boy, fell ill of fever and after three or four days' illness died on the 17th. He had been working at Bharsar tea garden. The next day, October 18th, the mother of this boy (Birkhu's wife), died. She also had had a few days' fever. There was then apparently a lull till November 7th, when Nathulia's son, a boy of 7, died after suffering from pain and swellings in the neck and fever. This is the first mention of swellings. On November 17th after two days' illness, the son of Bhuria died, aged 13. He also had fever and swelling in the neck. He had been working in the Bharsar garden. On 19th November the fifth death occurred—Saduli, a Dom girl, aged 10, who also had pain, fever, and swellings in the neck. Her father was a workman in the Bharsar garden. On November 20th Saduli's mother, aged 35, died of the same disease after three days' illness. Her husband worked in the Bharsar garden. The seventh and last case of this preliminary outbreak at Buransi, a girl of Khim Singh's, aged 8, fell ill on the 22nd November and died on 28th. Her brother worked in the Bharsar garden. This case was seen by the Assistant Surgeon, who examined it and found enlarged parotid glands and all symptoms of hill plague. All these cases except the last were among the low caste Doms who live in the Domana apart from the rest of the village. On the evening of the 25th November the Assistant Surgeon received a report from the *patwari* that in Duleth village, a mile from Buransi, Aitwaru, Dom's son, aged 6, had died that morning, and that the daughter aged 12 was sick. This village was visited next morning, and the girl was found to have a temperature of 104.6, pulse 130, eyes bloodshot and red with severe headache and fulness in the parotid region. The father said his son had had similar symptoms, with swellings in the throat, and had died after two days' illness. Both cases were diagnosed as plague. The village of Duleth is situated on the side of a steep mountain, one mile from Buransi and is a collection of 27 houses, more or less scattered and of the same pattern and class as those of the hill villages. Evidence of connection between Buransi and Duleth was clearly established, as Aitwaru had been over to Buransi for the Diwali on 14th November, and had had food there, eating and concerting with the Doms. The Dom Aitwaru as the Doms do, lived apart, but it is noteworthy that, on the occurrence of the death of Aitwaru's son the Doms, suspecting plague, immediately of themselves left their huts and went to the jungle, where the Assistant Surgeon found them. Aitwaru, with his sick daughter, was found in a hut a long way off from the rest of the Doms, who said she was suffering from *mahamari*. Aitwaru said that with the help of his wife he had buried his son in a *khad* and had come there with his sick daughter, who died that night and was buried near the first child. The hut and everything was burnt and the parent segregated.

Besides these cases, one man, Mishal, a Dom, had died on 17th at Kaproli, a village seven miles away from Buransi. He, however, had been visiting a sick friend at Buransi. Two points are noticeable here: (1) that all the cases belong to the Doms; (2) that most of the cases had connection some way with the Bharsar tea garden. These ten cases complete the first outbreak, and no more cases occurred in these parts till December 22nd.

Origin of the outbreak.—There is much difficulty in elucidating actual facts as to the origin of the outbreak. The first point that attracted attention was the fact that at Buransi many of the inhabitants and parents of the first cases worked at the Bharsar tea garden. Though called a garden, it was in reality not so, as there were no tea plants or fruit trees there; it was only being cleared for the purpose of a garden. The fact that people worked there was found on enquiry not to be a matter of much importance as applied solely to the case of Buransi, as the circumstance was common to all the country-side, the surrounding villages all supplying coolies for

work at Bharsar, many villages that supplied men being much closer to Bharsar than Buransi, and all the inhabitants of these villages around remained perfectly healthy and had no illness. There were 16 men living in out-houses on the hillside on the Bharsar garden; they were all healthy.

On enquiry at Bharsar itself it was found that this place was merely the side of a mountain, which was, as stated, being cleared for a fruit and tea garden. There were living there a Eurasian and his son, named MacMullen. These two men had left Sialkote in the middle of August, and at the time there was no plague at Sialkote. From Sialkote they went to Amritsar, where they stopped four days, going on to Saharanpur, where they stayed two days. There was no plague at either of these places. From Saharanpur they went on to Kotdwara, the terminus of the railway, and then marched slowly on foot to Pauri (five marches), arriving there end of August. They stayed a night in Pauri, and went over to the Mission at Chopra, four miles off, where they stayed one week, going on then to Bharsar, 20 miles distant from Chopra, where they stayed one night only, going on to Masseti tea garden, eight miles further north. At Masseti they stayed three days, then came back to Bharsar, staying a week together there. The father then returned to Sialkote and left the son at Bharsar. Coolies were first engaged during middle of September from thirteen surrounding villages to work at Bharsar. On November 22nd, when the outbreak at Buransi was enquired into, it was found that 155 coolies from 31 villages had been working at Bharsar for some weeks, and it was feared that the Buransi men might have infected others, but the men were all inspected, and it was found that no other man working in Bharsar was ill, and that no other village supplying men to Bharsar was affected with any illness whatever, except Duleth and Ira villages that were infected direct from Buransi. Sixteen men living at Bharsar were all healthy. They lived in houses on the hillside, working daily on the place. As I remarked above, the people first affected were Buransi people, and only Buransi people. From October 12th to November 22nd seven cases of *mahamari* occurred at Buransi. No other cases occurred anywhere else; yet the Buransi men were mixing all this time with men from 31 other villages who worked at Bharsar. The Buransi men who were at Bharsar were not attacked, but the women and children who stayed together at home in the village were affected. The Buransi coolies that worked at Bharsar had no special connection with the MacMullens. They did the same work as the other coolies in clearing the land. Some few made baskets out of bamboo cut in the jungle.

One man of Buransi, Juma, worked as cook for the MacMullens, but he did not begin this work till October 22nd, and then two deaths from *mahamari* had occurred (on 17th and 18th) at Buransi. This man went to his house daily till November 22nd, when all intercourse was stopped with the village. No Buransi coolies went into any houses, and no coolies lived at the place until the outbreak began, when the 16 men above mentioned were permanently lodged there. All the coolies working at Bharsar took their midday food there; this they brought with them each day. Sainji village supplied most coolies in September; Buransi supplied most in October; these are much the largest villages in the neighbourhood.

The MacMullens' food and milk came from Suknyana three miles off. No rats had died at Bharsar, nor were any seen about the place.

The MacMullens were two of many people who came from the Punjab to Garhwal, and it would, indeed, be a strange combination of circumstances that would result in their introducing plague to a well known *mahamari* district, a secluded spot 75 miles distant in the hills and some hundreds of miles, from their original starting place, Sialkote, where there was no plague at the time of their departure. They had brought no servants, no horse; only one box of clothes between them, which they

daily opened. They brought no food with them from Sialkote; they had mixed daily for three weeks before arrival at their destination with all sorts of people; they had marched slowly on foot, halting at night, along the main road to Pauri, and no infected person was discovered anywhere *en route*. They stayed at Pauri itself and at the European Mission at Chopra a full week, and while there they had their clothes washed; they had no *dhobi*, and did not wash any clothes at Bharsar. Their date of arrival at Bharsar was five weeks before the first case at Buransi. Moreover, later experience showed—what Dr. Planck had previously pointed out in 1876—that, when *mahamari* shows itself in one *patti*, other *pattis* a long way off and having no possible connection with any early infected district show cases of the disease. In this case Kundai, *patti* Pindarpur, *pargana* Badhan, 50 miles east of Buransi, had 10 deaths (of pneumonic plague) in a family of 15 Doms in the middle of December 1901. No rats were found to have died in this village, but the disease was unquestionably pneumonic plague, and the deaths all occurred within ten days in the same family. All the people left the village and camped outside. At Kunet, 22 miles east of Buransi, in another valley and quite isolated, two cases of bubonic plague occurred on 3rd and 5th February 1902. Early in March three cases of plague occurred at Salaunj, *patti* Dhajhuli, and some cases of bubonic disease appeared later at Tarpali near Salaunj. Mr. McNair, the Deputy Commissioner, myself, and the whole staff, after enquiries of an exhaustive nature on the spot, came to the conclusion that the evidence of the endemic character of the outbreak at Buransi was overwhelming and admitted of no other possible explanation. The district around and all the region about Kainur, *viz.*, *pattis* Kundar Syun, Chaprakote, and Dhajhula, is so notorious as the home of *mahamari*, and outbreaks so frequent, that the inhabitants recognise the disease at the very first occurrence of a case. There is an idea prevalent in the hills that *mahamari* is connected with the excavation of earth or old houses, buildings, &c. At Bharsar a portion of a hill was being cut away for the foundation of a bungalow, but the earth had apparently never before been removed here, and there were no houses or ruins anywhere near. At Buransi, on the contrary, a new house was being built in the Doms' quarter where the disease broke out, and materials were obtained for this house from some old houses close by. Excavations had been made and work was in progress till the disease broke out, when it was at once abandoned. Strange to say, the people themselves connect the building of this house in some way with the outbreak of the disease, and, when questioned about it, they were exceedingly reserved in their answers and facts were with difficulty elicited. This leads one naturally to ask, What is the history of Buransi? Had *mahamari* ever occurred there before or not? As far as our enquiries went, it appears that *mahamari* visited Chaprakote *patti* eight years ago (Gadholi, 1894) and Buransi thirty years ago and not since then, and that in 1894 8 deaths occurred at Ira, eight miles away in another *patti* (Dhajhuli). Chandpur *pargana*, in which Buransi, Ira, and Duleth are, has had many outbreaks of *mahamari*.

The history as to dead rats having been found is contradictory. Some say that dead rats were found in the village just before the outbreak; others deny it. The *patwari* informed me that some dead rats were found in October, so that it may be taken as extremely probable that some dead rats were observed. In mid-winter rats are not to be seen about much in the hills, and, although rats infected with plague often leave their holes, many may have died in them and in the houses. The exact origin of this outbreak of *mahamari* is therefore problematical, but it is at present certainly confined to the limited area of Bali Chaprakote, and is unquestionably what is known as *mahamari* or hill plague. (Later isolated outbreaks occurred in *pargana* Badhan, 50 miles east of Buransi, and elsewhere.) I

believe it to have originated in Buransi among the Doms, and is possibly connected with the excavations and removal of earth above mentioned.

This brings us down to the period of the second outbreak or recrudescence of the *mahamari* in Buransi and neighbourhood. The last death at Buransi was on November 28th, and no fresh case occurred here till December 22nd, but two cases occurred at Talla Ira, 8 miles from Buransi, on 15th and 16th December. It will be remembered that Mishal, a Dom, who had visited a sick friend at Buransi, died at Kaproli, no doubt of *mahamari*, on November 17th. On his way from Buransi to Kaproli, he went to a marriage festival at Ira, three days before he died. This fact was known to the Deputy Commissioner, who in consequence had Ira and neighbouring villages watched. On the 15th December, or 31 days after Mishal's visit to Ira, the two cases above mentioned occurred, both children, girls aged 10 and 13, who died with fever and enlarged glands after three days' illness. No more cases occurred here.

The next case which occurred at Buransi (recrudescence) was that of Rukhnia, daughter of Motim, aged 14, who fell ill on 22nd December (24 days since last case) of pain, fever, and swelling in the neck, and died next day. Thereafter, up to January 31st, 24 cases occurred in Buransi, and up to the end of the epidemic there have been in all 31 cases at Buransi and 30 deaths.

On my arrival at Pauri on 9th January, I was informed that a lull had occurred, and no persons were at present suffering from the disease, but, in consequence of information from the Deputy Commissioner, Mr. A. W. McNair, that on the 9th four cases had fever, I marched on the 10th to Saknyana, 22 miles from Pauri, where I arrived the evening of that day. On my arrival at Buransi four cases were ill, two of which, No. 18, Lahu, boy aged 10, and No. 16, Dhugi, girl aged 14, both children of Birma, died on the night of the 10th. Their history left no doubt that they had been suffering from bubonic disease and, on examination of the dead bodies in both cases, the parotid glands were much enlarged, and the surrounding parts subject to oedematous swelling. At first I was not allowed to touch the bodies, but later they gave me permission to examine the body of the boy and incise the enlarged gland of the girl Dhugi. A partial *post-mortem* examination was made of the boy, and the abdominal and thoracic cavities opened. Cultures and smears from the parotid glands and liver were obtained. Both pleural cavities of the boy were filled with exudation, and a large amount of fluid was present in the abdominal cavity. Both liver and spleen were enlarged. There was considerable rigidity of the body (a strong frost was on), and considerable lividity on both bodies, but no ecchymoses were noticeable. There was marked adenitis of all the external lymphatic glands in both cases, and it was evident the whole lymphatic system was implicated. Both parotids of the boy were enlarged and the left parotid of the girl.

On examination of the living cases, I found them suffering from high fever, precordial pain, depression, injected conjunctivæ, and intense prostration. In each case the glands affected as buboes were the cervical and the parotids. On the night of the 10th cases Nos. 16 and 18 died. The living cases Nos. 14 and 17, when seen by me on the morning of 11th, were evidently sinking. Both cases were typical cases of bubonic plague as seen in the plains of India and elsewhere. Sambhi, a woman, No. 14, aged 50, had a temperature of 103.6, and was in a typhoid state. She could with difficulty be made to understand anything said to her, but complained greatly of the pain in the cervical region. She had the typical facies of a plague patient—anxious, haggard, sunken, and bloodshot eyes, pupils dilated, and complained of great thirst and severe headache. Her tongue was swollen, dry, and reddish at the edges. She died on 11th, and I was only with difficulty allowed to incise a slightly swollen cervical gland, from which cultures were

obtained. No. 17, Ausani, daughter of Doulata, aged 5, was in a similar condition, and had a large bubo of the right parotid region. She died on the 12th. As stated, from the three first mentioned cases, cultures and smears were secured, and from the first two cases a bacillus, similar morphologically in every respect to *B. pestis*, was eventually obtained in pure culture. The fifth case I saw was No. 19, a girl; it was a typical bubonic case.

The symptoms as described by Dr. Pearson in 1852 coincide exactly with what I saw in the outbreak at Buransi in 1902. They are not of course all present in every case, but the most marked are chilliness, giddiness, always unusually severe headache, trembling of the limbs, inability to maintain the erect posture, great prostration, high fever, continued thirst, characteristic tongue furred, then becoming red and dry at the edges, eyes heavy and bloodshot, rapid breathing, small frequent pulse, frequently nausea and vomiting, purging, clammy perspiration, heat, burning and pain in the precordia and occasional yellowness of skin, wandering delirium, great disturbance of nervous centres, buboes, and implication of the general lymphatic system. No pneumonic cases were observed, but there had been cases evidently of the septicæmic type. In all these, and in the previous 21 cases that had occurred in Buransi, the history in each instance was identical. They became ill with fever, complained of headache, pain, and thirst, had high temperature throughout the illness. In all cases the nervous system was manifestly involved, as in all septicæmic diseases. It was noticed in some cases in Buransi that the gland which constituted the bubo did not become prominent till just before death, but this has been commonly met with in plague. Children, especially girls, and their mothers, were attacked at Buransi; the men escaped, probably owing to their out of door life in the fields, the children mixing more about the village and the houses and while out in parties gathering wood or grass.

Mahamari seems to be more fatal in the bubonic form than the plains variety of plague: the pneumonic and septicæmic forms are probably, as elsewhere, nearly always fatal, but the bubonic form of *mahamari* carries off over 90 per cent. of the affected, which is a higher mortality than is experienced generally in India. Dr. Renny in 1850 remarks on the very high mortality. For instance, in the village of Sarkote, in 1846, there were 65 people; 45 took plague, only two recovering and 20 escaped infection. In one case, where there were 16 people, 14 took plague, all dying. In Bagwani Chaprakote, in 1882, out of 20 cases 19 died with buboes in neck and armpits. As before remarked, in Buransi this year, where nearly all the cases were of the bubonic form, out of 31 cases 30 died and, including other villages, out of 34 cases 33 died. So fatal, indeed, is the disease that the experienced officer will wisely consider all deaths and cases of illness occurring in an affected community at the time as *mahamari*, unless strong proof to the contrary exists. Indeed, after an experience of plague lasting over some years, I have always inclined to this view as the wisest one to adopt when plague is prevalent.

In concluding this report, my thanks are due to Mr. R. E. Hamblin, C.S., Commissioner of Kumaun, for his assistance, and to Mr. A. W. McNair, C.S., the Deputy Commissioner of Garhwal, who accompanied me and assisted me in every way in a work that was not congenial

and at the time of the year when the rigour of the climate, the frost, and the snow made camping in such latitudes anything but agreeable. To Mr. E. H. Hankin, the Chemical Examiner to the Government, my acknowledgments are also due for his kindness in placing his laboratory and appliances at my disposal for the bacteriological investigation.

BACTERIOLOGICAL EXPERIMENTS.

As elsewhere detailed, I arrived on January 11th at Buransi, and I examined on the 12th morning the dead bodies of a boy and girl, both children of Birma, who had died during the night of 11th. The boy Lalu, the son of Birma, aged 10 years, had an enlarged left parotid gland. A partial *post-mortem* examination was allowed, and from the liver and parotid gland smears and cultures were obtained. The tubes from this case were labelled (18), as this was the number assigned to the case in the second outbreak at Buransi. The agar tubes, inoculated from the liver by means of a sterilized pipette, were found eventually to be very satisfactory, as pure growth along the whole track of the inoculated blood was found on the surface of the agar. The tubes inoculated from the parotid gland also showed growth, but there were some contaminations of skin bacilli (*staphylococci* and *streptococci*), but *Bacillus pestis* was also isolated from parotid gland tubes in this case.

The other case was that of Dhagi, aged 14, daughter of Birma, who also had died on the night of the 11th January. It was only with difficulty and by dint of persuasion that I was eventually allowed to cut into the parotid gland and take smears and inoculate agar tubes. The case is numbered (16) in the list of cases that occurred in the second outbreak at Buransi. The smears showed bacilli, and the tubes eventually gave growth of *B. pestis*.

The third case from which specimens were taken was a woman aged 50, named Sambhi, mother of Kakona who had a high temperature throughout her illness, but not any typical bubo. She had pain in the cervical region. I was only allowed to incise the cervical glands, and the specimens obtained were not satisfactory. The smears showed bacilli, but the agar tubes gave growths of ordinary skin bacilli, only one tube remaining sterile. The smears examined at Buransi showed the bacilli in large numbers, and the appearances were identical with those of *B. pestis*. On treating smears with half per cent. of acetic acid and staining with carbol fuchsin, the typical so-called bipolar staining was observed. Therefore in all three cases the smears showed the bacilli, and the tubes taken at Buransi in each case except the last showed growths which in appearance were similar to growths of *B. pestis*, being of the so-called ground glass appearance. The growths on agar were by no means vigorous as the temperature so far north and at such an altitude was constantly low and incubation was with difficulty carried on in an empty biscuit box in front of a fire. The growths were found not to be sticky as is usual with plague growths, but later on when grown in an incubator at 37°C., they presented the usual sticky appearance. It appears, then, that the plague microbe grown slowly in the cold does not show stickiness. Microscopically the pure agar growths showed a coccobacillus, the form being more coccoid than bacillary. On arrival at Agra on February 7th, with the permission of Mr. Hankin, Bacteriologist to this Government, I started work on the cultures, which were then nearly one month old. I had, however, previously sent some tubes to Mr. Hankin, and he had set to work with the bacillus. His experiments were made chiefly with the cultures obtained from the boy Lalu (No. 18), while my observations were made with those obtained from the girl Dhagi (No. 16).

Experiment I.—A considerable quantity of the growth was inoculated on to salt agar (agar with 2 per cent. salt) from both the original culture tube and from a sub-culture. In both cases the tubes were placed for 24 hours in incubator 37°C. Naked eye appearance showed that the original planted mass had not increased much in size, and on microscopical examination typical involution forms were observed. Many experiments have now been made with various bacilli, and it has been found that *B. pestis* alone forms involution forms on salt agar. Had there been a growth on salt agar, the bacillus would not have been *B. pestis*. The bacillus having been isolated in pure culture, agar tubes were inoculated and sealed up for transmission to European bacteriologists.

Experiment II.—Two flasks of peptone bouillon with particles of *ghi* floating on the surface were inoculated with involution forms of the bacillus. One flask (a) was placed in incubator at 37°C., another flask (b) was grown in the cold (about 18°C.). Two similar flasks were inoculated with bacillus culture from ordinary agar, and one (c) placed in incubator, the other (d) grown in cold.

The two flasks (a) and (c) that were placed in the incubator showed typical stalactite growths after 48 hours and abundant long stalactites after 60 hours. The flasks (b) and (d) grown in the cold showed stalactite growths only after many days. The *B. pestis* is the only known bacillus that forms stalactites when grown in *ghi* bouillon. The stalactites are long and dependent from the under surfaces of the particles of *ghi*, and on shaking the flask the growth falls down in the form of a cloud. The flask contains much sediment, and after a few days the stalactites again form.

Experiment III.—Four rats were inoculated with pure 24 hours agar cultures. Two of the rats became slightly ill, but did not succumb to the disease. This unexpected result in a bacillus that macroscopically and microscopically corresponded to *B. pestis* and up to this conformed bacteriologically in all details to *B. pestis* was in the nature of a surprise. Mr. Hankin inoculated a great many rats, but with negative results. With a view to elucidating the peculiarity above mentioned, cultures were sent to Monsieur Haffkin, Plague Research Laboratory, Bombay, and his report is attached.

J. CHAYTOR-WHITE, MAJOR, I.M.S., M.D., C.M.,
D.P.H. (CAMB.),

Deputy Sanitary Commissioner, 1st Circle,
United Provinces of Agra and Oudh.

No. $\frac{187}{B-4}$, dated Agra, the 7th March 1902.

From—E. H. HANKIN, Esq., M.A., Chemical Examiner
and Bacteriologist, N.-W. Provinces and Oudh and
Central Provinces.

To—Sanitary Commissioner, N.-W. Provinces and
Oudh.

SIR,—In reply to your No. $\frac{458}{F}$, dated the 20th Febru-

ary 1902, I have the honour to state that the two cultures of alleged Garhwal plague sent me by you have the ordinary characters of attenuated *Bacillus pestis*. They resemble the cultures that I isolated from men, rats, and monkeys towards the end of the Jawalapur outbreak. They produce involution forms on salt agar and stalactite growth in butter broth in the manner typical of plague. The adhesive character of the growth is distinctly less than with ordinary Bombay plague, and is only shown in cultures kept in the incubator. In this respect the cultures resemble the plague above mentioned from Jawalapur. As shown by numerous experiments, the cultures were not virulent to rats when inoculated in small doses.

2. The gland smears submitted to me were typical of plague in appearance on microscopic examination.

No. 729, dated the 3rd April 1902.

From—W. M. HAFFKINE, ESQ., C.I.E., *Director-in-Chief, Plague Research Laboratory, Bombay,*
To—Sanitary Commissioner, *United Provinces of Agra and Oudh.*

Sir,—I have the honour to confirm this office deferred telegram of 25th ultimo sent to you in reply to your wire of 23rd idem, and which ran as follows:—

“Yours of 10th instant. Cultures Nos. 16 and 18 received from Agra, 18th. Typical stalactites in broth and usual plague appearance on agar obtained twentieth and subsequent days. Rather large doses of agar and broth cultures of both numbers inoculated subcutaneously, intraperitoneally, (and) intravenously in rats, guineapigs, (and) rabbits on twenty-second. All succumbed yesterday 24th, showing bacilli in organs. Rats now being tried with minimal doses. No involution forms so far, but this feature not constant. Cultures may be pronounced plague.”

2. I beg now to inform you that 24 hours agar-cultures were prepared from your specimens Nos. 16 and 18, and two rats infected by being scratched in the right thigh with a glass bristle brought in contact with each culture separately. Both animals succumbed, the first in five and the second in seven days, showing swollen glands in right inguinal region and plague bacilli in organs. Thus far the cultures do not differ from ordinary plague microbes.

A RECURRENCE OF EPIDEMIC DROPSY IN CALCUTTA IN 1901.

By LEONARD ROGERS, M.D., M.R.C.P.,

CAPTAIN, I.M.S.,

Offg. Prof. of Pathology, Medical College, Calcutta.

AT the beginning of June 1901 a slight outbreak of this rare but interesting disease occurred in Calcutta, which I was enabled, through the kindness of Lieutenant-Colonel R. L. Dutt in calling my attention to it, to see a few cases of. The disease, however, very soon after subsided, and there now appears to be little likelihood of my having an early opportunity of obtaining more material for investigation, so it may be worth while to briefly put on record the few facts observed.

This disease was first described as occurring in Calcutta in the latter part of the years 1877, 1878 and 1879, breaking out each time after the rainy season was over and dying down again in the following hot weather. After an interval it appeared again in 1881, this time during the the hot season. In addition to Calcutta a slight outbreak occurred in Dacca and a more extensive one in Shillong, while a large number of cases also appeared in Mauritius, all of these places having been apparently infected from Calcutta. A good summary of what is known of this disease will be found in a paper which was read by Professor Kenneth McLeod before the Epidemiological Society of London in January 1893, and published both in their proceedings and in the *Indian Medical Gazette* of 1893-94, and a shorter paper by the same author is included in Clifford Allbutt's *System of Medicine*. In order to allow of my cases being easily compared with those of the former outbreak, it will be well to mention the chief characters of the affection as described by Dr. McLeod. Dropsy,

usually preceded by fever, is the essential symptom, affecting first the feet and legs, but ascending to the hips or waist and affecting the upper extremities, and occasionally also the face. It persists for long and may effect the pleura and pericardium, but very rarely the peritoneum. Remittent pyrexia, usually from 100 to 101, but sometimes reaching 104, without rigors or sweating, usually appears before or with the other symptoms. Diarrhoea and vomiting was first noticed in the Mauritius cases, but was also seen in about half the Calcutta ones, the stools being frequent and scanty. Burning or pricking of the skin or aching of the deep parts was noted, but there was no numbness of paralysis. The eruption was specially noticed in many of the Mauritius cases as a diffuse redness on the face, or as morbiliform or dark red crescentic patches, with sometimes petechiæ in bad cases, affecting the trunk and limbs. There was no albumen in the urine. In severe cases dysnoea, palpitation, congestion of the lungs, rapid pulse and lividity may ensue. The liver may become enlarged secondary to the heart symptoms. The spleen is not enlarged except when malarial complications are present. The lymphatic glands are normal. Anæmia is an essential symptom of the disease, the red corpuscles being decreased and the white increased according to Lovell of Mauritius, but T. R. Lewis found nothing special in the blood in Calcutta. The duration of the disease was two to three months, the average according to Lovell being six weeks. It may be suddenly fatal on the fifth or sixth day, the mortality in Calcutta having been given as from 8 to 40 per cent., and in Mauritius as from 2 to 3 per cent. The difference may possibly be due to some of the Calcutta observers only seeing the more severe cases.

The Recent Outbreak.—The recurrence of the disease in 1901 occurred during the hot weather, and appears to have been limited to a few households in the northern part of the town around Harrison Road and Cornwallis Street. Groups of cases in three houses in different streets were seen by me, while a few more were seen by the Health Officer of Calcutta at the Bethune College for Girls. The outbreak was thus a very limited one, and it appears to have subsided with the onset of the rainy season, and, as far as I can learn, did not recur during the last cold weather or during the recent hot season.

Household in Tanner's Lane.—Out of 17 persons in this house no less than 14 had been attacked by the disease at the time of my visit. Shortly before the first case occurred some excavation had been going on just outside the house, which may or may not have had anything to do with the outbreak. The family was a very well-to-do Hindu one, who were intimately connected with another household in a house which was continuous with that attacked, yet none of the second household got the disease, which points to a very localised infectiousness. The father, mother and one grown up son were first attacked simultaneously, the woman having diarrhoea and dropsy, but the other only diarrhoea with frequent scanty stools passed with some distress. Ten days later another woman, a maid servant and three children were attacked on the same day, and seven days later still the rest of the family