

THE IDENTIFICATION OF KALA AZAR AND THE DISCOVERY OF *LEISHMANIA DONOVANI*

by

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IN the years following 1858, when the British government formally assumed power over the whole of British India, the government of Bengal became concerned by reports of an epidemic of quinine-resistant fever occurring in the district of Burdwan in Lower Bengal. The mortality was so great that the population, the productivity of the land, and consequently the government revenue were greatly diminished. Some eight to ten years after the epidemic of “Burdwan fever” had been brought to official attention, the Deputy Commissioner of the Garo Hills in south-west Assam reported that a particularly virulent form of fever, which resembled malaria, was decimating the population and that they were asking to be relieved of hut tax as a result. This disease was known locally as kala azar or black disease.

Kala azar is characterized by intermittent or remittent fever and enlargement of the spleen; in the later stages there is emaciation, anaemia, and darkening of the skin. Napier and Muir describe the onset as occurring in one of three ways, malarial, typhoid, and insidious,¹ but without a microscope it can be impossible to diagnose accurately in the initial stages.

Before the 1820s, the history of kala azar is obscure. Garcia da Orta, a Portuguese physician and botanist who published *Coloquios dos simples e drogas he cousas medicinais da India* at Goa in 1563, described a case of fever that he cured by dosing the patient with ginger conserve and root of China in cinnamon water. Orta diagnosed a disease of the lymphatic system associated with “swellings on the liver and excrescences, and I was convinced that it was lymphatic, accompanied by some arid melancholy”.² Sir Harold Scott suggested that Orta might have described kala azar,³ although the disease has not been recorded in the area of Goa.

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The Ross Archives are kept in the Library of the London School of Hygiene and Tropical Medicine, and the Rogers' Papers are in the Contemporary Medical Archives Centre at the Wellcome Institute for the History of Medicine.

¹ L. E. Napier and E. Muir, *Kala azar: a handbook for students and practitioners*, London, Milford, 1923, pp. 37–40.

² G. da Orta, *Colloquies on the simples and drugs of India*, trans. by Sir Clements Markham, London, Southeren, 1913, p. 387.

³ H. H. Scott, *A history of tropical medicine*, London, Edward Arnold, 1939, vol. 2, p. 1035.

Two hundred years later in 1768, when the naval surgeon James Lind described the diseases of warm climates, he included a chapter on those of the East Indies, although he did not speak from personal experience. Lind mentioned no disease that could be construed as kala azar, nor did his namesake and contemporary, the royal physician James Lind, who wrote his doctoral thesis in 1768 on malaria in Bengal. This Lind described a fever emanating from the marshes around Calcutta but without mentioning any splenic enlargement. By 1794, Richard Shannon had noticed enlargement of the spleen in association with inflammation of the liver, saying that it was “commonly called *ague-cake*”,⁴ but this term is usually connected with malaria. For treatment he recommended mercury, which various medical writers continued to advocate for the next fifty years.

In the 1828 edition of his book on the diseases of India, Sir James Annesley described two cases of splenic enlargement. The first gives an account of gross enlargement of the spleen that responded to internal treatment with calomel and external washes of nitro-muriatic acid over the splenic area so that the patient, a soldier, was able to return to his unit: this would appear unlikely in a case of kala azar. The second case, from which the patient died, appears from the post mortem report to have been a case of cerebral malaria.⁵

One of the earliest descriptions of fever with splenic enlargement caused by kala azar was made by William Twining, a surgeon in Calcutta from 1824 until his death in 1835. In an article in the *Transactions of the Medical and Physical Society of Bengal* he noted that splenic disease “prevails in Bengal to a very great extent and indeed is frequent through all the low districts of Hindoostan”.⁶ He added that some cases of “tumid spleen” were emaciated with acute anaemia and intermittent fever, and that it affected both Europeans and the local inhabitants of Bengal. However, some of these cases would appear to be of malaria rather than kala azar. Despite this understandable confusion, Twining noticed the complication of cancrum oris in kala azar with its fatal consequences and attributed it to treatment with mercury. In 1832, Twining followed his pamphlet with a book on the diseases of Bengal in which he devoted a lengthy chapter to diseases of the spleen. He described the dried up and scaly appearance of the skin associated with anaemia and emaciation, continuing, “We sometimes see a chronic enlargement of the spleen, in adults of pale, sallow and unhealthy aspect; who eat and drink as they did in health, and seem to endure the disease for many months without much suffering: except the inconvenience of a tumid belly, attended with shortness of breath”.⁷ He also remarked on the more rapid progress of the disease in children and noticed the gross hypertrophy of the spleen that

⁴ R. Shannon, *Practical observations on the operation and effects of certain medicines in the prevention and cure of diseases to which Europeans are subject in hot climates* . . . , London, Vernor & Hood, 1794, pp. 177–178.

⁵ J. Annesley, *Researches into the causes, nature and treatment of the more prevalent diseases of India and of warm climates generally* . . . , London, Longman, Rees, Orme, Browne & Green, 1828, vol. 2, pp. 7–9.

⁶ W. Twining, ‘Observations on diseases of the spleen particularly on the vascular engorgement of that organ common in Bengal’, *Trans. Med. Phys. Soc. Bengal*, 1827, 3: 351–412.

⁷ W. Twining, *Clinical illustrations of the more important diseases of Bengal, with the result of an inquiry into their pathology and treatment*, Calcutta, Baptist Mission Press, 1832, pp. 271–360.

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could sometimes occur. He associated this enlargement with intermittent and remittent fever and noted that the incidence of the disease rose at the end of the monsoon. He differed from many of his colleagues in condemning treatment with mercury and purgatives and recommending quinine and iron.

Nearly ten years later, Annesley published a second concise edition of his book, in which he said that while inflammation of the spleen was not a common disease in India as a whole, it was prevalent in Bengal.⁸ He commented on the different post mortem appearance of the spleen; in certain cases it was more friable and dark in colour, which would indicate malaria to modern eyes, while in others, although enlarged, there was no obvious change to the naked eye in consistency or colour. Annesley also observed that enlargement of the spleen was frequently associated with intermittent and remittent fever and that great splenic enlargement could take place without the patient's suffering inconvenience or pain. He again recommended calomel more as a purgative than for its mercury content, adding that Twining had misconstrued his recommendations and "misled many as to the views I entertain upon this subject".

From the beginning of the 1860s, the government in Calcutta received many reports of an epidemic of fever, which Sir Leonard Rogers later considered to be kala azar,⁹ that was afflicting the area of Burdwan. Throughout the sanitary reports there are accounts of its mortality and the measures that were taken against it.

Dr J. Elliot, the civil surgeon of Burdwan, traced the first outbreak in 1824 or 1825 to a large village called Mahomedpore, thirty miles east of Jessore in Lower Bengal.¹⁰ It spread westwards with such severe mortality that some villages were totally depopulated while others declined considerably. It reached Burdwan about 1860, and Elliot said that the official figures of morbidity and mortality given by the police were underestimates. He thought that the disease was a form of malaria, using the term in the sense of "bad air" rather than in the modern sense of infection by *Plasmodium*. He mentioned enlargement of the spleen and liver in association with intermittent or remittent fever and frequently death with typhoid-like symptoms in one to three weeks. So swift a death would be unlikely in kala azar, but Elliot mentioned cases of longer duration in which remittent fever resistant to quinine occurred with gross enlargement of the spleen. He recommended treatment with laxatives and blisters over the spleen but added that many died before medical aid could be obtained.

The Annual Reports of the Sanitary Commissioners for Bengal emphasized the mortality of the epidemic fever in Burdwan. The government of Bengal was sufficiently concerned to appoint a Special Commission of Inquiry whose report was quoted by the Sanitary Commissioner, "Many large *baries*, in which there were formerly thirty or forty residents, have now been left with perhaps one solitary occupant; whole mohullas and streets have been deserted, and large villages which formerly told

⁸ Annesley, *op. cit.*, note 5 above, 2nd ed. (1841), pp. 312–316.

⁹ L. Rogers, *Report of an investigation of the epidemic of malarial fever in Assam or kala azar*, Shillong, Assam Secretariat Printing Office, 1897, pp. 182–192.

¹⁰ J. Elliot, *Report on epidemic remittent and intermittent fever occurring in parts of Burdwan and Neddea Divisions*. Calcutta, Bengal Secretariat Office, 1863.

their residents by thousands, can now almost number them by hundreds . . . Upon the whole, we believe that about 30 per cent of the whole population of the infected area have died".¹¹ The report for 1865 varies from the previous accounts of mortality in saying that "a healthy person was the exception; but the proportion of deaths appears to have been small".¹² The authorities differed on the type of fever, and the reports of the local medical officers, cited in the Annual Reports, indicate that more than one disease was involved. Possibly the sick were debilitated by kala azar, which would account for the quinine-resistant fever and splenic enlargement, and succumbed quickly to other infections. Death frequently occurred within three to four hours of the first attack.¹³

Medical personnel may have disagreed on the type of "contagious fever" sweeping through Lower Bengal but they were unanimous in attributing the cause to the unhealthy location of the villages and the insanitary habits of the indigenous populace, and in condemning the general ineffectiveness of treatment, which consisted mainly of the cleansing of water tanks and setting up government dispensaries, where several assistant surgeons died of the fever.

Reports that "Burdwan fever" was still occurring at the end of the decade indicate that those who had suffered from remittent fever and splenic enlargement for two or three years were dying: presumably they were cases of kala azar who had escaped death from a more urgent cause. The epidemic continued into the early years of the 1870s and the Sanitary Commissioner of Bengal, Surgeon-Major Charles J. Jackson, added a lengthy compilation of reports of local medical officers to his Annual Report of 1873. It included detailed maps showing that the incidence of cases was heaviest around the town of Burdwan and marking the situation of the relief dispensaries.¹⁴ Dr John G. French, the civil surgeon of Burdwan at this time, noted that the incidence varied with the time of year, decreasing during the first half and increasing between July and December. He also said that the morbidity was slight at first, built up to a peak, and after a period of "a certain number of years in a village may rise or fall in succeeding years but at last dies out".¹⁵

In 1869, further reports of an epidemic fever arrived in the Bengal Medical Department, but these were from a totally different area. The deputy commissioner of the Garo Hills in south-west Assam, who had been on tour there, wrote to Calcutta that his party had "passed through the village of Doomukpara, which is an outlying hamlet of Mandalongerri. The people of this village had left Mandalongerri on account of the 'Kala Haiza' sickness, which has carried off a good many people from that village".¹⁶ Kala haiza would appear to be a mishearing of the Assamese "kala azar" or the Urdu "kala hazar" or black pain. He added that the disease was common, affecting the

¹¹ Bengal, Sanitary Commission, First Annual Report, 1864-65, pp. 58-59.

¹² Bengal, Sanitary Commission, Second Annual Report, 1865, pp. 74-75.

¹³ Bengal, Sanitary Commission, Third Annual Report, 1866, p. 54.

¹⁴ Bengal, Sanitary Commissioner, Report, 1873, Part II, Report on the epidemic fever in Burdwan and Beerbhoom during 1871 and 1872.

¹⁵ J. G. French, 'Endemic fever in Lower Bengal', *Ind. Ann. med. Sci.*, 1873/74, 16: 419-485.

¹⁶ Bengal, Proceedings of the Government of Bengal in the Medical Department, April 1869, p. 43, no. 78.

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ability of the villagers to pay their taxes, and suggested that the civil surgeon of Goalpara should carry out an inspection and report with recommendations to halt the spread of the disease. These suggestions were acted upon rapidly, and during the next month Thomas Briscoe notified the authorities that he had examined three cases shown to him by the zemindar of Luckeepore. "The disease is brought on by repeated attacks of intermittent or remittent fever; the spleen becomes enormously enlarged; appetite very great: the sufferer loses flesh, and becomes a perfect skeleton, and, in general dies within a year."¹⁷ Briscoe added that the disease was caused by miasma from the swamps and that patients would not stay long enough at the dispensaries to be adequately treated. The authorities in Calcutta did not consider this brief report sufficient, and Briscoe was ordered to present a more detailed one with a definition of the disease. This was submitted the following year and, in addition to a description similar to the one in the previous report but culled from the examination of more cases, Briscoe noted the long duration of the disease and the discoloration of the skin, from which the name kala azar was derived. He again attributed the disease to "a malarious remittent fever with enlarged spleen" caused by the swamps around the villages and the dirty habits of the Garos, and finally said that it was well known that changing the sites of the villages would halt the disease and that the Garos would not submit to removal to dispensaries for long courses of treatment.¹⁸

Reports on "Burdwan fever" published in the 1870s show that it was gradually dying down in areas where the mortality had earlier been severe, and was becoming endemic rather than epidemic. In the meantime, in Assam kala azar was spreading from the Garo Hills along the route of the Grand Trunk Road.

In 1882, Dr J. J. Clarke wrote an account of kala azar based on information gathered by a Mr McNaught, the civil medical officer at Tura. Clarke described the disease, commenting that it was first noticed by medical officers in 1869 and was alleged by the indigenous people to have been endemic for anything up to thirty years. He again attributed the disease to "intense malarial poisoning" and said that it had spread out from the Garo Hills.¹⁹ Sir Leonard Rogers suggested that kala azar had spread to Assam from Rungpore District on the western banks of the Brahmaputra River, and, although he was unable to trace a direct connexion between "Burdwan fever" and kala azar, there was an increase in epidemic fever occurring in the north of Bengal not long before kala azar was reported from Assam. He commented that it seemed to follow lines of communication and to be associated with deficient rainfall.²⁰

The epidemic of kala azar continued in Assam with high mortality, and in 1885 an editorial in the *Indian Medical Gazette* said that "the Government of India . . . should appoint a commission, composed of two, or better three, members, to carry out a

¹⁷ *Ibid.*, May 1869, p. 19, no. 34.

¹⁸ *Ibid.*, February 1870, p. 32-33, no. 52.

In these early reports the spelling of the name of the disease varies between "kala haiza", "kala hazar" and "kala azar", but it was the third form that was quickly adopted.

¹⁹ J. J. Clarke, 'Kala azar, the black disease', *Annual Sanitary Report of the Province of Assam 1882, Appendix A*, pp. 36-37.

²⁰ Rogers, *op. cit.*, note 9 above, pp. 165-192.

thorough investigation during next cold weather” in order to decide whether kala azar was, as generally assumed, a form of malaria or a separate entity.²¹

Towards the end of November 1889, Surgeon-Major George M. J. Giles arrived in Assam on special duty to investigate kala azar. He considered that enlarged spleens were the norm among the natives of Bengal and Assam and irrelevant to the incidence of kala azar. Since malaria can also cause some splenic enlargement, there was reason for this confusion. He held that acute anaemia and a subnormal temperature “were the most marked clinical characteristics of the disease with which I had to deal”.²² Giles recorded that malaria was endemic in Assam but said that the disease did not account for the number of cases nor did it appear to be related to swampy ground. He concluded, therefore, that kala azar was ankylostomiasis, that beriberi was the same disease, and that the terms kala azar and beriberi should no longer be used.²³ From his report it would appear that Europeans and not the local people referred to kala azar as beriberi.²⁴

Giles’s conclusions were soon challenged by Surgeon-Captain Edwin F. H. Dobson, who found that convicts at the jail in Gauhati who had been treated for ankylostomiasis still died from kala azar, and that infestation by ankylostoma was quite common in apparently healthy people. He added that treatment with thymol to remove ankylostoma had a detrimental effect on patients with kala azar whether they had ankylostomiasis or not, and that infestation was common in other parts of India where kala azar was unknown.²⁵ Dobson continued with a detailed analysis of patients that he had treated for ankylostomiasis, their places of origin, where he treated them, and the number and type of parasites that were expelled from them as a result of the treatment.²⁶

Kala azar continued to spread, with the resulting mortality causing a decrease in the population by 31.5 per cent between 1891 and 1901,²⁷ and in 1896 Surgeon-Captain Leonard Rogers was appointed to carry out a further investigation. In his report, Rogers explored the history of kala azar and demolished Giles’s conclusions. He compared the types of anaemia in ankylostomiasis, malaria, and kala azar and described the post mortem appearance of patients who died from the disease. He also linked the disease with “Burdwan fever”, and despite being unable to stain his pathological specimens adequately, he came to the conclusion that kala azar was a particularly virulent form of chronic malaria which, because of its tendency to run in households, must have been carried by droplet infection. His recommendations were to move families from infected to healthy sites and to segregate the patients so that they could

²¹ [Editorial], ‘The “kala azar” or black death of the Garo Hills’, *Ind. med. Gaz.*, 1885, **20**: 83–84.

²² G. M. J. Giles, *A report on an investigation in the causes of the diseases known in Assam as kala-azar and beri-beri*, Shillong, Assam Secretariat Press, 1890, p. 11.

²³ *Ibid.*, pp. 63–66.

²⁴ *Ibid.*, pp. 1–2.

²⁵ E. F. H. Dobson, ‘Notes regarding the prevalence of the *Dochmius duodenalis*’, *Ind. med. Gaz.*, 1892, **27**: 354–357; 1893, **28**: 1–4, 40–43, 68–72.

²⁶ E. F. H. Dobson, ‘Further notes on the prevalence of anchylostomiasis, or the *Dochmius duodenalis*’, *ibid.*, 1893, **28**: 262–267.

²⁷ Sir Leonard Rogers, *Happy toil: fifty-five years of tropical medicine*, London, Muller, 1950, p. 29.

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not spread the disease.²⁸

The government of India was still unconvinced, and in 1898 Ronald Ross was ordered to investigate kala azar as well as complete his work on malaria. Ross asked to be relieved from the work on kala azar or to be given assistance but his request was ignored and an assistant denied him.²⁹ Initially, Ross studied a disease known variously as kala dukh (black pain in Hindustani), or kala jwar (black fever in Bengali), which occurred in the area of Darjeeling and Purnea in Upper Bengal. He then journeyed to Assam to inspect kala azar and decided that both diseases were the same,³⁰ an opinion seconded later by Rogers. Judging from his notebook, Ross relied heavily on reports by J. McNaught, the civil surgeon of Nowgong, and Dr J. C. Lavertine, which he copied out.³¹ He examined cases of kala azar that McNaught showed him and, despite finding little sign of malaria pigment and few parasites, agreed with Rogers' conclusion that kala azar was a form of untreated malaria complicated by other diseases. He also thought that the peculiarities of kala azar were caused by a degree of immunity to malaria parasites.³² During this period, Ross was being pressed for his report by J. T. W. Leslie, the secretary to the Sanitary Commissioner of India,³³ and was eager to hurry back to Calcutta to meet Dr Charles W. Daniels who had been sent to India by the Royal Society to inspect his work on malaria.³⁴

Ross submitted his report and returned to England, but doubts still remained about the nature of kala azar. In 1901, John W. W. Stephens and S. Rickard Christophers reported to the Royal Society that they had seen patients with fever "in the wards of the large native hospitals in Calcutta . . . [and] the great majority were classified as suffering from 'malarial cachexia and enlarged spleen . . .'. Quinine or cinchona, as we could see, frequently exerted no influence on the course of the temperature", and they found few, if any, malaria parasites.³⁵ Soon after this, in February 1902, Charles A. Bentley wrote to Rogers that the skin discoloration in kala azar was odd, as the internal organs were unpigmented. He suggested that the disease might be due to an unpigmented malaria parasite.³⁶ Subsequently, Bentley had some serological tests done on kala azar specimens at the Pasteur Institute, Kasauli, and became convinced that kala azar was undulant fever.³⁷ Rogers told Bentley that he must have been "completely carried away" by the results of the serum tests and warned him that he and J. Dodds Price, the district medical officer of Shillong, would be writing to the *Indian Medical*

²⁸ Rogers, op. cit., note 9 above.

²⁹ J. T. W. Leslie, letter to R. Ross, 2 June 1896. Ross Archives, 03/126.

³⁰ R. Ross, *Report on the nature of kala azar*, Calcutta, Office of the Superintendent of Government Printing, 1899, pp. 12–13.

³¹ R. Ross, diary and notes of researches on malaria and kala-azar . . . , Book II, official researches, MSS 1898–1899. Ross Archives, 03/074.

³² Ross, op. cit., note 30 above, pp. 68–69.

³³ J. T. W. Leslie, telegram to R. Ross, 25 October 1898. Ross Archives, 03/215.

³⁴ R. Ross, letter to P. Manson, 16 October 1898. Ross Archives, 02/169.

³⁵ J. W. W. Stephens, and S. R. Christophers, 'The relation between enlarged spleen and parasite infection', *Royal Society. Reports to the Malaria Committee*, 6th series, London, Harrison, 1902, pp. 20–21.

³⁶ C. A. Bentley, letter to L. Rogers, 21 February 1902. Rogers' Papers C 1/11.

³⁷ C. A. Bentley, 'Epidemic Malta fever in Assam – a short preliminary notice of certain recent discoveries relating to the true nature of *kala azar*', *Ind. med. Gaz.*, 1902, 37: 337–339.

Gazette the following month to point out Bentley's errors.³⁸ In their articles both men reiterated their belief that kala azar was a form of malaria.^{39,40}

Soldiers who were invalided home from India were frequently treated at the Royal Victoria Hospital at Netley, where William Leishman was on the staff of the Army Medical School. Leishman went to Netley in 1897 on his return to Great Britain from service in India. He was appointed assistant professor of pathology and worked on immunization in typhoid fever under Almroth Wright, becoming professor of pathology when Wright resigned in 1903. In 1900, a soldier who had developed dysentery while stationed at Dum Dum, a notoriously unhealthy spot some seven miles from Calcutta, was admitted to Netley. Under treatment the dysentery improved but the patient died in a state of gross emaciation and enlargement of the spleen. In 1903, Leishman reported the case in the *British Medical Journal* and said that, while he had had several of these cases, in this particular one he had noticed unknown parasites in smears taken post mortem from the spleen and stained with his own variation of Romonowsky's stain. Leishman confessed to bafflement over these bodies but subsequently noticed somewhat similar parasites in an experimentally infected white rat. These, he discovered, were dead and degenerated forms of trypanosomes so he tentatively suggested that kala azar was a form of trypanosomiasis.⁴¹

In July 1903, Charles Donovan, the professor of physiology at Madras Medical College, wrote to Ronald Ross enclosing a watercolour sketch of an unknown parasite that he had discovered in spleen pulp taken during life and at autopsy from cases of remittent fever with enlarged spleen. He asked Ross if he recognized the parasite,⁴² adding that he had written to the *British Medical Journal* describing it.⁴³ Ross sent the sketch to Leishman, who returned it saying that it appeared similar to the bodies that he had described, and mentioning that his attempts to infect animals with the parasite had been a failure.⁴⁴ He asked Ross to send him some of Donovan's slides. When Leishman returned the slides to Ross he said that the post mortem specimen was "absolutely identical with those I took from the Netley case" and, while the specimen taken during life contained other forms, he was convinced that they were related to those seen in the post mortem specimen.⁴⁵

In the meantime, Donovan had been in correspondence with Félix Mesnil in Paris and sent him a slide of his parasite to show Alphonse Laveran, who said that it was a new parasite of the genus *Piroplasma*.⁴⁶ It occurred to Donovan that his patients with splenic fever might be suffering from kala azar, a disease that he had never seen, and

³⁸ L. Rogers, letter to C. A. Bentley, 20 September 1902. Rogers' Papers C 1/17.

³⁹ L. Rogers, 'Note on serum reaction and the temperature curve in chronic malaria including *kala azar*', *Ind. med. Gaz.*, 1902, 37: 377-379.

⁴⁰ J. D. Price, 'Note on *kala azar*', *ibid.*, 1902, 37: 379-380.

⁴¹ W. B. Leishman, 'On the possibility of the occurrence of trypanosomiasis in India', *Br. med. J.*, 1903, i: 1252-1254.

⁴² C. Donovan, letter to R. Ross, 16 July 1903. Ross Archives, 47/146.

⁴³ C. Donovan, 'On the possibility of the occurrence of trypanosomiasis in India', *Br. med. J.*, 1903, ii: 79.

⁴⁴ W. B. Leishman, letter to R. Ross, 8 October 1903. Ross Archives, 47/148.

⁴⁵ W. B. Leishman, letter to R. Ross, 17 October 1903. Ross Archives, 47/151.

⁴⁶ C. Donovan, letter to R. Ross, 11 November 1903. Ross Archives, 47/153.

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he wrote to the *Indian Medical Gazette* appealing for specimens of splenic pulp, taken from patients with kala azar, to be sent to him for comparison.⁴⁷

At that time there was only one case of "Dum Dum spleen" at Netley, and, although no parasites could be found in the blood, army regulations did not allow samples of splenic pulp to be taken during life.⁴⁸ Leishman was trying to obtain permission for a spleen puncture when the patient died in January 1904.⁴⁹

Ross had already published a paper in the *British Medical Journal* during November 1903, disagreeing with Leishman's theory that the bodies found in spleen pulp were degenerated trypanosomes, suggesting that they were a new parasite, and noting the resemblance of the disease that Donovan described to kala azar.⁵⁰ Leishman, in his reply to Ross's paper, repeated his theory that the bodies were trypanosomes.⁵¹ Ross then followed his original paper with one in which he disagreed with Laveran's suggestion that they were *Piroplasma*, and should in consequence be called *Piroplasma donovani*, and said that he considered them a new genus that should be called *Leishmania donovani*.⁵² He repeated this opinion in greater detail a few weeks later.⁵³

Just before Christmas 1903, Charles Bentley sent telegrams to both Donovan and Ross saying that he had discovered Leishman's bodies in samples of splenic pulp taken during life from cases of kala azar,⁵⁴ thereby finally proving the connexion between the two. Laveran continued to maintain that the Leishman-Donovan bodies were a form of *Piroplasma*, but by January 1904 Leishman had expressed doubts whether his own theory of their being trypanosomes was tenable, as J. H. Wright had found similar bodies in cases of oriental sore.⁵⁵ Ross suggested that the bodies might be *Cercomonads*, and Leishman discussed the matter in an article the following month, adding that Laveran's attribution of the bodies to the genus *Piroplasma* appeared less and less likely.⁵⁶ He also drew attention to an account published three weeks previously in the *British Medical Journal* in which F. Marchand of Leipzig claimed to have demonstrated similar bodies to the Medical Society of Leipzig in February 1902. They were found post mortem in a patient who had splenomegaly associated with malaria and who had previously been in China.⁵⁷

⁴⁷ C. Donovan, 'A possible cause of kala-azar', *Ind. med. Gaz.*, 1903, 38: p. 478.

⁴⁸ K. McLeod, letter to R. Ross, 11 December 1903. Ross Archives, 47/154.

⁴⁹ W. B. Leishman, letter to R. Ross, 31 January 1904. Ross Archives, 47/165.

⁵⁰ R. Ross, 'Note on the bodies recently described by Leishman and Donovan', *Br. med. J.*, 1903, ii: 1261-1262.

⁵¹ W. B. Leishman, 'On the possibility of the occurrence of trypanosomiasis in India', *ibid.*, 1903, ii: 1376-1377.

⁵² R. Ross, 'Further notes on Leishman's bodies', *ibid.*, 1903, ii: 1401.

⁵³ R. Ross, 'A new parasite of man', *Thompson Yates and Johnston Laboratories Reports*, new series. 1903, 5: 79-82.

⁵⁴ C. A. Bentley, telegram to R. Ross, 24 December 1903. Ross Archives, 47/157.

⁵⁵ W. B. Leishman, letter to R. Ross, 13 January 1904. Ross Archives, 47/158.

⁵⁶ W. B. Leishman, 'Note on the nature of the parasitic bodies found in tropical splenomegaly', *Br. med. J.*, 1904, i: 303.

⁵⁷ F. Marchand, and J. C. G. Ledingham, 'On the question of trypanosoma in man', *ibid.*, 1904, i: 149-150.

By March 1904, and despite repeated failures, Donovan had been able to find *Leishmania donovani* in the peripheral circulation, although it was easier to find when the patient had developed a high temperature, Donovan gave 104.7°F. as the optimum, and the parasite had also been found in other internal organs.⁵⁸ Once *Leishmania donovani* had been identified as the causative organism of kala azar, news of its existence came in from other areas where the disease was endemic. By April 1904, the parasite had been identified by Dr Sheffield Neave in the Sudan,⁵⁹ and two months later in Egypt.⁶⁰ Subsequently, it was found at various places in the Levant.

At the beginning of 1904, Lt S. Rickard Christophers was appointed to special duty in Madras to inspect Donovan's work and to investigate *Leishmania donovani*. He had published two reports before the autumn.^{61,62} By June 1904, Leonard Rogers had cultivated *Leishmania donovani in vitro* after discovering that, like trypanosomes, they multiplied in a blood specimen kept at a temperature of 27°C.⁶³ This experiment was repeated by Christophers, who reported on his repetition of Rogers' work and expressed his doubt that the parasites were trypanosomes.⁶⁴

By the end of 1904, the term *Leishmania donovani* was in general use, but it is interesting to note that in the obituaries of Sir William Leishman, kala azar was given only a brief mention in an outline of his career and that greater emphasis was placed on his work with Sir Almroth Wright on vaccines against typhoid fever and his administrative abilities when he became Director General of the Army Medical Service. Donovan continued in the Indian Medical Service until his retirement, and died in 1951 having outlived that Service.

It was not until 1942, nearly forty years later, that the sandfly was conclusively proved to be a vector of kala azar,⁶⁵ although suspicion had been voiced by Sir Harold Scott in his outline of the history of kala azar and the search for its vector in his history of tropical medicine.⁶⁶ However, as his work was published in 1939, *Phlebotomus*, though under suspicion, had not been conclusively proved to be the vector.⁶⁷

⁵⁸ C. Donovan, letter to R. Ross, 3 March 1904. Ross Archives, 47/169.

⁵⁹ A. Balfour, telegram to R. Ross, 14 April 1904. Ross Archives, 47/171.

⁶⁰ L. Phillips, letter to R. Ross, 12 July 1904. Ross Archives, 47/173.

⁶¹ S. R. Christophers, 'A preliminary report on a parasite found in persons suffering from enlargement of the spleen in India', *Scientific Memoirs by Officers of the Medical and Sanitary Departments of the Government of India*, new series, no. 8, 1904.

⁶² S. R. Christophers, 'On a parasite found in persons suffering from enlargement of the spleen in India', second report, *ibid.*, no. 11, 1904.

⁶³ L. Rogers, 'Preliminary note on the development of trypanosoma in cultures of the Cunningham-Leishman-Donovan bodies of cachexial fever and kala azar', *Lancet*, 1904, ii: 215-216.

⁶⁴ S. R. Christophers, 'On a parasite found in persons suffering from enlargement of the spleen in India', third report, *Scientific Memoirs by Officers of the Medical and Sanitary Departments of the Government of India*, no. 15, 1905.

⁶⁵ C. S. Swaminath, H. E. Shortt, and L. A. P. Anderson, 'Transmission of Indian kala-azar to man by the bites of *Phlebotomus argentipes*, Ann. and Brun', *Ind. J. med. Res.*, 1942, 30: 473-477.

⁶⁶ Scott, *op. cit.*, note 3 above, vol. 1, pp. 548-563.

⁶⁷ P. C. Sen Gupta in the Sir U. N. Brahmachari Memorial Lecture to the Asiatic Society of Bengal, deals more fully with this aspect, although his treatment of the history of the disease before the discovery of the parasite is cursory. P. C. Sen Gupta, 'History of kala-azar in India', *Ind. med. Gaz.*, 1947, 82: 281-286.

Identification of kala azar

SUMMARY

The difficulties of identifying kala azar from the literature before discovery of the parasite are noted and early references to splenic enlargement in India discussed. The process of the mid-nineteenth-century epidemics of "Burdwan fever" in Bengal and kala azar in Assam are described and the linkage of the two epidemics by Sir Leonard Rogers is mentioned. G. M. J. Giles's belief that kala azar was caused by *Ankylostoma* and the demolishing of the reasons given by Giles in his report by E. F. H. Dobson are discussed, and the failures of R. Ross and L. Rogers to discover the parasite are explained. The work on kala azar of W. B. Leishman at Netley and C. Donovan in Madras with R. Ross acting as a liaison between them is described. Finally, the debate on the nature of the parasite is recorded.